Original Article

Assessment of Hospital Medical Emergency Team Operations in a Tertiary Care Center in Turkey

A Yılmaz[1], H Sevil[1], S Can[1], E Ararat[2], E Güvenç[3], S Diker[4]

[1]Department of Emergency Medicine, Uşak Research and Training Hospital, Uşak, [2]Department of Emergency Medicine, Antalya Kepez State Hospital, Antalya, [3]Department of Emergency Medicine, Buca Seyfi Demirsoy Research and Training Hospital, İzmir, [4]Department of Internal Medicine, Uşak Research and Training Hospital, Uşak, Turkey

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ABSTRACT

Background: Rapid Response Teams, strategically devised to mitigate mortality and morbidity stemming from unforeseen deteriorations and cardiac arrests within healthcare facilities, are ubiquitously implemented on a global scale. **Aim:** The aim of the study is to compare emergency physicians (EPs) and non-EPs on management protocols of Hospital Medical Emergency Teams (HoMET). **Methods:** This was a retrospective cross-sectional study. The hospital archive underwent a retrospective scanning process, and patient records were meticulously examined. The assessment encompassed various facets, including demographic characteristics, activation locations, and response and intervention times of HoMET teams, composed of both EPs and other healthcare professionals. Data analysis was conducted using SPSS software version 20.0. **Results:** A total of 1056 calls were included, with 52% (n = 549) involving male patients. The average age was 67.15 ± 19.45 years. EPs served as the team leader in 53% of the calls. Cardiac arrest was considered in 93.6% of the cases. The EPs group exhibited a higher average patient age, longer intervention times, and shorter arrival times ($P < 0.001$, $P = 0.027$, $P < 0.001$, respectively). A significant difference was observed in the locations of the calls and the groups of calls considering cardiac arrest ($P < 0.001$, $P < 0.001$, respectively). **Conclusion:** The optimization of intervention teams is imperative given the persistently high incidence and mortality rates associated with in-hospital cardiac arrests. Leveraging the expertise of EPs in the management of arrests and critical patients can potentially enhance the effectiveness of these teams. Nonetheless, further research is warranted to comprehensively explore and validate this aspect.

Keywords: *Emergency calls, emergency physician, hospital medical emergency team, rapid response team*

Introduction

Emergency Response Teams (RRTs), widely adopted globally, aim to avert unforeseen cardiac arrests and sudden death in patients resulting from the abrupt deterioration of patients in hospital settings. Originating in Australia and the United States in the mid-1990s, RRTs, also recognized as Medical Emergency Teams (MET) or Critical Care Outreach (CCOs), execute various tasks such as bedside patient triage, resuscitation, patient stabilization, advanced airway management, central vascular intervention, and the transfer of patients to the intensive care unit. These interventions are initiated in response to calls made by family members or healthcare professionals when patients experience clinical deterioration or in-hospital cardiac arrest (IHCA) within inpatient services.[1-3] While survival rates for adult IHCAs vary, outcomes are notably worse for nonmonitored or unwitnessed arrests. Therefore, early detection of clinically deteriorating patients within hospital services or beyond, coupled

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Address for correspondence: Dr. A Yılmaz, Department of Emergency Medicine, Uşak Research and Training Hospital, 64100, Uşak, Turkey.
E-mail: abdurrahman.dr@gmail.com

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with the prompt activation, widespread implementation, and appropriate composition of RRTs, is crucial for preventing in-hospital cardiopulmonary arrests.[2,3]

Traditionally, RRT, MET, and CCO teams are established in various compositions, incorporating a multidisciplinary approach that includes ICU (Intensive Care Unit) specialists, physician assistants, ICU nurses, anesthesia technicians (specializing in anesthesia or critical care), floor nurses, respiratory therapists, and other personnel. The common features of these teams are that they are fast and easily accessible, respond quickly to calls, and have advanced critical care skills.

The inception of medical teams in Turkish hospitals was initiated in 2008 and mandated through the 'Notification on Procedures and Principles for Ensuring and Protecting Patient and Employee Safety in Health Institutions and Organizations.' This notification, issued by the Ministry of Health on April 29, 2009, made the establishment of such teams compulsory. Globally, practices related to RRT and MET exhibit variations. In Turkey, hospital medical emergency teams (HoMET) are conventionally constituted with a specialist physician serving as the team leader, alongside an anesthesia technician and a nurse. This study's primary objective was to compare the management and outcomes of IHCA cases attended by HoMET consisted of EPs and others in a tertiary hospital in Turkey. Additionally, the research aims to assess the content of the emergency calls.

Materials and Methods

Study design

This retrospective was approved by Uşak University Medical Faculty Ethics Committee with reference number 155-155-12. The hospital, equipped with approximately 700 inpatient beds, comprises 42 level 3 and 35 level 2 ICU beds. The hospital archives were retrospectively reviewed within the dates between 01/01/2019 and 31/10/2022, focusing on patient records where the emergency call response system was activated, and the emergency response team was summoned. The parameters examined included age and gender of the patients, the location of emergency call activation (wards, ICU, outpatient clinics, other areas), the outcome of the emergency call (death, transfer to the emergency department, transfer to intensive care, remaining in the current location), whether the call was initiated for a potential cardiac arrest, preliminary diagnoses for the patient, the times taken for the teams to reach the patient for intervention, the team leaders for the calls (EPs and others), and the outcomes of the calls based on the team leaders.

In the hospital where the study was conducted, the HoMET is activated for patients in nonemergency in-patient wards, first- and second-level ICUs, outpatient clinics, hospital gardens, and internal waiting rooms who require emergency intervention due to a deteriorating clinical condition. Hospital staff, including doctors, nurses, and other auxiliary health personnel, activate the emergency response system by dialing 2222 through the hospital switchboard system. Upon activation, a notification is received by the designated device, and the location of the call is displayed on the device screen. RRTs are composed of an anesthesia technician with a minimum of 5 years of experience, a nurse possessing basic and advanced adult and pediatric life support certificates, and a specialist physician who leads the team. The team leader, as dictated by the hospital's internal protocol, may be an emergency medicine specialist, internal medicine specialist, pulmonologist, cardiologist, anesthesiology and reanimation specialist, thoracic surgeon, or cardiovascular surgeon.

Statistical analysis

The data were analyzed using SPSS software version 20.0. Descriptive statistics, including numbers, percentages, means, standard deviations (SDs), medians, minimums, and maximums, were utilized. In presenting intervention and arrival times, durations less than 1 minute were considered as 1 minute. Categorical data were compared using the Chi-square test. The normal distribution of continuous data was assessed with the Kolmogorov–Smirnov test. For variables not conforming to a normal distribution, the Mann–Whitney U Test was employed. A P value of <0.05 was considered statistically significant.

Results

Figure 1 illustrates the distribution of the call locations. In the comprehensive analysis of 1056 calls under study, the gender distribution revealed that 52% (n = 549) were male, and 48% (n = 507) were female. The average age of the patients was 67.15 ± 19.45 years, with a range of 1–100 years. Among the instances of blue code calls, 53.0% (n = 560) were led by EPs, whereas 47.0% (n = 496) were led by non-EPs. Notably, 75.6% (n = 798) of the calls were initiated concerning cardiac arrest. The remaining cases were attributed to preliminary diagnoses, with presyncope (11.2%), respiratory distress (5.7%), concern for the patient (4.4%), change in mental status (2.8%), and anaphylaxis (0.4%) being the most frequent.

Table 1 shows the comparison of gender, call location and type, and patient outcomes according to team leaders. Upon the team's arrival, it was observed that in a substantial 93.6% (n = 988) of cases, crucial initial interventions (monitoring, oxygen administration, fluid

support, medication administration, intubation) were already in progress before the resuscitation team's arrival. The response time for the resuscitation team averaged 2.78 ± 1.42 minutes (median: 2 min, maximum: 14 min). Simultaneously, the average intervention time for the team amounted to 21.36 ± 17.43 minutes (median: 20 min, maximum: 180 min). Concerning arrest rhythms, 70% (n = 686) of cases exhibited nonshockable rhythms, 2% (n = 22) had shockable rhythms, and 25.4% (n = 268) maintained sinus rhythm.

In the comparison based on team leaders, patients treated by EPs showed a significantly higher average age and shorter arrival time ($P < 0.001$; $P < 0.001$). Furthermore, the intervention time displayed statistical significance between groups ($P = 0.027$). Specifically, EPs exhibited a median intervention time of 20.0 (1.0–90.0) minutes, while their counterparts had 15.0 (1.0–180.0) minutes, with this difference being statistically significant ($P = 0.027$) [see Table 2].

No significant gender-based difference emerged between deceased and surviving patients ($P = 0.321$). However, a significant difference was found between the locations of the calls and the groups of calls, particularly concerning cardiac arrest ($P < 0.001$) [see Table 3].

Table 1: Comparison of gender, call location and type, and patient outcomes according to team leaders

Parameters	Parameters	Emergency physician *n* (%)	Others *n* (%)	Total *n* (%)
Gender	Female	276 (49.3)	231 (46.6)	507 (48)
	Male	284 (50.7)	265 (53.4)	549 (52)
Location of the call	In-patient services	229 (40.9)	164 (33.1)	393 (37.2)
	ICU	252 (45)	224 (45.2)	476 (45.1)
	Out-patient clinics	26 (4.6)	33 (6.7)	59 (5.6)
	Other	53 (9.5)	75 (15.1)	128 (12.1)
Emergency calls for possible cardiac arrest	Yes	434 (77.5)	364 (73.4)	798 (75.6)
	No	126 (22.5)	132 (26.6)	258 (24.4)
Outcomes	Exitus	311 (55.5)	168 (33.9)	479 (45.4)
	Transfer to ICU	89 (15.9)	93 (18.8)	182 (17.2)
	Transfer to ED	58 (10.4)	110 (22.2)	168 (15.9)
	Stayed in place	102 (18.2)	125 (25.2)	227 (21.5)

Table 2: Comparison of times of the groups according to the team leader

Age and time	Emergency Physician		Others		*P*
	Mean±SD	Median (Min-Max)	Mean±SD	Median (Min-Max)	
Age	69.72±17.31	74.0 (1-100)	64.24±21.25	69.0 (2-97)	<0.0001
Arrival time	2.6±1.3	2.0 (1.0 – 14.0)	3.0±1.5	3.0 (1.0-10.0)	0.0001
Intervention time	21.8±15.0	20.0 (1.0-90.0)	20.9±19.8	15.0 (1.0-180.0)	0.027

Table 3: Comparison of deceased and surviving patients according to gender, location of the call, and type of call

Parameters	Parameters	Survivor, *n* (%)	Non-survivor, *n* (%)	*P*
Gender	Female	269 (46.6)	238 (49.7)	0.321
	Male	308 (53.4)	241 (50.3)	
Place of intervention	Ward	203 (35.2)	190 (39.7)	<0.001
	ICU	196 (34)	280 (58.5)	
	Out-patient Clinic	59 (10.2)	0 (0)	
	Other	119 (20.6)	9 (1.9)	
Emergency calls for possible cardiac arrest	Yes	321 (55.6)	477 (99.6)	<0.001
	No	256 (44.4)	2 (0.4)	

ICU, Intensive Care Unit

Table 4: Comparison of deceased and surviving patients according to age, arrival time, and intervention time

Age and time	Survivor		Non-survivor		*P*
	Mean±SD	Median (Min-Max)	Mean±SD	Median (Min-Max)	
Age	61.07±21.39	65.0 (1-96)	74.47±13.62	77.0 (19-100)	<0.001
Arriving time	2.94±1.52	3.0 (1.0 – 14.0)	2.58±1.27	2.0 (1.0-10.0)	<0.001
Intervention time	11.61±14.56	7.0 (1.0-180.0)	33.02±12.81	30.0 (1.0-130.0)	<0.001

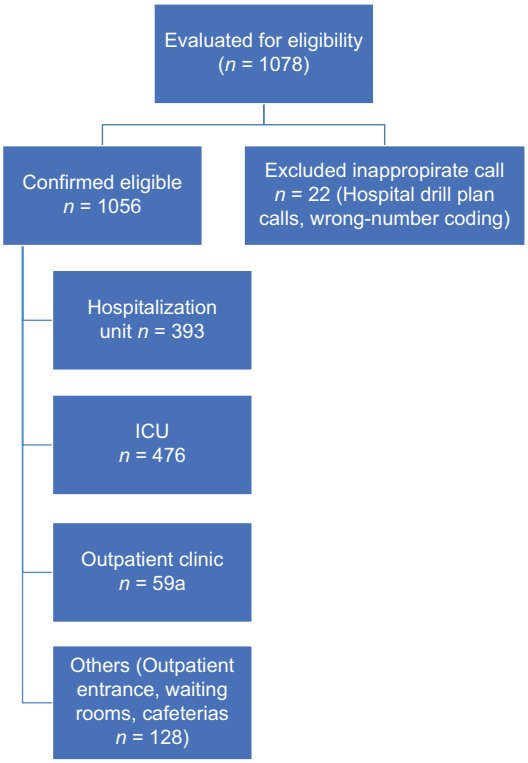

Figure 1: Consort flow diagram of patients. ICU, Intensive Care Unit

The average age of deceased patients was significantly higher ($P < 0.001$). The response time for the team to reach deceased patients was significantly shorter ($P < 0.001$), while the intervention time in the deceased group proved significantly longer ($P < 0.001$) [see Table 4].

Table 3. Comparison of deceased and surviving patients according to gender, location of the call, and type of call.

Discussion

The constitution of teams such as RRT, MET, and CCO exhibits variations across different countries; however, their unified objective remains the prompt and efficient intervention for patients experiencing clinical deterioration and arrests. Precise delineation and effective management of team components are pivotal in curbing mortality and morbidity rates among patients undergoing deterioration within hospital confines. In pursuit of this objective, our study aimed to determine whether the leadership of EPs exerts a discernible impact.

Our study revealed that 75.6% of IHEC instances were prompted by considerations of cardiac arrest, with 70% of these arrests exhibiting nonshockable rhythms. Preliminary diagnoses for the remaining cases encompassed presyncope (n = 118), respiratory distress (n = 60), patient concern (n = 47), altered mental status (n = 29), and anaphylaxis (n = 4). These call content alignment is similar to the report by Hejjaji *et al*.,[4] where 82.6% of the 44,000 patients in their study manifested nonshockable rhythms.

A notable difference was observed between deceased and surviving patients in calls made considering cardiac arrest. Accurately discerning true cardiac arrests from deteriorating patients is crucial for precisely identifying the needs of these individuals and organizing treatment accordingly. Bayramoğlu *et al*.[5] noted that inappropriate calls pose a significant hindrance to the correct and effective utilization of HoMET. Providing basic and in-depth training in recognizing cardiac arrest can facilitate accurate and prompt patient identification. Nirman *et al*. noted that only 4% of health professional students demonstrated good recognizability of cardiac arrest, suggesting a need for adjustments in educational systems.[6] Ongoing research is exploring the development of algorithms for early and accurate identification of arrests, with investigations into the role of AI-supported algorithms in this context.[7] Spångfors *et al*.[7] investigated the prediction of in-hospital arrests using the National Early Warning Score (NEWS) and found that a higher risk score in patients correlated with the identification of more arrest cases. In a comparative study, Kwon *et al*.[8] assessed the modified early warning system against deep machine learning, reporting that deep learning exhibited higher sensitivity with lower false alarm levels compared to the traditional system.

Significant differences in arrival times were observed between deceased and surviving patients, with a shorter time noted for deceased patients. Notably, calls originating from ICUs, where arrest cases are more likely, could serve as a positive incentive for the team to expedite their response. Furthermore, the close proximity of ICUs and the availability of shorter, more accessible routes may have contributed to the quicker response time. As previously highlighted, calls made considering cardiac arrest often prompt a faster team response, often leading to the encounter with actual arrest cases. Analyzing the locations of the calls revealed a substantial difference between groups, with a higher death rate in calls originating from intensive care units. It is anticipated that patients requiring intensive care would exhibit higher mortality rates compared to outpatient and ward patients. The literature on this subject presents varied findings. Hejjaji *et al*.[4] reported a majority of patients coming from ICU calls. Perman *et al*.[9] indicated that 59% of calls originated from the ICU, with lower mortality rates among ward patients, while the worst survival outcomes were observed in calls from unmonitored areas. Conversely, some studies

support the idea that close monitoring of patients in monitored areas can predict IHCA, potentially leading to higher survival rates in this group.[10,11]

There was a significant difference in intervention time between deceased and surviving patients, with a notably longer intervention time observed in the deceased group ($P < 0.001$). This prolonged intervention time in cardiac arrest management for nonsurvivors may be attributed to the challenges associated with achieving ROSC in the early stages. Li *et al*.[12] emphasized in their studies that increasing intervention time in in-hospital arrests correlated with decreased ROSC rates, linking this phenomenon to irreversible ischemic and reperfusion damage resulting from prolonged resuscitation efforts. Similarly, Rohlin *et al*.[13] reported that an extended resuscitation time leads to a decrease in 30-day survival; however, CPR duration alone cannot be solely relied upon as a prognostic factor.

In the study, 53% of the teams responding to in-hospital emergency calls were led by EPs. Among the patients treated by HoMET-EP, 55.5% experienced mortality, 15.9% were transferred to ICU, 10.4% were transferred to the ED, and 18.2% remained in their current location. Under the leadership of other specialties, 33.9% of the patients succumbed to mortality, 18.8% were transferred to ICU, 22.2% were transferred to the ED, and 25.2% continued in their current location. In Dacey *et al*.'s study,[14] outcomes varied, with 59% of patients having no transfer, 24% transferred to the ICU, 11% to the telemetry unit, 5% to the intermediate care unit, and 11% necessitating physician discussion facilitated by bedside intensivist consultation.

The composition of in-hospital emergency teams varies depending on the healthcare system, educational structures, and hospital settings of each country. To effectively reduce in-hospital mortality rates, these teams must be well organized and guided by protocols.[3] However, there is no consensus regarding the team's composition and the qualifications of its leader. Existing literature often compares leadership roles between physicians and nonphysicians. For instance, Lee *et al*.[1] reported that cases led by physicians demonstrated faster and more effective management of complex procedures, such as intubation and arterial cannulation, resulting in reduced ICU transfer rates. In contrast, Hejjaji *et al*.[4] found no significant survival differences between interventions led by attending physicians, physician trainees, and nonphysicians, although only around 7% of the 44,000 patients in their study were managed by nonphysician team leaders. Conversely, Dacey *et al*.[14] indicated that RRTs led by physician assistants with advanced critical care skills experienced fewer cardiac arrests and unplanned ICU transfers. Lyons *et al*.[15] described RRTs as generally nurse-led, while MET management is typically led by physicians, with no significant differences in mortality observed between the two groups. Leach *et al*.[16] highlighted the dynamic relationship between nurses and physicians in RRT activations, emphasizing the nurse's role in initiation and the physician's role in management continuation. Klejne *et al*.[17] stressed the importance of continuous education systems to bridge knowledge gaps in in-hospital resuscitation algorithms between nurses and doctors. Notably, our study contributes by evaluating HoMETs based on specialties. In terms of arrival times, EPs reached patients in 2.6 ± 1.3 minutes, whereas other specialties took 3.0 ± 1.5 minutes ($P < 0.001$). EPs had an intervention time of 21.8 ± 15.0 minutes, while other specialists had 20.9 ± 19.8 minutes ($P = 0.027$). EPs' expertise in responding promptly to unexpected calls and situations in EDs may have influenced their response to in-hospital calls. Similarly, their experience and practices in resuscitation might have contributed to longer intervention times. The age factor could also have influenced the extended intervention time, with the average age of patients treated under the leadership of emergency medicine specialists significantly higher than the other group ($P < 0.001$). This suggests that older patients treated by EPs might experience higher mortality rates, consistent with findings in other studies.[4,18]

EPs possess a comprehensive skill set honed through specialized training, making them well equipped to manage arrest patients. Their proficiency extends to complex tasks such as intubation, catheterization, ventilation, and judicious medication administration. This expertise enables EPs to autonomously handle multiple intricate responsibilities, contributing to the prevention of patients' progression into more critical conditions when integrated into RRTs designed as METs. EPs, with a foundation in emergency medicine, have progressively expanded their competencies into the critical care domain, intensifying their efforts since 2005.[19,20] The augmentation of their emergency medicine expertise with critical care training empowers EPs to function effectively within METs. Jeong *et al*.[21] reported that patients managed by EPs in emergency ICUs, subsequent to emergency services, experienced shorter transfer intervals without a concurrent increase in mortality. Weingart *et al*.[22] further asserted that EPs are adept at delivering high-quality treatment to critically ill patients across various hospital units, making them integral to hospital-wide protocols for resuscitation and critical care. In Turkey, EPs have been actively participating in HoMETs for approximately a decade.

The study encountered limitations, primarily in areas outside the ICU, where the absence of standardized criteria for HoMET activation posed challenges. Activation decisions were based on nonspecific indicators such as abrupt alterations in consciousness, breathing, and pulse, aiming to discern patients' deterioration and initiate the activation system. The second limitation of this study is the presence of continuously monitored patients facilitated expedited activation in the ICU.

Conclusion

The comprehensive capabilities of EPs extend beyond EDs, encompassing interventions in various hospital areas for patients in critical condition or requiring resuscitation. This expanded role suggests the potential for increased involvement of EPs in critical care or ICUs. Given the elevated mortality rates associated with IHCAs, the imperative lies in well-defining and effectively utilizing risk factors, implementing early intervention algorithms, and optimizing intervention teams. Further research is essential to delve into the effectiveness of EPs in this domain, ascertain the ideal composition of intervention teams, and assess the overall cost-effectiveness of HoMETs.

In conclusion, our investigation into the dynamics of HoMET in a tertiary care center has provided valuable insights into the leadership impact on in-hospital emergency calls. The findings underscore the significance of EPs in achieving prompt response times and effective management of critical interventions. The study's outcomes reveal a refinement understanding of the nuanced interplay between team leadership, patient outcomes, and the varied nature of emergency calls. As we navigate the evolving landscape of in-hospital emergency response, it becomes increasingly evident that harnessing the expertise of EPs contributes significantly to the optimization of HoMETs.

Future endeavors in this field should continue to explore the specific strengths and contributions of EPs, potentially guiding the refinement of protocols and team compositions for enhanced patient care and outcomes. This study, while illuminating certain aspects, prompts further avenues of research to comprehensively grasp the intricacies of emergency team dynamics within healthcare settings.

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Conflicts of interest

There are no conflicts of interest.

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