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REVIEW ARTICLE

The efficiency of the medical priority dispatch system in improving patient outcomes

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ABSTRACT

Background: One of the essential aspects of acquiring favorable patients' outcomes is to deliver appropriate care to them. In pre-hospital settings, the procedure begins with the dispatch since dispatchers manage the assistance requests. The medical priority dispatch system (MPDS) has been developed to improve the dispatcher's performance. It follows algorithms and questions which aid in classifying situations based on callers' answers to specific questions. This study aimed to assess the effectiveness of MPDS in enhancing patient outcomes.

Methods: We searched PubMed, MEDLINE, Scopus, and six other electronic databases up to 17 August 2019. A combination of keywords relevant to MPDS was used to search for English published randomized controlled trials, case–control, and cohort studies evaluating MPDS and its impact on patient outcomes.

Results: A total of 15 studies out of 755 were selected. All were observational cohort studies involving 1,394,366 participants; seven studies reported response time, four reported mortality rate, and four reported survival rates. We rated 14 of them as fair quality, and the rest were of poor quality based on the Newcastle–Ottawa scale. Eight studies supported the desired outcomes for the patient, whereas the rest depended on several factors to reach the desired outcomes.

Conclusion: The majority of studies reported good results; however, there was no significant difference, and this might be an area, where the practice may change.

Keywords: Medical priority dispatch system, MPDS, EMS priority dispatch, advanced MPDS, pre-hospital dispatch, communication center, emergency calls, computer-aided dispatch, patient outcomes, survival rate, mortality rate, response ime.

Introduction

Emergency medical services (EMS) is the first level of health care provided out of hospital [1]. Timely access to EMS at the site of emergency has shown to be an important factor in reducing mortality and limiting over 50 million accident-induced disabilities occurring every year worldwide [2,3]. A key aspect of EMS is emergency medical dispatch, which is responsible for receiving and managing requests for assistance. Before the 1970s, emergency dispatchers worldwide tended to be laypersons with little or no training in their field. Although it is a relatively new field, both as practice and research, the emergency dispatching system underwent great improvements over the years, starting from the introduction of the three-digit emergency number to the elevation of the standards of this profession to the current status, where dispatchers must be trained and certified to perform life-saving functions before responders arrive on the emergency scene [4]. Perhaps, one of the cornerstones in EMS dispatching was the introduction of a new medical priority dispatch system, which is a computerized dispatch system developed by Dr. Jeff Clawson. This system consists of software and is constantly refined by the expert

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panel by using large databases of emergency calls from high-performance EMS systems across the world [5]. Medical priority dispatch system (MPDS) relies on a set of protocols that allow dispatchers to categorize patients based on some information obtained by the dispatcher from the caller, such as the chief complaint and the answers to some key questions about the situation of the case, for example, if the patient is awake or if he is breathing [6,7,8]. This system was set to develop patient care from different aspects, and the dispatchers are responsible and well trained to assess the severity of the situations and classify them from minor medical problem (alpha) to life-threatening conditions (echo), in order to send the nearest appropriate unit. In life-threatening situations, they give helpful instructions to the caller before ambulance arrival and ensure the safety of the patient and responders at the emergency scene, since these dispatchers are the first link in the first responder chain [8,9].

Even though previous studies in this field were limited and the accuracy of the dispatch performance did not have clear criteria to be measured, some previous studies have demonstrated that patients with critical conditions, such as cardiac arrest and acute myocardial infarction, would receive high-priority response by MPDS. As a result, it would improve the overall patient outcomes [10,11]. As a rule, the structured process in obtaining information from the caller should not be broken; yet in 2007, Clawson et al. demonstrated in their research that the structured algorithms can be overridden if the MPDS protocols are inadequate for the patient care [12,13]. However, other studies have shown that the effectiveness of the MPDS is suboptimal in identifying clinical diagnostic cases, such as stroke, and anaphylaxis since its diagnosis is noticeably reduced because of the lack of protocol adherence by the dispatchers, as compared to non-priority medical dispatch [14,15]. The MPDS is a new and trending topic, and the systematic reviews about it are limited, so it is a good and important opportunity to fill the gap of knowledge and also to make some recommendations for the organizations since MPDS is an area, where dispatching practice may change.

Aim and objectives

The study aimed to assess the effectiveness of the medical priority dispatch system (MPDS) by evaluating and comparing between studies reporting patient outcomes in countries that use MPDS and characterizing its contributions in improving the overall patient outcomes.

Methods

This systematic review was designed to provide a complete summary of the current evidence relevant to the research question.

Criteria for considering studies for this review

Eligibility criteria

The PICOS model was used to create the research question for this review as suggested in the Cochrane Handbook [16] to start the literature research: P = population: patients who have been dispatched by an ambulance using MPDS; I = intervention: not applicable as no interventions were measured; C = comparison: not applicable as no interventions were measured; O = outcome: patient and health outcomes (mortality rate, survival rate, and response time); and S = studies: randomized control trials and observational studies (only case–control and cohort studies were included). We searched for the studies published in English in the last 5 years (from 2015 to 2019). Studies were considered eligible for analysis if the considered outcomes were measured and reported, which are response time, mortality rate, and survival rate. The papers, which did not clearly mention the dispatch systems that were used or the target outcomes from the system which were different than those required for the present review, such as targeting economic outcomes, were excluded. A cross-sectional study, case reports, conference abstracts, and letters were also excluded from the final results.

Search methods for identification of studies

The electronic research was started in May 2019. The scientific papers found in databases and search engines, including PubMed, MEDLINE, Embase, SciSearch, Ovid, Cochrane, Google Scholar, Science Direct, and Scopus, were considered. A combination of keywords such as Medical Subject Heading terms related to MPDS, such as computer-aided dispatch, MPDS, and emergency call center and Boolean operators to search for the included articles were used. The references from the retrieved papers were also checked to identify the possible articles to be included.

Data collection and analysis

Selection of studies

Articles up to 17 August 2019 were searched. Eligibility for the inclusion of the articles was determined independently by two reviewers. The papers which had clearly stated the system used in their research works and the targeted population were included, and if the research did not target patients who were responded by ambulance using MPDS, they were excluded. Besides, the articles about criteria-based dispatch, which is a symptom-based dispatch, undetermined or insufficiently strong study designs, editorials, and letters, were all excluded. All screening conflicts regarding eligibility were resolved at a consensus meeting attended by subinvestigator. Moreover, a flow chart was used to present the systemic phases of the systematic review produced according to the PRISMA statement [17].

Data extraction and management

Covidence software was used for data collection and extraction as it is an online tool by Cochrane for conducting systematic reviews. Mendeley was used for creating a database of bibliographic references. Moreover, the quality assessment tools to assess the included studies differed depending on the type of the study, such as the Newcastle–Ottawa tool [18] for observational studies and the Jadad score for randomized controlled trials.

Results

Literature research results

The PRISMA flow diagram summarizes the inclusion/exclusion process (Figure 1). In total, 755 studies were identified through a database search. After removing the duplicates, 448 abstracts were screened for eligibility, and 45 were assessed in full text. Four additional studies were identified through the search of reference lists of the included studies. Ultimately, 15 publications met the inclusion criteria and were included in the systematic review.

Study characteristics

We included 15 studies out of a total of 755 found, and all were observational, retrospective, and cohort studies involving 1,394,366 participants. All the studies were reported in English and originated from four high-income countries (Tables 1–3).

Response time

Nine studies reported response time depending on the dispatcher decision based on MPDS (Table 1). There is a variation on the results found which can be either due to

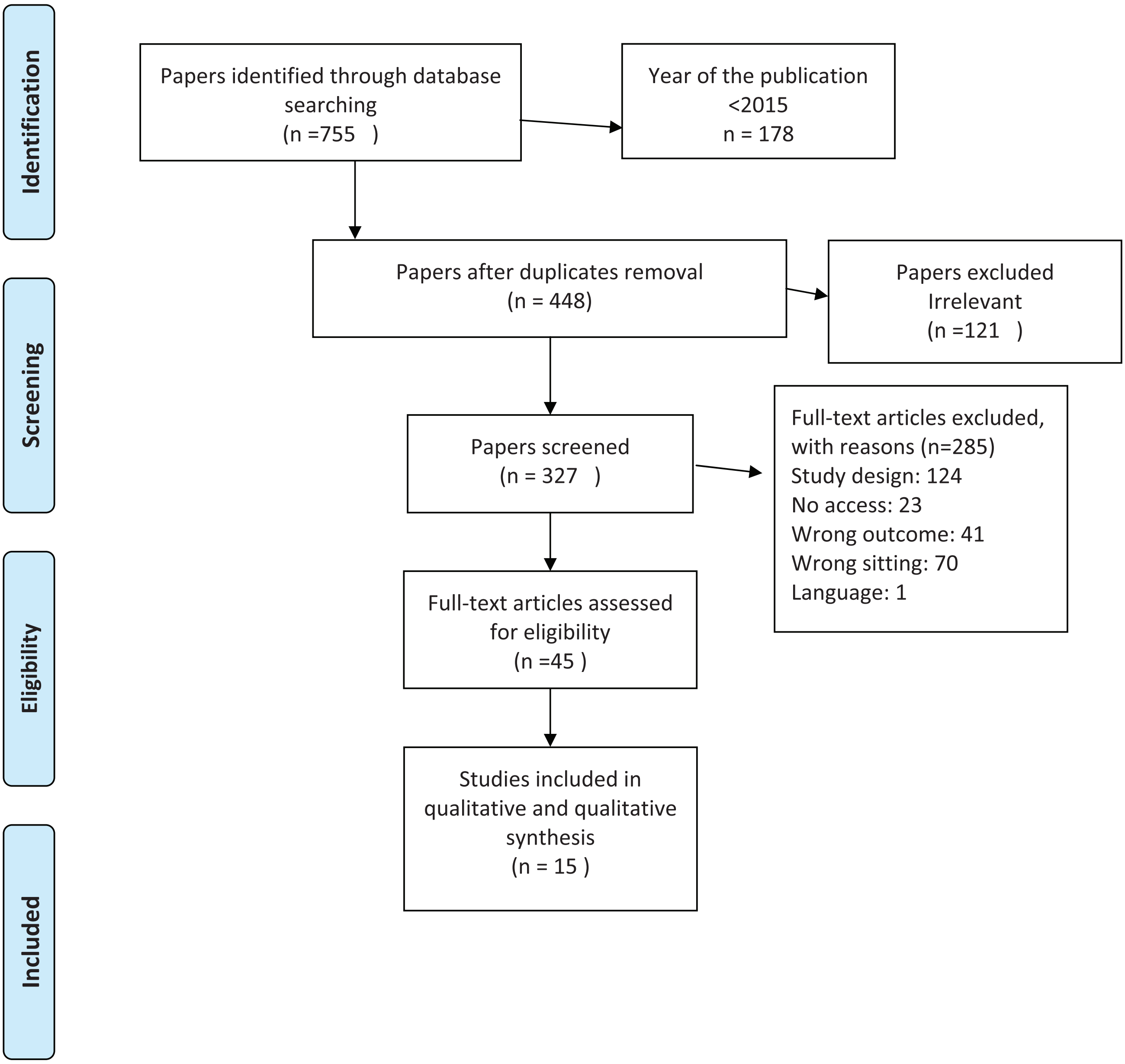

Figure 1. *PRISMA flow diagram.*

***Table 1**. Response time.*

First author, year of publication	Study design	Study quality level*	Country of publication	Patient population	Number of participants/ incidences	Main finding	Conclusion
Gardett, [19]	Observational, retrospective, cohort	★★★★★	USA	Hospital-confirmed strokes	603 cases	Data analysis shows that 215 of the cases had complete successful SDxT performed by EMD. Moreover, based on the complete SDxT results, 171 had clear evidence of stroke, 27 had no evidence of stroke, and 17 were unable to determine stroke status.	Stroke identification was low for both EMS and EMD. 34 seconds were needed to complete the SDxT, so they do not substantially add to call time nor increase response time or time to treatment.
Ball [20]	Observational, retrospective, cohort	★★★★★★	Australia	Electronic patient care records	211,473 cases	Data analysis shows that 111,485 of all included cases were priority 1, but only 16,520 of them were time critical. However, 99,988 of the cases, which dispatched as priority 2 or 3, had 467 time-critical cases among them.	The overall sensitivity was 93.32% (across all chief complaints) for time-critical cases that being dispatched as priority 1 while specificity was 48.67%.
Clawson [21]	Observational, retrospective, cohort	★★★★★★	USA	All EMD-identified stroke cases	603 stroke cases	Stroke protocol has been used in 304 cases, but only in 228 cases, SDxT was successfully completed.	The study shows that there was a high sensitivity (86.4%) in the identification of stroke by EMD using the SDxT but less specificity (26.6%).
Nehme [24]	Observational, retrospective, cohort	★★★★★★★	Australia	Code 1 time-critical patients	1,000,458 EMS responses	Patient-specific variables such as age, gender, chief complaint and its severity, and time of the call can predict ERT in addition to the system-level variables such as distance from the scene which improves the timeliness of EMS in response to time-critical emergencies. The reduction in response time of 2.47 seconds is associated with life-threatening cases.	System-level factors have a significant impact on ERT compared to patient-level factors.
Mould-Millman [25]	Retrospective, observational, cohort	★★★★★★★	USA	Patients having stroke records	548 Patients	475 patients transported with impression of stroke, of which 234 were confirmed to have stroke by neurologists. The dispatcher's sensitivity of stroke identification is 48.9%, and it increases to 56% when hemorrhagic stroke cases are excluded. The paramedics' sensitivity of stroke identification is increased by 15.2% when dispatchers categorized the call as a stroke.	The likelihood of identifying stroke by paramedics was increased when the Cincinnati pre-hospital stroke scale is positive or when EMD classified the case as stroke unless it was hemorrhagic or female patient
Oostema [28]	Observational, retrospective, cohort	★★★★★★	USA	EMS electronic records of suspected stroke cases	601 patients	Data analysis shows that 506 cases were dispatched as suspected stroke, and the number of them who received a discharge with differential diagnoses of stroke is 229. The sensitivity was 70.7%, whereas it was 35% in hemorrhagic stroke.	Correct recognition of stroke by dispatchers depended on neurological assessment, which shortened the response for these patients on the scene time. The EMS recognition of stroke cases can control transport and Door To CT times.
Seim [30]	Observational, retrospective, cohort	★★★★★★	USA	EMS response/ patient care reports	87,554 ambulance records	Data analysis shows that mean ambulance response time (MART) associated with ED closeness, density, and size of the population was 30 seconds faster. However, in low intervention cases (alpha or omega codes), there is no difference in response times.	The study supports that there was either a negative association or no association between neighborhood poverty and MART.
Scott [32]	Observational, retrospective, cohort	★★★★★★★	USA	Dispatch center electronic databases	16,763 alpha-level cases	About 89% of patients with alpha-level codes who received secondary triage were stable with normal vital sign values, and less than 0.5% had critical vitals. However, 1.1% of the cases were re-evaluated and retriaged as high-priority level.	Initiating secondary nurse triage can make identifying few ALPHA-level patients who are more serious than the initial EMD triage possible, especially in "sick person" code.

*Table 4.

Table 2. *Mortality rate.*

First author, year of publication	Study design	Study quality level*	Country of publication	Patient population	Number of participants/ incidences	Main finding	Conclusion
Clawson [10]	Observational, retrospective, cohort	★★★★★★	USA	All AMIs, as identified by ICD-9-CM codes	606 cases	EMDs have prioritized of AMI cases (89.9%) into the higher acuity priority levels. 287 (47.4%) of them were diagnosed with ST segment-elevated myocardial infarction, based on ICD-9-CM coding. Moreover, by the time of hospital discharge, a total of 63 deaths occurred (10.4%), and 54 of them (85.7%) were aged 55 years and older.	Approximately 90.0% of hospital-confirmed AMI patients were correctly triaged into priority 1, where advanced life support service is the standard. All deaths were found to be in patients who have AMI aged 35 years and older. This was strong evidence that the age cutoff used in the MPDS for suspected AMI (≥35 years) is highly reliable.
Clawson [22]	Observational, retrospective, cohort	★★★★★★	USA	All EMD-identified stroke cases	603 stroke cases	The SDxT, in stroke/TIA protocol, predicted 88% evidence of stroke among deaths in hospital-confirmed stroke patients.	Among hospital-confirmed stroke patients, the highest mortality rate occurred within either not alert or unconscious chief complaint protocols.
Scott [23]	Observational, retrospective, cohort	★★★★★★★	USA	Electronic patient care reports	61,346 patients' reports	Data analysis shows no significant difference in REMS in priority 1 and 2, but when it was compared to priority 3, there was a significant rise in the score. The highest dispatch priority was linked to large changes in REMS.	This study demonstrated that the REMS was associated with other accepted methods of classifying patient severity in the pre-hospital setting. Moreover, under EMS care, mostly ill patients have greater improvement. MPDS had a strong association with initial REMS. EMDs and paramedic transport priority are associated with REMS, as well as the severity of the illness and mortality.
Matthews [26]	Retrospective review	★★★★★★	UK	Unintentional drowning patients	509 patients	170 (33.4%) cases were fatal and resulted in death. The highest rates of fatal and non-fatal drowning were with 0–4 ages, whereas adults aged 65 and over were more likely to suffer from fatal drowning only. Cases of 0–4 and +65 years old and males were at higher risk of drowning	Based on the study, survival and mortality are linked to the age groups of the victims. Moreover, witnessed drowning is associated with non-fatal drowning.

*Table 4.

Table 3. *Survival rate.*

First author, year of publication	Study design	Study quality level*	Country of publication	Patient population	Number of participants/ incidences	Main finding	Conclusion
Dicker [22]	Observational, retrospective, cohort	★★★★★★	Australia	OHCA cases	7,966 OHCA cases	In 3,862 cases, resuscitation was attempted, and 1166 (30%) of them sustained ROSC to hospital handover, and 580 (15%) survived up to 30 days.	Survival or survival up to 30 days was not associated with bystander's CPR. However, survival might be affected by the quality of CPR.
Masterson [27]	Observational, retrospective, cohort	★★★★★★	Netherlands	OHCA attended by EMS patients' record	1,798 patients	Urban areas achieved ROSC and were more likely to get discharged alive from hospitals which influenced by 8 minutes or less, and this response interval represents 33% of the cases. Rural places had more pre-EMS arrival CPR (70%) and defibrillation (7%)	Significant differences between rural and urban Ireland in the survival rate are affected by the response time. Overall, arrest in public, less time to the scene, and pre-EMS arrival CPR are indicators for good outcomes but less significant than initial shockable rhythm since it is the most important indicator for discharging alive.
Oman [29]	A retrospective review	★★★★★★	UK	OHCAR record	145 cases of cardiac arrest	In 82 cardiac arrest cases, there was a potential rescuer. However, only 5 of these patients survived to hospital discharge. The average time to the first compression was 05:28 minutes. In 32 of 45 cases, the dispatcher-assisted CPR took place, and dispatcher recognized the arrest event within a minute.	Some of the callers attempted T-CPR, but there were significant delays happened due to the repeated questions and the long instructions process. The chance of survival might be reduced if there was a delay for starting compressions. Bystander CPR was delivered to 73.1% of the cases, and 57% of which were assessed by the dispatcher. Overall, 6% of patients survived to hospital discharge.
Tanner [31]	Cohort, retrospective	★★★★★★★	UK	OHCAR	2,281 patients aged 70 and older	Data analysis shows that 1405 of the total cases were witnessed, and the most common presenting rhythm was asystole. Overall, 2.9% of the total number of patients survived to hospital discharge.	The results indicated that in 70-year-old patients and older, the rate of survival to hospital discharge declined with increase in age group and if bystander's CPR was performed or not. Still, the survival rate was increased if the first rhythm was shockable and witnessed by bystanders.

*Table 4.

Table 4. Quality assessment.

Study ID	Selection	Comparability	Outcome	Total score
Gardett, 2017	3	1	1	5
Ball, 2016	4	1	1	6
Clawson, 2016	4	2	1	7
Ziad Nehme, 2016	4	2	1	7
Mould-Millman , 2018	4	2	1	7
J. Adam Oostema, 2018	3	2	1	6
Josh Seim, 2018	3	1	1	5
Greg Scott, 2016	3	2	1	6
Clawson, 2017	3	2	1	6
Scott, 2016	4	2	1	7
Bernadette L. Matthews, 2016	4	2	0	6
Dicker, 2018	3	2	1	6
S. Masterson, 2015	4	2	1	6
Oman G, 2016	4	1	1	6
Richard T, 2017	4	2	1	7

unclear chief complaint or high index of suspicion. The two previous studies [30,32] highlighted that the response time would be reduced in time-critical patients based on some aspects such as the social class of the neighborhood, in which the incidence of the emergency cases occurred and would be responded to [30], and the use of secondary triage which can raise the priority level for patients who have been given lower priority than what their actual condition required [32]. Although there was a reduction in response time in some cases, further four studies showed that there were no significant differences observed between using MPDS and change in response time. The findings of these four studies showed that the early recognition of stroke cases would not decrease the response time, but it would decrease the scene time. Therefore, there would be an early transportation for stroke cases [19,21,25,28]. Furthermore, three other studies revealed that the response time differs due to either the determinant codes used to dispatch priority that results in over- or under-triage in the MPDS [20] or due to the differences in the patient-level characteristics, such as age, gender, chief complaint, and criticality or system-level characteristics, such as extended working hours, paramedic fatigue, and geographical area. For example, the response time is faster in the first working hours, and it appears that the paramedics get tired after 8 hours. Furthermore, urban areas had lesser response times than rural communities [27,30].

Mortality rate

Four studies reported the association between mortality rate and MPDS recognition of emergency cases (Table 2). The most remarkable result to emerge from the studies is that there is an opposite correlation between early dispatch recognition and mortality rate [10,22,23]. Besides, one of these studies stated that MPDS codes give the highest level of priority to some cases, such as acute myocardial infarction (AMI), based on the highest recorded cases of death for a certain age group [10]. Another study showed the highest mortality rate in the dispatch codes based on the chief complaints accompanying stroke patients, which included "not alert" and "unconscious" types of chief complaints [22]. The last study showed the relationship between the priority levels in MPDS and its association with Rapid Emergency Medicine Score (REMS), which is a scale used to aid in identifying patients who might be at risk of poor prognosis or outcomes. The results presented that the initial REMS for patients, who had been dispatched to as echo (highest priority level), was 5.8, whereas it was 3.4 for alpha patients, but it will be decreased by 0.95 for echo patients and 0.25 for alpha patients. As the data show with each point of change in REM, mortality will be dropped since the benefit of it is granularity as a continuous measure based on objective data, such as vitals. However, one study showed that the mortality rate was highly dependent on the age group. For instance, the elderly had a higher mortality rate than children aged 5–19 years in drowning incidents [26].

Survival rate

Four studies regarding the influence of MPDS on survival rate were reviewed (Table 3). Two of them insisted that the survival rate is an age-related consequence as younger ages have higher survival rates [27,31]. Another study claimed that achieved return of spontaneous circulation (ROSC) and survival were significantly associated with the area urbanization, distance from the scene, and response time [27]. However, Dicker et al. insisted that survival up to 30 days was affected not only by bystander-cardiopulmonary resuscitation (CPR) but also by pre-EMS arrival defibrillation [22], whereas the other two stated the same [27,31]. One study revealed that telephone-cardiopulmonary resuscitation (T-CPR) had a negative impact on survival and hospital discharge as it causes a delay in the first compression because of the assessing questions and instructions [29].

Discussion

The majority of the included papers were associated with favorable outcomes for the patients. In particular, reducing response time for time-critical patients, by giving them the highest level of priority and thus sending the appropriate unit, is in strong association with the increased survival rate and decreased mortality rate. One of the included studies showed that the response time would decrease by an average of 20 seconds for emergency cases in poor neighborhoods. Part of the explanation may be the systemic use of GPS technology which makes it easier for the emergency units to reach the caller's location. Another possible explanation is that the response time starts once the crews report to the dispatchers about their arrival at the staging area, until assessing the scene safety. However, only one study reported this matter; therefore, the additional research works are required to be done [33]. Furthermore, one of the studies related to dispatcher-assisted CPR showed that there might be a delay in the time to the first chest compression because of the time wasted on questions [32]. The other two studies have shown that the delay does not only depend on the time and frequency of the questions but also depend on the linguistic variations which have an impact on the caller initiation or even attempt at CPR [33,34].

Regarding stroke cases, the previous studies showed that the response time could be faster to stroke patients if the cases were identified by dispatchers. Moreover, time to CT scan will be shorter if the EMS called for stroke alerts to the hospital, as well as shorter hospital stays. Besides, the symptoms of transient ischemic attack (TIA) in stroke cases can be subsided before the arrival of the ambulance, which can explain the reason of emergency medical dispatch (EMD) ability to identify some of the stroke cases more accurately than paramedics and EMTs (or vice versa). The results indicated some possible solutions to improve the rate of pre-hospital stroke diagnosis. One of them is by ensuring the accessibility of approved stroke assessment tool, such as stroke diagnostics tool (SDxT), for each dispatcher. Another is by assessing if there are any acute neurological changes in patients complaining of visual symptoms. The last one is to make continuous quality assessments to confirm the use of SDxT on every suspected stroke case. Moreover, the SDxT tool can be used in sick person and Falls protocols to improve the probability of stroke identification. In addition, since the highest rate of deaths relies on unconscious and non-alert codes, pre-alert before arriving to the hospital may be useful as acute hemorrhagic stroke is expected. This might be explained by the low Glasgow Coma Scale (GCS) among these patients, which leads to lowering the accuracy level of identifying them. There are a number of limitations in using SDxT. First, it is only used in stroke as a chief complaint. Second, the tasks of diagnostic tests require the presence of another person at the scene with the patient, to be performed and observed, since the patient cannot do this for himself. Finally, if the caller is not in the same place as the patient also known as a third party caller, the SDxT could not be completed.

Regarding AMI cases, the proper triage is used for assessing the severity of cases rather than giving accurate diagnose to send the appropriate response. Some of the AMI cases have been triaged with a low priority level (alpha code) in sick person and Falls protocol. There are a number of possible ways to improve the dispatchers' identification of atypical presentation of AMI, mainly with two protocols, which are either by determining any patterns in reported symptoms that might indicate the incidence of AMI or by getting the history of any cardiovascular diseases of the patient.

Regarding cardiac arrest cases, achieved ROSC to the hospital is associated with some factors, such as ethnicity and service area, whereas the survival up to 30 days is associated with ethnicity, witnessed status, arresting rhythm, etiology, arrest location, and response time. Moreover, defibrillation before EMS arrival had a higher chance of 30-day survival as compared to those who have not received pre-EMS defibrillator. The effect of early defibrillation on cardiac arrest patients is high, but the number of defibrillation attempts is low.

To improve cost-effectiveness, studies have recommended targeted automated external defibrillator (AED) deployment in higher incidence locations in combination with improving public access to defibrillation programs and awareness by increasing community basic life support training and establishing an EMS- linked emergency department (ED) register.

The smartphone application, such as GoodSAM (smartphone-activated medics), offers further promises in reducing elapsed time in the initiation of CPR and defibrillation after an Out of hospital cardiac arrest (OHCA) is identified.

Regarding the most common health problems that fall under either over- or under-triage, both are dependent on the chief complaint in the MPDS. For example, the chief complaints of chest pain, heart problems, collapse/ unknown problem, and headache were highlighted as having over-triaged code, whereas convulsions/seizures and breathing problems were commonly under triaged. Furthermore, subcodes might be needed by further research to improve this aspect. Moreover, Scott et al. stated that most of the cases are triaged with an alpha code (low priority), while they actually have higher vital signs such as seizure/convulsions (due to being in a post-ictal state with low GCS), heart problems, and sick persons, which is the most challenging one. However, due to uncertainties about the patient conditions, some over triage will be necessary.

A serious limitation of this study, due to the heterogeneity of the studies, was not possible to do a meta-analysis. Furthermore, conducting a systematic review needs an access to a wide range of databases and search engines to get the papers. Some of the papers did not describe the methodology, objectives, or even the dispatching system that they used in their study, which were not mentioned clearly. Thus, it is possible that some relevant studies were missed or because others were not published in English. Besides, this review is limited to target the patient outcomes, so possibly the studies were excluded, which were conducted on MPDS but not covering patient's health. Furthermore, the present study was limited by the exclusion of observational cross-sectional studies that reported response time and the outcome variable because they assessed the prevalence of MPDS but not its effectiveness. These types of studies are very important for future improvements in emergency medical dispatch but were not for the purpose of this systematic review.

This review collected papers that were published between 2015 and 2019, which indicates that it provides an overview of the current state of the MPDS in the EMS field. This is considered as a major strength of the study.

One of the previous reviews on the MPDS showed that the accuracy results have low level and added that it is possible to improve the MPDS accuracy by adding some information such as vital signs and clarifying the areas of injuries specifically for traumatic patients [36]. Other two reviews showed that the results were not comparable due to the heterogeneity of the included studies, which made it difficult to reach a meaningful conclusion [35,37]. One of the two reviews added that it is possible to improve the errors of identifying critical cases in the dispatch by evaluating the performance of the MPDS diagnostic tools and integrating them with public educational efforts for identifying the symptoms of emergency cases and activating EMS [37]. Besides, as OHCA is considered to be one of the most time-critical situations, some additional features can be added to the dispatching system in the purpose of improving patient's experience. Of these features, the authors recommend a pre-arrival protocol, which assists the dispatcher in providing the caller with information for finding the nearest AED device and resuscitation instructions. The use of this protocol would reduce the time for defibrillation, thus improving the OHCA survival rate [38]. One other recommendation regarding these features is implementing a cardiac arrest notifying application, which sends a notification (CPR needed) to all the people, who downloaded the application in specific geographical distance from the scene, depending on the global mapping system. If availability of the first responder was ensured by the message receiver, the location of the patient and the nearest AED would be sent. Once the event is responded by a professional responder, the notifications would automatically be removed from the devices and replaced by a message, saying that the assistance is no longer required. Furthermore, under any circumstances and for ensuring the safety of the responders, the requests for CPR assistance will not be sent if the scene is not safe [39].

Conclusion

The majority of studies reported good results; however, they were not of a significant difference. The present limited data supported that the patients who have been given high priority by the dispatcher received faster pre-hospital treatment than those who had not prioritized. Still, more studies are needed to clarify the impact of high-priority response to time-critical patients and the accuracy of the dispatcher recognition itself on the patient outcomes. The EMS field is relatively new but the same as the MPDS, and both need continuous investigations and improvements. Therefore, this might be an area, where practice may change in the future.

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List of Abbreviations

AED	Automated external defibrillator
AMI	Acute myocardial infarction
CPR	Cardiopulmonary resuscitation
DTCT	Door To CT
ED	Emergency Department
EMD	Emergency Medical Dispatch
EMS	Emergency medical services
ERT	Emergency response time
ICD-9-CM	AMI identifying code
MART	Mean ambulance response time
MPDS	Medical priority dispatch system

Neurological assessment; altered mental status, facial drop, one side body weakness

OHCA	Out of hospital cardiac arrest

Patient condition characteristics; age, gender, race, etiology, witnessed status, and cardiac rhythm

REMS	Rapid Emergency Medicine Score
ROSC	Return of Spontaneous circulation
SDxT	Stroke Diagnostics Tool
STEMI	ST Segment-Elevated Myocardial Infarction
T-CPR	Telephone - Cardiopulmonary Resuscitation
TIA	Transient Ischemic Attack

Conflict of interests

The authors declare that there is no conflict of interest regarding the publication of this article.

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Consent for publication

Not applicable.

Ethical approval

The research was approved by King Abdullah International Medical Research Center (KAIMRC) ref number: SP19/317/J, dated: 25 JUNE 2019.

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