Title
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Journal
Resuscitation, 81(11)

ISSN
0300-9572

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Publication Date
2010-11-01

DOI
10.1016/j.resuscitation.2010.06.019

Peer reviewed

Volume 81, Issue 11 November 2010 ISSN 0300-9572

ELSEVIER

RESUSCITATION

OFFICIAL JOURNAL OF THE EUROPEAN RESUSCITATION COUNCIL

IN THIS ISSUE

Resuscitation 81 (2010) 1499–1504

Contents lists available at ScienceDirect

Resuscitation

journal homepage: www.elsevier.com/locate/resuscitation

Clinical Paper

How many emergency dispatches occurred per cardiac arrest?☆

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ARTICLE INFO

Article history:
Received 2 February 2010
Received in revised form 12 June 2010
Accepted 17 June 2010

Keywords:
Out-of-hospital cardiac arrest
Ambulances/utilization
Emergencies/classification
Emergency Medical Dispatch
Emergency Medical Service
Communication Systems/Standards
Emergency Medical Services/Standards
Emergency Medical Services/Utilization
Risk assessment
Triage

ABSTRACT

Background: The Medical Priority Dispatch System (MPDS) is an emergency medical dispatch (EMD) system that is widely used to prioritize 9-1-1 calls and optimize resource allocation. Calls are assigned an MPDS determinant, which includes a number (1–32) representing chief complaint and priority (Alpha through Echo) representing acuity.
Objective: This study evaluates the number of emergency dispatches per cardiac arrest (NOD-CA) in cardiac arrest and non-cardiac arrest MPDS determinants.
Methods: All patients assigned a determinant by MPDS from January 1, 2008 to June 30, 2009 in a large metropolitan area were included. Prehospital electronic patient care records were linked with dispatch data. For each MPDS determinant, the number of calls for which the paramedic impression was listed as "Cardiac Arrest – Non-Traumatic" was tabulated. The NOD-CA was calculated for each cardiac arrest and non-cardiac arrest MPDS determinant. Non-MPDS calls with cardiac arrests were analyzed separately.
Results: A total of 101,642 patients were included. Among them, 555 had "Cardiac Arrest – Non-Traumatic" listed as the paramedic impression. The Cardiac/Respiratory Arrest/Death protocol had the highest number of cardiac arrests (285), followed by Breathing Problems (99) and Unconscious/Fainting (76). Overall, 183 dispatched occurred for each cardiac arrest, 131 of which resulted in a lights and sirens response. The NOD-CA was 7 in the Cardiac Arrest/Death protocol, 122 in Breathing Problems, and 104 in Unconscious/Fainting. 31 Cardiac arrests occurred in non-MPDS dispatch categories ($N = 62{,}989$), most of which were calls for medical assistance from police or fire units.
Conclusions: MPDS was designed to detect cardiac arrest with high sensitivity, leading to a significant degree of mistriage. The number of dispatches for each cardiac arrest may be a useful way to quantify the degree of mistriage and optimize EMS dispatch. This large descriptive study revealed a low NOD-CA in most cardiac arrest MPDS determinants. We demonstrated significant variability in the NOD-CA among non-cardiac arrest MPDS determinants, and few cardiac arrests in non-MPDS dispatch categories.

1. Introduction

Emergency Medical Dispatch (EMD) is a system of categorizing and prioritizing emergency calls in order to send an appropriate ambulance response. The Medical Priority Dispatch System (MPDS) is a computer-based EMD system that uses callers' responses to scripted questions to categorize cases into groups, called determinants, based on complaint and perceived acuity.

Numerous studies have examined the predictive accuracy of MPDS and other EMD systems for a variety of outcomes, including paramedic-assigned acuity score, physician diagnosis of an acute illness, "Code 3" or "lights and sirens" return, and the need for Advanced Life Support intervention.[1–18] Most research has demonstrated that MPDS and other EMD systems identify most but not all urgent calls with a considerable degree of overtriage.[7–10,12,14,16,19–21]

Cardiac arrest has been extensively studied both as a determinant and an outcome. The sensitivity in detecting cardiac arrest increased from 15% to 50% after introduction of the EMD process in one system.[22] Deviation from standard questioning was a cause of low sensitivity to properly diagnose cardiac arrest.[23] Other evaluations of the sensitivity of EMD to detect whether a patient was in cardiac arrest ranged from 55% to 88%.[2,22,24–28]

Specificity of EMD for detecting cardiac arrest varies widely. In a study of over 2000 patients assigned an MPDS determinant for

☆ A Spanish translated version of the summary of this article appears as Appendix in the final online version at doi:10.1016/j.resuscitation.2010.06.019.

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doi:10.1016/j.resuscitation.2010.06.019

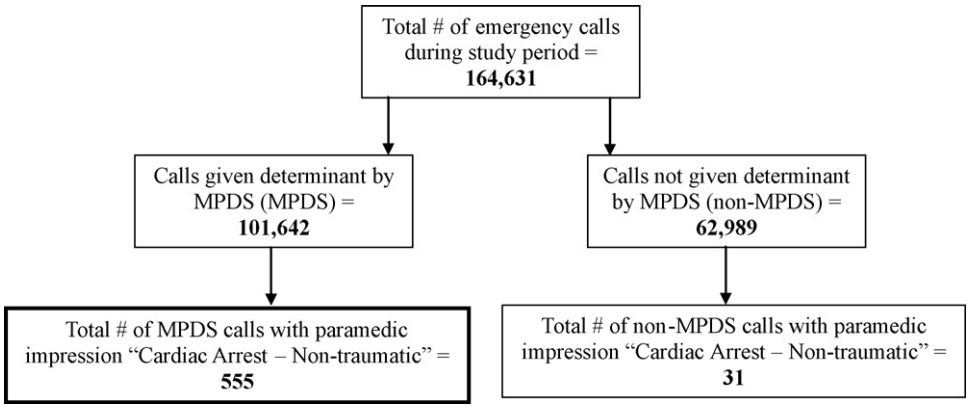


Fig. 1. Case selection and patient distribution. MPDS = Medical Priority Dispatch System.

cardiac arrest, paramedic impression was listed as cardiac arrest in only 36% of cases.[27] An Australian study showed that MPDS had a specificity of 99% for cardiac arrest.[28] It is unclear what accounts for this significant variability.

This study examines how many emergency dispatches took place for each cardiac arrest, both in MPDS determinants for cardiac arrest and in other determinants. We will also provide descriptive data about how dispatchers in our system classify calls that turn out to be cardiac arrests.

2. Methods

The City and County of San Francisco is an urban area with a population of 800,000 and a size of 47 square miles that receives approximately 60,000 calls for emergency medical assistance annually. All calls receive an Advanced Life Support response. High priority or "code 3" calls receive a "lights and sirens" response consisting of a fire department engine (staffed with one paramedic) and an ambulance staffed with at least one paramedic. Low priority or "code 2" calls receive an ambulance staffed with at least one paramedic. Most ambulances are staffed by fire department personnel, but a small percentage of calls receive private paramedic-staffed ambulance. An electronic prehospital care record is established for each patient that includes patient demographics, medical history, signs and symptoms, and clinical interventions. Additionally, paramedics enter an impression of the patient, typically after the call is completed, via a drop-down menu of standardized impressions.

9-1-1 Callers are asked a series of scripted questions that include the patient's level of consciousness, age, chief complaint, and other complaint-specific questions. A Computer-Aided Dispatch System records general information regarding each call, including date, time, and location of call, dispatch time, dispatch code, and disposition. Medical Priority Dispatch System (MPDS, Version 11.3, Medical Priority Consultants, Salt Lake City, UT) is used to categorize cases. MPDS is a computer-based dispatch system that uses callers' responses to scripted questions to categorize cases into numerical complaint-based categories called protocols, which are further assigned a priority (Alpha, Bravo, Charlie, Delta, or Echo) based on their perceived acuity. Alpha and Bravo represent the lowest acuity calls; these calls generally receive a no lights and sirens or "code 2" response in our system. Charlie, Delta and Echo represent higher acuity calls that receive a lights and sirens or "code 3" response in our system. Calls may be further assigned a numerical subgroup and a modifier, which provide responders with more specific details about the call. Together, the numerical protocol, priority (Alpha through Echo), subgroup, and modifier (when present) make up the MPDS determinant. For instance, a call may be assigned to the MPDS determinant 6D2A. The number 6 is the protocol for Breathing Problems, D (or Delta) represents priority, 2 is a subcategory which informs providers that the patient is not alert, and A is a modifier that indicates the patient has a history of asthma.

All patients from January 1, 2008 to June 30, 2009 were identified from the Computer-Aided Dispatch System and linked to an electronic prehospital care record. All patients assigned a determinant by MPDS were included in this study. A subset of emergency calls that did not go through the MPDS process (and therefore did not receive an MPDS determinant) but ended up having an ambulance dispatched and a paramedic impression listed as "Cardiac Arrest – Non-Traumatic" were analyzed separately. Most of these non-MPDS calls were thought to represent non-medical fire department calls that were either initially categorized incorrectly or evolved into a medical call, or calls for medical assistance by police or fire personnel.

The number of dispatches per cardiac arrest (NOD-CA) was calculated by dividing the total number of calls by the number for which the paramedic impression was listed as "Cardiac Arrest – Non-traumatic". The NOD-CA calculation was performed for the system as a whole, for cardiac arrest MPDS determinants, and for all other MPDS determinants in which a call was listed with the paramedic impression of "Cardiac Arrest – Non-traumatic". We elected not to analyze other paramedic impressions related to cardiac arrest, such as traumatic arrest, as doing so would be beyond the scope of a single descriptive study. Calls listed with paramedic impressions related to obvious death or "dead on arrival" were also not included in the NOD-CA calculation. MPDS determinants in which no calls had the paramedic impression of "Cardiac Arrest – Non-traumatic" were included in system-wide calculations but not reported individually as their NOD-CA would be infinity (number of dispatches divided by zero).

Absolute numbers and percentages were compared directly, and statistical significance was assessed where appropriate via a two-tailed paired *t*-test using Statistics Calculator (StatPac Inc., Bloomington, MN). The University of California, San Francisco Committee on Human Research approved this study.

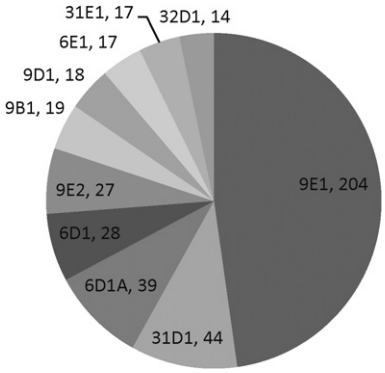
3. Results

A total of 164,632 emergency calls were made to the dispatch center during the study period (Fig. 1). A total of 62,989 calls did not go through MPDS, leaving 101,642 for analysis. Among these 101,642 calls, 555 had "Cardiac Arrest – Non-Traumatic" listed as the paramedic impression. For the overall system, among coded calls, 183 dispatches occurred for each cardiac arrest.

The Cardiac/Respiratory Arrest/Death protocol (MPDS protocol 9) had the highest absolute number of cardiac arrests at 285

Table 1
Number of ambulances dispatched per cardiac arrest in each MPDS determinant for cardiac arrest determinants (a) and non-cardiac arrest determinants (b). MPDS = Medical Priority Dispatch System. # and % Arrests = # and % of calls for which the paramedic impression was listed as "Cardiac Arrest – Non-traumatic." NOD-CA = number of dispatches per cardiac arrest.

MPDS	Description	Total # calls	#Cardiac arrests	%Cardiac arrest	NOD-CA
a.					
9B1	Cardiac or respiratory arrest/death – obvious death	210	19	9.05%	11
9B1A	Cardiac or respiratory arrest/death – obvious death, cold/stiff	88	8	9.09%	11
9B1E	Cardiac or respiratory arrest/death – obvious death, non-recent	14	4	28.57%	4
9D1	Cardiac or respiratory arrest/death – ineffective breathing	536	18	3.36%	30
9D2	Cardiac or respiratory arrest/death – ineffective breathing, other	102	1	0.98%	102
9E1	Cardiac or respiratory arrest/death – working arrest, not breathing	836	204	24.40%	4
9E2	Cardiac or respiratory arrest/death – working arrest, breathing uncertain	155	27	17.42%	6
9E3	Cardiac or respiratory arrest/death – working arrest, hanging	28	1	3.57%	28
9O1	Cardiac or respiratory arrest/death – expected death	28	3	10.71%	9
		1997	285	14.27%	7
b.					
1A1	Abdominal pain	1584	1	0.06%	1584
1D1	Abdominal pain – not alert	284	1	0.35%	284
2D2	Allergies/envenomations – not alert	95	1	1.05%	95
6C1	Breathing problems – abnormal breathing	1239	8	0.65%	155
6C2A	Breathing problems – cardiac history, *asthma*	2145	1	0.05%	2145
6D1	Breathing problems – severe respiratory distress	5516	28	0.51%	197
6D1A	Breathing problems – severe respiratory distress, *asthma*	1951	39	2.00%	50
6D2	Breathing problems – not alert	440	3	0.68%	147
6D3A	Breathing problems – clammy, *asthma*	217	1	0.46%	217
6E1	Breathing problems – ineffective breathing	443	17	3.84%	26
6E1A	Breathing problems – ineffective breathing, *asthma*	136	2	1.47%	68
10A1	Chest pain – breathing normally < 35 y/o	126	1	0.79%	126
10C1	Chest pain – abnormal breathing	1252	4	0.32%	313
10C2	Chest pain – cardiac history	938	1	0.11%	938
10C4	Chest pain – breathing normally > 35 y/o	1249	1	0.08%	1249
10D1	Chest pain – severe respiratory distress	1050	5	0.48%	210
10D2	Chest pain – not alert	655	5	0.76%	131
10D3	Chest pain – clammy	1480	4	0.27%	370
11D1	Choking – not alert	80	1	1.25%	80
11D2	Choking – abnormal breathing	153	1	0.65%	153
11E1	Choking – ineffective breathing	77	4	5.19%	19
12C1E	Convulsions/seizures – pregnancy, *epilepsy*	10	1	10.00%	10
12C3	Convulsions/seizures – cardiac history	38	1	2.63%	38
12D1	Convulsions/seizures – not breathing	44	2	4.55%	22
12D2	Convulsions/seizures – continuous or multiple	1207	3	0.25%	402
12D2E	Convulsions/seizures – continuous or multiple, *epilepsy*	990	1	0.10%	990
12D3	Convulsions/seizures – irregular breathing	337	4	1.19%	84
12D4	Convulsions/seizures – breathing regularly not verified > 35 y/o	773	1	0.13%	773
13C1	Diabetic problems – not alert	584	1	0.17%	584
13D1	Diabetic problems – unconscious	199	1	0.50%	199
17B1	Falls – possibly dangerous body area	3211	1	0.03%	3211
17B3	Falls – unknown status	1946	2	0.10%	973
17D1	Falls – dangerous body area	1153	2	0.17%	577
17D3	Falls – unconscious or not alert	1105	4	0.36%	276
19D1	Heart problems/AICD – severe respiratory distress	291	2	0.69%	146
19D2	Heart problems/AICD – not alert	151	1	0.66%	151
20A1	Heat/cold exposure – alert	1	1	100.00%	1
21D2	Hemorrhage/laceration – not alert	365	1	0.27%	365
23C8I	Overdose/poisoning – unknown status, *intentional*	118	1	0.85%	118
23D1A	Overdose/poisoning – unconscious, *accidental*	29	1	3.45%	29
26A1	Sick person – no priority symptoms	4149	1	0.02%	4149
26A2	Sick person – non-priority complaints	37	1	2.70%	37
26B1	Sick person – unknown status	582	1	0.17%	582
26C1	Sick person – cardiac history	880	1	0.11%	880
26C2	Sick person – other	2	1	50.00%	2
26D1	Sick person – not alert	1277	2	0.16%	639
27D2G	Stab/gunshot/penetrating trauma – not alert, *gunshot*	54	1	1.85%	54
28C1U	Stroke – not alert, *last normal unknown*	155	3	1.94%	52
29D2	Traffic/transportation accident – high mechanism	711	1	0.14%	711
31C1	Unconscious/fainting – alert with normal breathing	378	1	0.26%	378
31C2	Unconscious/fainting – cardiac history	594	1	0.17%	594
31D1	Unconscious/fainting – unconscious	4606	44	0.96%	105
31D2	Unconscious/fainting – severe respiratory distress	40	5	12.50%	8
31D3	Unconscious/fainting – not alert	1885	8	0.42%	236
31E1	Unconscious/fainting – ineffective breathing	378	17	4.50%	22
32B3	Unknown problem (man down) – unknown status	1290	2	0.16%	645
32D1	Unknown problem (man down) – life status questionable	1853	14	0.76%	132
33A1	Transfer/interfacility – no priority symptoms	137	1	0.73%	137
33C1	Transfer/interfacility – not alert	78	2	2.56%	39
33C1T	Transfer/interfacility – not alert, *transfer*	59	2	3.39%	30
33C6	Transfer/interfacility – emergency response requested	113	1	0.88%	113
		101642	270	0.27%	376



MPDS	Description
9E1	Cardiac or respiratory arrest/death - working arrest, not breathing
31D1	Unconscious/fainting - unconsious
6D1A	Breathing problems - severe respiratory distress, *asthma*
6D1	Breathing problems - severe respiratory distress
9E2	Cardiac or respiratory arrest/death - working arrest, breathing uncertain
9B1	Cardiac or respiratory arrest/death - obvious death
9D1	Cardiac or respiratory arrest/death - ineffective breathing
6E1	Breathing problems - ineffective breathing
31E1	Unconscious/fainting - ineffective breathing
32D1	Unknown problem (man down) - life status questionable

Fig. 2. Top 10 MPDS determinants by absolute number of cardiac arrest. This depicts the distribution and absolute number of the top 10 MPDS determinants in order of absolute number of cardiac arrest. Data are listed as MPDS determinant, absolute number of cardiac arrest. Descriptions of each determinant are shown. MPDS = Medical Priority Dispatch System determinant.

(Table 1a). The NOD-CA was 7 in this protocol. The 9E1 determinant (working arrest, not breathing) had more cardiac arrests than any other MPDS determinant, and comprised over 37% of all cardiac arrests (Fig. 2). The NOD-CA in 9E1 was 4. Fewer than 5% of calls in the following determinants were cardiac arrests: 9D1 (ineffective breathing, NOD-CA 30), 9D2 (ineffective breathing, other, NOD-CA 102), and 9E3 (working arrest, hanging, NOD-CA 28).

Among non-cardiac arrest protocols, the most cardiac arrests (99) occurred in the Breathing Problems protocol (MPDS protocol 6) (Table 1b). These comprised fewer than 1% of calls in protocol 6. The NOD-CA was 122. Among determinants, 6D1A (severe respiratory distress, asthma) had the highest number of cardiac arrests at 39. (NOD-CA 50, Table 1b, Fig. 2) Between the two severe respiratory distress determinants (6D1A and 6D1), which represent patients with and without a history of asthma respectively, patients in 6D1A (with asthma) had significantly more cardiac arrests (6D1A 2%, 6D1 0.5%, $p < 0.01$).

There were 76 cardiac arrests in the Unconscious/Fainting protocol. The NOD-CA was 104 (Table 1b). The vast majority (44) of cardiac arrests occurred in 31D1 (unconscious), but these comprised less than 1% of calls in this determinant. Although 31E1 (unconscious with ineffective breathing) had a low absolute number of cardiac arrests (17), they made up 4.5% of all calls in the determinant. Five out of the 40 calls (12.5%) in 31D2 (unconscious with severe respiratory distress) were cardiac arrests. This determinant had an NOD-CA of 8.

Thirty-one cardiac arrests occurred in non-MPDS dispatch categories (Table 2). Most of the 62,989 calls that did not go through MPDS were non-medical fire department calls such as fires, building alarms, and traffic accidents. The majority of cardiac arrests in non-MPDS dispatch categories, however, occurred in calls for medical assistance by fire or police units. The majority of cardiac arrests in non-MPDS categories (17 or 55% of non-MPDS arrests) occurred in the XM (code 3 medic) dispatch category, which represents a request to dispatchers by fire, police, or EMS personnel to send an ambulance with lights and sirens. Cardiac arrests represented less than 0.2% of all calls in this category. Three cardiac arrests also occurred in the MED category, which dispatchers use to assign an ambulance to a call when adequate information cannot be obtained to complete the MPDS process in a timely manner. Again, cardiac arrests represented less than 0.2% of calls in this category.

Table 2
Distribution of cardiac arrests among non-MPDS categories. MPDS = Medical Priority Dispatch System. # and %Arrests = # and % of calls for which the paramedic impression was listed as "Cardiac Arrest – Non-traumatic.".

Non-MPDS	Description	# Calls	#Arrests	%Arrest
72E8	Surf rescue	25	1	4.00%
99M9	Transfer	18	1	5.56%
E	Dispatch engine	3265	1	0.03%
IND	Industrial accident	122	1	0.82%
MED	Medical call – initial	1594	3	0.19%
WF	Working fire	434	1	0.23%
XM	Code 3 medic	9074	17	0.19%
XMB	Life threat – medic	4	1	25.00%
XR	Code 2 ALS Ambulance	8688	3	0.03%
53B3	Code 3 medical	132	2	1.52%
	Total	23356	31	0.13%

4. Discussion

MPDS is a computer-based dispatch system designed to synthesize information from callers to categorize calls and determine an appropriate response. It was designed to be highly sensitive for cardiac arrest. This presumably leads to low specificity, and a significant degree of overtriage. The range of specificity of MPDS for cardiac arrest in prior studies has varied from 36 to 99%.[27,28] Few studies have quantified how much mistriage occurs, especially in non-arrest determinants.

The NOD-CA may be a useful measure for identifying and quantifying mistriage. In cardiac arrest dispatch determinants (those in MPDS Protocol 9), the expected NOD-CA would be low, reflecting a higher incidence of cardiac arrest in these determinants relative to the total number of dispatches. In all other determinants, one would expect a relatively high NOD-CA due to the presumably low incidence of CA. We examined both cardiac arrest and non-cardiac arrest dispatch categories and attempted to highlight determinants that deviated from this expected pattern.

In the cardiac arrest protocol (MPDS protocol 9), there were 7 dispatches for each cardiac arrest, reflecting the expected high overall incidence of cardiac arrest in this protocol. Several determinants in protocol 9 had extremely low rates of cardiac arrest and correspondingly high NOD-CAs. The 9D2 determinant (ineffective breathing, other) had an NOD-CA of 102, indicating that over 100 ambulances were dispatched for only one cardiac arrest. Another determinants (9E2 – working arrest, breathing uncertain) had an NOD-CA over 20, and several others were not far behind. These data support the notion that dispatchers using EMD struggle to diagnose cardiac arrest. They also raise questions about the utility of multiple cardiac arrest determinants and subgroups, as some are infrequently and often inaccurately applied. Previous studies have noted challenges in identifying cardiac arrest for emergency medical dispatchers.[29] Agonal breathing or "signs of life" as well as caller characteristics and anxiety have been cited as obstacles in identifying cardiac arrest.[26,29,30]

Breathing Problems (MPDS protocol 6) had the second largest absolute number of cardiac arrests and the most among non-

cardiac arrest (MPDS Protocol 9) dispatches; these represented a small fraction of all calls in this protocol. The NOD-CA was high (122) as one would expect. A large study of the London Ambulance Service (LAS) found that Breathing problems make up a significant portion (16%) of EMS calls, but fewer than 1% of calls result in cardiac arrest.[31] Increasing MPDS priority was associated with higher rates of cardiac arrest. Interestingly, in the above mentioned LAS study, asthmatics had a lower rate of cardiac arrest. In our study, significantly more cardiac arrests occurred in the 6D1A determinant (severe respiratory distress, asthma) than in the 6D1 determinant (severe respiratory distress).

The Unconscious/Fainting protocol contained the third highest absolute number of cardiac arrests with an NOD-CA of 104. A prior study by our group found that the Unconscious/fainting protocol was highly sensitive (99%), but extremely nonspecific (2%) for predicting ALS interventions, a proxy for acuity.[11] Our results are in accord with previous data showing that a significant amount of overtriage occurs in this protocol. However, two determinants in this protocol, 31E1 (ineffective breathing) and 31D2 (severe respiratory distress), had high rates of cardiac arrest and low NOD-CAs. The absolute numbers of cardiac arrests in these determinants were small. It is unclear why these two determinants with respiratory-related modifiers have such high rates of cardiac arrest when compared with other determinants of similar acuity in the protocol.

Several other MPDS determinants deviated from previously described patterns. In earlier studies, approximately 6% of cardiac arrest calls were initially categorized as either seizure or chest pain.[9,14,21,22,27] In our study, fewer than 1% of cardiac arrests were assigned to these protocols (Table 1b).

Over 30 cardiac arrests occurred in non-MPDS categories. We previously reported high rates of prehospital interventions in non-MPDS categories in another EMS system.[12] To our knowledge, calls that were eventually determined to be cardiac arrests by paramedics but did not go through the MPDS process (non-MPDS) have not been previously described. Most cardiac arrests non-MPDS determinants were requests for medical assistance by police, fire, or EMS units in the field. Adding a protocol to MPDS to assist dispatchers with categorizing such calls might aid in detection of cardiac arrests or other acute events.

4.1. Limitations

This study is limited by the fact that all of its data comes from one urban community. This study also used a paramedic impression to determine whether or not a cardiac arrest occurred. Although this impression was chosen from a standardized list, there might have been some variability among paramedics in the definition of "Cardiac Arrest – Non-traumatic." A significant number of our calls did not undergo the MPDS process, which could have led to selection bias.

5. Conclusion

The number of dispatches for each cardiac arrest may be a useful way to quantify the degree of mistriage and optimize EMS dispatch. This descriptive study of over 100,000 calls revealed a low NOD-CA in most cardiac arrest MPDS determinants. Several cardiac arrest determinants had few cardiac arrests and a high NOD-CA, which might bring into question their utility. A large number of cardiac arrests occurred in non-cardiac arrest determinants, among which we demonstrated significant variability in the NOD-CA. Some cardiac arrests occurred in calls that did not go through MPDS, many of which were calls for assistance by police or fire personnel.

Conflict of interest

KAS receives compensation for medical direction from American Health and Safety Training, Inc. and the San Francisco Fire Department.

References

[1]. Bailey ED, O'Connor RE, Ross RW. The use of emergency medical dispatch protocols to reduce the number of inappropriate scene responses made by advanced life support personnel. Prehosp Emerg Care 2000;4:186–9.

[2]. Flynn J, Archer F, Morgans A. Sensitivity and specificity of the Medical Priority Dispatch System in detecting cardiac arrest emergency calls in Melbourne. Prehosp Disaster Med 2006;21:72–6.

[3]. Shah MN, Bishop P, Lerner EB, et al. Derivation of emergency medical services dispatch codes associated with low-acuity patients. Prehosp Emerg Care 2003;7:434–9.

[4]. Myers JB, Hinchey P, Zalkin J, et al. EMS dispatch triage criteria can accurately identify patients without high-acuity illness or injury. Prehosp Emerg Care 2005;9:119.

[5]. Shah MN, Bishop P, Lerner EB, et al. Validation of EMD dispatch codes associated with low-acuity patients. Prehosp Emerg Care 2005;9:24–31.

[6]. Michael GE, Sporer KA. Validation of low-acuity emergency medical services dispatch codes. Prehosp Emerg Care 2005;9:429–33.

[7]. Palumbo L, Kubincanek J, Emerman C, et al. Performance of a system to determine EMS dispatch priorities. Am J Emerg Med 1996;14:388–90.

[8]. Neely KW, Eldurkar J, Drake ME. Can current EMS dispatch protocols identify layperson-reported sentinel conditions? Prehosp Emerg Care 2000;4:238–44.

[9]. Feldman MJ, Verbeek PR, Lyons DG, et al. Comparison of the medical priority dispatch system to an out-of-hospital patient acuity score. Acad Emerg Med 2006;13:954–60.

[10]. Craig A, Schwartz B, Feldman M. Development of evidence-based dispatch response plans to optimize ALS paramedic response in an urban EMS system (abstract). Prehosp Emerg Care 2006;10:114.

[11]. Sporer KA, Youngblood GM, Rodriguez RM. The ability of emergency medical dispatch codes of medical complaints to predict ALS prehospital interventions. Prehosp Emerg Care 2007;11:192–8.

[12]. Sporer KA, Johnson NJ, Yeh CC, et al. Can emergency medical dispatch codes predict prehospital interventions for common 9-1-1 call types? Prehosp Emerg Care 2008;12:470–8.

[13]. Ramanujam P, Guluma KZ, Castillo EM, et al. Accuracy of stroke recognition by emergency medical dispatchers and paramedics-san diego experience. Prehosp Emerg Care 2008;12:307–13.

[14]. Clawson J, Olola C, Heward A, et al. Cardiac arrest predictability in seizure patients based on emergency medical dispatcher identification of previous seizure or epilepsy history. Resuscitation 2007;75:298–304.

[15]. Clawson J, Olola C, Heward A, et al. Ability of the medical priority dispatch system protocol to predict the acuity of "unknown problem" dispatch response levels. Prehosp Emerg Care 2008;12:290–6.

[16]. Clawson J, Olola C, Heward A, et al. The Medical Priority Dispatch System's ability to predict cardiac arrest outcomes and high acuity pre-hospital alerts in chest pain patients presenting to 9-9-9. Resuscitation 2008;78:298–306.

[17]. Clawson J, Olola C, Scott G, et al. Effect of a Medical Priority Dispatch System key question addition in the seizure/convulsion/fitting protocol to improve recognition of ineffective (agonal) breathing. Resuscitation 2008;79:257–64.

[18]. Clawson J, Olola CH, Heward A, et al. Accuracy of emergency medical dispatchers' subjective ability to identify when higher dispatch levels are warranted over a Medical Priority Dispatch System automated protocol's recommended coding based on paramedic outcome data. Emerg Med J 2007;24:560–3.

[19]. Neely KW, Eldurkar JA, Drake ME. Do emergency medical services dispatch nature and severity codes agree with paramedic field findings? Acad Emerg Med 2000;7:174–80.

[20]. Calle P, Houbrechts H, Lagaert L, et al. How to evaluate an emergency medical dispatch system: a Belgian perspective. Eur J Emerg Med 1995;2:128–35.

[21]. Clawson J, Olola C, Heward A, et al. The Medical Priority Dispatch System's ability to predict cardiac arrest outcomes and high acuity pre-hospital alerts in chest pain patients presenting to 9-9-9. Resuscitation 2008.

[22]. Heward A, Damiani M, Hartley-Sharpe C. Does the use of the Advanced Medical Priority Dispatch System affect cardiac arrest detection? Emerg Med J 2004;21:115–8.

[23]. Hallstrom AP. Dispatcher-assisted "phone" cardiopulmonary resuscitation by chest compression alone or with mouth-to-mouth ventilation. Crit Care Med 2000;28:N190–192.

[24]. Clark JJ, Culley L, Eisenberg M, et al. Accuracy of determining cardiac arrest by emergency medical dispatchers. Ann Emerg Med 1994;23:1022–6.

[25]. Hallstrom A, Cobb L, Johnson E, et al. Cardiopulmonary resuscitation by chest compression alone or with mouth-to-mouth ventilation. N Engl J Med 2000;342:1546–53.

[26]. Garza AG, Gratton MC, Chen JJ, et al. The accuracy of predicting cardiac arrest by emergency medical services dispatchers: the calling party effect. Acad Emerg Med 2003;10:955–60.

[27]. Merchant RM, Kurz MM, Gupta R, et al. Identification of cardiac arrest by emergency dispatch. Acad Emerg Med 2005;12:457.

[28]. Flynn J, Archer F, Morgans A. Sensitivity and specificity of the medical priority dispatch system in detecting cardiac arrest emergency calls in Melbourne. Prehosp Disaster Med 2006;21:72–6.
[29]. Bang A, Herlitz J, Martinell S. Interaction between emergency medical dispatcher and caller in suspected out-of-hospital cardiac arrest calls with focus on agonal breathing. A review of 100 tape recordings of true cardiac arrest cases. Resuscitation 2003;56:25–34.
[30]. Hauff SR, Rea TD, Culley LL, et al. Factors impeding dispatcher-assisted telephone cardiopulmonary resuscitation. Ann Emerg Med 2003;42:731–7.
[31]. Clawson J, Olola C, Heward A, et al. Profile of emergency medical dispatch calls for breathing problems within the medical priority dispatch system protocol. Prehosp Disaster Med 2008;23:412–9.