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Comparison of Medical Priority Dispatch (MPD) and Criteria Based Dispatch (CBD) relating to cardiac arrest calls☆

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ABSTRACT

Background: Prompt emergency medical service (EMS) system activation with rapid delivery of pre-hospital treatment is essential for patients suffering out-of-hospital cardiac arrest (OHCA). The two most commonly used dispatch tools are Medical Priority Dispatch (MPD) and Criteria Based Dispatch (CBD). We compared cardiac arrest call processing using these two dispatch tools in two different dispatch centres.
Methods: Observational study of adult EMS confirmed (non-EMS witnessed) OHCA calls during one year in Richmond, USA (MPD) and Oslo, Norway (CBD). Patients receiving CPR prior to call, interrupted calls or calls where the caller did not have access to the patients were excluded from analysis. Dispatch logs, ambulance records and digitalized dispatcher and caller voice recordings were compared.
Results: The MPDS-site processed 182 cardiac arrest calls and the CBD-site 232, of which 100 and 140 calls met the inclusion criteria, respectively. The recognition of cardiac arrest was not different in the MPD and CBD systems; 82% vs. 77% ($p = 0.42$), and pre-EMS arrival CPR instructions were offered to 81% vs. 74% ($p = 0.22$) of callers, respectively. Time to ambulance dispatch was median (95% confidence interval) 15 (13, 17) vs. 33 (29, 36) seconds ($p < 0.001$) and time to chest compression delivery; 4.3 (3.7, 4.9) vs. 3.7 (3.0, 4.1) min for the MPD and CBD systems, respectively ($p = 0.05$).
Conclusion: Pre-arrival CPR instructions were offered faster and more frequently in the CBD system, but in both systems chest compressions were delayed 3–4 min. Earlier recognition of cardiac arrest and improved CPR instructions may facilitate earlier lay rescuer CPR.

1. Introduction

Emergency medical dispatch (EMD) centres are the initial contact points between callers experiencing a medical emergency and the systems initiating emergency responses. How these calls are processed is of great importance both for initial and final outcome.[1,2] In out of hospital cardiac arrest (OHCA), absolute survival decreases 3–5% for each minute delay of care.[3,4] This emphasises the importance of early recognition of cardiac arrest with swift processing of calls. Dispatchers are trained to elucidate signs of cardiac arrest from callers and provide pre-arrival instructions for lay rescuers willing to start life-saving chest compressions until ambulance arrival. Emergency medical dispatch is being increasingly acknowledged as the "true anchor link in the chain of survival"[5] as it has the potential to remedy both poor lay rescuer efforts and stagnant survival rates.[6–8]

Despite efforts to provide effective emergency medical dispatch for cardiac arrest patients, several challenges persist. Inability to recognise cardiac arrest due to factors such as agonal breathing, and prolonged time intervals to provide CPR instructions even when cardiac arrest is recognised have been reported.[8–10] There is no common consensus on which decision support tool should be used

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to ensure optimal emergency medical dispatch for cardiac arrest patients.

Two of the most commonly used dispatch concepts are Medical Priority Dispatch (MPD) and Criteria Based Dispatch (CBD). MPD is a software based programme that uses scripted caller interrogation protocols to provide symptom-based information to prioritise calls and allocate resources.[11] The MPD software guides the dispatcher through a series of structured questions and algorithms after which the system determines whether the emergency call is immediately life threatening.[12] CBD uses guidelines with prompts (rather than more strict protocols with algorithms) based on caller descriptions of signs and symptoms, to provide direction and assistance in defining appropriate levels of care.

The aim of this study was to compare two commonly used medical dispatch tools in handling cardiac arrest calls; Medical Priority Dispatch (MPD) used in Richmond, USA and Criteria Based Dispatch (CBD) used in Oslo and Akershus, Norway. Primary outcome was defined as time to chest compressions performed from dispatch-assisted CPR instructions.

2. Methods

2.1. Description of Richmond emergency medical communication centre

The City of Richmond covers ~160 km^2 and has a resident population of 202,000, but rises in the working day to over one million. The Richmond Ambulance Authority was formed by an act of the Virginia General Assembly in 1991 as the exclusive, not for profit, EMS service to Richmond, Virginia's Capital city. They dispose a total of 32 ambulances, and in 2011 they conducted 56,000 responses and 42,000 transports. The emergency medical communication centre operates a Medical Priority Dispatch (MPD) protocol based system with a cardiac arrest protocol prescribing compression only CPR in arrests of presumed cardiac origin. All staff members are trained and qualified as Emergency Medical Dispatchers (EMD), with communication supervisory staff qualified in Quality Improvement and holding the additional 'EMD-Q' qualification. EMD-Q qualified staff are able to review and assess call takers and the calls they process against national academy quality criteria to ensure consistency and quality of call handling. The emergency medical communication centre employs 16 dispatchers responding to an average of 11 cardiac arrest calls per year.

2.2. Description of Oslo emergency medical communication centre

The Oslo and Akershus Emergency Medical Services is run by Oslo University Hospital and covers ~5400 km^2 and a population of 1 170 000. The Oslo Emergency Medical Services dispose a total of 45 ambulances. They deliver emergency and non-emergency services to the city and conducts approximately 250 000 responses and 112 000 transports per year.

In this study only Oslo and Nordre Follo regions were included, with an area of ~890 km^2 and a population of 621 000.

The emergency medical communication centre is staffed by registered nurses with additional training in emergency medical dispatch who answer emergency calls, and certified paramedics who coordinate ambulance responses. The Criteria Based Dispatch (CBD) tool is "Norsk Indeks for Medisinsk Nødhjelp",[13] a version of the Criteria Based Dispatch guidelines developed in King County,[14] edited and adapted by the Norwegian Medical Association. The cardiac arrest protocol used during the study period prescribed both compression and ventilation CPR (30:2) in willing and able callers, but with focus on chest compressions if callers were resistant or had difficulties performing ventilations. The emergency medical communication centre employs 24 dispatchers each responding to an average of 10 cardiac arrest calls per year.

2.3. Study design and data collection

Observational study of consecutive adult cardiac arrest calls between May 1st 2010–April 30th 2011 in the MPD site, and January 1st–December 31st 2007 in the CBD site. Cardiac arrest cases were identified from respective cardiac arrest registries of ambulance confirmed arrests. Digitalized voice recordings of cardiac arrest cases were audited. Clarification of consciousness and normal breathing was used to evaluate protocol compliance. Recognition of cardiac arrest and incidence of pre-arrival instructions with appropriate time intervals were recorded. Additional information was obtained from respective computer based programmes containing automated time records and dispatchers' codes, as well as ambulance records.

The following cases were excluded: patients being awake and thus not in cardiac arrest at time of call, caller not with patient, cases without need for CPR instructions (health care facility or medical personnel at scene performing CPR), cases where calls were interrupted before recognition of cardiac arrest was possible, and cases with missing or corrupted audio files.

Cardiac arrest was classified as recognised by the dispatcher when one of the following criteria was met: CPR instructions offered, documented as cardiac arrest in dispatch chart or when cardiac arrest was unmistakably described by person with patient, but CPR instructions were not offered due to circumstances at scene. Absence of normal breathing was classified as clarified if the dispatcher recognised CA or asked specifically if the patient was breathing normally.

2.4. Statistical analysis

Statistical calculations were performed using a spreadsheet programme (Excel 2007, Microsoft Corp, Redmond, WA, USA) or a statistical software package (SPSS 19.0, SPSS Inc., Chicago, IL, USA). Values are given as numbers with percentages or medians with 95% confidence intervals. Categorical outcome data were analysed using 2-sided Fishers exact test. Comparisons of continuous data were done with independent samples non-parametric Mann–Whitney *U*-tests. *p*-Values ≤ 0.05 were considered significant.

3. Results

During the study period the two EMS systems responded to 414 cardiac arrests. 174 patients met the pre-defined exclusion criteria. Analyses were therefore based on 100 calls from Richmond using the MPD system and 140 calls from Oslo and Akershus using the CBD system (Table 1).

Protocol adherence was similar for the MPD and CBD systems with 100 (100%) vs. 136 (97%) calls successfully clarifying consciousness ($p = 0.14$) and 100 (100%) vs. 137 (98%) clarifying respiratory arrest ($p = 0.27$), respectively. Absence of *normal* breathing was initially clarified by the dispatcher in 28 (28%) in the MPD system and 51 (36%) of the calls in the CBD system ($p = 0.17$), and cardiac arrest recognised in 82 (82%) and 108 (77%) ($p = 0.42$) calls respectively. In both systems the most frequent reason for not recognising cardiac arrest was misinterpretation of agonal breathing (Table 2).

Pre-arrival CPR instructions were offered in 81% vs. 74% ($p = 0.22$) of eligible cases and declined in 7% vs. 5% ($p = 0.58$) in the MPD vs. CBD systems, respectively. The most frequent reason for not offering CPR instructions was failure to recognise cardiac arrest due to agonal breathing. (Table 2).

Table 1
Consecutive adult, non-traumatic, out-of-hospital cardiac arrests included for analysis.

	Medical Priority Dispatch	Criteria Based Dispatch
Out-of-hospital cardiac arrests	182	232
Patients not in cardiac arrest at time of call	23 (13)	45 (19)
Caller not with patient	13 (7)	11 (5)
Call interrupted/missing audio	13 (7)	5 (2)
Health care facility/Ongoing CPR without need of instructions	33 (18)	31 (13)
Calls available for dispatch instructions	100 (55)	140 (60)

Values given as numbers (percentages).

Time to ambulance dispatch was 15 (13, 17) seconds in the MPD system vs. 33 (29, 36) seconds in the CBD system ($p < 0.001$). Initial pre-arrival instructions (e.g. "put the patient down on the floor") were offered to 81% vs. 74% of callers ($p = 0.22$) and time to initiate these instructions was 1.8 (1.6, 2.1) vs. 1.7 (1.4, 2.0) min in the MPD and CBD systems, respectively. Pre-arrival instructions lead to chest compressions more frequently (65% vs. 31%, $p < 001$) and rapidly 3.7 (3.0, 4.1) vs. 4.3 (3.7, 4.9) min, $p = 0.05$ in the CBD system compared to the MPD system. Ventilations were also delivered more frequently in the CBD system, 31% vs. 3% in the MPD system ($p < 0.001$) (Table 3 and Fig. 1). With 33 and 31 patients already receiving CPR at the time of call to the MPD and CBD dispatch centres respectively, plus 31 and 90 patients respectively after CPR instructions, 64 of 182 (35%) with confirmed arrests in the MPD site and 121 of 232 (52%) in the CBD site received dispatch-assisted bystander CPR.

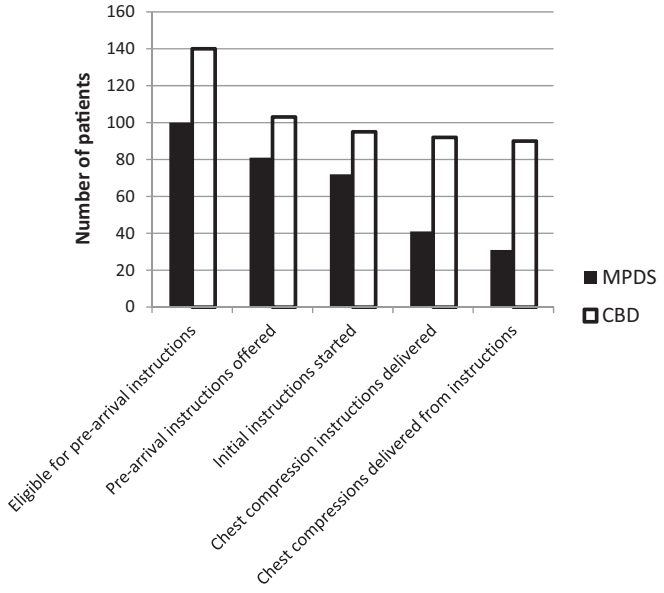

Fig. 1. Pre-arrival and chest compression instructions leading to chest compressions delivered.

4. Discussion

Few differences were observed when comparing the efficacy and efficiency of two commonly used dispatch tools, Medical Priority Dispatch (MPD) and Criteria Based Dispatch (CBD). Both systems dispatched ambulances efficiently, although 18 s faster in the MPD system. Recognition of cardiac arrest was within the range of previously reported efficacy,[1,15] and agonal breathing remains the single most important reason for not recognising cardiac arrest in both systems.[10,16,17] Despite some improvements seen after targeted educational efforts and protocol changes focused on agonal breathing,[18,19] an effective remedy eludes us. As recognition of cardiac arrest has been shown to increase the victims' chance of survival,[1] EMS systems should strive towards 100% recognition in eligible calls.

Pre-arrival CPR instructions have been reported to double bystander CPR rates and increase survival.[7] In the present study the number of patients receiving bystander CPR doubled in the MPD system and quadrupled in the CBD system after CPR instructions were initiated, but it is unknown how many would have started CPR after calling, but before ambulance arrival if instructions had not been offered. In a best case scenario where all eligible callers manage to perform dispatch guided chest compressions, approximately ¼ of the patients would still not receive bystander CPR as the patient was either not in arrest at the time of call to the dispatch centre, the caller was not with the patient, or the call was interrupted.

Both systems have the potential to further increase bystander CPR rates by both improving recognition of cardiac arrest

Table 2
Efficacy of recognition of cardiac arrest and pre-arrival CPR instructions.

	Medical Priority Dispatch ($n = 100$)	Criteria Based Dispatch ($n = 140$)	p-Value
Clarification of consciousness	100 (100)	136 (97)	0.14
Respiratory arrest established	100 (100)	137 (98)	0.27
Abnormal respiration established	28 (28)	51 (36)	0.17
Recognition of cardiac arrest	82 (82)	108 (77)	0.42
Reasons for not recognising cardiac arrest			
Misinterpretation of agonal respiration	13 (13)	26 (19)	
Breathing/consciousness not clarified	0	4 (3)	
Caller provides inadequate information	3 (3)	1 (1)	
No apparent reason	2 (2)	1 (1)	
Pre-arrival instructions offered	81 (81)	103 (74)	0.22
Reasons for not offering instructions			
Cardiac arrest not recognised	18 (18)	32 (23)	
Caller is clearly unable	0	1 (1)	
Caller believes person is dead	1 (1)	2 (1)	
No apparent reason	0	2 (1)	
CPR instructions declined by caller	7 (7)	7 (5)	0.58
Reasons for declining instructions			
Caller is unable/refuses	7 (7)	6 (4)	
Ambulance arrives	0	1 (1)	

Values given as numbers (percentages). Groups were compared using a Fisher's Exact test.

Table 3
Time intervals for dispatch of ambulance, ambulance response, and CPR instructions.

	Medical Priority Dispatch ($n = 100$)	Criteria Based Dispatch ($n = 140$)	p-Value
Dispatch of ambulance (s)	15 (13, 17)	33 (29, 36)	<0.001
Initial instructions started (%) (min)	72 (72) 1.8 (1.6, 2.1)	95 (68) 1.7 (1.4, 2.0)	0.57 0.65
CPR instructions started (%) (min)	41 (41) 3.4 (3.1, 4.1)	92 (66) 2.6 (2.3, 3.1)	<0.001 0,001
Chest compressions delivered (%) (min)	31 (31) 4.3 (3.7, 4.9)	90 (65) 3.7 (3.0, 4.1)	<0.001 0.05
Ventilations delivered (%) (min)	3 (3) 4.1 (3.4, 4.8)	43 (31) 3.9 (3.4, 4.5)	<0.001 0.91
Length of call (min)	4.7 (4.4, 4.8)	8.1 (7.0, 9.0)	<0.001
Ambulance response interval (min)	6.1 (5.5, 6.6)	9.7 (9.0, 10.3)	<0.001

Values given as medians with 95% confidence intervals. Groups were compared using a non-parametric Mann–Whitney U-test for continuous data and Fisher's Exact test for categorical data.

and providing more efficient pre-arrival instructions. Pre-arrival instructions in both systems were slow and/or inefficient to the extent that ~30% of callers who accepted pre-arrival instructions never managed to perform chest compressions. This was most apparent in the MPD system with shorter ambulance response intervals as ambulances often arrived prior to completion of pre-arrival instructions. In the CBD system time to first compression was half a minute faster than in the MPD system, which can constitute a clinical relevance due to the importance of time intervals in delay of care. These findings should prompt us to develop more efficient protocols to recognise and confirm suspicion of cardiac arrest and facilitate prompt bystander chest compressions.

Recent publications addressing best practices for implementing and measuring dispatch-assisted CPR indicate that best-practice benchmarks are not well established. One minute from call receipt to recognition of cardiac arrest and 2 min to delivery of chest compressions has been proposed as benchmarks based on a survey of the King County EMS system,[20] a recent scientific statement from the American Heart Association suggested one minute from call receipt to delivery of CPR instructions could be an achievable target.[5,21] This will require significant changes in both interrogation and pre-arrival instruction protocols with less time spent to establish lack of normal breathing and simplified chest compression instructions. This might decrease the specificity in recognition of cardiac arrest, and likely lead to dispatch instructed chest compressions performed on victims not in cardiac arrest. With more than 30 years of experience with evolving pre-arrival CPR instructions, King County EMS has provided compelling data supporting an approach with focused dispatch assessment and more aggressive dispatcher chest compressions instructions. During a 2.5 year study period, 313/17 000 victims received dispatch assisted chest compressions without being in cardiac arrest. Only minor injuries were recorded; the most serious being five victims suffering fractures without any visceral damage.[22]

The following limitations need to be addressed. This was an observational non-randomised study, and although we compared the dispatch tools related to cardiac arrest calls, the use and usefulness of these tools are influenced by a number of organisational, educational and cultural differences and traditions between the two sites, such as level of experience and proficiency in the dispatchers, and resources available. These factors were outside the scope of this investigation. Also, we did not collect data on dispatch suspected cardiac arrests that were not confirmed by ambulance crews. We are therefore unable to compare specificity in recognising cardiac arrest between the two dispatch tools. Time intervals and bystander performance from audio logs will always be open to interpretation, and the level of accuracy regarding if and when the patient actually receives CPR may be debated. Lastly, the unfortunate difference in data collection period between the two sites was due to differences in original inclusion criteria leading to the study having to be repeated at one of the sites to ensure identical prospective inclusion criteria.

5. Conclusion

Pre-arrival CPR instructions were offered faster and more frequently in the CBD system, but in both systems chest compressions were delayed 3–4 min. Earlier recognition of cardiac arrest and improved CPR instructions may facilitate earlier lay rescuer CPR.

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Conflicts of interest statement

Hardeland, Olasveengen, Lorem, Farstad, Lawrence and Garrison have no conflicts.

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