ORIGINAL RESEARCH

Profile of Emergency Medical Dispatch Calls for Breathing Problems within the Medical Priority Dispatch System Protocol

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Abbreviations:
ALS = advanced life support
CA = cardiac arrest
CAQ = Cardiac Arrest Quotient
BI = blue-in
IEAD = International Academies of Emergency Dispatch
LAS = London Ambulance Service
MPDS = Medical Priority Dispatch System
SRD = Severe Respiratory Distress

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Abstract

Introduction: A common chief complaint to emergency dispatch communication centers worldwide is "breathing problems". The chief complaint of breathing problems represents a wide spectrum of underlying diseases, patient conditions, and onset types. The current debate is on the potential ability of a dispatch protocol to safely and with high specificity, differentiate patients with minor or non-critical conditions from those conditions that pose risk to the patient and require advanced life support evaluation and care. This issue also has extended into the paramedic prehospital evaluation realm.

Objective: The objective of this study was to describe the distribution of Medical Priority Dispatch System (MPDS) codes representing the spectrum of clinical descriptions within the *breathing problems* chief complaint and their associated outcomes, at the scene and during transport, as determined by [UK] paramedics.

Methods: A retrospective, one-year study (September 2005 to August 2006) of a de-identified aggregate dataset from the London Ambulance Service (LAS) Trust was evaluated. A profile of the distribution of calls, incidents, patients, and outcomes (cardiac arrest [CA] and blue-in [BI] high acuity i.e., patients transported with lights and siren based on paramedic protocol) for the *breathing problems* chief complaint was evaluated. Odds ratios and 95% confidence intervals (CI) were used to quantify associations between the MPDS priority level's concurrent asthmatic conditions and outcomes. Two-sided Fisher's exact p-values were obtained to determine statistically significant associations, at a level of 0.05.

Results: Sixteen percent (95,848/599,093) of all the patients were classified under the *breathing problems* chief complaint. Of these 95,848 patients, 367 (0.38%) were CA outcomes, and 7.82% (n = 7,493) were BI outcomes. The Cardiac Arrest Quotient (i.e., the number of CA cases as a percentage of the number of patients) for the ECHO priority level was 46 times higher than was that of non-ECHO priority levels: DELTA and CHARLIE (17.05% vs. 0.37%). Asthmatics were associated with CA outcome (OR(95%CI): 0.60(0.47, 0.77), p <0.001), but not with BI outcome.

Conclusions: The MPDS coding yielded a richer mix of severe outcomes in the higher priority levels. The *Severe Respiratory Distress* coding had the greatest number of patients and severe outcomes. Future studies that help refine the Severe Respiratory Distress code in the MPDS by more specific subgroups of patients would be beneficial.

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Introduction

A common chief complaint to 9-9-9, 9-1-1, 1-1-2, and 0-0-0 emergency communication centers around the world is *breathing problems*. In three large centers on three different continents, this primary priority symptom represents 11.6% to 14.9% (i.e., Melbourne: 11.6%, Manchester/Liverpool: 13.0%, Montreal: 14.9%) of all calls.[1] Because of the potential for serious underlying

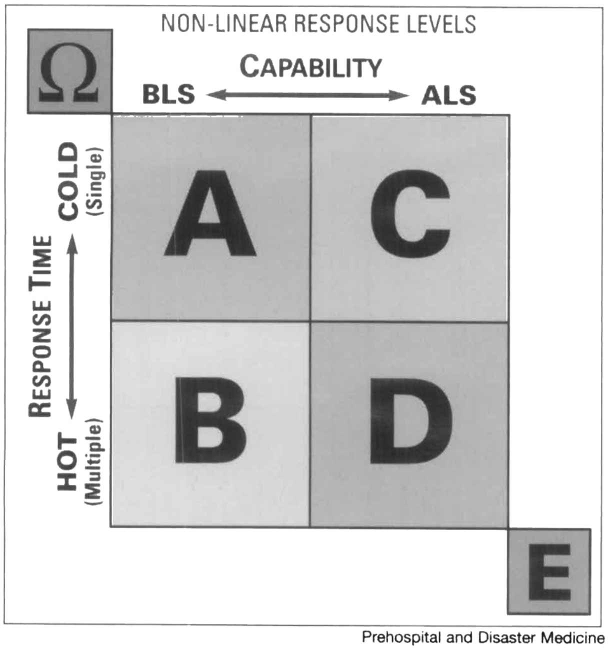

Figure 1—Non-Linear Response Levels Matrix of the Medical Priority Dispatch System v112
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problems and possible medication-related care or emergency intervention, advanced life support (ALS) responders are almost universally sent, when available, to these patients.

An interesting ongoing debate in medical dispatch circles is the potential ability of a protocol to safely and with high specificity differentiate patients with minor or non-critical conditions from those conditions that pose risk to the patient and require ALS evaluation and care.[2] This issue also has extended into the paramedic prehospital evaluation realm.[3] The International Academies of Emergency Dispatch (IAED) Council of Standards has examined this issue several times since 1990 and has not recommended any further protocol triage methods that it believes are capable of safely making these critical distinctions. The breathing problems chief complaint protocol remains the only pure, all ALS-coded chief complaint in the Medical Priority Dispatch System (MPDS) and is based on the response methodology matrix used by the IAED to group various codes into distinct response levels (Figure 1).

The *breathing problems* chief complaint represents a wide spectrum of underlying diseases, patient conditions, and onset types. At the dispatch level, the triggering onset usually is something that catches the patient's or caller's attention as a sudden event or an abnormally increasing problem over a relatively short period of time.[4]

The clinical make-up of these calls to dispatch centers, regarding various dispatch descriptor types and other associated symptoms, has not been published previously. No data have been published as to the scene acuity levels found when evaluating and treating these patients.

With the use of the IAED unified protocol, i.e., identical MPDS protocol coding system now present in approximately 3,000 sites in 23 countries, the distribution of MPDS codes representing the spectrum of problem types and co-morbid symptoms within the *breathing problems* chief complaint, may be increasingly useful to understand emergency medical services (EMS) resource deployment needs and to manage local response assignments. This also will help identify new areas upon which to base future outcome-related research.[5]

Objectives

The objectives of this study were to describe the distribution of MPDS codes that represent the spectrum of clinical descriptor types and co-morbid symptoms within the *breathing problems* chief complaint and their associated cardiac arrest outcome (on-scene and during transport), as well as paramedic designations of high acuity.

Methods

All studies that used the LAS de-identified, aggregated data sets were exempted from National Health Service (NHS) Ethics Service, which identified that this study did not require approval and awarded an exemption letter. A retrospective, one-year study (September 2005 to August 2006) of a de-identified, aggregate data set of MPDS codes (v11.2 UKE-Ω Protocol within ProQA™ software v3.4.3)[5] obtained from the London Ambulance Service (LAS) Trust was evaluated. Calls, dispatch incidents, patients, and outcomes were examined for their overall frequency among all 33 chief complaint types, and for the distribution of individual descriptor-based determinant codes within the *breathing problems* chief complaint protocol. A database was obtained from the LAS Trust, which is thought to be the largest medical call-receiving center in the world. The two outcome variables present in the dataset were: (1) scene or transport-encountered cardiac arrests (CA); and (2) a paramedic-assigned acuity designation called "blue ins" (BI) based on the responders' protocol requiring this designation for hospital alert prior to transporting a patient "blue lights-and-siren" (HOT).[6,7] The specific process used in this acuity-assigning process has been described in more detail by the authors in recently published studies.[8,9]

Calls, incidents, patients, and patient outcome were tabulated by MPDS priority levels, determinant code, and presence or absence of a concurrent asthmatic condition to obtain baseline descriptive statistics. Because the MPDS *breathing problems* protocol provides a suffix coding option of "A" when a history of asthma is determined through key questioning, patients with a reported history of asthma could be identified as a subgroup for study. Association between asthmatic conditions by MPDS priority levels and determinant codes and patient outcomes then was performed. In addition, an examination of association between the MPDS ECHO, which is the dispatch level for the most severe (ineffective) *breathing problems* chief complaint category/non-ECHO priority dispatch level patients and patient outcomes was performed. Finally, statistical differences between the cardiac arrest quotient (CAQ) and blue-in quotient (BIQ) for ECHO patients also were calculated. The CAQ is defined as the number of CA cases found at scene as a fraction of the total number of patients in a specific MPDS code.[10] Similarly, BIQ is the number of BI cases found at scene as a fraction of the total number of patients in a specific MPDS code. It is important

MPDS Priority Level	Descriptor Code	Asthmatic	Calls (n = 190,442; 16.7%) n (%)*	Incident (n = 111,17; 14.7%) n (%)†	Patients (n = 95,848; 16.0%) n (%)§	BI (n = 7,493; 21.4%) n (%)‖	CA (n = 367; 10.9%) n (%)¶
CHARLIE	n		16,131 (8.5)	13,555 (12.1)	11,021 (11.5)	435 (4.0)	18 (0.2)
	Abnormal breathing (C-1)	No	9,988 (5.2)	8,424 (7.5)	6,689 (7.0)	237 (3.5)	12 (0.2)
		Yes	2,968 (1.6)	2,445 (2.2)	1,988 (2.1)	55 (2.8)	2 (0.1)
	Subtotal		12,956 (6.8)	10,869 (9.7)	8,677 (9.0)	292 (3.4)	14 (0.2)
	Cardiac history (C-2)	No	2,424 (1.3)	2,055 (1.8)	1,811 (1.9)	107 (5.9)	4 (0.2)
		Yes	751 (0.4)	631 (0.6)	533 (0.6)	36 (6.8)	0 (0.0)
	Subtotal		3,175 (1.7)	2,686 (2.4)	2,344 (2.5)	143 (6.1)	4 (0.2)
DELTA	n		174100 (91.4)	98,056 (87.8)	24,735 (88.41)	7,040 (8.31)	334 (0.4)
	Delta override (D-0)	No	6 (<0.001)	4 (<0.001)	3 (<0.001)	0 (0.0)	0 (0.0)
		Yes	12 (0.01)	7 (0.01)	7 (0.01)	0 (0.0)	0 (0.0)
	Subtotal		18 (0.01)	11 (0.01)	10 (0.01)	0 (0.0)	0 (0.0)
	Severe respiratory distress (D-1)	No	106,832 (56.1)	60,128 (53.8)	52,195 (54.5)	4,535 (8.7)	251 (0.5)
		Yes	51,952 (27.3)	29,274 (26.2)	25,305 (26.4)	2,184 (8.6)	70 (0.3)
	Subtotal		158,784 (83.4)	89,402 (80.0)	77,500 (80.9)	6,719 (8.7)	321 (0.4)
	Not alert (D-2)	No	2,407 (1.3)	1,358 (1.2)	1,175 (1.2)	79 (6.7)	6 (0.5)
		Yes	548 (0.3)	308 (0.3)	265 (0.3)	18 (6.8)	2 (0.8)
	Subtotal		2,955 (1.6)	1,666 (1.5)	1,440 (1.5)	97 (6.7)	8 (0.6)
	Clammy (D-3)	No	9,037 (4.8)	5,107 (4.6)	4,265 (4.5)	176 (4.1)	4 (0.1)
		Yes	3,306 (1.7)	1,870 (1.7)	1,520 (1.6)	48 (3.2)	1 (0.1)
	Subtotal		12,343 (6.5)	6,977 (6.3)	5,785 (6.0)	224 (3.9)	5 (0.1)
ECHO	n		211 (0.1)	106 (0.1)	92 (0.1)	18 (19.6)	15 (16.3)
	Echo override (E-0)	No	8 (<0.001)	4 (<0.001)	4 (<0.001)	1 (25.0)	0 (0.0)
		Yes	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	Subtotal		8 (<0.001)	4 (<0.001)	4 (<0.001)	1 (25.0)	0 (0.0)
	Ineffective breathing (E-1)	No	165 (0.1)	83 (0.1)	72 (0.1)	15 (20.8)	12 (16.7)
		Yes	38 (0.0)	19 (0.0)	16 (0.0)	2 (12.5)	3 (18.8)
	Subtotal		203 (0.1)	102 (0.1)	88 (0.1)	17 (19.3)	15 (17.1)
All MPDS Priority Levels			1,137,873	758,695	599,093	34,963	3,377

Table 1—Patient breathing problems by calls, incidence, and paramedic-determined patient outcome (MPDS = Medical Priority Dispatch System)

*The number and percentage of each *breathing problems* descriptor code calls as a fraction of all the *breathing problems* chief complaint calls (n = 190,442). †The number and percentage of each breathing problems descriptor code incidences as a fraction of all the *breathing problems* chief complaint incidences (n = 111,717). §The number and percentage of patients in each *breathing problems* descriptor code as a fraction of all *breathing problems* chief complaint patients (n = 95,848). ‖The number and percentage of blue-in cases in each *breathing problems* descriptor code as a fraction of the corresponding number of patients in that descriptor code. ¶The number and percentage of cardiac arrest cases in each *breathing problems* descriptor code as a fraction of the corresponding number of patients in that descriptor code.

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MPDS Priority Level	Patients n (%)	CA n (%*)	CAQ† (%)	BI n (%§)	BIQ‖ (%)	RD (95% CI)¶	p**
ECHO (less overrides††)	88 (0.1)	15 (4.1)	17.1	17 (0.2)	19.3		
Non-ECHO	95,760 (99.9)	352 (95.9)	0.4	7,476 (99.8)	7.8	0.04 (0.02, 0.06)	<0.001
All Breathing Problems	95,848	367	0.4	7,493	7.8		

Table 2a—Cardiac arrest and Blue-in quotients for ECHO and non-ECHO Medical Priority Dispatch System (MPDS) priority levels. *Cardiac Arrest as a fraction of all CA outcomes in the entire MPDS protocol; †Cardiac Arrest Quotient (CAQ) is the number of cardiac arrest cases as a percentage of the number of patients; §Blue-in as a fraction of all BI outcomes in the entire MPDS protocol; ‖Blue-In Quotient (BIQ) is the number of blue-in cases as a percentage of the number of patients; ¶Risk difference between CA (risk: 0.041) and BI (risk: 0.002) outcomes for ECHO patients; **Two-sided Fisher's Exact test *p*-value for the association between severity of outcome (CAQ/BIQ) and ECHO MPDS priority level; ††The discretionary EMD upgrading of the determinant code.[11]

MPDS Chief Complaint	Patients n (%)	CA n (%*)	OR (95%CI)†	CAQ§ (%)	BI n (%‖)	OR (95%CI)†	BIQ¶ (%)
Breathing Problems	95,848 (16.1)	367 (20.8)		0.4	7,493 (22.3)		7.8
Non-Breathing Problems**	499,903 (83.9)	1,398 (79.2)	1.37 (1.22, 1.54)	0.3	26,093 (77.7)	1.54 (1.50, 1.58)	5.2
All MPDS Chief Complaints	595,751	1,765		0.3	33,586		5.6

Table 2b—Cardiac arrest and Blue-in quotients for breathing and all non-breathing problems Medical Priority Dispatch System (MPDS) Chief Complaint. *Cardiac Arrest as a fraction of all CA outcomes in the entire MPDS protocol; †Odds ratio and 95% confidence interval for CA and BI outcomes in the breathing problems chief complaint; §Cardiac Arrest Quotient (CAQ) is the number of cardiac arrest cases as a percentage of the number of patients; ‖Blue-in as a fraction of all BI outcomes in the entire MPDS protocol; ¶Blue-In Quotient (BIQ) is the number of blue-in cases as a percentage of the number of patients; **Non-breathing problems excluding the MPDS priority protocol 9 "Cardiac or Respiratory Arrest/Death" (patients: n = 3,342; CA: n = 1,612; BI: n =1,377)

to note that all the CA cases (n = 367) were subsets of the BI cases (n = 7,493).

The Intercooled Stata for Windows® software (Stata Statistical Software: Release 9.2 (1984–2007), StataCorp, College Station, TX) was used for all the data processing. The *p*-values obtained from the Fisher's exact test were used to establish significant association (at 5% significance level) between paramedic-determined patient outcome i.e., CA/non-CA and BI/non-BI cases and MPDS priority level parameters. Odds ratios (OR) with 95% confidence intervals (95%CI) were used to assess and quantify the degree of association.

A letter of exemption was awarded by the NHS National Research Ethics Service.

Results

For the year studied, the LAS Control Center received a total of 1,137,873 "9-9-9" phone calls, out of which, 758,695 incidents were created, and eventually 599,093 patients were encountered. Ultimately, 3,377 cardiac arrest (CA) outcomes and 34,963 Blue-in (BI) outcomes were recorded by responders either at scene or during transport (Table 1).

Out of the 33 chief complaint protocols utilized within the MPDS Protocol System, the *breathing problems* protocol (MPDS protocol 6) constituted 16.0% (95,848/599,093) of all of the patients, 16.7% (190,442/ 1,137,873) of all the calls, 14.7% (111,717/758,695) of all the incidents, 10.9% (367/3,377) of all the CA outcomes, and 21.4% (7,493/34,963) of all the BI outcomes. Within the *breathing problems* chief complaint protocol alone, there were 0.38% (367/95,848) CA outcomes and 7.8% (7493/95848) BI outcomes recorded by responders.

The CAQ for patients categorized in the ECHO level of the protocol (17.1%) was 46 times that of the patients categorized in the non-ECHO levels (0.4%) (Table 2a). The ECHO MPDS priority level was associated with severity of outcome (p <0.001). The probability of identifying CA outcome in ECHO patients was significantly higher than was that of BI outcome by 4% (risk difference-RD (95%CI: 0.04 (0.02, 0.06)).

The odds of identifying CA or BI outcomes was nearly 1.5-fold in patients with breathing problems, compared to non-breathing problem patients (Table 2b). The CAQ ratio of

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MPDS Priority Level	Chief Complaint	Asthmatic Condition	n	Cardiac Arrest			Blue-Ins		
				n (%)	OR (95% CI)*	$p^{\dagger}$	n (%)	OR (95% CI)*	$p^{\dagger}$
CHARLIE	Abnormal breathing (C-1)	No	6,689	12 (0.18)			237 (3.540)		
		Yes	1,988	2 (0.10)	0.56 (0, 2.24)	0.75	55 (2.77)	0.77 (0.58, 1.04)	0.103
	Cardiac history (C-2)	No	1,811	4 (0.22)			107 (5.91)		
		Yes	533	0 (0.00)	0.00 (0, 3.26)	0.58	36 (6.75)	1.15 (0.78, 1.70)	0.472
DELTA	Delta override (D-0)	No	3	0 (0.00)			0 (0.00)		
		Yes	7	0 (0.00)	--	--	0 (0.00)	--	--
	Severe respiratory distress (D-1)	No	52,195	251 (0.48)			4,535 (8.69)		
		Yes	25,305	70 (0.28)	0.57 (0.44, 0.75)	<0.001	2,184 (8.63)	0.99 (0.94, 1.05)	0.796
	Not alert (D-2)	No	1,175	6 (0.51)			79 (6.72)		
		Yes	265	2 (0.75)	1.48 (0, 6.46)	0.645	18 (6.79)	1.01 (0.60, 1.71)	1.000
	Clammy (D-3)	No	4,265	4 (0.09)			176 (4.13)		
		Yes	1,520	1 (0.07)	0.70 (0, 4.67)	1.000	48 (3.16)	0.76 (0.55, 1.05)	0.104
ECHO	Echo override (E-0)	No	4	0 (0.00)			1 (25.00)		
		Yes	0	0 (0.00)	--	--	0 (0.00)	--	--
	Ineffective breathing (E-1)	No	72	12 (16.67)			15 (20.83)		
		Yes	16	3 (18.75)	1.15 (0.31, 4.41)	1.000	2 (12.50)	0.54 (0, 2.41)	0.727
Overall	All Levels	No	66,214	289 (0.44)			5,150 (7.78)		
		Yes	29,634	78 (0.26)	0.60 (0.47, 0.77)	<0.001	2,343 (7.91)	1.01 (0.97, 1.07)	0.498

Table 3—Association between Medical Priority Dispatch System Priority Levels Asthmatic conditions and paramedic determined patient outcomes

* Odds ratio and 95% confidence interval.

† Two-sided Fisher's Exact p-values

1.4 (0.38/0.28) for *breathing problems* to *non-breathing problems* chief complaints and the BIQ ratio of 1.5 (7.82/5.22) for *breathing problems* to *non-breathing problems* chief complaints, were nearly the same (Table 2b). The breathing problems chief complaint was significantly associated with severity of outcomes, validating the difference between CAQ and BIQ.

Overall, asthma patients with breathing problems only were statistically associated with CA outcome (p <0.001) and not with BI outcome (Table 3). The odds of identifying CA outcome in asthma patients compared to non-asthma patients was reduced by about 40% (OR (95%CI): 0.60 (0.47, 0.77). A similar pattern was observed in the DELTA determinant code level 1 (6-D-1, *Severe Respiratory Distress (SRD)* patients (OR (95%CI): 0.57 (0.44, 0.75)). The DELTA determinant code level 2 (6-D-2, *Not alert*) was not significantly associated with CA outcome. However, asthma patients classified under the 6-D-2 code were 1.5 times more likely to identify CA outcome in asthma patients (OR (95%CI): 1.48 (0, 6.46)), compared to non-asthma patients. In the BI group, the odds to identify BI outcome in asthmatic patients was insignificantly increased in the CHARLIE determinant code level 2 (6-C-2, Cardiac history) (OR (95%CI): 1.15 (0.78, 1.70)) and in the DELTA determinant code level 2 (OR (95%CI):1.01 (0.60, 1.71)).

Discussion

This first reported distribution of the signs and symptoms sub-groups within the *breathing problems* chief complaint provides two previously unknown findings. First, within this protocol, the ability of the ECHO determination process to identify critically ill patients appears to be successful, although patients with ineffective breathing are not encountered often. When ineffectively breathing (but conscious) patients are identified, they contain a high percentage of CA (16.7%) and BI patients (20.8%). Only Protocol 9—Cardiac or Respiratory Arrest/Death, with a CAQ of 48.2%, shows a greater specificity in identifying CA. On Protocol 6, the ECHO-coded patients proved more able (nearly 46 times higher CAQ) to identify CA outcomes than the non-ECHOs. ECHO also demonstrated greater ability (nearly three times higher BIQ) to identify BI outcomes than the non-ECHO patients.

Second is the seemingly disproportionate number of cases coded as *SRD* in the *breathing problems* protocol (descriptor code 6-D-1). According to the protocol, SRD is defined as difficulty speaking between breaths and/or changing skin color. This code accounted for 12.9% (77,500/599,093) of all patients. In comparison, a recently obtained MPDS code database from the Manchester/Liverpool system, descriptor code 6-D-1 made up nearly 9.7% (27,435/282,147) of all calls to the emergency medical dispatch center. In London, the DELTA tier alone accounts for 88.4% (84,735/95,848) of all breathing problems, and it accounts for 14.1% (84,735/599,093) of all the emergency medical dispatch patients.

This SRD group possibly poses the greatest challenge for refinement within the entire MPDS. It contains almost 10% (321/3,377) of all cardiac arrests encountered in the prehospital system. But with so many patients classified in this single code—nearly an eighth of all EMS cases—responder resources can be severely strained attempting to service all such cases with a maximum response. For example, in most North American EMS systems, these calls receive an ALS ambulance plus first responders. In the UK, all are classified as Category A (response 75% of the time at scene within eight minutes).[11,12] Thus, the system pays a heavy price without the ability to more specifically determine the truly sick and deteriorating breathing problems patients from those that are not. This has been an age-old problem—one that has not been resolved by EMD protocol processes without the potential for critically ill or dying patients to be under-triaged. Future research must address the potential for breaking down this single category of cases into smaller sub-groups that may lend themselves to more specific prioritization for response.

Because of coding hierarchy bias found within the 6-D-1 code group, ability to see if certain single signs or symptoms, or a combination of both, are where the CA and/or BI patients reside (*difficulty speaking between breaths, changing color, not alert, and clammy*) is limited with the coding process and the dataset used. Using one example of this, it is possible that every patient exhibiting SRD also was "not alert". Hierarchy bias never has been mentioned in any dispatch-related study, other than those by this group of authors.[8] Partitioning out the individual symptoms and combinations of symptoms, requires examining the full set of answers to key questions. This is virtually impossible in non-automated interrogation and coding systems. Correlating signs and symptoms with an outcome may then reveal better ways to capture these patients. This is an area the authors intend to study further.

It is interesting to note that the aggregate CAQ found in each MPDS priority level matched its higher or lower position in the prioritization ranking. This speaks to the relatively correct placement of individual patient/type descriptor codes into each general level (CHARLIE, DELTA, and ECHO).

One significant variation from code within level placement is found in descriptor code 6-D-3 Clammy. It had the lowest CAQ of any of the other descriptor codes by almost half of the next lowest code—*abnormal breathing* (i.e., without any other symptoms or cardiac history). The more nonspecific nature of this patient descriptor code suggests that it may either be eliminated in questioning or be placed in the CHARLIE tier, where similar lower specificity codes lie.

For all patients classified as *breathing problems*, the presence or absence of an asthmatic condition is determined and, when an asthma history is reported, such codes are labeled with an "A" suffix, for response discrimination or study identification purposes. The finding of concurrent asthma history allowed for the separate evaluation of these patients, as compared to those without this reported history. Overall, BI outcomes were more likely (though not significantly) to be identified in the asthma group. Cardiac arrest outcomes were more identifiable (though not significantly) only among asthma patients with ineffective breathing (6-E-1) or not alert conditions (6-D-2). Interestingly, it was only among patients with asthma with SRD that the odds of identifying CA were significantly reduced (by about 43%).

Overall, BI and CA cases were highly associated (p <0.001) for both asthmatic and non-asthmatic patients. This was an expected result, since all CA patients also were included in the BI category. This study does not attempt to determine the statistical association or difference in predictability between the interrogation and logic processes resulting in these various codes. This area is recommended for future studies.

Limitations

A significant potential limitation in dispatch-related studies is the actual level of compliance to protocol that must be demonstrated by the communications center providing such data.[13] Failure to assure high EMD compliance to protocol invalidates the accuracy of interrogation, coding, or condition-based pre-arrival instructions.[8,14] This center has been accredited by the IAED and, during the study period, maintained a very high compliance to protocol of 97.0% for chief complaint selection correctness, 98.5% for key questioning compliance, and 99.5% for determinant descriptor code accuracy.[9,15,16]

Another potential limitation of this study is that the data set comes from a single EMD center representing one geographic region (London). As stated, London is reputedly the largest EMD communications center of its kind in the world, and the data comparisons strongly suggest that most chief complaint distributions tend not to vary substantially by region, country, or even continent. Nevertheless, there always is the possibility that another dataset from another region, with different EMDs, especially if compliance to protocol varies, could produce different findings. This also may be even more relevant regarding the occurrence of asthma in this specific European area.

Some sample sizes, e.g., CA and BI outcomes in some specific determinant descriptor codes, are quite small. Therefore, further studies with larger sample sizes are needed to validate the findings. However, no other single emergency medical dispatch center would be able to provide larger, yearly sample sizes than what was obtained from the LAS. Thus, multi-center studies would be beneficial to validate these findings. In addition, although all CA cases also were BI cases, any individual case limitations could not be determined, because of aggregate data.

Another limitation to any dispatch outcome study is the ability of the calling public to understand questioning terminology and recognize signs in patients—and connect the two. The relay and/or recollection of information between those calling and those with the patient, i.e., in another room or after leaving the patient to telephone for help, may delink the findings from the intended function of the protocol's interrogation system. Information gleaning (interrogation) methodology represents a whole different area of protocol study that has had little significant reporting in literature.[8,17]

Conclusions

Because breathing problems constitute such a large percentage of EMS cases, the topic deserves more in-depth study by EMD and EMS research organizations. The data and results here should be viewed as a first attempt to identify various conditions and levels of severity of patients with a primary complaint of breathing problems as reported to the Emergency Medical Dispatcher. Examining severe outcomes, as determined by the paramedic crews patient outcome evaluation, shows that MPDS coding yields an increasingly richer mix of BI and CA cases with an escalating priority level—that is DELTA yielded a richer mix of severe patients than did CHARLIE, while ECHO yielded a richer mix than did DELTA. Of particular interest was the comparatively high percentage of CA and BI contained in the ECHO level (E-1) *ineffective breathing coded* patients.

By far the greatest number of patients were coded as MPDS Protocol 6 DELTA level 1 (6-D-1), *Severe Respiratory Distress.* This code yielded the greatest total number of BI and CA patients, but also the greatest number of non-CA and non-BI patients. These results suggest that EMS systems and their patients may derive substantial benefit if future studies can facilitate an EMD process that better defines conditions, signs, and symptoms predictive of high acuity for patients within this code, and separates those sub-groups of patients into several determinant codes for appropriate response and further scene evaluation. Hierarchy bias within the MPDS logic-based software system also may be contributing to the large number of patients in the 6-D-1 coding. Finally, the presence of asthma, as identified by the EMD, showed no association with higher patient acuity (i.e., BI), and in most cases, actually was associated with lower acuity (i.e., CA) cases.

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Conflict of Interest

JC is the CEO and Medical Director of the Research and Standards Division of Priority Dispatch Corp. and a member of the Council of Standards, Board of Certification, and Board of Trustees of the International Academies of Emergency Dispatch. He is the inventor of the Medical Priority Dispatch Protocol and Quality Assurance System studied herein. BP is Academics and Standards Editor for the IAED and Chair of the IAED Council of Research. CO is a medical informatics researcher and biostatistics expert employed part-time by the IAED for study development and validation only. AH is the Distribution Manager for the London Ambulance Service NHS Trust, UK. GS is a Medical Protocol and Quality Assurance Consultant at Priority Dispatch Corporation and serves on the IAED Council of Standards.

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