

Criteria-based emergency medical dispatch of ambulances fulfils goals

Mikkel Strømgaard Andersen^{1,2}, Helge Præstgaard Carlsen¹ & Erika Frischknecht Christensen^{1,2}

ABSTRACT

INTRODUCTION: In Denmark, Alarm 112 (112) calls and emergency medical dispatch (EMD) are two separate institutions. 112 calls are mainly answered by the police. In Aarhus, a new EMD centre for the Region of Central Jutland (1.2 million people) opened on 1 December 2009. It was the first to employ health-care professionals and to use a new tool for criteria-based dispatch called Danish Index. The aim of the present paper is, for the first time in Denmark, to describe the level of urgency of patients transported by ambulance based on the Danish Index categories A-E and to determine if ambulance response time target values were reached.

MATERIAL AND METHODS: The present paper is an observational cohort study based on consecutive, electronically collected data from the initial six months of operation (1 December 2009 to 31 May 2010) of the new EMD centre in Aarhus.

RESULTS: A total of 73,484 patients were included. The distribution according to level of urgency was as follows: A 28.7% (n = 21,104), B 13.5% (n = 9,890), C 21.0% (n = 15,418), D 35.1% (n = 25,818), E 1.7% (n = 1,254). The median ambulance response time intervals for levels A and B were 6.5 and 11.9 min., respectively. Comparison of level A response time intervals with the equivalent target values showed that the 75, 92 and 98 percentiles were 10.0/10 min., 14.6/15 min., 18.6/20 min., respectively.

CONCLUSION: In a cohort of 73,484 patients, the highest level of urgency (A) was found in 28.7% of cases, while the largest group, 35.1% of patients, were level D cases – these patients had a need for transport, but not by ambulance. The level A target response time requested by 112 was achieved.

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Evidently, patients with an acute life-threatening condition should receive a more rapid ambulance response than patients with a non-acute condition. The dispatch of ambulances should consequently be prioritized according to the severity of the patient's condition. Until recently, this has not been the case in Denmark. The single most important target has, until now, been the average response time for *all* ambulances requested by Alarm 112 (112) calls with little concern for the severity

of patient's condition. This means that previously no data were available on the severity of diseases and injuries of patients transported by ambulance in Denmark.

Pre-hospital care has developed from a basic patient transport service into being an important part of treatment. The education and training of the various levels of emergency medical technicians/paramedics has increased and improved [1, 2]. Several levels of pre-hospital competencies are available: the top level consists of anaesthesiologist-staffed mobile emergency care units (MECU) dispatched as a second tier to the ambulance for severely ill and injured patients [2-4]. A key issue in this context is dispatching the correct help to the right patient in due time. This is emphasized by declaring the alarm call and dispatch of emergency medical services as "the first link" in the so-called chain of survival. The chain covers the steps from the emergency call is made until the patient is received at the hospital [5].

In Denmark, apart from Copenhagen, this first link in the chain of survival is managed by two separate institutions: the 112 centres operated by the police and the emergency medical dispatch (EMD) centre which

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1) Emergency Medical Dispatch Centre
Prehospital, Region of Central Jutland
2) Centre for Emergency Medical Research, Aarhus University Hospital

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Emergency Medical Dispatch Centre, Aarhus, Region of Central Jutland. Photographer: Mikkel Strømgaard Andersen.

until recently was operated solely by the ambulance services with no medical direction [2, 3, 6]. In Copenhagen, 112 calls are received by the municipal Copenhagen Fire Brigade [2].

New ambulance service contracts are based on the level of severity and urgency of the patient's condition: A: potentially life-threatening, "immediate response"; B: urgent, but not life-threatening; C: non-urgent ambulance; D: non-urgent supine patient transport and E: other service or advice/instruction including taxis.

The introduction of these categories made it necessary to implement criteria-based dispatch (CBD), medical EMD direction and recruitment of health-care professionals in the EMD centre. The Danish CBD protocol,

Danish Index [7], was translated and revised from the Norwegian Index [8, 9]. Other Scandinavian countries are using similar indices [10, 11].

In Aarhus, the new EMD centre for the Region of Central Jutland opened on 1 December 2009. It was the first to employ health-care professionals to decide (based on the Danish Index) the level of urgency, type of response and, consequently, prioritize the order in which ambulances and specialized pre-hospital units are dispatched.

The fact that emergency medical dispatch is now a part of the health-care system amounts to a major change in Danish pre-hospital emergency care. This study presents the first Danish data on the dispatch of ambulances after implementation of the Danish Index. The purpose was to describe the distribution of patients throughout the five levels of urgency, A-E, and to determine whether the regional pre-set target values for response times for ambulances were achieved.

MATERIAL AND METHODS

The EMD in Aarhus covers the Region of Central Jutland which has 1.2 million inhabitants and covers an area of 13,124 square kms. It is the largest of the five Danish regions with an overall population density of 95.5/ square kms varying from urban to rural areas. The highest density in this region is in the eastern part which includes Aarhus, the second largest city in Denmark.

The responsibility for pre-hospital care lies with the publicly administered regions. The regions engage private companies, such as Falck, or municipal fire departments to run the ambulance services.

In the Region of Central Jutland, the new response time interval targets for ambulance urgency level A are 75% within 10 min., 92% within 15 min. and 98% within 20 min.; and B: 60% within 10 min. and 75% within 20 min. The region has a total of 62 ambulances, nine MECUs manned with an anaesthesiologist and a paramedic, five rapid response cars manned with nurses or paramedics and 25 non-ambulance cars for the transfer of supine patients. Starting from April 2011, a helicopter manned with an anaesthesiologist, a paramedic and a pilot will also be available.

The EMD centre is manned by non-health-care dispatchers who perform the technical dispatch of the units and monitor the geographical coverage of ambulances. The main task of the health-care professionals in the EMD (nurses and ambulance personnel) is call-handling, which is supervised by a medical doctor during daytime and on-call support 24/7. The police-operators answer all 112 calls and request ambulances electronically. The health-care EMD-personnel monitor 112 activity on screens in the EMD centre and call the caller back *after* the police-operator has finished talking to the caller. In

FIGURE 1

A page from the Danish Index.

28 Vejtrækningsproblemer

1	KRITERIER	RÅD	Akutlæge med	Paramedic med	Lægehelikopter	Sygeplejerske	1. hjælp	2	RESPONS
A - Akut	Fremmedlegeme: Se 03 Fremmedlegeme Hjertesvigt: Se 10 Brystsmerter - hjertesygdom Krampeanfald: Se 23 Krampeanfald Overdose: Se 30 Beruselse - overdose Hyperventilationsanfald: Se 28 Psykiatri Børn: Se 30 Sygt barn								
	A.28.01 Reagerer ikke på tilråb og på at blive rusket.	3	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	A.28.02 Kan næsten ikke at trække vejret.	1.2.3.4	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	A.28.03 Kan næsten ikke snakke sammenhængende.	1.2.3.4	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	A.28.04 Har høj feber og kan næsten ikke synke.	1.2.3.4	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	A.28.05 Er fortsat vågen, men er lige ved at besvime.	1.2.3.4	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	A.28.06 Skade og vejtrækningsproblemer.	6	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	A.28.07 Brystsmerter og vejtrækningsproblemer.	1.2.3.4.7	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	A.28.08 "Kogen" i brystet og vejtrækningsproblemer.	1.3.4.7	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	A.28.09 Bleg og klam.	1.3.4	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	A.28.10 Nylig opereret og pludselig fået vejtrækningsproblem.	1	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	A.28.11 Langvarig seneleje og pludselig fået vejtrækningsproblemer.	1	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
B - Haster	A.28.12 Nylig gennemgået fødsel. Pludselig fået vejtrækningsproblemer.	1	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	B.28.01 Barn som hoster hele tiden. Virker sløvt og medtaget.	1.5	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
C - Planlagt	B.28.02 Har kendt astma eller anden lungesygdom og bliver hurtigt værre trods medicin.	1	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	C.28.01 Vejtrækningsproblemer, men virker ikke udmattet.	1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
D - Liggende transport	Ingen kriterier i denne kategori i dette oplag!								
E - Alm.	E.28.01 Feber og hoste, men virker ikke medtaget.	8	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	E.28.02 Hurtig vejtrækning, følelse af ikke at få luft, angst og prikken rundt om munden eller i fingrene hos ung, ellers frisk pt.	9	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	E.28.03 Har lidt vanskelig ved at trække vejret, men virker ikke medtaget.	5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		

some cases, the health-care EMD-personnel are not able to reach the caller before the ambulance has reached the patient. The health-care dispatcher can change the response level, according to the Danish Index, after having talked to the caller and can provide advice until the ambulance arrives.

Requests to the EMD for transportation and ambulances also come from sources other than 112 calls, such as hospitals, primary care doctors, nursing homes, etc.

This is an observational cohort study based on consecutive, electronically collected data from the six first months of operation (1 December 2009 to 31 May 2010) of the EMD centre in Aarhus. Data are given as median and percentiles or mean and percentages.

Data are stored electronically and include the core data defined in the Utstein recommendations for reporting on medical dispatch [12] including time of request reception, ambulance call-out time, ambulance departure, arrival at the scene and arrival at hospital. All telephone calls are logged and can subsequently be re-played, if needed. The ambulance response time is defined as the period from the request is received by the EMD to the arrival of the first ambulance on the scene. The Danish Index categories A-E are also stored in the database. The Danish Index is based on the initial description of the major symptom, such as "breathing difficulty", "chest pain", "unconsciousness", etc. It is a very important tool for the health-care dispatchers in their task of dividing patients into levels of urgency from A to E. A total number of 37 major symptoms are described. For each symptom, there is a description of the patient's condition graded according to severity. Within the A-E categories, there is a further graduation by numbers describing severity. Example: Breathing difficulty is number 28; the highest grade of severity A1 is "does not respond when spoken to or shaken by the shoulder" and the number for this condition is A.28.01 (**Figure 1**). For each category, a response level is defined as well as supplementary questions and advice to lay bystanders and to health-care professionals.

Trial registration: not relevant.

RESULTS

During the first six months of the new EMD centre's existence, a total of 73,484 urgent or non-urgent patients were transported and/or given advice. An average of 404 patients were transported and/or given advice on a daily basis, with 463 on weekdays and 300 on weekends. The distribution of A-E levels of urgency was A 28.7%, B 13.5%, C 21.0%, D 35.1% and E 1.7%; numbers are shown in **Table 1**.

The ambulance response time for level A and B requested from 112 was a median 6.5 min. and 11.9

min., respectively. The distribution of response times compared with the target values are shown in **Table 2**.

A total of 18,292 (24.9%) of the overall 73,484 transports were A and B ambulances electronically requested from 112. The remaining part of all transports (A-E) were requested through 83,579 telephone calls from hospitals, doctors in primary care, municipality social affairs and nursing homes.

DISCUSSION

This study presents the first Danish data on severity and urgency of the patient's condition in a consecutive cohort of patients for whom an ambulance or non-ambulance supine transport was requested.

Nearly one third, 28.7%, was of the highest urgency level (A), and the largest group, 35.1%, was patients needing only supine transfer, but no observation or treatment (urgency level D).

The target response times [13] for ambulances requested by the 112, as defined a priori by the regional political decision-makers, are reported annually. The target response times for the whole study period were reached. Response times were longer in the first months which can be explained by weather conditions including unusually large amounts of snow and several episodes

TABLE 1

Number of patients and distribution of urgency levels A-E – in a 6-month period.

	A	B	C	D	E	Total
December	3,770	1,450	2,759	4,336	202	12,517
January	3,391	1,605	2,720	4,583	233	12,532
February	3,217	1,447	2,481	4,202	127	11,474
March	3,743	1,817	2,687	4,678	163	13,088
April	3,396	1,746	2,364	3,958	241	11,705
May	3,587	1,825	2,407	4,061	288	12,168
Total	21,104	9,890	15,418	25,818	1,254	73,484

TABLE 2

Percentiles and distribution of ambulance response time of tasks requested by 112.

Month	A75, min.	A92, min.	A98, min.	B60, min.	B75, min.	A+B, n
December	10.2	15.0	19.6	13.9	19.0	3,340
January	10.4	15.2	19.9	15.0	19.4	3,034
February	10.6	14.8	18.3	14.4	18.8	2,709
March	9.9	13.8	17.4	15.0	18.1	3,162
April	9.5	14.2	17.8	12.9	16.2	2,946
May	9.6	14.3	18.1	13.2	17.2	3,103
6 months in total	10.0	14.6	18.6	14.1	18.2	18,294
Goal	10	15	20	15	20	

of severe snow from mid December 2009 to March 2010.

The fraction of urgency level A calls observed in this study was 28.7%, which seems rather high, but there is no previous data for comparison. The high fraction of urgency level A calls may be explained by the present system in which police-operators take all 112 calls and the EMD health-care dispatchers are only involved in some cases. The fraction of urgency level A cases may change after the implementation of the future system starting May 2011, at which point the EMD will take over all 11 calls concerning requests for emergency medical services.

The large number of calls from hospitals and doctors was a surprise as it was not possible to get reliable information on this beforehand. Not all calls resulted in the dispatch of an ambulance, which explains part of the mismatch between the number of calls (83,579) and the number of dispatched ambulances (73,484). Included in the 73,384 ambulances are also the 18,292 ambulances directly requested electronically by police 112 operators.

No Danish data are available for comparison of the distribution with regard to levels of urgency. Foreign studies have reported on the distribution of levels of urgency. In a system with four urgency levels, a Helsinki-based study by Kuisma et al [14] found a distribution of A 5.7%, B 27.0%, C 47.4% and D 19.9%. These categories are not directly comparable with the A-E levels of the Danish Index; for example, differences apply in target response times between our system and the system from Helsinki. In Helsinki, the maximum response time for A and B is 8 min. (in 90% of cases). This means that A and B combined in the Helsinki study corresponds to our most urgent category A (with 10-min. response time). In Helsinki, A and B combined constitutes 32.7% and in our study category A constitutes 28.7%. Furthermore, in the Helsinki system, category C has a response time of 20 min., which equals our category B. In the Helsinki study, all patients in category A, B and C receive an ambulance within 20 min. This means that in Helsinki, 80.1% (A+B+C) of all ambulance turn-outs are within 20 min., whereas in our study, only 42.2% (A+B) receive an ambulance within 20 min.

Garza AG et al [15] reported on an EMS system from The United States. Four levels of urgency were present in this system, but the maximum allowed response time for the least acute patients was 19 min. and 59 sec. All patients in this system should get an ambulance within 20 min. which is only the case in 42.2% (A + B) of the cases in our study. The results of both Kuisma et al and Garza et al suggest over-triage compared with our study.

It should be stated that especially studies from The United States are done on EMD systems with huge dif-

ferences in organization and staffing compared with our study, which makes a direct comparison of results difficult. Apart from the differences in response times, the use of the Medical Priority Dispatch System designed for non-health-care dispatchers amounts to a considerable difference between the systems. Hinchey et al [16] also reports on an EMD system from The United States with four levels of urgency. The least urgent category constitutes 8.9% of all dispatched ambulances and the more urgent categories constitute 91.1%. The study by Hinchey et al was also conducted on an EMD system using MPDS. The scarce data for comparison of EMD systems is one of the main reasons for the creation of the Utstein guidelines for EMD reporting [12], and our study hopefully contributes to the total pool of data on EMD.

Since we started the study, the four other regions in Denmark have employed health-care EMD personnel and are now using the Danish Index. In future, national studies on EMD will therefore be possible. The distribution of urgency levels A-E is likely to change once all 112 calls regarding emergency medical services are handled by health-care dispatchers; yet, the change can be in either direction.

The new pre-hospital developments are part of major changes of Denmark's entire emergency system; changes which will lead to fewer, but larger and one-entry emergency departments using new triage tools. A national tender for the electronic pre-hospital patient record is planned. With the implementation of this we will have electronically stored information on the total course of medical emergencies starting from the 112 call or other request for ambulance and continuing until the patient's treatment is finished – thereby creating continuity in the whole patient journey. This also creates new and unique fields of research as well as the possibility for improved quality.

In conclusion, we found that in a cohort of 73,484 patients, the distribution of the level of urgency was A: 28.7%, B: 13.5%, C: 21.0%, D: 35.1% and E: 1.7%. Overall, during the first six months, the new target response times for A and B requested from 112 were achieved, but during winter time, response times exceeded the established targets.

CORRESPONDENCE: Mikkel Strømgaard Andersen, Præhospitalet, Region Midtjylland, Olof Palmes Allé 34, 8200 Aarhus N, Denmark.
E-mail: mikkelsen.andersen@ph.rm.dk

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CONFLICTS OF INTEREST: none

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