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First-Year Experience of Medical Emergency Care, a New Healthcare Chain for Acute Life-Threatening Medical Conditions at the ED

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Abstract

Background: There is a high inflow of patients at most medical emergency departments (ED). In 2013 the Medical Emergency Care (MEC) healthcare chain was introduced at the NU-hospital group, Sweden, in order to better identify, alerting and treat the critically ill adult medical patients.

Aim: The primary aim of this retrospective study was to characterize medical patients who were judged and handled as critically ill according to the concept of MEC during the first year following its introduction.

Methods: This is a single-center, consecutive cohort study of all patients initially taken care of at the ED using the concept of MEC at the NU Hospital group, Västra Götaland health care region, Sweden, between February 26 2013 and February 28 2014.

Results: A total of 856 patients were registered as MEC patients, representing 3.2% of all adult medical ED patients. Of these, 610 patients were included in the study. Many of the patients were elderly (40% above 80 years) and suffered from multi-morbidity. The median length of stay in hospital was 7 days and in-hospital mortality 19.5%.

Discussion: MEC is a structured concept of taking care of critically ill medical patients to early identify and initiate treatment of patients with critical symptoms and vital signs. Further research is needed to better and more accurately identify alarming symptoms and vital signs in an attempt to reduce mortality and shorten length of stay in hospital.

Keywords: Medical emergency departments; Medical emergency care; Critically-ill medical patients

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Introduction

There is a high inflow of patients at most medical emergency departments (ED), and thus a need to efficiently determine how a patient should be prioritized. Assessment of the severity of disease is an important part. Different triage systems have been developed [1-7]. In Sweden the Rapid Emergency Triage and Treatment System- Adult (RETTS-A) is often used [8]. It is based on a categorical measurement scale with five different levels, were vital signs and the main acute symptoms are crucial [4,9]. RETTS has a high sensitivity to identify critically ill adult patients and to anticipate in-hospital mortality, 30-day mortality and length of stay (LOS) in hospital [4,10,11]. However, there is a need to develop the triage method to also appropriately assess challenging medical patients, such as frail elderly patients with a high burden of comorbidity, patients with mental illness, dementia, drug addiction and communication problems [12].

Medical Emergency Teams (MET) are often used to care for the most critically ill patients. A

multidisciplinary team with advanced life support skills takes care of the patient using a structured approach, initiated on defined calling criteria based on vital signs [13,14]. The MET concept has been extensively evaluated in ward patients and in trauma patients [15-23]. In some studies the MET concept has been associated with reduced number of admissions to intensive care units (ICU) [17], reduced mortality from unexpected cardiac arrest, as well as reduced overall hospital mortality [15,18]. However, in the Medical Emergency Response, Intervention and Therapy (MERIT) trial, there were no differences in cardiac arrests, ICU admissions, or unexpected deaths in hospitals using and hospitals not using MET for ward patients [21]. There are only a few studies on MET systems for critically ill non-trauma patients at the ED [24-27]. Thus, the evidence for triage and MET systems at the medical ED is scarce [9,28].

At the Norra Älvsborg and Uddevalla (NU) hospital group there is a long-standing tradition of dealing with trauma patients in a healthcare emergency chain by a structured approach on the principles of Advanced Trauma Life Support (ATLS) [23,29]. There has been no similar, structured approach for the acute critically ill medical patients. In 2013 the medical emergency care (MEC) healthcare chain was therefore introduced, in order to better identify, alerting and treat the critically ill adult medical patients.

The primary aim of this retrospective study was to characterize medical patients who were judged and handled as critically ill according to the concept of MEC during the first year following its introduction, and to describe their comorbidity in terms of Charlson Comorbidity Index (CCI) [30], working diagnoses on arrival, length of stay (LOS) in hospital, and in-hospital mortality.

Methods

Study design

This is a single-center, consecutive cohort study of all patients initially taken care of with the concept of MEC at the ED within the NU Hospital group, Västra Götaland health care region, Sweden, between February 26, 2013 and February 28, 2014. The NU Hospital group serves a population of about 280,000.

Medical emergency care (MEC) is a new, locally developed healthcare chain to better identify and treat acute life-threatening medical conditions at the ED. The MEC concept consists of four steps. The first step is that a patient is triaged red in the ambulance based on RETTS triage system. This leads to an alert to the ED, and then to further triage by the nurse at the ED. The second step is that the patient has to fulfill one of the following criteria: airway obstruction/stridor, SpO_2<90% despite oxygen treatment (15 liters), respiratory rate <8 or >30, regular heart rhythm >130/min or irregular heart rhythm >150/min with altered general condition, systolic blood pressure <90 mmHg despite intravenous fluid, unconsciousness (RLS>3 or GCS< 8) or ongoing seizure. If one of the criteria in the second step is fulfilled a medical call is initiated by the triage nurse at the ED. The exclusion criteria for initiating a medical call is if the patient fulfills the criteria for assessment by one of the following health care chains: cardiac arrest call, rescue PCI call and stroke call. The medical calls are divided into red calls and sepsis calls. A sepsis call means that the criteria for a medical call is fulfilled and there are also signs of infection, like fever or chills, cough, urinary problems, wound, diarrhea and vomiting. The third step is the structured handling of the patient by the MET, consisting of two medical doctors, two ED nurses, two assistant nurses and if needed an anesthesiologist. At sepsis calls a specialist of infectious diseases is also present. The fourth step is that the MET treats the patient following a flowchart based on the structural approach according to Medical Advanced Life Support (Medical ALS) and Advanced Medical Life Support (AMLS) [31,32]. A patient record developed for medical calls is used for registration of activities (Figure 1).

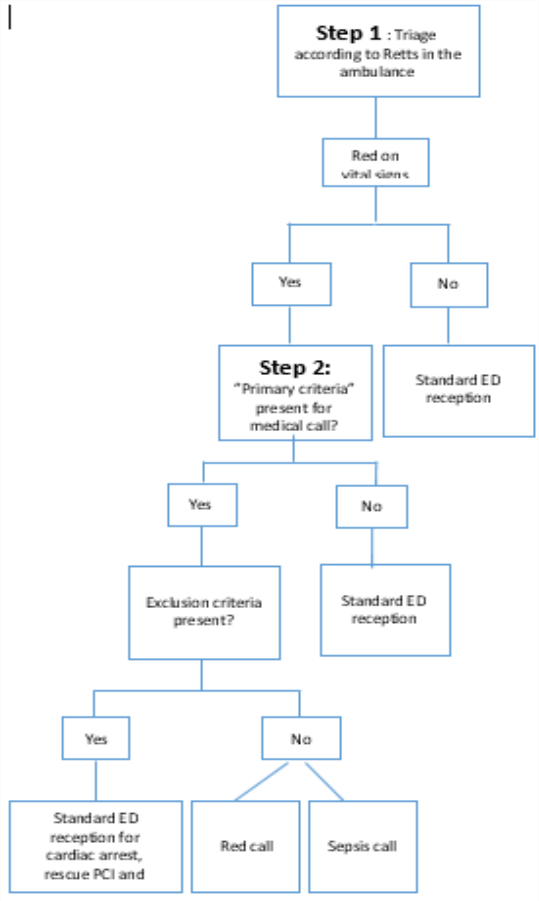

Figure 1: Medical Emergency Care (MEC) is a healthcare chain where identification, alerting and treatment of the critically ill adult medical patient is done in order to identify and treat acute life-threatening conditions.
Step 1: Triage red based on vital signs according to rapid emergency treatment triage (RETTS) in the ambulance: airway obstruction/stridor; $Sp0_2$ <90%; Respiratory rate <8 or >30; Regular heart rhythm >130 or irregular heart rhythm > 150; Systolic blood pressure <90mmHg; Unconsciousness RLS >3 or GCS <8; Ongoing seizure.
Step 2: Further extended evaluation by the ED triage nurse. Primary criteria are fulfilled if airway obstruction, pathological respiratory rate, unconsciousness or ongoing seizure as described above, and by the following criteria for SpO_2, heart rhythm and systolic blood pressure: SpO_2 <90% despite oxygen treatment (15 liters); Regular heart rhythm >130 or irregular heart rhythm >150 with altered general condition; Systolic blood pressure <90 despite intravenous fluid.
ED: Emergency Department; GCS: Glasgow Coma Scale; RLS: Reaction Level Scale [42].

The study was approved by the ethical board at the University of Gothenburg, Sweden (Diary number: 962-13).

Patient sample

All consecutive patients seeking medical care at the ED from February 26, 2013 to February 28, 2014 and taken care of according to the concept of MEC were retrospectively included. Exclusion criteria were if the patient or a relative was unwilling or unable to give written informed consent, and if patients were wrongly registered as MEC,

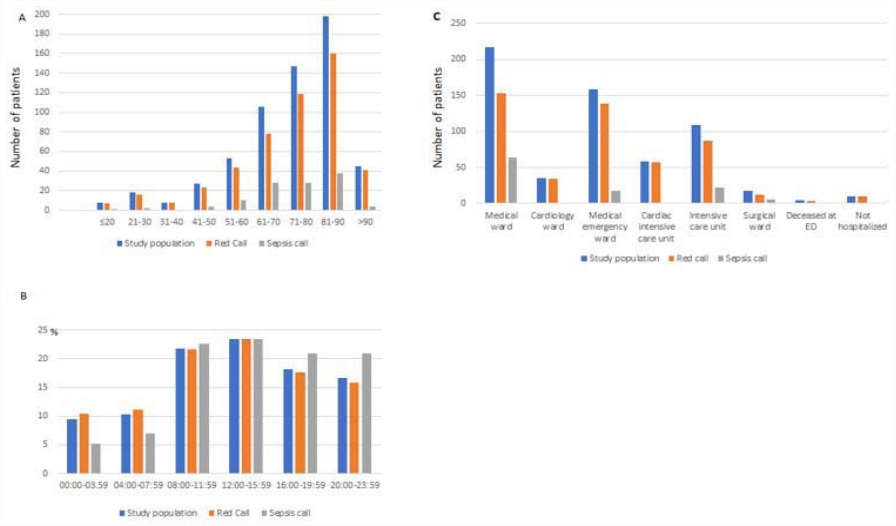

Figure 2: A) Age distribution within the study population; B) Time of day of arrival to emergency department; C) Distribution of patients after initial care in the ED.

i.e., patients not taken care of according to the concept of MEC.

Data collection

Information was retrospectively gathered from the patient´s medical records from the ambulance, ED and medical wards.

From February 2014 a first inquiry by letter with information about the study and request for informed consent to gather data was sent to patients who were still alive. If they were dead a first contact by telephone with registered relatives were taken before the informed consent letter was sent to them.

The following parameters were recorded; gender, age, date and time of arrival to the ED, main symptom and vital signs in the ambulance, preliminary diagnosis and discharge diagnosis from the ED, department the patient was admitted to, LOS in the hospital, in-hospital mortality, medical history, and comorbidity according to CCI [30].

Statistical analysis

Results for continuous/ordinal variables are presented as mean±standard deviation (SD) or median with interquartile range (i.e. 25th, 75th percentile). Proportions are presented as percentages (with missing data, where present, excluded from the calculations). Comparisons between groups were performed using Mann-Whitney U test and Fisher's exact test for continuous/ordinal and categorical variables, respectively. Correlations between continuous variables were assessed using Spearman's rank correlation coefficient. All tests are two-sided and p-values below 0.05 were considered statistically significant. Analysis was performed using SAS v9.4 for Windows.

Results

Demographic and baseline characteristics

Patients, symptoms and signs.

During the 12-month registration period, 27,162 adult medical patients were admitted to the ED, of whom 856 were registered as MEC patients. On average there were 2.3 MEC patients per day, representing 3.2% of all adult medical patients coming to the ED. Written informed consent for the study was given by 634 patients. Of these, 24 patients were excluded because they had been incorrectly registered and not taken care of according to the MEC concept.

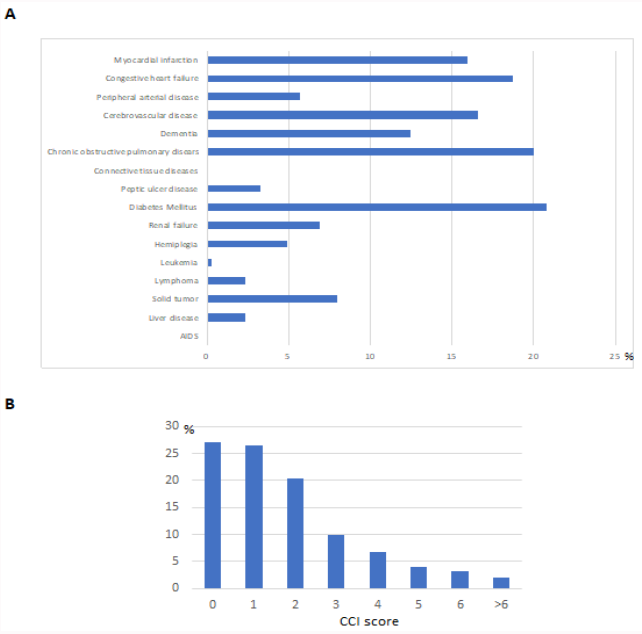

Figure 3: A) Prevalence of co-morbidities as defined by CCI in the total medical call cohort. Values presented in percent of total population; B: CCI score within the study population. All values in percent of total population.

The final study population thus consisted of 610 patients, of whom 41.8% were females. The mean age was 72.6±16.6 years (for women 74.0±17.6 and for men 71.6±15.8 years) (Table 1). Eighty-one percent of the patients were older than 61 years of age, 64% were older than 71 and 40% were older than 81 (Figure 2a).

Of the MEC calls, 495 were red calls and 115 sepsis calls. There was no significant difference in age between red and sepsis calls. Sixty-three percent of the patients arrived at the ED during daytime (8am-8pm) and 37% during night (8pm-8am) (Figure 2b). There was no significant difference between red and sepsis calls regarding time of arrival to the ED. The most common main symptoms on admission to the ED were dyspnea, unconsciousness and chest pain, either present in 72% of the study population (Table 1).

Common pathological vital signs were SpO_2 ≤90% on air observed

Table 1: Basic characteristics (gender, age, symptoms and vital signs) of the total medical call population and divided into red calls and sepsis calls.

	Study population	Red Call	Sepsis Call
	n=610	n=495	n=115
Gender			
Female	255 (41.8)	220 (44.4)	35 (30.4)
Age; mean sd	72.6±16.6	72.5±17.2	73.0±13.9
The 13 most common symptoms in the ambulance			
Dyspnea	266 (43.6)	207 (41.8)	59 (51.3)
Unconsciousness	101 (16.6)	96 (19.4)	5 (4.3)
Chest pain	75 (12.3)	71 (14.3)	4 (3.5)
Seizure attack	37 (6.1)	34 (6.9)	3 (2.6)
Vomiting	32 (5,2)	20 (4.0)	12 (10.4)
Fatigue	28 (4.6)	18 (3.6)	10 (8.7)
Syncope	27 (4.4)	27 (5.5)	0 (0.0)
Altered general condition	25 (4.1)	14 (2.8)	11 (9.6)
Palpitation	21 (3.4)	19 (3.8)	2 (1.7)
Fall in the home	17 (2.8)	14 (2.8)	3 (2.6)
Depersonalization	14 (2.3)	10 (2.0)	4 (3.5)
Delirium	12 (2.0)	8 (1.6)	4 (3.5)
Abdominal Pain	12 (2.0)	7(1.4)	5 (4.3)
Other	72 (11.8)	52 (10.5)	20 (17.4)
Vital signs			
Airway			
Obstructive airway	50 (8,2)	48 (9.7)	2 (1.7)
Respiratory rate			
mean±sd (65/5)*	28.7±10.3	27.7±10.5	32.7±8.6
≤ 8 (65/5)	6 (1.1)	6 (1.4)	0 (0.0)
≥30 (65/5)	288 (53.3)	209 (48.6)	79 (71.8)
SpO_2			
Mean ± sd (6/2)	86.3±11.7	86.0±12.1	87.5±9.2
SpO_2 ≤90% on air initially (5/2)	337 (55.9)	273 (55.7)	64 56.6)
Of these SpO_2 ≤90% after administration of 15 l oxygen (108/18)	39 (18.5)	33 (20.0)	6 (13.0)
Pulse			
mean±sd (2/0)	109.8±35.1	108.7±36.4	114.4±28.5
Regular heart rhythm with frequency ≥ 130 with altered general condition (3/0)	83 (13.7)	63 (12.8)	20 (17.4)
Irregular heart rhythm with frequency ≥ 150 with altered general condition (3/0)	72 (11.9)	61 (12.4)	11 (9.6)
Blood Pressure (BP)			
systolic BP; mean±sd (6/1)	133.9±36.0	135.3±36.7	128.0±32.6
diastolic BP; mean±sd (22/3)	80.1±23.3	81.6±23.7	74.0±20.7
Systolic BP ≤90 initially (6/1)	92 (15.3)	71 (14.5)	21 (18.4)
Of these Systolic BP ≤90 after administration of iv fluid (20/4)	30 (44.1)	22 (43.1)	8 (47.1)
RLS (Reaction level scale)			
mean sd (120/28)	2.0±1.9	2.2±2.1	1.3±0.8
Unconsciousness (RLS>3)	120 (19.7)	117 (23.6)	3 (2.6)
Ongoing seizures	29 (4.8)	29 (5.9)	0 (0.0)
Signs of infection	213 (34.9)	107 (21.6)	106 (92.2)

Data presented as number (percent), unless otherwise stated.
*Number of patients with missing data, in the red call and sepsis call groups, respectively.
BP: Blood Pressure; RLS: Reaction Level Scale [42].

Table 2: The 15 most common working diagnoses at the emergency room and the discharge diagnoses of the 15 most common working diagnoses in the emergency room.

	The 15 most common working diagnoses in the ED*			The discharge diagnoses of the 15 most common working diagnoses in the ED			Both/common working diagnosis and discharge diagnosis
	Total medical call	Red call	Sepsis call	Total medical call	Red call	Sepsis call	Total medcal call
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n
Sepsis	103 (17.2)	49 (10.1)	54 (47.4)	93 (15.3)	48 (9.7)	45 (39.5)	61
Pneumonia	93 (15.5)	55 (11.3)	38 (33.3)	108 (17.7)	66 (13.3)	42 (36.8)	62
Cerebrovascular disease	42 (7.0)	42 (8.7)	0 (0.0)	30 (4.9)	29 (5.9)	1 (0.9)	26
Intoxication	38 (6.3)	38 (7.8)	0 (0.0)	38 (6.2)	38 (7.7)	0 (0.0)	36
Atrial fibrillation	37 (6.2)	36 (7.4)	1 (0,9)	38 (6.2)	37 (7.5)	1 (0.9)	32
Chronic obstructive pulmonary disease exacerbation	37 (6.2)	35 (7.2)	2 (1.8)	31 (5.1)	28 (5.7)	3 (2.6)	22
Infection (pneumonia excluded)	32 (5.3)	15 (3.1)	17 (14.9)	33 (5.4)	17 (3.4)	16 (14.0)	11
Heart failure	30 (5.0)	30 (6.2)	0 (0.0)	43 (7.1)	42 (8.5)	1 (0.9)	14
Pulmonary edema	29 (4.8)	29 (6.0)	0 (0.0)	2 (0.3)	2 (0.4)	0 (0.0)	1
Seizure	26 (4.3)	26 (5.4)	0 (0.0)	29 (4.8)	29 (5.9)	0 (0.0)	21
Arrhythmia (atrial fibrillation excluded)	24 (4.0)	24 (4.9)	0 (0.0)	25 (4.1)	25 (5.0)	0 (0.0)	6
Unconsciousness	13 (2.2)	13 (2.7)	0 (0.0)	6 (1.0)	6 (1.2)	0 (0.0)	5
Pulmonary embolism	12 (2.0)	12 (2.5)	0 (0.0)	5 (0.8)	5 (1.0)	0 (0.0)	1
Aortic dissection/rupture	10 (1.7)	10 (2.1)	0 (0.0)	1 (0.2)	1 (0.2)	0 (0.0)	1
Myocardial infarction	8 (1.3)	8 (1.6)	0 (0.0)	27 (4.4)	27 (5.5)	0 (0.0)	6
Other	65 (10.8)	63 (13.0)	2 (1.8)	100 (16.4)	95 (19.2)	5 (4.4)	51

*Working diagnoses were missing in 10 red call and 1 sepsis call patients and discharge diagnosis was missing for 1 sepsis call patient.

initially in 337 patients (56%) and reduced to 39 patients after initial oxygen treatment. Respiratory rate ≥30/min was initially observed in 288 patients (53%). Systolic blood pressure ≤90mm Hg was initially observed in 92 patients (15%) and reduced to 30 patients after administration of intravenous fluid. Signs of infection were present in 213 patients (35%), however only 115 sepsis calls were initiated (Table 1). Furthermore, 14% had a regular heart rhythm with ≥130 beats/min with altered general condition and 12% had an irregular heart rhythm with ≥150 beats/min with altered general condition (Table 1). Atrial fibrillation was found in 31% (among red calls 32%, among sepsis calls 23%), supraventricular tachycardia in 3%, ventricular tachycardia in one patient and bradycardia (<50 beats/min) in 1% on the first electrocardiogram registrated. Signs of ischemia on the electrocardiogram was found in 8% of the study cohort.

From the ED 98% of the MEC patients were admitted to a ward department at the hospital. Of these patients, 53% were in need of intensive care (medical emergency ward, cardiac intensive care unit, intensive care unit), while the remaining patients were stable enough in vital parameters to be admitted to a medical or surgery ward department (figure 2c). Less than two percent of the patients could return home, and less than one percent died at the ED.

Charlson comorbidity index (CCI)

The most common comorbidities included in CCI among the patients were diabetes mellitus (21%), chronic obstructive pulmonary disease (20%), congestive heart failure (19%), cerebrovascular disease (17%) and myocardial infarction (16%). Three-hundred-and-twenty-five patients (53%) scored 0 or 1 in CCI, 185 (30%) 2-3 and 98 (16%) more than 3. The mean CCI in the total study population of medical calls was 1.80±1.81, in the red calls group 1.75±1.81 and in the sepsis group 2.00±1.82 (Figure 3).

Working diagnosis

The 15 most common working diagnoses at the ED and hospital discharge diagnoses are shown in Table 2. Fifty-nine percent of the working diagnoses were consistent with the discharge diagnoses. The two most frequent working and discharge diagnoses were sepsis and pneumonia. Three (3) to 86% of the discharge diagnoses were consistent with the working diagnosis. The working diagnosis with the lowest accuracy was pulmonary edema, pulmonary embolism and aortic dissection/rupture, all 10% or less accuracy, and the working diagnosis with the highest accuracy were atrial fibrillation (86%), arrhythmias other than atrial fibrillation (83%), seizure (81%) and myocardial infarction (75%).

Length of stay (LOS) in hospital

The median LOS in hospital for all patients as well as patients discharged alive was 7 days (for all patients: interquartile range 3 to 13 days and for patients discharged alive: interquartile range 4 to 13 days). The in-hospital mortality rate was 19.5% (20.0% among red calls and 17.4% among sepsis calls). There was no significant association between LOS and gender or time of day of arrival to the ED. LOS was significantly correlated with age (r=0.18 for the whole cohort, r= 0.31 for those discharged alive, p<0.0001 for both) and with CCI (r=0.18 for the whole cohort, r=0.24 for those discharged alive, p= 0.0008 and p=0.0005, respectively). Patients admitted to the ICU had a significantly longer hospitalization time compared to those who were not (median 9 and 7 days, respectively (p=0.0006)). Vital signs on admission such as SpO_2 ≤90% on air initially were significantly related to longer hospitalization (median 9 days compared to 6 days among those without this sign (p<0.0001), as were signs of infection (median 8 days compared to 7 days among those without infection signs (p<0.0001) (Table 3).

Discussion

MEC is a structured concept of taking care of critically ill medical patients in an attempt to early identify critical symptoms and signs, initiate adequate treatment and select patients in need of intensive care. Of the patients coming to the ED at the NU-hospital group 3.2% were MEC patients. Most of them were elderly (40% where over 80 years old). Many suffered from multiple comorbidities, and as they were severely ill required special attention and fast handling to try to reverse the critical condition.

The MEC patients were critically ill, which was confirmed by an in-hospital mortality of 19.5%, admittance rate to any form of intensive care of over 50%, as well as a low percentage of patients being discharged home directly from the ED.

Of all medical calls about 80% were red calls and 20% sepsis calls. The most common symptom in both was dyspnea. In almost 100 red calls the patients had signs of infection. The need for specific sepsis calls could therefore be questioned. Signs of infection were present in as many as 35% of all patients, showing that infection often is the trigger for worsening of elderly patients with multi-morbidity, and giving an obvious opportunity for treatment.

Comorbidities were common, and about half of the patients had a CCI of 2 or higher. Forty-two percent of the MEC patients had a documented cardiovascular disease. These findings harmonize with previously reported prevalence of comorbidities [33].

The most common pathologic vital signs for becoming a MEC patient were related to respiration. There were fewer patients than might have been expected with symptoms such as chest pain, and with working and discharge diagnoses such as myocardial infarction, cardiogenic chock, cardiac arrest and stroke. This is explained by the fact that these patients often were included in other health care chains. Thus, the patients described in this article are not representative for all severely ill medical patients coming to the ED.

Some working diagnoses, such as atrial fibrillation, arrhythmias, and seizure correlated well with the discharge diagnosis. Since these conditions often can be effectively treated, adequate and early diagnosis is of great importance. That is true also for many other dangerous and treatable conditions seen in MEC patients. Identifying often missed such diagnoses and educate team members to improve diagnostic accuracy must be a continuous part of the work in every ED.

Overall, most of the main symptoms were weakly/poorly associated with LOS in hospital, with unconsciousness as an important exception. Higher age and multi-morbidity according to the CCI were correlated to longer LOS in hospital. This emphasizes the importance of future studies to focus on acute severely ill elderly and frail medical patients with high comorbidity. Widgren et al have introduced an instrument in addition to RETTS to evaluate patient care needs based on autonomy, including both function and age (http://www.predicare.se). Frailty instruments, e.g. FRESH, should also be considered. Such an adapted triage model could after the most acute phase enhance admission of frail elderly patients to an appropriate care form, e.g. units for comprehensive geriatric assessment (CGA) [34].

There are only few previous studies on MET systems for critically ill non-trauma patients at the ED [24-27], Prospective controlled studies are obviously difficult to perform. It would also be of importance to study long-term mortality and quality of life.

Limitations of the Study

The main limitation of our study is its retrospective design with no control group. Another limitation is that some data was missing, for example body temperature. Only 610 of 856 patients (71.3%) gave informed consent to participate, but this corresponds to what is often seen in this type of studies [35,36].

Conclusions

On average there were 2.3 MEC patients per day, representing 3.2% of all adult medical ED patients. The patients were characterized by high age, multi-comorbidity, and especially a high proportion of a history of cardiovascular disease. The short-term prognosis is poor, and the length of stay in hospital is long. Further research is needed on long-term outcomes in this important group of patients.

Disclosure

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