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Causes of death among non-urgent patients in the emergency department who die within 30 days

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ABSTRACT

INTRODUCTION. Patients triaged as non-urgent in the emergency department constitute a diverse group with a low mortality rate assumed to be able to wait three hours for a physician. Little is known about the causes of death of non-urgent patients who die shortly after admission. We examined whether deaths among non-urgent patients were preventable.

METHOD. Using data from the Copenhagen Triage Algorithm Study, we conducted a review of electronic medical records of all patients triaged as non-urgent who died within 30 days of presentation and constructed short summaries. These summaries were reviewed by two senior physicians who determined whether each death was expected or unexpected. The unexpected deaths were further assessed as unrelated or related to admission and if related as preventable or unpreventable. Any disagreements were settled by a third senior physician.

RESULTS. Among the patients triaged as non-urgent, 335 of 14,655 (2%) died within 30 days. When comparing biomarkers and age, the non-urgent patients resembled the patients in other triage categories who died within 30 days. Most deaths were expected or not preventable (96%). The preventable deaths (n = 13, 4%) were among older patients with comorbidities. Causes of death were sudden cardiac arrest (n = 3), infection (n = 4), kidney failure (n = 1), electrolyte derangement (n = 1) and unknown (n = 4).

CONCLUSION. Preventable deaths among non-urgent patients were rare and no overrepresentation was observed of specialties or diseases.

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Emergency departments (ED) worldwide use triage algorithms to prioritise patients and assess their perceived urgency upon arrival [1]. Triage algorithms vary around the world. However, most triage algorithms stratify patients according to their vital parameters [2] and symptoms at arrival [3]. The final triage level is usually represented by a colour or numeric value that determines how quickly the patient must be seen by a physician [4]. Patients assigned to the non-urgent triage levels are considered low-risk patients with a low mortality rate [2, 5]. In some triage systems, allocation to the non-urgent triage group means that the patient can wait for a doctor for up to three hours [2, 6, 7].

Investigating the causes of death of non-urgent patients may potentially contribute to the prevention of unnecessary morbidity and mortality in relation to ED presentation due to under-triage [8]. Under-triage is a known limitation in triage systems, leading to poorer outcomes due to excessive waiting times [9]. Other studies have found that patients in the lower triage groups who die are, on average, older and have longer length of stay than patient who do not die shortly after their ED presentation [10].

The purpose of this study was to describe the frequency and causes of death among patients triaged as non-urgent at presentation to the ED. We also aimed to determine whether the deaths were unexpected and if they could have been predicted and possibly prevented.

METHODS

This was a substudy of patients included in the Copenhagen Triage Algorithm (CTA) trial, which was described elsewhere [2, 6]. In brief, the CTA trial was a cluster-randomised, controlled trial comparing the new evidence-based triage algorithm CTA to the Adaptive Process Triage (ADAPT) in two large EDs in the Capital Region of Copenhagen. All patients above 16 years of age who presented to the ED were included. Any patient seen and triaged in the ED was defined as a presentation. The EDs did not handle patients with gynaecologic and obstetric complaints or patients suspected of major trauma. The study showed that CTA was non-inferior to ADAPT on 30-day mortality. In both the CTA and the ADAPT, patients are categorised into five groups according to urgency; red, orange, yellow, green and blue [2]; Red – resuscitation or immediate assessment and treatment, orange – emergent assessment and care are assessed within 15 min., yellow – urgent care and assessment are assessed within 60 min. and green – non-urgent are assessed within 180 min. Patients with minor injuries were allocated to the blue triage group and were excluded from the study. Both triage algorithms comprise two steps: 1) vitals parameters 2) action cards (ADAPT) or clinical assessment (CTA).

This study included all patients who were triaged as non-urgent (green) and died within 30 days of their presentation to the ED. Readmissions within 30 days of the initial presentation were excluded. The date and causes of death were collected from the Danish Cause of Death Register. Causes of death in the cohort were compared to all deaths in Denmark in the corresponding period. The patients' past medical history and information regarding the current ED presentation were assessed systematically according to predefined factors using the electronic patient records (see Supplementary materials **https://content.ugeskriftet.dk/sites/default/files/2023-08/a01230037-supplementary.pdf**). Data on sex, age, a brief medical history, chief complaint, lab tests, other diagnoses given during hospitalisation, treatment, circumstances of death and time from presentation to death were collected and summarised (see Supplementary materials). These were sent to a panel of three senior physicians specialising in internal medicine, emergency medicine and cardiology. Two physicians evaluated all patient cases separately, blinded to each other's results. Any disagreements were decided by the third physician. If necessary, the physicians could ask for more information or access to the patient chart.

For each patient, the panels assessed whether the death was expected or unexpected. An expected death was defined as deaths among patients with a terminal illness, where a death within a few months was to be expected. An example could be a patient with metastasised cancer or terminal heart failure. The unexpected deaths were further grouped as 1) related to the admission and preventable or 2) related to admission and unpreventable or 3) unrelated to admission. Related to admission was defined as a patient dying during admission directly following the primary presentation, death from an illness related to the symptoms or diagnoses given at the primary presentation or complications from treatment initiated at the primary presentation. Preventable deaths were defined as any death in which interventions during the initial presentation could potentially have

prevented the death in any way.

Statistics

Variables with a normal distribution were described with mean and standard deviations and compared using the unpaired t-test. Medians and interquartile range were reported in variables with non-normal distribution. Wilcoxon signed-rank tests were used to compare factors between the groups. Fisher's exact test was used to compare the cause of death. A $p < 0.05$ was considered significant. Kaplan-Meier survival analysis was performed to show the distribution of deaths during the study period. Statistical analysis was made using R version 3.3.3 [11].

Ethics

The CTA study was presented to the Regional Ethics Committee, which determined that no formal approval was needed under Danish law (H-4-2014-FSP). The study was approved by the Danish Data Protection Agency (HEH-2014-118) and the Danish Health and Medicines Authority (3-3013-1119/2). The study was conducted in accordance with the Helsinki Declaration.

Trial registration: Clinicaltrials.gov:NCT02698319.

RESULTS

The CTA study included 40,709 patients with 45,977 patient visits between 1 March 2015 and 31 January 2016. Among these, 19,106 patient visits (42%) by 14,655 (36%) patients were classified as non-urgent. Among the patients triaged as non-urgent, 335 patients (2.2%) died within 30 days.

Table 1 shows baseline characteristics, vital signs and biomarkers of the study population, compared to those of patients triaged as non-urgent who were alive at 30 days and patients at all triage levels who died within 30 days. The patients who died were significantly older than the survivors in the non-urgent group (80.5 versus 57.1 years; $p < 0.001$). Male and female patients were equally represented in all groups. All biomarkers except lactate, pH, PO_2 and alanine aminotransferase (ALAT) were significantly different when comparing the patients who died within 30 days of presentation to the surviving patients. When comparing the patients in the non-urgent group who died to the patients from the other three triage groups (red, orange and yellow), small but statistically significant differences were observed in age and several biomarkers (C-reactive protein (CRP), leucocytes, neutrophils, Na^+, Ca^{2+} and albumin). There was a longer average time from admission to death in the non-urgent group than in the other triage groups (14.5 versus 12.2; $p \leq 0.001$). Only five patients died within 24 hours of presenting to the ER.

TABLE 1 Statistical comparison of the non-urgent patients who died within 30 days of admission and the rest of the non-urgent group, as well as statistical comparison of the non-urgent patients who died within 30 days and all other patients who died within 30 days of admission.

	Non-urgent dead within 30 days (N = 335)	Non-urgent alive after 30 days (N = 18,145)	p value	All dead within 30 days (N = 1,957)	p value
Baseline characteristics					
Age, mean (± SD), yrs	80.5 (± 10.9)	57.1 (± 21.7)	< 0.001	78.5 (± 13.0)	< 0.001
Male, n (%)	166 (49.5)	8,897 (49.0)	0.94	975 (49.8)	0.91
CTA, n (%)	187 (56.1)	10,679 (58.9)	0.68	993 (49.0)	< 0.001
Time until death, mean (± SD), days	14.5 (± 8.4)	-		12.2 (± 9)	< 0.001
Biomarkers, median (IQR)					
Haemoglobin, mmol/l	7.1 (6.1-8.2)	8.3 (7.5-9.0)	< 0.001	7.2 (6.1-8.3)	0.64
Leucocytes, × 10^9/l	9.7 (7.6-13.7)	8.3 (6.5-10.7)	< 0.001	11.1 (8.0-15.7)	< 0.001
Neutrophils, × 10^9/l	7.5 (5.0-11.0)	5.6 (4.1-7.9)	< 0.001	8.8 (6.0-12.8)	0.001
Thrombocytes, × 10^9/l	282 (192-346)	243 (199-299)	0.005	263 (185-363)	0.8
Na^+, mmol/l	136 (132-139)	139 (136-141)	< 0.001	137 (133-141)	0.008
K^+, mmol/l	4.1 (3.8-4.6)	4.0 (3.7-4.3)	< 0.001	4.1 (3.7-4.7)	0.94
Ca^{2+}, mmol/l	2.0 (2.0-2.0)	2.3 (2.3-2.4)	< 0.001	2.3 (2.1-2.4)	< 0.001
Creatinine, µmol/l	93 (67-150)	72 (60-89)	< 0.001	96 (69-151)	0.65
Albumin, g/l	35 (31-39)	41 (38-44)	< 0.001	34 (30-38)	0.04
ALAT, U/l	25 (18-41)	28 (21-38)	0.3	28 (19-45)	0.27
INR	1.0 (1.0-1.0)	1.0 (1.0-1.1)	< 0.001	1.1 (1.0-1.3)	< 0.001
CRP, mg/l	46 (11-105)	4 (3-28)	< 0.001	60 (16-138)	0.002
Lactate, mmol/l	1.5 (1.0-2.3)	1.0 (0.7-1.6)	0.06	1.9 (1.0-3.4)	0.4
pH	7.44 (7.37-7.48)	7.44 (7.42-7.48)	0.45	7.42 (7.32-7.48)	< 0.001
PaO_2, kPa	9.8 (8.8-12.0)	11.1 (9.2-12.6)	0.29	10.6 (8.6-14.7)	0.2
Vital signs					
Systolic blood pressure, mean (± SD), mmHg	135 (± 29)	139 (± 23)	0.03	130 (± 31)	0.001
SaO_2, median (IQR), %	96 (95-98)	97 (96-99)	0.28	96 (93-97)	0.2
Heart rate, mean (± SD), /min.	85 (± 18)	82 (± 15)	0,005	93 (± 23)	< 0.001
Respiratory rate, mean (± SD), /min.	18 (± 4)	17 (± 2)	< 0.001	21 (± 7)	< 0.001

ALAT = alanine aminotransferase; CTA = Copenhagen Triage Algorithm; INR = international normalised ratio; IQR = interquartile range; SD = standard deviation.

The mortality rate for all patients did not differ significantly between the two triage algorithms (3.35% and 3.28% for CTA and ADAPT, respectively; p = 0.68). However, as shown in the main study, significantly more patient visits were recorded in the non-urgent group using the CTA than in ADAPT (9,502 and 6,765 respectively). Therefore, we found that the patients who died in the non-urgent group were more likely to be from the CTA group (p < 0.001) than from the ADAPT group.

Causes of death in the cohort compared to the corresponding data from the Danish Cause of Death Register for 2015 data are reported in **Table 2** [12]. As with the general Danish population, the main causes of death among non-urgent patients were cancer and heart disease. Overall, the causes of death were very similar, except for a small but significant difference in the groups “respiratory disease”, “symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified” and “death without medical information”.

TABLE 2 Cause of death in the group of non-urgent patients who died within 30 days of admission along with 2015 data from the Danish Cause of Death Register [12].

Diagnosis[a]	Non-urgent dead, n (%)	Danish Cause of Death Register, n (%)	p value
A-01 Certain infectious and parasitic disease	11 (3.3)	970 (1.9)	0.06
A-02 Cancer	105 (31.6)	15,953 (30.5)	0.77
A-03 Other neoplasia	3 (0.9)	324 (0.6)	0.47
A-04 Disease in blood, blood-forming organs or disorders involving the immune mechanism	2 (0.6)	261 (0.5)	0.69
A-05 Endocrine and metabolic disease	11 (3.3)	1,790 (3.4)	1.00
A-06 Mental and behavioural disorders	18 (5.4)	3,558 (6.8)	0.33
A-07 Diseases of the nervous system	18 (5.4)	2,342 (4.5)	0.43
A-08 Heart disease	47 (14.2)	8,250 (15.8)	0.41
A-09 Other vascular disease	32 (9.6)	4,703 (9.0)	0.70
A-10 Diseases of the respiratory system	25 (7.5)	6,055 (11.6)	0.02
A-11 Diseases of the digestive system	18 (5.4)	2,148 (4.1)	0.27
A-12 Diseases of the skin and subcutaneous tissue	0	58 (0.1)	1.00
A-13 Diseases of the musculoskeletal system and connective tissue		376 (0.7)	0.18
A-14 Diseases of the genitourinary system	6 (1.8)	824 (1.6)	0.66
A-15 Pregnancy, childbirth and the puerperium	0	0	1.00
A-16 Certain conditions originating in the perinatal period	0	122 (0.2)	1.00
A-17 Congenital malformations, deformations or chromosomal abnormalities	0	135 (0.3)	1.00
A-18 Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified	3 (0.9)	1,766 (3.4)	0.01
A-19 Accident	6 (1.8)	1,332 (2.6)	0.49
A-20 Suicide	2 (0.6)	584 (1.1)	0.60
A-21 Homicide	0	34 (0.1)	1.00
A-22 Unknown circumstance	0	38 (0.1)	1.00
A-23 Legal intervention incl. war	0	0	1.00
A-24 Deaths without medical information	25 (7.5)	600 (1.1)	< 0.01
Data not available	3 (0.9)	-	
Total	335	52,225	

a) The emergency departments did not handle patients with gynaecologic and obstetric complaints or patients suspected of major trauma during the trial.

Patient distribution is shown in **Figure 1.** Most deaths in the cohort were categorised as either expected, unpreventable or unrelated to the primary presentation (n = 322 (96.2%)). Distribution and baseline characteristics of patients within the groups as determined by review are presented in **Table 3.**

FIGURE 1 Patient distribution as evaluated by the specialists.

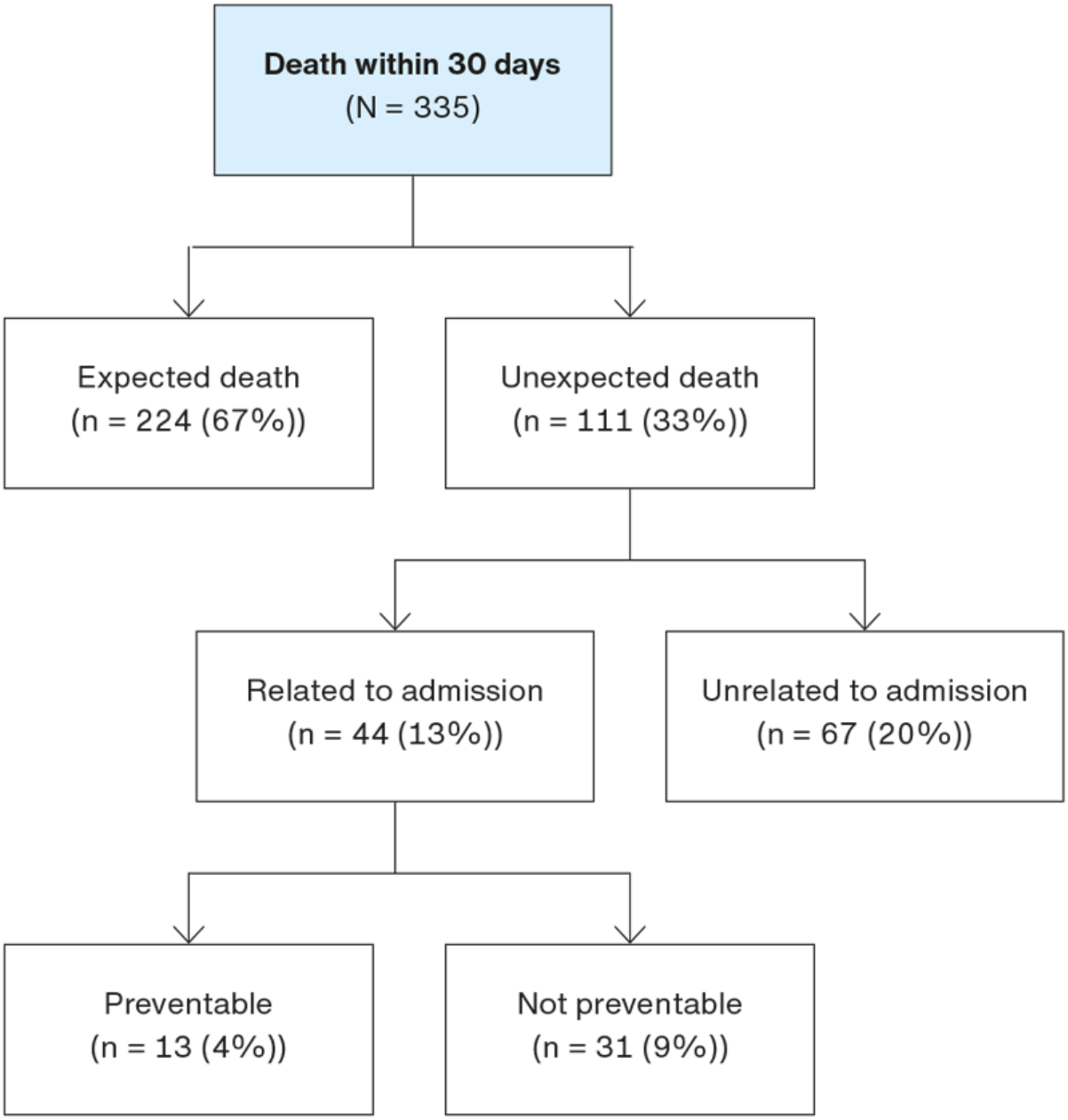

TABLE 3 Baseline characteristic of the further investigated sample in total and by category as decided by the specialists.

			Unexpected				
	Complete sample (N_{tot} = 335)	Expected (N = 224)	all (N = 111)	unrelated to admission (N = 67)	related to admission		
					all (N = 44)	preventable (N = 13)	unpreventable (N = 31)
Age, median (IQR), yrs	83 (73-89)	81 (72-89)	83 (76-90)	84 (79-91)	83 (73-88)	74 (71-84)	83 (77-91)
Male, n (%)	166 (50)	118 (53)	48 (43)	30 (45)	18 (41)	5 (38)	13 (42)
CTA, n (%)	187 (56)	124 (55)	63 (57)	36 (53)	27 (61)	8 (62)	19 (61)
Time until death, mean (± SD), days	15 (± 8.4)	15 (± 8.2)	14 (± 8.9)	16 (± 8.5)	11 (± 8.9)	11 (± 9.9)	11 (± 8.6)
CCI	3.22	3.94	1.77	1.69	1.89	0.92	2.23
DNR, n (%)	153 (46)	120 (54)	33 (30)	13 (19)	20 (45)	5 (38)	15 (48)

CCI = Charlson Comorbidity Index; CTA = Copenhagen Triage Algorithm; DNR = do not resuscitate; IQR = interquartile range; SD = standard deviation.

Preventable deaths

After review by the senior physicians, 13 (3.8%) cases were assessed as potentially preventable, one of these (8%) died within 24 hours of admission, two (15%) died within 48 hours of admission and four (31%) died during the index admission. These cases were distributed evenly among all specialties with a diverse assortment of medical and surgical complaints. Case summaries of each individual case are supplied in Additional data 2.

Most patients had at least one known medical condition upon admission. A history of psychiatric illness was present in four of the patients.

Abdominal complaints (n = 3), trauma (n = 3) and infections (n = 4) were the most frequent causes of primary admission. Other causes were dehydration, electrolyte derangements, declining health and neurological problems. Two-thirds of the patients (n = 8 (62%)) were deemed stable and well enough for discharge from their initial admission. Four patients were readmitted within 30 days (on day one, four, five and 20 after discharge).

Infections was the most common cause of death (n = 4) followed by sudden cardiac arrest (n = 3) and electrolyte derangement (n = 2). In four cases, the causes of death were unknown and were registered in the Cause of Death database as their preexisting conditions (e.g., arteriosclerosis).

DISCUSSION

Our study found that two thirds of the deaths in patients triaged as non-urgent were expected deaths. The causes of death for these patients were very similar to the causes of death in the general Danish population. The cohort largely consisted of the end-stage of terminally ill patients or deaths from otherwise non-preventable conditions. Only one in 25 died of a potentially preventable condition, which corresponds to one in 887 who were triaged as non-urgent upon presentation to the ED. In general, these patients were older and the vast majority had a chronic illness. In all, our study showed that very few deaths could have been prevented by assigning more patients to a more urgent triage category, indicating that under-triage was not a major problem in this cohort.

The triage term “non-urgent" covers different ways of looking at the patients and their need for treatment and care. Both triage systems, however, presuppose that patients in this group are stable enough to be able to wait for up to three hours before being assessed by a physician [2]. The non-urgent triage cohort included a very diverse group of patients, covering about a third of all patient visits from minor complaints (e.g. gastroenteritis) to complaints related to chronic or terminal illness (e.g. disseminated cancer) or a medical device (e.g. catheters or stomas).

The CTA triage system allows the triaging staff to lower the patients’ triage level based on their clinical assessment. The overrepresentation of patients from the CTA arm of the study in this cohort might indicate that

they used this possibility to lower the triage level of chronically ill patients who would have little to no gain from a higher triage category. Crowding in the ED is known to be associated with poor patient outcomes [1, 10], especially in cases in which the crowding leads to over- or under-triage [13, 14]. A previous study found that under-triage might have led to a rise in mortality rate of 70% in overcrowded situations and a rise in unwanted outcome [9, 15]. On the other hand, as non-urgent patients can wait longer for treatment, an overall lower triage might lessen the crowding in the ED and ensure that triage deadlines are observed. Our study aimed to examine the possibility of under-triage leading to fatal outcomes. However, in this study, only 13 of 14,655 (0.1%) patients in the non-urgent group suffered preventable deaths. These findings are similar to those of earlier studies, estimating that about 5% of hospital deaths had a 50% or greater chance of being prevented [16]. Even though these findings involve few patients, some factors might help further evaluate the urgency of patients in the ED.

Our study found that biochemically the cohort resembled patients who died in more urgent triage categories, and that routine biomarkers in the ED were strong predictors of 30-day mortality [17-19]. This might work as a second line of triage, giving the staff an opportunity to catch critically ill patients that the formalised triage missed. On the other hand, terminally ill patients in need of minor assistance (changing of catheters) gain little from more urgent treatment. Instead, an expanded use of the blue triage group (the fifth level of the triage model) and fast tracks, redirection to general practice [20] or open admissions which bypasses the ED, are other options already used to varying degrees.

Limitations

Though the original study was large, our cohort in this study consisted of relatively few patients. This made some subgroups small and the significance of some of our findings difficult to interpret.

As triage is primarily designed to determine the risk of a patient within the first minutes to one hour, the use of 30-day mortality as the primary selection criterion is a limitation of this study. However, if we had used 24-hour, 48-hour or in-hospital mortality, few of the preventable deaths would have been recognised. Not all patients had blood sampling on admission, and thus the comparison could not be done for all patients. Since the completion of the trial, the specialty of emergency medicine has been implemented in Denmark. This may have changed how patients are seen and treated in EDs in Denmark. However, the triage systems investigated in this study are still in use as of the publication of this study.

CONCLUSION

This sub-study of the CTA found that 2.2% of patients triaged as non-urgent died within 30 days of admission, and that the vast majority of deaths were expected deaths among terminally ill patients. Only a few cases were potentially preventable, and even these occurred among elderly patients with known comorbidities. The unexpected deaths presented with a range of different medical and surgical complaints.

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