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Prehospital management and outcomes of patients calling with chest pain as the main complaint

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Abstract

Background Chest pain is a frequent cause of health care contacts. We examined the prehospital management, in-hospital discharge diagnoses, and mortality of patients calling a non-emergency and emergency medical service with chest pain.

Methods The Copenhagen Emergency Medical Services (EMS) consists of a non-emergency medical helpline (calls to 1813) and emergency medical service (1-1-2 calls). We included all calls to the Copenhagen EMS with a primary complaint of chest pain from 2014 to 2018 in Copenhagen, Denmark. The outcomes were: emergency response (ambulance dispatch, other transports/self-transport/home visits, self-care, and unknown/cancelled response), in-hospital diagnosis within 7 days after the call (cardiovascular, pulmonary, or other non-cardiovascular/pulmonary) and 30-day mortality.

Results Among 4,834,071 calls, 91,671 were registered with chest pain at the Copenhagen EMS. The first call for each patient was kept for analysis ($n=66,762$). In total, 91.4% were referred to the hospital, 75.8% ($n=50,627$) received an ambulance and 15.6% ($n=10,383$) received other transport/self-transport/home visits. Overall, 26.9% ($n=17,937$) were diagnosed with a cardiovascular disease, 5.2% ($n=3,490$) a pulmonary disease, 52.8% ($n=35.242$) other non-cardiovascular/pulmonary disease, and 15.1% ($n=10,093$) received no diagnosis. Among ambulance-transported patients, the prevalence of cardiovascular discharge diagnoses was higher (32.1%) and fewer received no diagnosis (11.0%). Cardiovascular disease was less prevalent among patients not transported by ambulance and patients not referred to hospital at all (2-13.4%) and in patients ≤ 40 years of age (< 10%). The 30-day mortality was below 5% regardless of diagnosis (0.6-4%), and 65,704 (98.4%) were still alive 30 days later.

Conclusion Nearly all patients calling with chest pain were referred for treatment. Among ambulance-transported patients, around half of the patients did not have a cardiovascular/pulmonary disease. While current practices appear reasonable, improved differentiation of chest pain patients in telephone consultations could potentially both improve the treatment and management of these patients and reduce the in-hospital burden of non-acute chest pain consultations.

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Keywords Chest pain, Ischemic heart disease, Emergency medical services

Introduction

Globally, chest pain is considered one of the most prevalent causes of patient contacts to the health care system. Roughly 7 million patients in the United States contact the emergency departments (ED) each year due to chest pain, and chest pain is the second most frequent condition in the ED [1]. The fact that chest pain is the most frequent medical complaint in contacts to the emergency medical services, and the large number of calls and ambulance transports related to this single dominating complaint emphasizes the need to evaluate how such calls are managed and assess patients' outcomes [2].

Chest pain is a common symptom of cardiovascular disease [3] and raises concern among patients as well as health care professionals. Referral to urgent diagnosis and treatment is broadly recommended for acute chest pain to rule out severe conditions and improve patients' chance of surviving and recovering if chest pain is of cardiac origin [4]. However, chest pain can also be less severe, such as in the case of gastrointestinal complaints, musculoskeletal pain, depression, or anxiety where urgent hospital treatment is often unnecessary [5]. Among patients contacting ED in the United States, more than half appear to have chest pain with a non-cardiac cause [6]. In many cases, the first contact with health services is a telephone call making the initial medical assessment challenging. Referring patients to health care institutions for evaluation is costly [7]. Over-triaging of chest pain patients during the first medical contact can therefore lead to a considerable overuse of resources and unnecessary financial pressure on the healthcare system.

In a previous Danish study of calls to the 1-1-2 emergency number, 11% of calls were related to chest pain [8]. Similarly, chest pain has been found to be the primary symptom in 16% of all ambulance transports [9].

The aim of this study was to examine prehospital emergency response, in-hospital diagnosis, and 30-day mortality for patients who had called a non-emergency or emergency medical service due to chest pain.

Methods

Study design and setting

This register-based study included all calls registered at the Copenhagen Emergency Medical Services (EMS) in the Capital Region of Denmark in a 5-year period from 1st of January 2014 till the 31st of December 2018. The Capital Region has a population of 1.8 million people with an area of 2.561 km^2 [10]. The Copenhagen EMS consist of two medical services, an out-of-hours general practitioner service (reached by dialling 1813), and the 1-1-2 emergency number [11]. Apart from these medical services inhabitants of the Capital Region can seek medical help or advice from their general practitioner who typically are available between 8 am and 4 pm. In case of a life-threatening medical condition, patients are advised to call the 1-1-2 emergency number, where nurses and paramedics evaluate the urgency of the call and dispatch ambulances and other vehicles accordingly. Moreover, the 1813-medical helpline is a medical helpline, intended as an out-of-hours service, for non-emergencies, that are medical conditions requiring immediate attention but not presumed to be life-threatening. The 1813-medical helpline is predominantly staffed by nurses, but also medical doctors. They provide medical guidance to patients, refer to hospital emergency department, and dispatch ambulances [12]. The same software system is used by both the 1813-medical helpline and the 1-1-2 emergency number, which enables health care professionals to transfer calls between the two services but also to use services linked to any of the two services. However, two different protocols are used. While the 1813-medical helpline uses a locally developed electronic decision support system, the 1-1-2 emergency number uses the Danish Index, a criteria-based dispatch decision support tool [13].

Data collection and processing

The data used in this study originates from the Danish National Patient Registry [14], the Danish Civil Registration System [15] and the Copenhagen EMS.

Information about the calls, including the primary complaint and the immediate response provided to the patients was registered by the health care staff at the Copenhagen EMS. In this study, we linked this information to diagnoses registered during the emergency department visits and hospital admissions through the Danish National Patients Registry and deaths registered in the Danish Civil Registration System using the civil registration number, a unique ID assigned to all Danish citizens [15, 16]. Patient characteristics such as age, and ethnicity were also collected from the Danish Civil Registration System [15].

Selection of participants

We included patients who had called the 1813-medical helpline or 1-1-2 emergency number and were recorded with a primary complaint of chest pain. Chest pain patients were included regardless of their disease history. Only patients that could be identified in the Danish Civil Registration System were included. Furthermore, only the first of possibly several calls during the 5-year time interval for each patient was included for analysis to ensure independence.

Outcomes

The following outcomes were considered; prehospital emergency response, in-hospital diagnosis following the call, and all-cause mortality.

The prehospital emergency response was defined as the immediate response initiated by the call-taker at the Copenhagen EMS and were divided into four categories: ambulance dispatch, other transports/self-transport/home visits (this category included almost exclusively self-transport), self-care, and unknown or cancelled response. Patients who were advised to wait and call again in case of worsening of their condition or asked to call their general practitioner the following day were categorized as self-care. Ambulance dispatch includes all patients who were dispatched with an ambulance of type A, B and C urgency, with A being potentially life-threatening conditions, B representing urgent but not life-threatening conditions and C consisting of conditions where transportation and observation are necessary but not urgent. Details of the type of ambulances and other vehicles are described elsewhere [11, 17].

Only hospitalized patients received an in-hospital diagnosis at discharge, defined as primary diagnosis by using International Classification of Diseases 10th Revision (ICD-10) codes registered within 7 days of their first contact. However, patients not initially hospitalized but who had a hospital contact within 7 days of their call were also registered as having received an in-hospital diagnosis based on their subsequent contact. ICD-10 codes registered at any hospital department including the emergency department and out-patient clinics were considered.

We used one primary diagnosis for each patient according to a prioritized ranking. Cardiovascular diagnoses were ranked highest followed by pulmonary diagnosis and lastly other diagnosis were listed. For example, if a patient had a myocardial infarction (MI) diagnosis and diagnosis of Type 2 diabetes, only the MI diagnosis was considered. A prioritized ranking list of the primary diagnoses and the belonging ICD-10 codes can be seen in Table S1.

Patients, who received primary diagnosis of ICD-10 I00-I99 were classified with cardiovascular diseases. Pulmonary diseases included J00-J99. Other non-cardiovascular/pulmonary diseases were defined as any other ICD-10 code. Finally, we defined 30-day mortality as deaths from any cause registered between time of call and 30 days after.

Statistical methods

We assessed the prevalence of all three outcomes (emergency response, in-hospital diagnosis, and 30-day mortality) among all chest pain patients and in subgroups of choice of medical service (1813-medical helpline and 1-1-2 emergency number). A comparison between 30-day mortality among patients with a cardiovascular or pulmonary diagnosis and patients with other diagnosis was conducted.

Categorical variables were described with absolute numbers and percentages. Ethnicity was divided into three categories: ethnic Danes, immigrants, and 2nd generation immigrants.

An immigrant was defined as an individual born abroad whose parents were neither Danish citizens nor born in Denmark. In contrast, 2nd generation immigrants were born in Denmark, while their parents were neither Danish citizens nor born there. As for the remaining population, they were classified as ethnic Danes.

Continuous variables such as age were presented as medians with interquartile range. Additionally, we assessed the in-hospital diagnosis and 30-day mortality according to the emergency response, the distribution of in-hospital diagnosis according to sex and age groups (<30, 30–39, 40–49, 50–59, 60–69, 70–79, ≥80), and patient characteristics and outcomes for survivors and non-survivors at 30-day follow-up. We calculated 95% confidence intervals for the 30-day mortality according to primary diagnosis and compared the mortality of the primary diagnosis groups using chi-square test.

Differences between study groups were tested using the Kruskal-Wallis rank sum test and the chi-square test.

We used R version 4.2.1 for the data management and analyses [18].

Results

A total of 4,834,071 calls were registered at the Copenhagen EMS during the study period, and 98,849 calls were regarding patients with a primary symptom of chest pain. Among these, 91,671 patients existed in the Danish Civil Registration system. We included the first of the chest pain calls for each patient resulting in a study population of 66,762 calls (1813-medical helpline: 34,904 calls, 1-1-2 emergency number: 31,858 calls) (Fig. 1).

In Table 1, characteristics of chest pain patients according to their choice of medical service is illustrated. The median age for the total study population was 55.3 years (IQR: 38-71.6). For patients calling the 1813-medical helpline, the median age (median=49.3; IQR: 32.5–66.2) and the proportion of males (47.0%) were lower compared to 1-1-2 emergency number (median age=62.1; IQR: 45.8–75.3) (males: 52.6%).

The response provided to the patients is also shown in Table 1. In total, 91.4% of the patients were referred to a hospital while only 5.9% (n=3,939) were suggested to perform self-care and 2.7% (n=1,813) were not registered with a response or had the dispatched vehicle cancelled. However, patients who contacted the 1-1-2 emergency number were more likely to get an ambulance dispatched

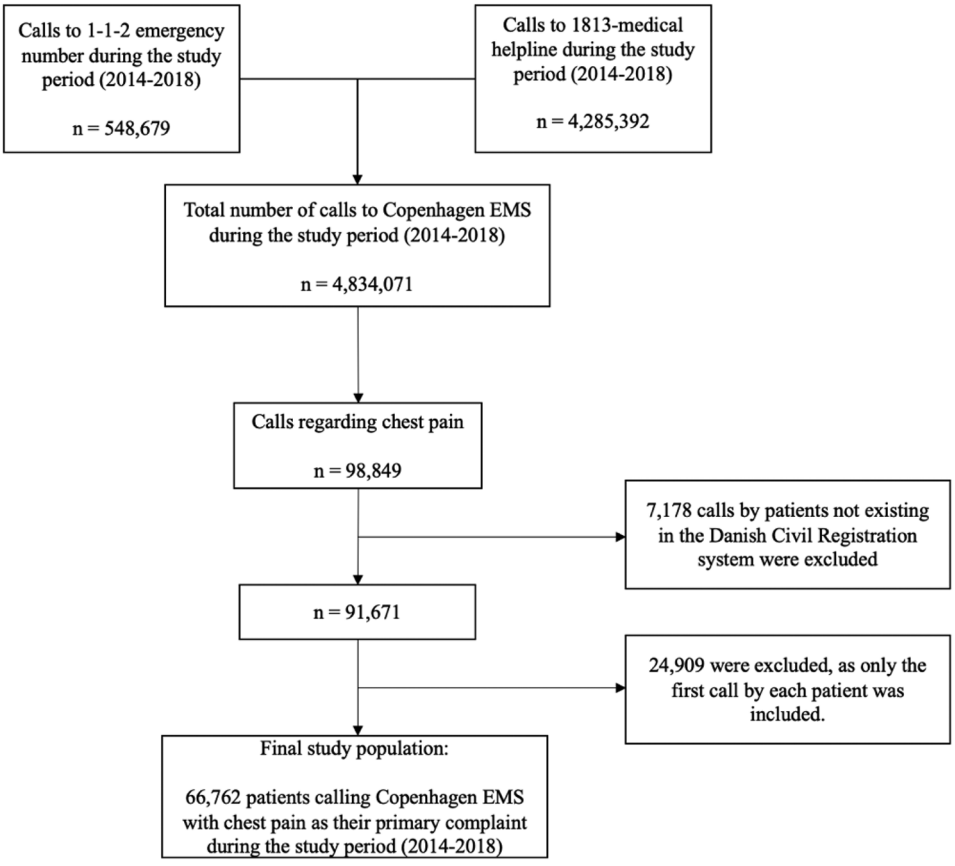

Fig. 1 Flowchart of the selection of participants

Table 1 Patient characteristics, response, diagnosis and 30-day mortality for chest pain patients calling Copenhagen EMS (2014–2018)

Variable	Level	1-1-2 emergency number (*n* = 31,858)	1813-medical helpline (*n* = 34,904)	Total (*n* = 66,762)	*P*-value
Age	Median (IQR)	62.1 (45.8–75.3)	49.3 (32.5–66.2)	55.3 (38-71.6)	< 0.001
Sex	Male	16,749 (52.6)	16,404 (47.0)	33,153 (49.7)	< 0.001
Ethnicity	Ethnic Danes	24,920 (78.4)	26,299 (75.5)	51,219 (76.9)	
	Immigrants	5,979 (18.8)	6,670 (19.1)	12,649 (19.0)	
	2nd gen. Immigrants	874 (2.8)	1,881 (5.4)	2,755 (4.1)	
	Unknown ethnicity	85	54	139	< 0.001
Response category	Ambulance dispatch	30,684 (96.3)	19,943 (57.1)	50,627 (75.8)	
	Other transports/Self-transport/Home visits	297 (0.9)	10,086 (28.9)	10,383 (15.6)	
	Self-care	33 (0.1)	3,906 (11.2)	3,939 (5.9)	
	Unknown or cancelled response	844 (2.6)	969 (2.8)	1,813 (2.7)	< 0.001
In-hospital diagnostic categories received within 7 days	Cardiovascular diseases	10,835 (34.0)	7,102 (20.3)	17,937 (26.9)	
	Pulmonary diseases	1,693 (5.3)	1,797 (5.1)	3,490 (5.2)	
	Other non-cardiovascular/pulmonary diseases	15,531 (48.8)	19,711 (56.5)	35,242 (52.8)	
	No diagnosis	3,799 (11.9)	6,294 (18.0)	10,093 (15.1)	< 0.001
30-day mortality	Mortality	799 (2.5)	259 (0.7)	1,058 (1.6)	< 0.001

(96.3%) compared to those who called the 1813-medical helpline (57.1%). Types of ambulances can be seen in Table S2. However, the total number of patients referred to hospital or other medical assessment did not differ much according to the choice of medical service, as 97.2% of the patients who called 1-1-2 emergency number were transported to the hospital by an ambulance, other transport, or received a home visit, while the same

response was provided to 86% of the patients, who called the 1813-medical helpline.

The prevalence of cardiovascular disease and the 30-day mortality was highest among patients who had called the 1-1-2 emergency number (cardiovascular disease: 34%; 30-day mortality: 2.5%) versus 1813-medical helpline (cardiovascular disease: 20.3%; 30-day mortality: 0.7%). Overall, 26.9% were diagnosed with a cardiovascular disease, 5.2% with a pulmonary disease, 52.8% with other non-cardiovascular/pulmonary disease, and 15.1% received no diagnosis. (Table 1).

Table 2 shows in-hospital diagnosis of chest pain patients according to the emergency response. The median age was higher among patients transported by an ambulance (median = 60.4; IQR: 44.9–74.1) compared to patients receiving other forms of response or guidance (other transports/self-transport/home visits: Median = 40.7; IQR: 27.1–55.4; self-care: Median = 29.3; IQR: 22.3–45.5). Most of the patients suffered from a non-cardiovascular/pulmonary disease regardless of which emergency response they received from the Copenhagen EMS. Hence, 51.3% of ambulance transported patients and 77.1% of patients, who were seen at the hospital but not transported by an ambulance, were diagnosed with a non-cardiovascular/pulmonary disease. Despite this, among patients who received an ambulance, 32.1% had a cardiovascular disease (ACS: 13.4%) and 5.5% had a pulmonary disease. Among patients provided with other transport, self-transport, or home visit 13.4% had a cardiovascular disease (ACS: 5.2%), while cardiovascular diseases were found among 2% (ACS: 0.6%) of the patients referred to self-care. In comparison, overall, 11.1% were diagnosed with ACS. A total of 81.2% of patients referred to self-care, did not get a diagnosis, indicating that these patients had no hospital contact during the first 7 days after the call. The distribution within response category of each sub-diagnosis included in the diagnosis categories (cardiovascular diseases, pulmonary diseases, and other non-cardiovascular/pulmonary diseases) are available in Table 2. The prevalence of ACS including AMI and unstable angina pectoris was highest amongst patients who received an ambulance (13.4%) compared to patients assigned to other transports/self-transport/home visits or self-care, and patients not assigned to transport (0.6–5.2%). In total, 1.6% of the patients died within 30 days. Moreover, the 30-day mortality for patients receiving an ambulance dispatch was 2.0%, while it was comparatively low for patients who received other transports/self-transport/home visits and for patients referred to self-care (0.3%) (Table 2).

The prevalence of the diagnosis categories according to patients' age and gender is illustrated in Fig. 2. We found a higher prevalence of patients diagnosed with cardiovascular disease with increasing age. The increase in pulmonary diseases with increasing age was modest, whereas the share of patients receiving no diagnosis, or having a non-cardiovascular/pulmonary disease decreased rapidly with increasing age. Generally, the prevalence of cardiovascular disease was lower among females than males, whereas the prevalence of non-cardiovascular/pulmonary diseases was higher. The prevalence of pulmonary diseases was similar across sex and females were only slightly more likely to not receiving a diagnosis compared to males. Patients younger than 40 were least likely to be diagnosed with a cardiovascular disease (3–10%) (Fig. 2). Additionally, the primary diagnoses for the different age groups are listed in Table S3, where the prevalence of ACS among patients younger than 40 was lower (0.4–2.5%) compared to patients who were 40 and above (7.9–18.2%).

The 30-day mortality was below 5% regardless of the diagnosis of the patient, but patients subsequently diagnosed with a cardiovascular disease or a pulmonary disease, had a significantly higher 30-day mortality (3.3%, 95% CI[3.1;3.6] to 4%, 95% CI[3.4;4.7]) compared to patients who suffered from non-cardiovascular/pulmonary diseases (0.6%, 95% CI[0.5;0.7] to 1%, 95% CI[0.8;1.2]) (Fig. 3).

Table 3 provides an overview of the patients according to their vital status (dead/alive) 30 days after their first contact to the Copenhagen EMS. The median age of the 1,058 patients who died was 80.1 years (Table 3). Most of the patients who died within 30 days had called 1-1-2 emergency number (75.5%) and were diagnosed with a cardiovascular disease (56.6%) while 13.3% had a pulmonary disease.

Discussion

At the Copenhagen EMS patients calling with chest pain were nearly invariably referred to hospital care. However, at the 1-1-2 emergency number patients almost always received an ambulance dispatch, which just over half of the patients at the 1813 medical helpline did. Additionally, the conditions appeared more severe in patients calling the 1-1-2 emergency number compared to the medical helpline as the proportion of cardiovascular diagnoses and 30-day mortality were higher. Overall, around 35% of the chest pain patients received a cardiovascular or pulmonary diagnosis, and the proportion of especially cardiovascular diagnoses, increased with increasing age. Diagnosis of cardiovascular disease was lowest among patients younger than 40 (3–10%). The 30-day mortality was below 5% regardless of the discharge diagnosis (0.6-4%), but patients diagnosed with cardiovascular or pulmonary disease, had a 3–6 times higher 30-day mortality compared to patients suffering from non-cardiovascular/pulmonary diseases.

Table 2 Diagnosis category, sub-diagnosis, and 30-day mortality according to emergency response for chest pain patients

Variable	Level	Ambulance dispatch (*n* = 50,627)	Other transports/ Self-transport/ Home visits (*n* = 10,383)	Self-care (*n* = 3,939)	Unknown or cancelled response (*n* = 1,813)	*P*-value
Age	Median (IQR)	60.4 (44.9–74.1)	40.7 (27.1–55.4)	29.3 (22.3–45.5)	41.1 (25.9–62.1)	< 0.001
Sex	Male	25,047 (49.5)	5,284 (50.9)	1,897 (48.2)	925 (51.0)	0.0078
Ethnicity	Ethnic Danes	39,715 (78.6)	7,426 (71.6)	2,791 (70.9)	1,287 (71.2)	
	Immigrants	9,528 (18.9)	2,151 (20.8)	587 (14.9)	383 (21.2)	
	2nd gen. Immigrants	1,271 (2.5)	789 (7.6)	557 (14.2)	138 (7.6)	
	Unknown ethnicity	113	17	4	5	< 0.001
Diagnosis' categories	Cardiovascular diseases	16,272 (32.1)	1,389 (13.4)	79 (2.0)	197 (10.9)	
	Pulmonary diseases	2,791 (5.5)	594 (5.7)	65 (1.7)	40 (2.2)	
	Other non-cardiovascular/pulmonary diseases	25,978 (51.3)	8,004 (77.1)	598 (15.2)	662 (36.5)	
	No diagnosis	5,586 (11.0)	396 (3.8)	3,197 (81.2)	914 (50.4)	< 0.001
Primary diagnosis						
Cardiovascular diseases	Cardiac arrest	163 (0.3)	≤ 3	≤ 3	≤ 3	
	Acute myocardial infarction	4,626 (9.1)	272 (2.6)	13 (0.3)	39 (2.2)	
	Unstable angina pectoris	2,172 (4.3)	269 (2.6)	11 (0.3)	30 (1.7)	
	Heart failure	1,389 (2.7)	58–61	9–12	12 (0.7)	
	Ischemic heart disease	1,237 (2.4)	136 (1.3)	7 (0.2)	13–16	
	Atrial fibrillation	2,315 (4.6)	132 (1.3)	7 (0.2)	26 (1.4)	
	Other cardiovascular diseases	4,370 (8.6)	519 (5.0)	30 (0.8)	74 (4.1)	< 0.001
Pulmonary diseases	Pneumothorax	121 (0.2)	49 (0.5)	8–11	≤ 3	
	Chronic obstructive pulmonary disease	694 (1.4)	33 (0.3)	≤ 3	4–7	
	Other respiratory diseases	1,976 (3.9)	512 (4.9)	54 (1.4)	32 (1.8)	< 0.001
Other non-cardio-vascular/pulmonary diseases	Diabetes Mellitus	301 (0.6)	39 (0.4)	4 (0.1)	6 (0.3)	
	Stroke – TCI	59 (0.1)	≤ 3	0 (0.0)	0 (0.0)	
	Bleeding	161 (0.3)	13 (0.1)	5 (0.1)	6 (0.3)	
	Diseases of the nervous system	397 (0.8)	59 (0.6)	9 (0.2)	4 (0.2)	
	Neoplasms	269 (0.5)	20 (0.2)	5 (0.1)	≤ 3	
	Certain infectious and parasitic diseases	503 (1.0)	148 (1.4)	19 (0.5)	18 (1.0)	
	Diseases of the blood	151 (0.3)	16 (0.2)	≤ 3	5 (0.3)	
	Endocrine, nutritional, and metabolic diseases	571 (1.1)	66 (0.6)	≤ 3	13 (0.7)	
	Diseases of the eye and adnexa	55 (0.1)	4 (0.0)	≤ 3	≤ 3	
	Diseases of the ear and mastoid process	116 (0.2)	13 (0.1)	≤ 3	0 (0.0)	
	Diseases of the digestive system	1,710 (3.4)	408 (3.9)	28 (0.7)	34 (1.9)	
	Diseases of the musculoskeletal system and connective tissue	1,827 (3.6)	1,198 (11.5)	68 (1.7)	79 (4.4)	
	Diseases of the skin and subcutaneous tissue	55 (0.1)	13 (0.1)	≤ 3	0 (0.0)	
	Diseases of the genitourinary system	423 (0.8)	44 (0.4)	11 (0.3)	7 (0.4)	
	Pregnancy, childbirth, and the puerperium	25–28	13 (0.1)	5 (0.1)	0 (0.0)	
	Mental and behavioural disorders	834 (1.6)	115 (1.1)	8 (0.2)	21 (1.2)	
	Certain conditions originating in the perinatal period	≤ 3	≤ 3	0 (0.0)	0 (0.0)	
	Congenital malformations, deformations, and chromosomal abnormalities	36 (0.1)	≤ 3	0 (0.0)	≤ 3	
	Symptoms, signs, and abnormal clinical and laboratory findings, not elsewhere classified	12,496 (24.7)	4,317 (41.6)	239 (6.1)	298 (16.4)	
	External causes of morbidity and mortality	572 (1.1)	132 (1.3)	29 (0.7)	22 (1.2)	
	Unspecific diagnosis	5,414 (10.7)	1,383 (13.3)	156 (4.0)	141 (7.8)	< 0.001

Table 2 (continued)

Variable	Level	Ambulance dispatch (*n* = 50,627)	Other transports/ Self-transport/ Home visits (*n* = 10,383)	Self-care (*n* = 3,939)	Unknown or cancelled response (*n* = 1,813)	*P*-value
Unknown or no diagnosis	-	5,586 (11.0)	396 (3.8)	3,197 (81.2)	914 (50.4)	< 0.001
30-day mortality	Mortality	1,007 (2.0)	28 (0.3)	12 (0.3)	11 (0.6)	< 0.001

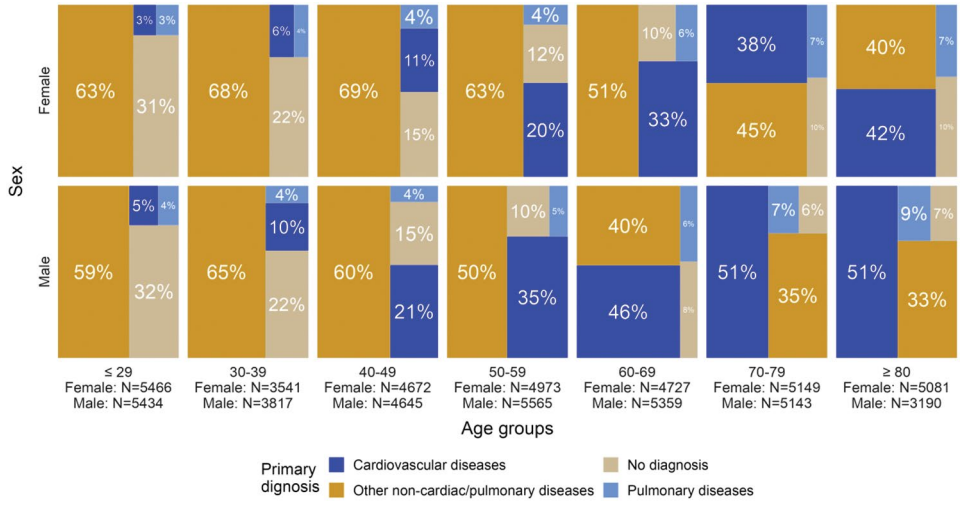

Fig. 2 Distribution of diagnoses according to sex and age groups for chest pain patients. Legend: The figure illustrates the diagnoses the patients received within 7 days from their call to the Copenhagen Emergency Medical Services in the study period (2014–2018). The size of the box illustrates the proportion of that diagnosis in the specific sex and age stratum

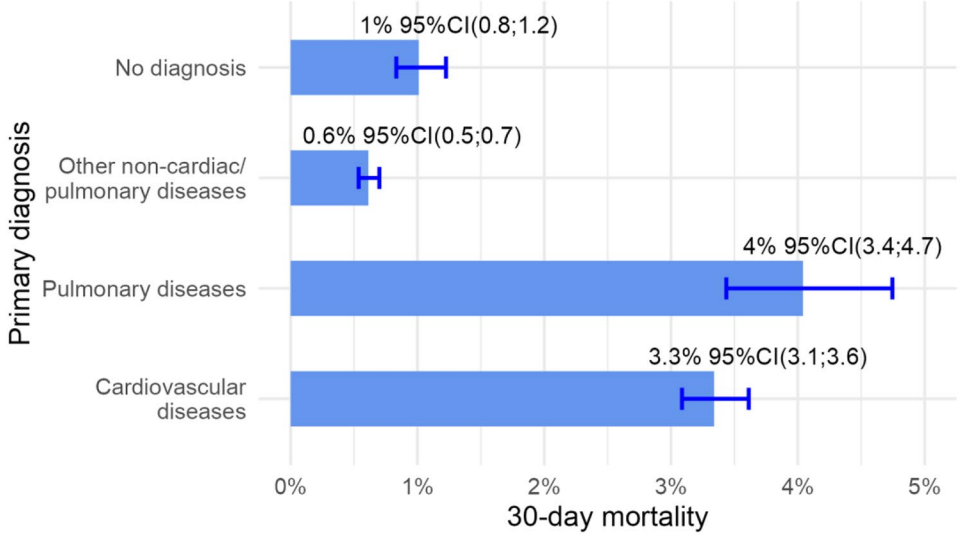

Fig. 3 The 30-day mortality among chest pain patients according to primary diagnosis. Legend: The figure shows the 30-day mortality according to primary diagnosis with 95% confidence intervals. The 30-day mortality for those diagnosed with cardiovascular disease was significantly higher compared to those not receiving a diagnosis ($p < 0.001$) and those with other non-cardiovascular/pulmonary diseases ($p < 0.001$). Similarly, the 30-day mortality for those with pulmonary diseases was significantly higher compared to those not receiving a diagnosis ($p < 0.001$) and those with other non-cardiovascular/pulmonary diseases ($p < 0.001$)

Table 3 Characteristics of chest pain patients according to vital status at 30-day follow-up

Variable	Level	Alive after 30 days (*n* = 65,704)	Dead after 30 days (*n* = 1,058)	Total (*n* = 66,762)	*P*-value
Age	Median (IQR)	54.8 (37.6–71.1)	80.1 (70.9–87.5)	55.3 (38-71.6)	< 0.001
Sex	Male	32,541 (49.5)	612 (57.8)	33,153 (49.7)	< 0.001
Ethnicity	Ethnic Danes	50,267 (76.7)	952 (90.0)	51,219 (76.9)	
	Immigrants	12,546 (19.1)	102–105	12,647-50	
	2nd gen. Immigrants	2752 (4.2)	≤ 3	2753-6	< 0.001
Type of emergency service	1-1-2 emergency number	31,059 (47.3)	799 (75.5)	31,858 (47.7)	
	1813-medical helpline	34,645 (52.7)	259 (24.5)	34,904 (52.3)	< 0.001
Response category	Ambulance dispatch	49,620 (75.5)	1,007 (95.2)	50,627 (75.8)	
	Other transports/Self-transport/Home visits	10,355 (15.8)	28 (2.6)	10,383 (15.6)	
	Self-care	3,927 (6.0)	12 (1.1)	3,939 (5.9)	
	Unknown or cancelled response	1,802 (2.7)	11 (1.0)	1,813 (2.7)	< 0.001
Diagnosis' categories	Cardiovascular diseases	17,338 (26.4)	599 (56.6)	17,937 (26.9)	
	Pulmonary diseases	3,349 (5.1)	141 (13.3)	3,490 (5.2)	
	Other non-cardiovascular/pulmonary diseases	35,026 (53.3)	216 (20.4)	35,242 (52.8)	
	No diagnosis	9,991 (15.2)	102 (9.6)	10,093 (15.1)	< 0.001

In our study, almost all patients were referred to hospital care either by an ambulance (more than 75%) or by other transportation (around 15%). More than half of the admitted patients were discharged without receiving a specific cardiovascular or pulmonary diagnosis, which aligns with previous findings [9, 19]. In a Danish study, 50% of ambulance transported chest pain patients were discharged without any diagnosis of disease [9]. Similarly, the proportion of non-cardiovascular chest pain cases in the ED was found to be 60% in another Dutch study [19]. A South African study found that respiratory diseases were the cause of chest pain in 46% of hospital admissions following an emergency call by patients with chest pain, while cardiovascular diseases were the second most common cause (43%) [20]. However, direct comparison between our and the South African study's findings are limited due to dissimilarities between the study populations, emergency helpline, EMS, and hospital systems.

Chest pain is acknowledged as a cardinal symptom of acute onset of ischemic heart diseases; thus, protocols recommend dispatch of high priority. Since 96% of the patients with chest pain received an ambulance following their contact with the 1-1-2 emergency number, the results suggest that these patients are managed according to protocol. However, triaging chest pain patients at the 1813 medical helpline is challenging and given that almost half of the chest pain calls were to the medical helpline, this is a commonly occurring issue. Overall, mortality was low at among patients calling the 1813 medical helpline but considering that the 1813 medical helpline is intended for urgent but non-emergency situations and that the majority of calls to this service are non-emergencies, it is alarming that 25% of these patients were diagnosed with a cardiovascular or pulmonary disease and that 25% of those who died within 30 days had called the 1813 medical helpline. This indicates that chest pain patients do not necessarily interpret their symptoms as signs of severe conditions and therefore often contact non-emergency medical services in emergency situations. It is not feasible to simply increase ambulance dispatch at the non-emergency medical helpline without improving the risk stratification of chest pain patients, because of the burden that would pose on health care capacity. This highlights the importance and need for improved triaging tools, especially at non-emergency medical helplines, and further research on this topic is warranted.

Cardiovascular diseases were infrequent among patients younger than 40 (ACS: 0.4–2.5%). The low risk of cardiovascular disease, but also hospitalization in general, among young chest pain patients have been documented previously [21]. Risk stratification in young patients could be improved by using cardiovascular disease history [21], however determining the history of cardiovascular and pulmonary disease is already included in the chest pain protocols at the Copenhagen EMS [13]. Pain intensity and location and size of the area affected by pain have also been found to predict high-risk or low-risk chest pain patients [22]. Although protocols advise clarifying the timing and activity of pain onset and type or sensation of pain, questions of size of the area or intensity could possibly be included in protocols, specifically. Research on how to improve protocols is warranted to improve the ability of differentiating cardiovascular and pulmonary induced chest pain from benign chest pain during the first medical contact, especially for telephone consultations, where physical examinations and diagnostic procedures are not possible. Information that can be

collected by ambulance personnel, including electrocardiography (ECG), oxygen saturation, and fever have also been found to predict high versus low-risk chest pain, and might enable early diagnosis [22]. An early POC-troponin measurement has also shown to be useful to rule-in AMI [23]. Collecting these data is already considered standard practice for chest pain patients in the ambulance. A recent Scandinavian study found that the ECG and vital signs were registered for almost all ambulance transported chest pain patients [24]. Thus, it is uncertain whether additional emphasis on these predictors would in fact improve the risk stratification further.

Limitations

Patients not registered with a Danish civil registration number were excluded, as we were not able to track their subsequent diagnoses or 30-day mortality. However, this was a very low proportion of patients in our study.

Another limitation was that we did not know which condition patients not referred for treatment suffered from. However, if they were hospitalized during the following 7 days of a call, we would include information of their in-hospital diagnosis regardless of whether they were referred to the hospital during the initial call.

Conclusion

Nearly all chest pain patients calling the 1-1-2 emergency number and a bit more than half of those calling the 1813 medical helpline received an ambulance. Around half of the ambulance transported chest pain patients did not have a cardiovascular/pulmonary disease, and patients younger than 40 were found to be at low risk of cardiovascular disease. Depending on the discharge diagnosis the 30-day mortality ranged from 0.6 to 4%, but the mortality among patients with cardiovascular or pulmonary disease were 3–6 times higher than patients suffering from non-cardiovascular/pulmonary diseases. While current practices appear reasonable, improved differentiation of chest pain patients in telephone consultations could potentially both improve the treatment and management of chest pain patients and reduce in-hospital burden of non-acute chest pain consultations, especially at the non-emergency medical helpline which was a common choice of service for chest pain patients.

Supplementary Information

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Supplementary Material 1

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Author contributions
The first draft of the manuscript were written by SA. All of the other authors (ALM, FG, HB, KK, FF, CTP, HCC, SNB and FL) have contributed with suggestions to improve the study and critically revised the work. SA, ALM, FG and CTP performed the data management and analyses.

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Data availability
No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate
Ethical approval is not required for retrospective register-based studies in Denmark. However, this study was approved by the Danish Patient Safety Authority (case number:3-3013-2795/1, reference EMGW) and The Capital Region of Denmark (Region Hovedstaden), the institution responsible for the data, (approval number: P-2019-191). Additionally, researchers in Denmark are, under certain conditions, allowed to handle sensitive data. However, to protect personal data all analyses were carried out on a secure server at Statistics Denmark, where all data is pseudonymized, and no results were reported for groups with less than 4 individuals. All authors certify that the study was performed in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards. Written informed consent is not required for this study.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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