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The prevalence of life-threatening diagnoses in emergency department patients with chest pain in a national group

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ABSTRACT

Objective: We describe the prevalence of seven life-threatening diagnoses in Emergency Department (ED) patients with chest pain in a national ED group.
Methods: Using data from 141 EDs staffed by US Acute Care Solutions (USACS) from January 2021 to December 2024 in 17 U.S. states, we used descriptive statistics to tabulate prevalences of seven life-threatening conditions in ED patients with atraumatic chest pain: acute coronary syndrome (ACS), pulmonary embolism (PE), pneumothorax, thoracic aortic dissection (TAD), esophageal rupture, pericardial tamponade, and ruptured aortic aneurysm. We used logistic regression to estimate the association between ACS, PE, or any life-threatening diagnosis with ED visit and site characteristics.
Results: In 13,744,869 ED encounters, 951,152 (6.9%) had a complaint of atraumatic chest pain with 52,410 (5.5%) of these diagnosed with a life-threatening condition in the ED. ACS was most common (4.5%), followed by PE (0.78%), pneumothorax (0.13%), TAD (0.09%), esophageal rupture (0.007%), pericardial tamponade (0.005%), and ruptured aortic aneurysm (0.002%). The prevalence of life-threatening diagnoses was higher in patients who were older, male, covered by commercial insurance, who had higher-acuity triage emergency severity index (ESI) levels, arrived by ambulance, and were seen in western U.S. EDs.
Conclusion: Approximately 1 in 18 ED patients with atraumatic chest pain presents with a life-threatening condition. ACS is the most common followed by PE, pneumothorax and TAD. Other diagnoses are very rare. These data may serve as a priori pre-test probabilities for ED clinicians in the evaluation of chest pain.

1. Introduction

1.1. Background

More than 140 million patients visit emergency departments (EDs) in the United States annually. Chest pain is the second most common chief complaint, accounting for 8.4 million US ED visits in 2022 [1]. The differential diagnosis for atraumatic chest pain is broad and familiar to emergency clinicians, ranging from high acuity, potentially life-threatening diagnoses to benign conditions. Life threatening causes of chest pain include relatively common conditions like acute coronary syndrome (ACS) and pulmonary embolism (PE) as well as less common conditions like thoracic aortic dissection (TAD), pneumothorax, pericardial tamponade, esophageal rupture (Boerhaave Syndrome), and ruptured thoracic aortic aneurysm. Clinicians get limited exposure to many of these less common conditions, sometimes encountering them only a handful of times throughout a career. That limited experience combined with variable clinician

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risk tolerance can result in both underdiagnosis and over-screening [2-5].

1.2. Importance

Understanding the prevalence of life-threatening conditions in atraumatic chest pain and their risk factors may help clinicians accurately estimate a priori pre-test probabilities and inform diagnostic decision-making. Earlier small studies reporting the prevalence of life-threatening conditions in chest pain have estimated that 5–10% are eventually diagnosed with ACS, 1% with pulmonary embolism, and 0.1% with TAD [6-8]. The diagnosis of life-threatening conditions in patients with chest pain is sometimes difficult as patients can present atypically. Misdiagnosis of chest pain in the ED can lead to malpractice litigation [9]. In a large study of paid malpractice claims, the two leading diagnoses in terms of both dollars paid and number of successful claims were acute myocardial infarction and “chest pain, not further defined” [10]. To our knowledge, no recent studies have used a large national database to assess the rate of common and uncommon life-threatening diagnoses in ED patients with chest pain.

1.3. Goals of the investigation

We used a large sample of U.S. ED patients with chest pain to describe the prevalence of the seven major life-threatening diagnoses responsible: ACS, PE, TAD, pericardial tamponade, pneumothorax, esophageal rupture, and ruptured aortic aneurysm. Furthermore, we assessed patient and ED characteristics associated with any of the seven diagnoses.

2. Methods

2.1. Study design and setting

We performed a retrospective cross-sectional study using visit-level data from US Acute Care Solutions (USACS), a national acute care practice that provides physician and advanced practice provider staffing to hospitals. A balanced panel consisting of 141 USACS EDs with data for the entire study period (January 1, 2021, to December 31, 2024) including both hospital-based and free-standing EDs (FSEDs) from 17 states with variable annual volumes, geographic locations, urbanicity and trauma designations was used. Data on diagnoses made following hospital admission or on subsequent presentations was not accounted for in this dataset. Visit characteristics, ED diagnoses and demographics were abstracted by trained billing specialists. Detailed information on the construction and maintenance of this dataset has been described in prior work [11, 12]. The study was deemed to be exempt from Institutional Review Board review by the Allegheny Health Network.

2.2. Selection of sample

The study sample consisted of all visits to included EDs by adult patients (patient age ≥18 years) from 2021 to 2024 where the patient's chief complaint was specified. We excluded any visits without a chief complaint, as well as those with dispositions of Left Without Treatment (LWT), Left Against Medical Advice (AMA), or Dead on Arrival (DOA). The resulting sample included 13,744,869 visits to 141 EDs. Patient complaint was a single free text field. We identified all visits with a complaint of “chest pain” or related symptoms, for example, “chest pressure” or similar symptoms relating to “chest pain” as specified in Appendix Fig. 1. We excluded visits with words related to trauma or injury. This identified 951,152 patients (6.9%) with a complaint of chest pain. The seven life-threatening diagnoses of interest were selected a priori by the study team based on conditions commonly considered in the ED evaluation of atraumatic chest pain.

2.3. Methods of measurement

We used patient variables available in the dataset and theoretically related to the risk of a life-threatening diagnosis according to the authors' consensus. We also included patient, facility, and geographic variables related to the location and type of ED. Patient-level factors included the patient's age and sex, insurance type, if they arrived by ambulance, and the emergency severity index (ESI) level assigned at ED triage. Facility-level factors included the type of site (FSED or hospital-based ED), the trauma level designation, and if the ED was an emergency medicine residency training site. Patients who may have been transferred to another facility following diagnosis were included in the analyses of admitted patients. Geographic factors included the region in which the ED was located and whether the location was urban, suburban, or rural. Sta States included in each region are consistent with Census Bureau classifications and are outlined in Appendix Table 1.

2.4. Outcome measures

The primary outcome measure was the patient being diagnosed with any (i.e., one or more) of the seven potentially life-threatening diagnoses (ACS, PE, TAD, esophageal rupture, pneumothorax, ruptured thoracic aortic aneurysm, or pericardial tamponade) during an ED visit in which chest pain was a complaint. The list of life-threatening diagnoses was created by author consensus from those commonly considered in the ED evaluation of atraumatic chest pain. To be included, the diagnosis could appear in any position among the listed diagnoses on the patient encounter (i.e., first, second, third, etc.). International Classification of Disease (ICD-10) codes were identified by the study team that corresponded with the seven conditions and reviewed by all authors for correctness (see Appendix Table 2).

2.5. Primary data analysis

We used descriptive statistics to tabulate study data by prevalence of life-threatening diagnoses in the overall sample and among the sample of patients with a complaint of chest pain. We then used separate logistic regressions to estimate the association between a patient being diagnosed with ACS, PE, or any of the seven life threatening diagnoses and included factors. Due to the relatively small number of visits resulting in each of the other five diagnoses, logistic regression analyses for these outcomes were not performed, as sample sizes were inadequate to yield reliable estimates. We estimated cluster robust standard errors, which correct for heteroscedasticity and correlation between patients in the same ED. Multicollinearity among variables was assessed with variance inflation factors. We computed a variance inflation factor for each coefficient in the logistic regression equation, and multicollinearity was not detected. We used R 4.4.2 for the statistical analysis.

3. Results

3.1. Patient and emergency department characteristics

From 2021 to 2024, 13,744,869 encounters were included across the 141 EDs. Of these, 951,152 patients (6.9%) presented with a complaint of atraumatic chest pain. Mean patient age was 52.3 years (standard deviation [SD] 18.4), 53.9% were female, 35.2% had private insurance, 32.4% Medicare, 20.4% Medicaid, and 9.1% were uninsured or self-pay. Additional visit characteristics are listed in Appendix Table 3, and characteristics of the 141 included sites are described in Appendix Table 4.

3.2. Chest pain visit outcomes

Of the 951,152 patients with chest pain, 52,410 (5.5%) were diagnosed with one of the seven life-threatening conditions. ACS was the most common with 42,878 cases diagnosed. This represented 4.5% of

chest pain visits and 0.67% of all ED visits. Pulmonary embolism and pneumothorax were the next most common conditions with 7395 (0.78%) and 1263 chest pain encounters (0.13%), respectively. TAD accounted for 892 (0.09%) cases, while ruptured aortic aneurysm, pericardial tamponade, and esophageal rupture were each diagnosed in fewer than 80 patients over the study period with a prevalence <0.01% (Table 1). These outcomes were reported for the entire study period because they remained consistent across all four years (Appendix Table 5). While the prevalence of these seven life-threatening conditions was higher among patients who presented with chest pain, there were a larger number of life-threatening diagnoses in patients who presented *without* chest pain than in those who presented *with* chest pain. Specifically, only 35.8% of all patients with these life-threatening diagnoses presented *with* chest pain, and this percentage varied by diagnosis (Appendix Table 6).

3.3. Unadjusted prevalences of life-threatening diagnoses by patient and site characteristics

The prevalence of life-threatening diagnoses for various patient groups is illustrated in Table 2. The prevalence broadly increased with patient age, with a prevalence of 9.9% and 9.4% in age 75+ and 65–74 years, respectively, compared to 2.4% and 1.1% in patients aged 35–44 and 18–34 years. The prevalence in male patients (7.5%) and in those who arrived by ambulance (9.3%) was higher than in females (3.8%) and non-ambulance arrivals (4.5%). The prevalence increased with more acute ESI levels at triage, increasing from 0.08% for ESI 4 to 12.0% for ESI 1. Medicare insurance had the highest prevalence (8.4%) while those insured by Medicaid had the lowest (3.1%).

There were no large differences in prevalence of life-threatening diagnoses between urban, suburban, and rural EDs, by ED training site or ED volume. Level 1 trauma centers had a higher prevalence (7.6%), compared to EDs with other trauma levels and non-trauma centers. FSEDs had lower rates of life-threatening diagnoses (3.6%) compared to hospital-based EDs (5.6%). Patients presenting to EDs in the western US had the highest life-threatening diagnosis prevalence (7.4%), while prevalence in the other regions ranged from 5.0%–5.6%. These prevalences were reported for all seven diagnoses across the entire study period but remained consistent across all four years (Appendix Table 7). Appendix Table 8 reports the prevalences by specific diagnosis.

3.4. Adjusted predictors of ACS, PE and any potentially life-threatening diagnosis

Adjusted analyses are illustrated in Table 3. Age and gender were strong predictors of being diagnosed with ACS and any of the seven life-threatening conditions studied. Compared with the reference group of patients aged 45–54 years, younger groups had substantially lower odds of ACS (OR 0.11, 95% confidence interval [CI] 0.10–0.12 for age 18–34; OR 0.44, 95% CI 0.41–0.47 for age 35–44), while older patients had significantly higher odds (OR 2.18, 95% CI 2.06–2.31 for ≥75 years). For PE, younger adults also had lower odds (OR 0.65, 95% CI 0.59–0.71 for age 18–34), while the risk rose modestly in older groups (OR 1.21, 95% CI 1.10–1.34 for ages 65–74). Male patients were almost twice as likely as females to be diagnosed with ACS (OR 1.91, 95% CI 1.84–1.97) and had higher odds for any of the seven diagnoses (OR 1.80, 95% CI 1.75–1.85), but the increase was smaller for PE (OR 1.19, 95% CI 1.13–1.25). Arrival by ambulance was consistently associated with higher risk (OR 1.44, 95% CI 1.35–1.55 for ACS; OR 1.13, 95% CI 1.05–1.21 for PE; OR 1.41, 95% CI 1.32–1.50 for any diagnosis). Higher acuity ESI levels showed a graded association: ESI 1 patients were far more likely to be diagnosed with ACS (OR 13.61, 95% CI 11.13–16.65) or any life-threatening condition (OR 12.01, 95% CI 9.90–14.56), while ESI 3–4 patients were much less likely to result in a life-threatening diagnosis. Compared with commercially insured patients, Medicaid,

Table 1
Outcomes of emergency department visits with chest pain.

Life-threatening diagnosis	Chest pain complaint count (% of total chest pain visits)
Total Visits (2021–2024)	951,152
Any of 7 Diagnoses	52,410 (5.51%)
Acute Coronary Syndrome	42,878 (4.51%)
Pulmonary Embolism	7395 (0.78%)
Pneumothorax	1263 (0.13%)
Thoracic Aortic Dissection	892 (0.09%)
Boerhaave Syndrome	71 (0.007%)
Pericardial Tamponade	45 (0.005%)
Ruptured Aortic Aneurysm	18 (0.002%)

Totals reported across the entire study period because prevalence remained consistent throughout the four years studied. Yearly totals are reported in Appendix Table 4.

Table 2
Summary statistics for ED visits with chest pain as a complaint in a national group (2021–4)*.

Characteristics of study population		Count
Total EDs		141
Total ED Visits		13,744,869
Total Chest Pain Visits (% of Total ED Visits)		951,152 (6.92%)
Chest Pain Visits with Life-Threatening Diagnosis (% of Chest Pain Visits)		52,410 (5.51%)
Patient characteristics		Total chest pain visits with one of seven included diagnoses (% by row)
Patient Age	18–34	2155 (1.11%)
	35–44	3695 (2.40%)
	45–54	8251 (5.01%)
	55–64	12,814 (7.40%)
	65–74	13,142 (9.35%)
	75+	12,353 (9.87%)
Patient Sex	Female	19,675 (3.84%)
	Male	32,735 (7.46%)
ESI	1	5224 (55.47%)
	2	30,688 (7.57%)
	3	16,076 (3.11%)
	4	54 (0.35%)
	5	0 (0.00%)
Arrived by Ambulance	Yes	18,869 (9.26%)
	No	33,541 (4.49%)
Insurance Type (Primary Payer Group)	Commercial	15,894 (4.75%)
	Medicare	25,875 (8.43%)
	Medicaid	6036 (3.12%)
	Self-Pay	2991 (3.46%)
	Other	1614 (5.48%)
ED characteristics		Total chest pain visits with one of seven included diagnoses (% by row)
ED Annual Visit Volume	< 20,000	5687 (5.08%)
	20,000 to 50,000	31,994 (5.44%)
	≥ 50,000	14,729 (5.86%)
ED Type	Hospital-based	49,826 (5.66%)
	Free-standing	2584 (3.63%)
EM Residency Training Site	Yes	4456 (5.79%)
	No	47,954 (5.49%)
Trauma Level	Level 1	3539 (7.56%)
	Level 2	7629 (5.59%)
	Level 3	3589 (5.41%)
	Level 4	2193 (4.94%)
	None	35,460 (5.40%)
Urban-Rural Classification	Rural	6220 (5.94%)
	Suburban	31,344 (5.56%)
	Urban	14,846 (5.25%)
Region	Midwest	8129 (5.40%)
	Northeast	7673 (5.59%)
	South	26,053 (5.01%)
	West	10,555 (7.35%)

ESI = Emergency Severity Index.
ED = Emergency Department.
EM = Emergency Medicine.
* Totals reported across the entire study period because incidence remained consistent throughout the four years studied. Yearly totals are reported in Appendix Table 6.

Table 3
Adjusted odds ratios (OR) in multivariate logistic regression for outcome measure of chest pain patients being diagnosed with ACS, PE, pneumothorax, or any of the seven diagnoses.

Independent variable		Any of 7 diagnoses (OR, 95% CI)		Acute coronary syndrome (OR, 95% CI)		Pulmonary embolism (OR, 95% CI)	
Patient Age Group (Ref. Group: 45–54)	0.29	0.29	(0.10, 0.12)	0.11	(0.10, 0.12)	0.65	(0.59, 0.71)
	0.53	0.53	(0.41, 0.47)	0.44	(0.41, 0.47)	0.86	(0.79, 0.94)
	1.39	1.39	(1.42, 1.54)	1.48	(1.42, 1.54)	1.01	(0.93, 1.10)
	1.87	1.87	(1.91, 2.11)	2.00	(1.91, 2.11)	1.21	(1.10, 1.34)
	2.01	2.01	(2.06, 2.31)	2.18	(2.06, 2.31)	1.14	(1.02, 1.27)
Patient Sex (Ref. Group: Female)	1.80	1.80	(1.84, 1.97)	1.91	(1.84, 1.97)	1.19	(1.13, 1.25)
ESI Level (Ref. Group: 2)	12.01	12.01	(11.13, 16.65)	13.61	(11.13, 16.65)	0.47	(0.34, 0.66)
	0.49	0.49	(0.43, 0.50)	0.46	(0.43, 0.50)	0.72	(0.66, 0.78)
	0.08	0.08	(0.02, 0.06)	0.03	(0.02, 0.06)	0.21	(0.14, 0.31)
Arrived by EMS (Ref. Group: No)	1.41	1.41	(1.35, 1.55)	1.44	(1.35, 1.55)	1.13	(1.05, 1.21)
Primary Payer (Ref. Group: Commercial)	0.78	0.78	(0.70, 0.80)	0.75	(0.70, 0.80)	0.92	(0.85, 1.00)
	0.81	0.81	(0.76, 0.85)	0.80	(0.76, 0.85)	0.94	(0.87, 1.02)
	0.74	0.74	(0.68, 0.80)	0.74	(0.68, 0.80)	0.80	(0.69, 0.94)
	0.84	0.84	(0.80, 1.00)	0.89	(0.80, 1.00)	0.68	(0.58, 0.79)
ED Volume (Ref. Group: 20 K - 50 K Visits)	1.02	1.02	(0.86, 1.22)	1.02	(0.86, 1.22)	1.02	(0.87, 1.19)
	1.03	1.03	(0.83, 1.31)	1.04	(0.83, 1.31)	1.01	(0.86, 1.19)
Free Standing ED (Ref. Group: No)	0.93	0.93	(0.77, 1.15)	0.94	(0.77, 1.15)	0.90	(0.74, 1.10)
EM Residency Training Site (Ref. Group: No)	0.83	0.83	(0.56, 1.22)	0.82	(0.56, 1.22)	0.92	(0.58, 1.44)
Trauma Level (Ref. Group: No Designation)	1.30	1.30	(0.90, 1.81)	1.28	(0.90, 1.81)	1.30	(0.92, 1.85)
	0.74	0.74	(0.53, 0.93)	0.71	(0.53, 0.93)	0.94	(0.72, 1.23)
	0.74	0.74	(0.55, 0.92)	0.71	(0.55, 0.92)	0.90	(0.65, 1.23)
	1.05	1.05	(0.78, 1.60)	1.12	(0.78, 1.60)	0.70	(0.50, 0.98)
Urban-Rural Classification (Ref. Group: Urban)	0.91	0.91	(0.68, 1.27)	0.93	(0.68, 1.27)	0.85	(0.68, 1.06)
	1	1	(0.87, 1.21)	1.02	(0.87, 1.21)	0.90	(0.77, 1.04)
Region (Ref. Group: Midwest)	1.26	1.26	(1.01, 1.62)	1.28	(1.01, 1.62)	1.10	(0.84, 1.44)
	0.91	0.91	(0.74, 1.13)	0.91	(0.74, 1.13)	0.87	(0.71, 1.07)
	1.44	1.44	(1.06, 1.74)	1.36	(1.06, 1.74)	1.79	(1.35, 2.36)
Year (Ref. Group: 2021)	0.97	0.97	(0.94, 1.05)	0.99	(0.94, 1.05)	0.90	(0.83, 0.96)
	1.00	1.00	(0.97, 1.12)	1.04	(0.97, 1.12)	0.86	(0.80, 0.93)
	1.00	1.00	(0.97, 1.11)	1.03	(0.97, 1.11)	0.91	(0.83, 0.99)

ESI = Emergency Severity Index.
EMS = Emergency Medical Services.
ED = Emergency Department.
EM = Emergency Medicine.

Medicare, and other payer groups had significantly lower odds of ACS, PE, and any of the seven life-threatening diagnoses. These insurance findings differ from the unadjusted prevalences because the multivariable models adjust for patient age, acuity, arrival mode, and site characteristics.

Site and temporal factors also contributed to variation in diagnoses. Patients treated in trauma centers had mixed associations, with lower odds of ACS in level 2–3 centers (OR 0.71, 95% CI 0.53–0.93 and OR 0.71, 95% CI 0.55–0.92, respectively) compared to non-designated sites, but no differences in any of the other diagnoses. Regional variation was also evident: Patients in the West had higher odds of both ACS (OR 1.36, 95% CI 1.06–1.74) and PE (OR 1.79, 95% CI 1.35–2.36) relative to the Midwest, while those in the South and Northeast showed no significant differences in PE risk. Urban–rural and suburban classifications were not significantly associated with diagnostic outcomes.

4. Discussion

Here we report the largest detailed study to date assessing the prevalence of life-threatening diagnoses in ED patients presenting with or without chest pain. Atraumatic chest pain accounted for approximately 1 in 14 of ED encounters from 2021 to 2024. Of those visits, 1 in 18 were diagnosed with one or more of the seven potentially life-threatening diagnoses included as study outcomes. Ultimately, approximately 1 in 22 (4.5%) had ACS, 1 in 130 (0.78%) had a PE, 1 in 1000 (0.09%) had TAD, 1 in 750 (0.13%) had a pneumothorax, 1 in 14,000 (<0.01%) had esophageal rupture, 1 in 20,000 (<0.01%) had pericardial tamponade, and 1 in 50,000 (<0.01%) had a ruptured thoracic aortic aneurysm. These estimates can be viewed by emergency physicians as the a priori pretest probability of finding these conditions in undifferentiated U.S. ED patients with chest pain.

Conversely, the great majority – 17 in 18 (almost 95%) – of chest pain cases were not diagnosed with potentially life-threatening diagnoses during their ED visit. This underscores the importance of careful risk stratification to target testing and interventions to those at highest risk. Additionally, it highlights the potential to optimize admissions, imaging, and costs by deploying clinical management tools that align diagnostic intensity with the relatively low overall prevalence of life-threatening disease.

Previous studies have largely reported similar results. Using 2005–2011 data from the NHAMCS, Hsia et al. found that 5.5% of ED chest pain presentations were ultimately diagnosed with a life-threatening diagnosis, nearly identical to our study demonstrating stability in the incidence of these life-threatening diagnoses [13]. They reported 5.1% as ACS and 0.4% as other diagnoses, also similar to our findings. In their 2020 review of patients presenting to three French EDs over a 2-month period, Lefevre-Scelles et al. found 7 patients with PE among 881 with a chief complaint of chest pain (0.79%), similar to our findings [7]. Using data from 1996 to 2010 in 33 U.S. EDs in New York and New Jersey, Alter et al. found 782 aortic dissections among an estimated 763,000 patients with atraumatic chest pain, an incidence of 1 in 978 patients (0.10%) [8]. Interestingly, one systematic review focusing on the prevalence of ACS in chest pain covering the years 1992–2015 reported quite different results, noting wide variation in ED patients across variable American and international settings with a median prevalence of 13% and a study range from 5% to 42% [6]. A review of death certificates over a 17-year period estimated the incidence of ruptured aortic aneurysms to be about 1 in 43,000 (similar to the 1 in 50,000 in our study) [14]. The variability in prevalence rates across studies is likely multifactorial, indicating differences in the healthcare seeking behaviors of patients, access to other sources of care, disease prevalence, and other factors. Such differences reinforce the importance

of maintaining modern prevalence estimates as healthcare patterns and populations shift to calibrate pre-test probability.

Several visit-level and demographic factors were linked to higher or lower prevalence of life-threatening diagnoses. As expected, increasing age was a prominent predictor of increased risk for many of these conditions, even after adjustment, particularly for ACS and TAD. The odds of ACS in males were more than double that of females. This may be a combination of higher ACS disease prevalence in males, females being less likely to have chest pain as the cause of ACS, or females' greater propensity to seek health care evaluation [15-18]. More acute ESI levels were a very strong predictor of a life-threatening diagnosis, a result that has been reported previously [19]. Diagnostic data such as EKG at triage is likely a significant contributor to the stronger association with ACS compared to the other life-threatening diagnoses, as EKG findings could impact the ESI assignment. Similarly, under-triage of patients with more severe illness results in a delay in key diagnostic studies that result in appropriate disposition [20]. In the current study, most patients with a life-threatening diagnosis were triaged to either ESI 1 or 2. PE was the exception, with higher proportions of ESI 3 and 4. Arrival by ambulance was also strongly associated with being diagnosed with a life-threatening diagnosis, which is both intuitive and consistent with prior publications [21,22]. Some facility factors appeared to be predictive in unadjusted analyses, but their significance largely disappeared in the multivariable analysis, suggesting that the setting is less predictive than demographics and clinical factors. One exception was presentation to an ED in the Western U.S. which is more likely to be an indicator of healthcare access to non-ED settings and/or propensity to seek care rather than geographic risk of life-threatening diagnosis [23,24]. The increased risk in Level 1 trauma centers is likely a result of referrals or EMS protocols that preferentially direct more acute patients there.

Patients arriving to the ED by ambulance are more likely to have higher acuity presentations, receive earlier assessments, and be assigned higher acuity ESI levels [21,22,25]. In the current study, approximately one in ten patients with chest pain arrived by ambulance. These patients received higher acuity ESI designations, and were more likely to have a life-threatening diagnosis.

Importantly, our study found a greater number of the designated life-threatening diagnoses in patients who presented with complaints other than chest pain than in those who presented *with* chest pain. This is a powerful reminder that these diagnoses, which clinicians typically associate mostly with chest pain, can, and frequently do, present without chest pain. The absence of a complaint of chest pain does not exclude these life-threatening diagnoses, and clinicians must maintain a high index of suspicion evaluating patients for these conditions.

5. Limitations

There are several limitations to this study. First, results from our study EDs may not generalize to other EDs, including critical access hospitals and other limited resource settings, which were not represented in the data. However, given the large number of sites, heterogeneity of regions, ED type and size, these results are likely generalizable to other EDs in the US. Second, our team decided on seven life-threatening diagnoses that can present with chest pain. Other life-threatening conditions like sepsis, myocarditis, and others can present with chest pain. Therefore, our reported prevalences may be an underestimate of the life-threatening potential of chest pain. Third, we used free text complaint data to identify atraumatic chest pain encounters. This process was limited to the available data. This may have resulted in some misclassification of visits related to spelling errors and additional phrases or complaints used by patients and healthcare personnel that were not captured in our chest pain definition. Notably, our prevalence of chest pain visits (6.9%) was slightly higher than other datasets. For example, 2022 National Hospital Ambulatory Medical Care Survey (NHAMCS) estimates of chest pain as the principal reason for ED visits reported the proportion as 5.4%. Fourth, we used the ED ICD-10 diagnosis to define life-threatening diagnoses. We could not follow patients to assess whether, for example, a patient who was admitted with a diagnosis of non-specific chest pain was given one of the life-threatening diagnoses in the hospital or after discharge. This would lead to an underestimate of the prevalence of life-threatening diagnosis. Fifth, we included pneumothorax as a potentially life-threatening diagnosis. While some diagnoses (i.e. pneumothoraces and pulmonary emboli) may exist on a spectrum of severity, the retrospective nature of these analyses did not provide sufficient data to determine severity of these atraumatic presentations. However, the authors chose to include these diagnoses are they must be considered in the clinical setting and may present as immediately life-threatening.

6. Conclusions

In conclusion, we found that the prevalence of pre-defined life-threatening diagnoses was 5.5%, with the largest majority being ACS, and a large proportion of the remaining cases being PE. Patients who were older, male, arrived by ambulance, had commercial insurance, and who were assigned higher acuity ESI designations at triage, particularly those designated as ESI 1, had a higher likelihood of a life-threatening diagnosis.

CRediT authorship contribution statement

Daniel R. Rice: Writing – original draft, Supervision, Project administration, Methodology, Investigation, Formal analysis, Conceptualization. **Michael J. Pallaci:** Writing – review & editing, Supervision, Project administration, Methodology, Investigation, Conceptualization. **Michael B. Weinstock:** Writing – review & editing, Methodology, Conceptualization. **Samuel S. Cray:** Writing – review & editing, Conceptualization. **Krista M. Foster:** Visualization, Software, Methodology, Investigation, Formal analysis, Data curation. **Jonathan J. Oskvarek:** Writing – review & editing, Project administration, Investigation, Conceptualization. **John J. Bedolla:** Validation, Project administration, Methodology, Conceptualization. **Amer Z. Aldeen:** Writing – review & editing, Validation, Resources. **Jesse M. Pines:** Writing – review & editing, Supervision, Resources, Project administration, Methodology, Investigation, Data curation, Conceptualization.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ajem.2026.05.006.

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