ORIGINAL RESEARCH

9-1-1 Caller-Described Heart Attack Symptoms

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Abbreviations:
CD: chest discomfort
CE: case entry
CP: chest pain
EMD: Emergency Medical Dispatcher
HA: heart attack
IAED: International Academies of Emergency Dispatch
MPDS: Medical Priority Dispatch System
QPR: Quality Performance Review
SSx: specific symptoms
VPN: Virtual Private Network

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Abstract

Introduction: Heart attacks (HAs) present clinically with varying symptoms, which are not always described by patients as chest pain (CP) or chest discomfort (CD). Emergency Medical Dispatchers (EMDs) select the CP/CD dispatch protocol for non-chest pain HA symptoms or classic HA complaint of CP/CD. Nevertheless, it is still unknown how often callers report HA symptoms other than CP/CD.

Objectives: The objective of this study was to characterize the caller's descriptions of the primary HA symptoms, descriptions of the other HA symptoms, and the use of a case entry (CE) question clarifier.

Methods: A retrospective descriptive study analyzed randomly selected EMD audios (where CD/CD protocol was used) from five accredited emergency communication centers in the United States. Several Quality Performance Review (QPR) experts reviewed the audios and recorded callers' initial problem descriptions, the use of and responses to the CE question clarifier, including the EMD-assigned final determinant code.

Results: A total of 1,261 audios were reviewed. The clarifier was used only 8.5% of the time. The CP/CD symptoms were mentioned alone or with other problems 87.0% of the time. Overall, CP symptom was mentioned alone 70.8%, HA alone 4.0%, and CD symptom alone 1.4% of the time.

Conclusion: 9-1-1 callers report potential HA cases using a variety of terms and descriptions—most commonly CP. Other less-common symptoms associated with a HA may be mentioned. Therefore, EMDs must be well-trained to be prepared to probe the caller with a clarifying query to elicit more specific information when "having a heart attack" is the only complaint initially mentioned.

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Introduction

Not all heart attacks (HAs) present clinically with the classic symptoms of chest pain (CP) or chest discomfort (CD). Numerous studies have reported non-CP symptoms to be common for myocardial infarctions (ie, HAs).[1–5] Delays in getting hospital treatment for HAs are also common[1,5–7] and tend to occur more often in patients experiencing their first HA episode and/or present with unexpected HA symptoms.[1]

Emergency Medical Dispatchers (EMDs) using the Medical Priority Dispatch System (MPDS) are all taught in their certification training course to select Protocol 10 (Chest Pain/Chest Discomfort) as the Chief Complaint Protocol for non-CP HA symptoms—in addition to using Protocol 10 for the classic HA complaint of CP/CD. Specifically, the EMD instructions in the Additional Information section of Protocol 10 read:

> EMDs may initially receive non-specific complaints in heart attack cases. Due to patient denial or caller confusion, the following symptoms may not be recognized as a heart attack: aching pain, chest pain/discomfort (now gone), constricting band, crushing discomfort, heaviness, numbness, pressure, and tightness. While these symptoms are most common in the chest, they may also (or only) be present in the arm(s), jaw, neck, or upper back. These symptoms should be handled on Protocol 10.

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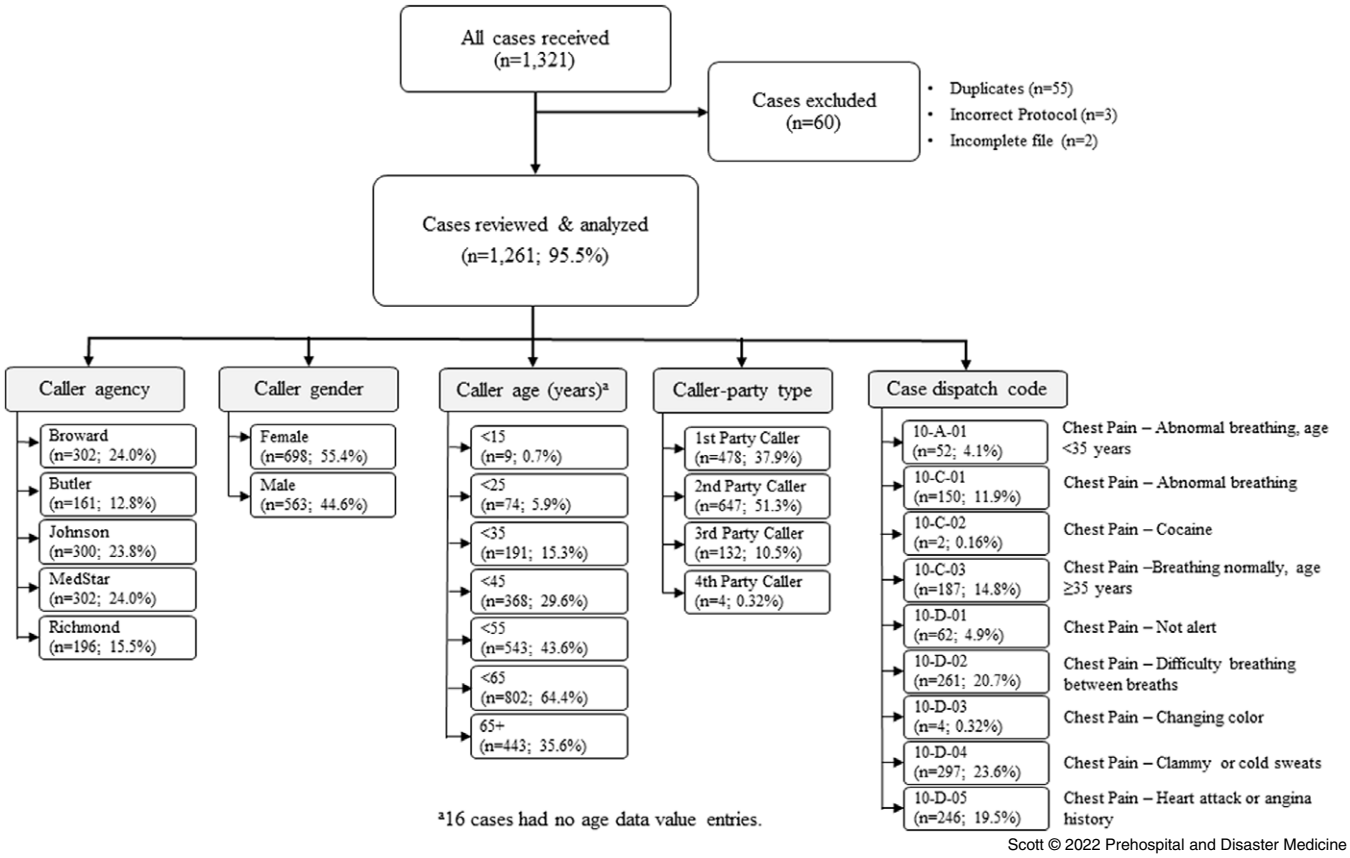

Figure 1. Case Characteristics.

Despite the above detailed and long-standing EMD instructions, it is still unknown how often callers report HA symptoms other than CP/CD, including what specific words and phrases callers use to describe these potential HAs. This study examined the use of MPDS Protocol 10 by EMDs and sought to identify specific caller descriptions of HA symptoms other than CP/CD.

Objectives

The objective of the study was to characterize the caller descriptions of (classic and non-classic CP) HA symptoms, the distributions of the identified descriptions of the HA symptoms, and the distribution of the use of case entry (CE) question clarifier.

Methods

Design and Setting

The retrospective, non-randomized descriptive study was conducted from January through October 2021 at five emergency communication centers in the United States of America: (1) Medstar Mobile Healthcare, Fort Worth, Texas USA; (2) Johnson County Emergency Communications, Olathe, Kansas USA; (3) Richmond Ambulance Authority, Richmond, Virginia USA; (4) Broward County Sheriff's Office, Regional Communications, Fort Lauderdale, Florida USA; and (5) Butler County Emergency Communications, El Dorado, Kansas USA. All are accredited by the International Academies of Emergency Dispatch (IAED; Salt Lake City, Utah USA) as Accredited Centers of Excellence (ACE) and have demonstrated high compliance to dispatch protocols.

Population

Since this was a descriptive study, sample size determination was not possible. Therefore, it was estimated that each of the five agencies would collect 300 audio files—totaling 1,500 cases—depending on the available resources. However, due to manpower constraints, some agencies did not meet their target of 300 cases.

Study Case Review Process

Cases were accessed using two options: (1) Virtual Private Network (VPN)—for agencies that had Quality Review Program (QPR) in place; and (2) manual case extraction and upload—for review by QPR experts.

VPN Process—This process involved using a structured quality assurance software (AQUA; Priority Dispatch Corp, Inc.; Salt Lake City, Utah USA) for case randomization and review. The QPR provides dispatch agencies with external, unbiased call review and immediate support for implementing the AQUA program. It included case review, quality assurance, and weekly mentoring feedback that is backed and supported by the IAED. In this study, the QPR professional established a VPN connection with the agency's server, auto-randomly extracted cases that had been handled in Protocol 10 (Chest Pain/Chest Discomfort) in the ProQA software database, and uploaded into AQUA for review.

Manual Process—In this process, each agency randomly selected cases from a pool of cases that were triaged using the Chief Complaint 10 (Chest Pain/Chest Discomfort) protocol where the EMD was compliant to the protocol. The agencies performed

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Symptom Category	Patient's Gender and Age: n (%)							
	<35 Years		≥35 Years		<45 Years		≥45 Years	
	Female (N = 123)	Male (N = 68)	Female (N = 575)	Male (N = 495)	Female (N = 216)	Male (N = 152)	Female (N = 482)	Male (N = 411)
Classic								
Chest Pain (CP)								
CP Alone	**92 (74.8)**	**40 (58.8)[a]**	401 (69.7)	360 (72.7)	**163 (75.5)**	**93 (61.2)[a]**	**330 (68.5)**	**307 (74.7)[a]**
CP & HA	1 (0.8)	1 (1.5)	13 (2.3)	14 (2.8)	3 (1.4)	4 (2.6)	11 (2.3)	11 (2.7)
CP & SSx	17 (13.8)	10 (14.7)	**84 (14.6)**	**39 (7.9)[a]**	29 (13.4)	21 (13.8)	**72 (14.9)**	**28 (6.8)[a]**
CP & HA & SSx	0	0	4 (0.7)	1 (0.2)	0	0	4 (0.8)	1 (0.2)
Chest Discomfort (CD)								
CD Alone	2 (1.6)	4 (5.9)	5 (0.9)	6 (1.2)	3 (1.4)	4 (2.6)	4 (0.8)	6 (1.5)
CD & HA	0	0	0	0	0	0	0	0
CD & SSx	1 (0.8)	1 (1.5)	8 (1.4)	3 (0.6)	2 (0.9)	2 (1.3)	7 (1.5)	2 (0.5)
CD & HA & SSx	0	1 (1.5)	0	0	0	1 (0.7)	0	0
Non-Classic[b]								
Heart Attacks								
HA Alone	3 (2.4)	4 (5.9)	**14 (2.4)**	**29 (5.9)[a]**	5 (2.3)	9 (5.9)	**12 (2.5)**	**24 (5.8)[a]**
HA & SSx	1 (0.8)	2 (2.9)	7 (1.2)	5 (1.0)	2 (0.9)	3 (2.0)	6 (1.2)	4 (1.0)
SSx Alone	7 (5.7)	6 (8.8)	45 (7.8)	41 (8.3)	**10 (4.6)**	**16 (10.5)[a]**	42 (8.7)	31 (7.5)

Table 1. Primary Problem – Distributions of Cases by Patient's Symptom, Gender, and Age
Abbreviations: CP, chest pain; HA, heart attack; SSx, specific symptoms (such as tightness, pressure, numbness, heaviness, aching, sharp/stabbing, constricting, and crushing); CD, chest discomfort.

[a] Significant difference between patient gender.

[b] Chest pain/chest discomfort not mentioned.

the case selection process at varying frequencies (ie, daily, weekly, or monthly basis) then uploaded the cases online via a secure website for review.

The audio files for the selected cases were reviewed by the QPR professionals to identify patient information (gender, age, caller party) as well as to capture the complaint description, in the caller's own words, to determine the initial chief complaint as well as any associated signs/symptoms. This information was then logged in a spreadsheet template for data analysis.

Outcome Measures

The endpoints of the study were: (1) caller descriptions of (classic and non-classic CP) HA symptoms; (2) distributions of the identified descriptions of the HA symptoms; and (3) distribution of the use of CE question clarifier.

Data Analysis

STATA for Windows software (STATA Statistical Software, BE—Basic Edition, Release 17.0; StataCorp LLC; College Station, Texas USA) was used for data analysis. The records in the dataset were evaluated manually for accuracy and completeness—duplicates, incorrect case (ie, not a CP/CD call), and incomplete audio file were excluded.

The primary symptoms were then classified into classic and non-classic CP/CD categories. The *Classic CP Symptoms* category included four groups: CP alone (mentioned without additional problems); CP and HA (mentioned together); CP and specific symptoms [SSx] (mentioned together); and CP, HA, and SSx (mentioned together). The *Classic CD Symptoms* category included four groups: CD alone; CD and HA; CD and SSx; and CD, HA, and SSx. The *Non-Classic Symptoms* category included three groups: HA alone; HA and SSx; and SSx alone.

The differences in the outcome measures were then assessed by patient gender and age, caller party-type, and the use of a CE key question clarifier. The significance of the inter-group differences was assessed at the two-sided Chi-Square Test 0.05 significance level cut-off. Detailed documentation of other HA symptoms, key question clarifiers, and caller-provided answers to the clarifiers were also presented.

Ethics Approval

The study was approved by the International Academies of Emergency Dispatch Institutional Review Board (IRB# IRB00006450).

Results

A total of 1,261 audio cases for Protocol 10 were reviewed (Figure 1). Of these cases, 90.2% were either second party (51.3%) or first party (38.9%); 55.4% were female callers; overall, 15.3% were under 35 years of age (median: 57 years); and 69.0% were DELTA calls/cases (highest: 10-D-4 [24.0%] and 10-D-02 [21.0%]).

Overall, 87% of the time, CP or CD symptoms were mentioned alone or accompanied with other problems. However, CP symptom was mentioned alone 70.8%, HA alone 4.0%, and CD

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Symptom Category	Caller-Party Type: n (%)				
	1st Party (n = 478)	2nd Party (n = 647)	3rd Party (n = 132)	4th Party (n = 4)	P Value
Classic					
Chest Pain (CP)					
CP Alone	332 (69.5)	458 (70.8)	102 (77.3)	1 (25.0)	.067
CP & HA	11 (2.3)	16 (2.5)	2 (1.5)	–	.910
CP & SSx	61 (12.8)	77 (11.9)	11 (8.3)	1 (25.0)	.458
CP & HA & SSx	2 (0.42)	3 (0.46)	–	–	.892
Chest Discomfort (CD)					
CD Alone	8 (1.7)	9 (1.4)	–	–	.523
CD & HA	–	–	–	–	–
CD & SSx	7 (1.5)	6 (0.93)	–	–	.500
CD & HA & SSx	1 (0.21)	–	–	–	.650
Non-Classic[a]					
Heart Attacks					
HA Alone	13 (2.7)	32 (5.0)	4 (3.0)	1 (25.0)	**.036**
HA & SSx	7 (1.5)	6 (0.93)	2 (1.5)	–	.837
SSx Alone	41 (8.6)	46 (7.1)	11 (8.3)	1 (25.0)	.474

Table 2. Primary problem – distributions of cases by patient's symptom and caller-party type.
Abbreviations: CP, chest pain; HA, heart attack; SSx, specific symptoms (such as tightness, pressure, numbness, heaviness, aching, sharp/stabbing, constricting, and crushing); CD, chest discomfort.
[a] Chest pain/Chest discomfort not mentioned.

symptom alone 1.4% of the time. Otherwise, other SSx were mentioned alone only (without CP, CD, or HA) 7.9% of the time. Generally, the distributions of symptoms did not statistically differ significantly by patient gender at the two-sided Fisher's Exact test's 0.05 cut-off level of significance. Nevertheless, CP was significantly mentioned alone for the female more than male patients younger than 35 years (74.8% and 58.8%; P = .022, respectively) and younger than 45 years (75.5% and 61.2%; P = .003, respectively; Table 1). However, it was mentioned alone for only male more than female patients aged 45 years or older (74.7% and 68.5%; P = .040, respectively).

Chest pain was mentioned in addition with other SSx for female more than male patients overall (14.5% and 8.7%; P = .002, respectively), for female patients aged 35 years or older (14.6% and 7.9%; P = .001, respectively), or female patients aged 45 years or older (14.9% and 6.8%; P <.001, respectively).

Chest discomfort was mentioned alone more only for those younger than 35 years of age than those aged 35 years or older (3.1% and 1.0%; P = .020, respectively).

Heart attack was mostly mentioned alone for male more than female patients overall (5.9% and 2.4%; P = .002, respectively), and among those aged 35 years or older (5.9% and 2.4%; P = .004, respectively) or among those aged 45 years or older (5.8% and 2.5%; P = .011, respectively).

Finally, SSx were mostly mentioned alone only among male than female patients younger than 45 years (10.5% and 4.6%; P = .030, respectively).

The distributions of HA symptoms alone (mentioned alone without any other accompanying problems) was the only category that significantly differed, statistically, by caller party type (P = .036; Table 2). Generally, the second party callers (5.0%) mention the HA symptoms alone more often than the other callers, followed by third party callers (3.0%) and first party callers (2.7%).

Apart from the classic and non-classic CP symptoms, callers reported that patients presented numerous other trunk, head, neck, and extremity-related symptoms, including respiratory, vision, and motion/coordination problems (Table 3).

Overall, the clarifier for the CE chief complaint query ("Tell Me Exactly What Happened") was used only 8.5% of the time (Table 4). Specifically, the distribution of the use and non-use of the clarifier significantly differed among the patients where the following problems/symptoms were mentioned: CP alone (57.0% versus 72.1%, respectively; P = .001); CP and HA (7.5% versus 1.8%, respectively; P <.001); CP, HA, and other SSx (1.9% versus 0.3%, respectively; P = .011); CD alone (3.7% versus 1.1%, respectively; P = .025); CP, HA, and other SSx (0.9% versus 0.0%, respectively; P = .001); and HA and other SSx (5.6% versus 0.8%, respectively; P <.001).

For the cases where EMDs used a CE question clarifier, callers were able to provide more detailed and accurate descriptions of the problem that enabled the EMDs to effectively code the case as Chief Compliant Chest Pain/Chest Discomfort (Table 5).

Discussion

The findings in this study demonstrate that 9-1-1 callers report suspected or potential HA cases using a variety of terms and descriptions, most commonly CP, with symptoms such as numbness, pressure, tightness, heaviness, aching, constricting, crushing, as well as arm, shoulder, back, and neck pain also mentioned at times. Since poor knowledge of HA signs and symptoms by the public has been associated with delays in care and worsened patient outcomes,[7–12] it is important that EMDs are well-educated on both commonly used terms—and less commonly used terms—associated with a HA and to select Protocol 10 (Chest Pain/Chest Discomfort) promptly for such cases. Effective EMD triage of

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Symptom Category	Symptom Description
Trunk Symptoms	• Shoulder/arm pain • Upper back pain (between shoulder blades) • Shoulder/arm pain & upper back pain • Shoulder/arm pain & others • Palpations in chest • Burning chest pain, sweating • Chest is burning • Pain where pacemaker is • Heart feels funny • Heart problems • Pain in upper left chest area • Heart pumping too fast • Racing heart • Holding chest • Stomach pain & feel like passing out • Heart pounding
Head & *Neck* Symptoms	• Neck/throat pain • Neck/throat pain & shoulder/arm pain • Jaw pain • Neck/throat pain & upper back pain • Neck/throat pain & others • Light-headed, numb lips & fingers, heart palpitations • Lightheaded
Extremity Symptoms	• Side pain • Arm numbness • Right arm is tight • Numbness in extremities & lips • Pain in leg, legs lock up & toes curl • Numbness in hands • Numbness in legs & arms • Pain in legs, feels dizzy • Tingling • Left arm feels weak
Others	• Can't breathe • High blood pressure • Cold and clammy • Blurred vision, nausea • Acid reflux • Cold sweats • Falling down a few times • Numbness in face • Feeling odd, sweating, dizzy • Shortness of breath, feel like passing out, jaw numbness

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Table 3. Other Heart Attack and Additional Symptoms

these cases enables the dispatch of the proper emergency medical responder personnel as well as the delivery of needed dispatch life support instructions, even before arrival of trained responders, such as precise instructions on taking aspirin that could be on-hand at the patient's location.[13]

Symptom Category	Question-Clarifier Usage: n (%)		
	Not Used (n = 1,154; 91.5%)	**Used (n = 107; 8.5%)**	**P Value**
Classic			
Chest Pain (CP)			
CP Alone	832 (72.1)	61 (57.0)	**.001**
CP & HA	21 (1.8)	8 (7.5)	**<.001**
CP & SSx	135 (11.7)	15 (14.0)	.478
CP & HA & SSx	3 (0.26)	2 (1.9)	**.011**
Chest Discomfort (CD)			
CD Alone	13 (1.1)	4 (3.7)	**.025**
CD & HA	–	–	–
CD & SSx	11 (0.95)	2 (1.9)	.370
CD & HA & SSx	–	1 (0.93)	**.001**
Non-Classic[a]			
Heart Attacks			
HA Alone	46 (4.0)	4 (3.7)	.900
HA & SSx	9 (0.78)	6 (5.6)	**<.001**
SSx Alone	92 (8.0)	7 (6.5)	.599

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Table 4. Primary Problem – Distributions of Cases by Patient's Symptom and Question Clarifier

Abbreviations: CP, chest pain; HA, heart attack; SSx, specific symptoms (such as tightness, pressure, numbness, heaviness, aching, sharp/stabbing, constricting, and crushing); CD, chest discomfort.

[a] Chest pain/Chest discomfort not mentioned.

While this study did not report hospital-confirmed discharge diagnosis of the cases studied, a previous study indicated that EMDs following MPDS Protocol 10 (Chest Pain/Chest Discomfort) with high protocol compliance can accurately identify and triage hospital-confirmed cardiac-related problems—including hospital-diagnosed HAs—using the Chest Pain/Chest Discomfort Protocol with a high degree of sensitivity and a moderate degree of specificity.[14]

The term "having a heart attack" is often used by both the patient herself/himself and the second party caller (ie, someone with the patient at the time of calling the 9-1-1 service) as the sole complaint description, or in combination with other SSx. When given only the description "having a heart attack" by a caller, it has been a long-standing practice for EMDs to query the caller for more clarifying information, most importantly for specific physical symptoms that the patient is experiencing. The results of this study reinforce the importance of that practice—although the clarifier was seldom used (only approximately nine percent of the time)—indicating that callers provided quite substantial and accurate descriptions of the problems. In fact, a recent study demonstrated the risk of lower priority triage for hospital-confirmed HA patients when EMDs do not recognize non-CP HA symptoms, although this occurs at a relatively low frequency (0.5%) within the MPDS.[15]

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Case Entry Question Description and Clarifier Answer
Clarifier Description
• Why do you think you are having a heart attack? • Where do you feel/are having (lots of) pain? • To confirm/clarify, you said you're having chest pain? • Tell me exactly what happened or what's wrong or what medical problem you're having? • Did something hit him, or does it just feel something hit him? • Is he complaining because his arm is injured or he's having chest pain? • Confirm that she is not choking on something in her throat. • Explain what you mean by he's having problems with chest and back. • What symptoms are you having? • Just confirming you having chest discomfort, is that correct? • He/she is having blood pressure issues? And what else? • What symptoms is he having? What does he mean when he says his heart is coming out of his chest? • So, the main thing that's wrong with you is chest pain, or your speech, which one? • Is she complaining of any injury from the fall? • You said she drank what now, and you said where is her pain now?
Caller-Provided Clarifier Answer
• I have history with heart trouble, and I'm having shortness of breath and a little tightness in chest, and feel like I'm passing out. • I have real bad chest pain, I had open-heart surgery last year, I know what it feels like to have a heart attack. • I am feeling numbness on my right side, tingling. • Chest pain, he has CHF and COPD. • Chest pain, leg pain, arm pain, tingling, headache right in my eye. • Excruciating pain on side, waist, breastbone or under her right breast, stomach/lower abdomen, shoulders, foot, lower/upper back, rib cage, lower chest or chest, upper abdomen and right below ribs, right side of chest, right arm up into throat, sharp pains at the heart level. • Feels like my arm is falling asleep and I feel like I'm going to fall out. • Hard breathing or grasping in his chest, chest pounding or feels heavy, dizzy, chest feels like it's hot. • He collapsed and he's been holding onto the left side of his chest. • He feels like he is having a heart attack or stroke. Left eye is twitching. • He's got swollen lymph nodes in his stomach. And his stomach is swollen and enlarged liver. Feeling like someone squeezing his chest. • He's really dizzy, light-headed, he's nauseous. • I have heart problems. • I'm sweating profusely. • I'm a heart patient and I'm having some indigestion. I've had heart attacks before, and my chest is indicating that that's the problem. • I'm having a panic attack. I just feel like my chest hurts and I feel sick. • I'm shaky, my chest hurts, really bad. • Lots of pain. My kidneys are not functioning. I'm having chest pain. • My throat feels full. • My legs/feet are swelling. I'm profusely sweating and aching all over. • Nine stents and he has a lot of chest pain right now and he feels he needs the ambulance. • She has tightness in the chest. Lethargic. • She's grabbing at her chest. • She's vomiting, headache, and chest pain.

Table 5. Descriptions of Case Entry Question Clarifiers and Answers

The other non-classic CP/CD symptoms that were reported here are mostly consistent with other studies that have examined patient descriptions of HA symptoms.[1–4,8,9]

Future studies that evaluate the predictive value of specific 9-1-1 caller-described terms and symptoms mentioned in this study to determine cases of hospital-confirmed HAs could be useful for medical dispatch protocol evolution and improved prioritization of potential HA cases reported to 9-1-1.

Limitations

There are some limitations to this study. The study did not attempt to collect hospital discharge diagnosis outcome data of the patients reported to 9-1-1 with HA symptoms; therefore, the authors were unable to draw any associations between specific symptoms reported and actual formally diagnosed HA. Such analysis is recommended for future studies to explore. Additionally, while five separate, accredited dispatch agencies (from four states in the USA) contributed to this study, that contribution represents only a small fraction of EMD agencies that use the MPDS in North America and world-wide, hence, generalizability of the results is not entirely known.

Conclusion

9-1-1 callers report potential HA cases using a variety of terms and descriptions—most commonly CP—however, other less-common symptoms associated with HA may be mentioned in combination or individually. Other symptoms may include numbness, pressure, tightness, heaviness, constricting, crushing, as well as arm, back, shoulder, jaw, and neck pain. The EMDs must be well-educated on caller descriptions associated with HA symptoms and be prepared to probe the caller with a clarifying query to elicit more specific information when "having a heart attack" is the only complaint initially mentioned. Proper prioritization by EMDs may potentially reduce treatment time and improve care, including pre-arrival aspirin administration, for a subset of patients with HAs who do not present with the classic symptoms of CP or CD.

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