# Characteristics of Acute Myocardial Infarction Cases Coded as Low-Acuity at Dispatch

*Chris Olola, PhD; Meghan Broadbent, BS; Isabel Gardett, PhD; Greg Scott, MBA, EMD-QI; Jeff Clawson, MD*

1. International Academies of Emergency Dispatch, Salt Lake City, Utah, USA.

**Corresponding Author**
Chris Olola, PhD
International Academies of Emergency Dispatch
110 S. Regent Street, Suite 800
Salt Lake City, Utah 84111, USA
Phone: +1-801-363-9127
Fax: 801-359-0996
Email: chris.olola@emergencydispatch.org

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## ABSTRACT

**Objective:** The objectives of this study were to compare hospital-confirmed acute myocardial infarction (AMI) outcomes with emergency medical dispatch (EMD) low-acuity cases and to identify any common characteristics of the AMIs assigned to those low-acuity codes.

**Methods:** This was a retrospective study utilizing EMD, emergency medical services (EMS), and hospital discharge datasets, collected at two emergency communication centers in Salt Lake County, Utah. The study sample included all hospital-confirmed medical cases that arrived to the hospital via EMS. Primary outcome measures were the numbers of AMIs categorized by patient age and gender, Chief Complaint Protocol, and dispatch determinant code; secondary measures were comparisons between EMD- and EMS-recorded symptoms.

**Results:** A total of 8,007 ALPHA priority-level cases with corresponding hospital records were identified. Of these, 40 (0.50%) were identified as AMIs. Overall, the AMI cases fell into five Chief Complaint Protocols (*Sick Person, Falls, Unconscious/Fainting, Abdominal Pain/Problems, and Hemorrhage/Lacerations*). Older age and discharge to medical facility (rather than to home or self-care) were identified with AMI cases. The most commonly reported symptom was a fall.

**Conclusions:** Overall, the number of AMI cases assigned to the ALPHA priority level is very low and is confined to very few Chief Complaint Protocols. No specific sets of characteristics appear to differentiate these calls from other ALPHA-level calls, or to identify them as AMIs, with the possible exception of older median age. In general, the ALPHA-coded AMIs in this study showed characteristics consistent with missed or silent AMIs widely described in other healthcare settings.

## INTRODUCTION

Cardiovascular disease remains the most common cause of death worldwide, with ischemic heart disease (IHD) causing nearly nine million deaths per year, according to the World Health Organization.[1] Overall, coronary heart disease (CHD) is estimated to cause about one-third of all deaths in people over 35 years old, and the incidence of CHD is expected to continue to rise, especially in developing countries.[2] Acute myocardial infarctions (AMIs)—heart attacks—represent a significant portion of this overall CHD mortality, with approximately 620,000 Americans suffering a first heart attack, and 295,000 suffering a repeat event, each year.[3] Early recognition of an AMI can increase the patient's likelihood of survival,[4] especially when early recognition leads to early monitoring, treatment, and transport in the prehospital setting.[5,6]

However, identification of AMI can be complicated by the wide variety of symptomologies or presentations. While the most common symptom of AMI is chest pain, so-called "atypical" presentations are in fact quite common and extremely variable, representing as much as one-third of all AMI cases.[7,8] Symptoms may vary depending on patient age or gender,[7,9] the site of the infarction within the heart muscle,[10] comorbidities,[9] and many other factors. Because they often aren't recognized as early, such atypical presentations tend to have poorer outcomes.[8,11]

Emergency Medical Dispatchers (EMDs) are often the first point of contact with the medical care system for patients experiencing AMI, and as such, their ability to identify AMI correctly in order to send the most appropriate response is particularly important. Despite the fact that EMDs work in a nonvisual environment and rely on the caller's report of the scene to determine the patient's problem, a recently-published study by this research group demonstrated that EMDs correctly triaged approximately 90% of all hospital-confirmed AMIs into the higher priority levels (those that require an Advanced Life Support, or ALS, response).

Within that overall strong identification rate, though, was a small percentage of AMIs triaged as ALPHA-level calls. The ALPHA priority level (Fig. 1) is intended to handle relatively low-acuity calls, with a recommended response of Basic Life Support (BLS) units, running without lights-and-siren. Better understanding the specific characteristics of those AMIs that the EMDs triaged into the ALPHA level can increase our understanding about which specific presentations of AMI are most often under-triaged. This information may in turn drive future development of the Medical Priority Dispatch System™ (MPDS®), the scripted dispatch protocol system used by the EMDs to handle the cases, so that fewer of these serious incidents will be missed in the future.

## OBJECTIVE

This study had two primary objectives. The first was to compare hospital-confirmed AMIs outcomes with emergency medical dispatch low-acuity cases (coded as ALPHA-level) and determine associated ALPHA-level codes assigned at dispatch. The second objective was to identify common characteristics of the AMIs assigned to those ALPHA-level codes.

## METHODS

### Design and Setting

The retrospective descriptive study utilized emergency medical dispatch, EMS, and hospital datasets, collected at two emergency communication centers in North America (Salt Lake Valley Emergency Communications Center and Salt Lake City Fire Department), from January 1, 2013 to December 31, 2014, using MPDS (version 12.2 ©1979-2012, ProQA version 5.1, Priority Dispatch Corp., Salt Lake City, UT, USA). Both agencies are accredited users of the Medical Priority Dispatch System (MPDS), meaning that they maintain very high compliance to the protocol; both regularly achieve compliance rates in the high 90th percentile.

### Studied System

The MPDS uses six priority levels to define the relative urgency and response needs of the patient. Each priority level is associated with a baseline response mode: COLD or HOT (Fig. 1). The COLD response mode includes the OMEGA, ALPHA, and CHARLIE-level calls, while the HOT response mode includes the BRAVO, DELTA, and ECHO-level calls. In general, EMS response may include ambulance (or other vehicles) with either Advanced Life Support (ALS) or Basic Life Support (BLS) personnel. ALS is the typical response type for CHARLIE, DELTA, and ECHO levels, while a BLS-only COLD response is recommended for ALPHA-level cases. Also, within each priority level, the EMD assigns a specific determinant and its associated descriptor: a succinct description of the presenting problem. These determinant descriptors provide responders with more specific and useful information about the situation, help EMDs assign specific complaints or symptoms to the correct priority levels, and also allow more insight into the range of conditions handled on each protocol.

### Study Population

The study sample included all the hospital-confirmed medical cases, classified using ICD-9-CM codes, that had corresponding dispatch data coded as ALPHA-level calls, under all the medical Chief Complaint Protocols. Cases were obtained by linking EMD and EMS/Hospital datasets.

### Outcome Measures

The primary outcome measures were (1) the number of AMIs categorized by patient age and gender and by Chief Complaint Protocol, and (2) comparison of EMD-described patient problems and EMS findings on scene. Secondary outcomes included distribution of patient symptoms, EMD-described patient problems, and disease characteristics—specifically whether the infarction was found to be an ST-elevation myocardial infarction (STEMI) or a non-ST-elevation myocardial infarction (non-STEMI).

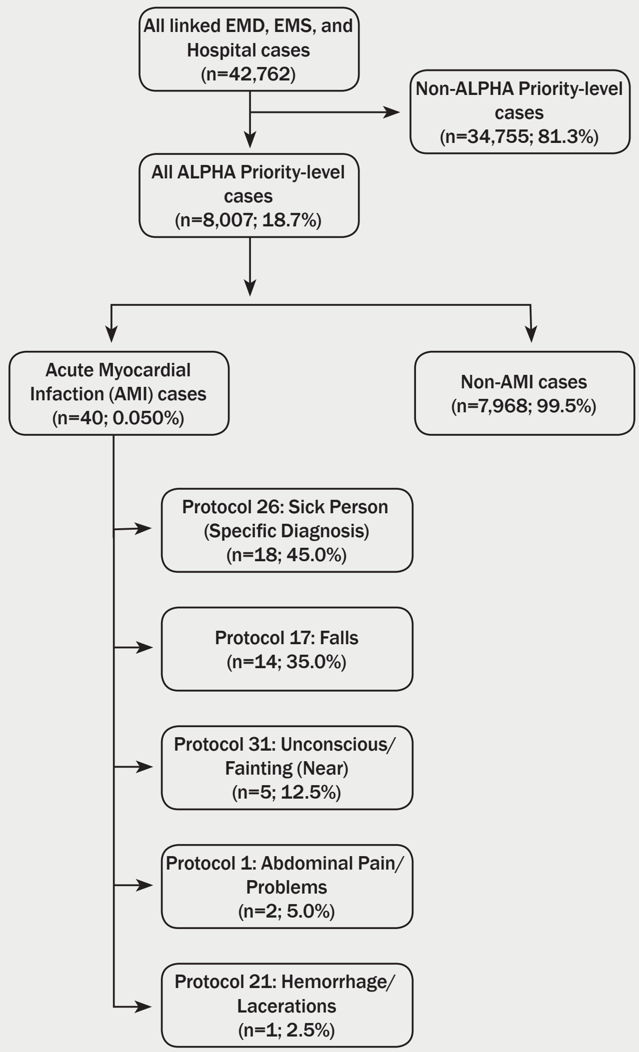
### Data Analysis

STATA for Windows software (STATA Statistical Software: release 14.1, ©1985-2015 StataCorp, College Station, TX) was used for data analysis, using already de-identified hospital-confirmed outcomes and corresponding medical dispatch data coded as ALPHA-level calls. The presentations of symptoms were identified using both EMD and EMS records, including when a specific symptom was part of the determinant code/descriptor, noted in the EMD's recorded account of the complaint and patient's condition, or recorded in the EMS responder narrative. A patient was determined to have shown that symptom if it was recorded in any of these locations. The indicator of 'flu-like' symptoms was considered if any of the following symptoms were present: abdominal pain, nausea, vomiting, dizziness, diaphoresis, sick, weakness, dehydrated, chills, change in color, other pain (aches), flushed/feverish, shaking, and/or headache. Descriptive statistics were used to characterize the distributions of all ALPHA-level cases and of ALPHA-level AMIs, hospital discharge destinations, and Chief Complaints. For all cases for which an electrocardiogram (ECG) was performed by paramedics on scene, ECG recorded output/finding was correlated with EMD-recorded symptoms.

## RESULTS

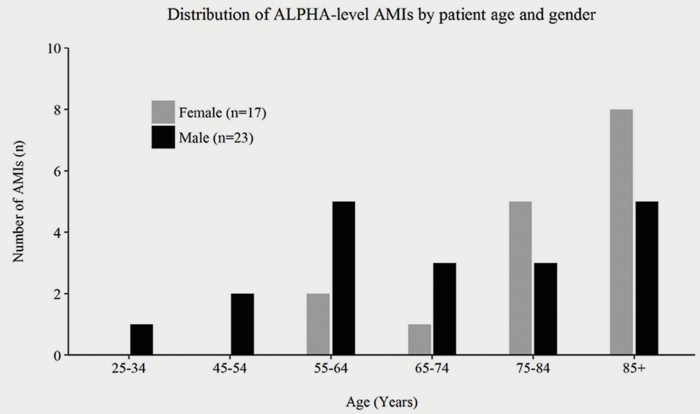
A total of 8,007 ALPHA priority-level cases with corresponding hospital records were identified. Of these, 40 (0.50%) were identified as having an Acute Myocardial Infarction (AMI). ALPHA-level cases in general were broadly distributed across 22 Chief Complaint Protocols. However, those with an AMI were distributed across only 5 Chief Complaint Protocols: Sick Person (45.0%), *Falls* (35.0%), *Unconscious/Fainting* (12.5%), *Abdominal Pain/Problems* (5.0%), and *Hemorrhage/Lacerations* (2.5%) (Fig. 1).

ALPHA-level patients overall had a median age of 53 years (female: 59 years, male: 47 years). However, ALPHA-level AMI patients had a median age of 77.5 years (female: 80 years, male: 74 years). Among the ALPHA-level AMI patients, gender was unequally distributed, with a higher percentage of males than females (57.5% and 42.5%, respectively) (Fig. 2). A 60.0% majority (35.0% female, 25.0% male) of the AMIs were of age 75 years and older, with 40.0% (22.5% female, 17.5% male) of age 85 years and older. Generally, ALPHA-level AMIs were more prevalent among male patients age 74 years and below, and among female patients age 75 and above.




EMD=Emergency Medical Dispatch; EMS=Emergency Medical Services

**Figure 1.** Sampling of ALPHA Priority-level Cases




AMI=Acute Myocardial Infarctions

**Figure 2.** Distribution of AMIs categorized by patient age and gender.

| Hospital discharge destination | All ALPHA cases (n=8,007) n (%) | AMIs (n=40) n (%) |
|---|---|---|
| Medical Facility | 1,026 (12.8) | 17 (42.5) |
| Home/Self-Care | 5,963 (74.5) | 11 (27.5) |
| Home Health Service | 409 (5.1) | 6 (15.0) |
| Expired | 67 (0.84) | 3 (7.5) |
| Hospice | 59 (0.74) | 1 (2.5) |
| Other Health Care Institution | 44 (0.55) | 1 (2.5) |
| Other Institution | 63 (0.79) | 1 (2.5) |
| Hospital | 219 (2.5) | * |
| Other | 157 (2.0) | * |

AMI=Acute Myocardial Infarction; *No calls

**Table 1.** Hospital discharge destinations for all ALPHA-level cases and for ALPHA-level AMIs.

Of all the ALPHA-level cases, approximately 80% were discharged to home (74.5% home/self-care; 5.1% home health service). Another 12.8% were discharged to a medical facility. (Table 1). Conversely, 42.5% of those with an ALPHA-level AMI were discharged to a medical facility, followed by home/self-care (27.5%), and home health service (15.0%).

The dispatch determinant codes to which the AMI cases were assigned varied by Chief Complaint Protocol. The most common included the Sick Person code for "no priority symptoms" (and no symptoms from a list of selectable symptom types) and the codes for some specific "non-priority symptoms" (Table 2). The next most common were the Falls determinant code for injury to a "not dangerous body area" and the Unconscious/Fainting determinant code for "fainting episode(s) and alert ≥35 years." All the falls occurred at ground level, and while a majority (85.7%, n = 12) of the fall patients were reported as having injuries, all either occurred on "not dangerous body areas" (such as ankle, arm, foot, knee, or wrist) consistent with a ground-level fall, or were reported as "non-recent" injuries, indicating that the fall that caused the injuries occurred six hours or more before the call for assistance.

Of the 40 ALPHA-level AMI patients, the highest reported symptom was a fall (n=17, 43%), followed by generalized symptoms of feeling 'sick' (n=9, 23%) and dizziness (n=6, 15%) (Table 4). Of the patients who fell, 35% (n=6) still remained on the floor unable to get up at the time of the call. Only 2 (5%) patients presented with symptoms of chest pain, and no patients had a reported history of heart problems.

Across all Chief Complaint Protocols, 82.5% (n=33) of ALPHA-level AMI patients reported a 'flu-like' symptom: 84.8% (n=28) of these were identified via EMS, and 81.8% (n=27) were accurately described by the EMD—leading to a 96.4% agreement between the EMD descriptions of the patient's problems and subsequent EMS findings on-scene of 'flu-like' symptoms.

| EMD-Identified Chief Complaint (Protocol number) | Acute Myocardial Infarction Cases | | |
|---|---|---|---|
| | (N =40) n (%) | Dispatch Determinant Description (Code) | n (%) |
| Sick Person (26)[β] | 18 (45.0) | No priority symptoms (26-A-1) | 9 (50.0) |
| | | Non-priority complaints—Unwell/ill (26-A-10) | 4 (22.2) |
| | | Non-priority complaints—Nausea (26-A-6) | 2 (11.1) |
| | | Non-priority complaints—Vomiting (26-A-11) | 2 (11.1) |
| | | Non-priority complaints—Dizziness/Vertigo (26-A-3) | 1 (5.6) |
| Falls (17) | 14 (35.0) | Not dangerous body area (17-A-1G)[£] | 5 (35.7) |
| | | Non-recent (≥6 hours) injuries (17-A-2)[†] | 3 (21.4) |
| | | Not dangerous body area (17-A-1) | 3 (21.4) |
| | | Non-recent (≥6 hours) injuries (17-A-2G)[†£] | 1 (7.1) |
| | | Public assist (17-A-3)[‡] | 1 (7.1) |
| | | Public assist ( 17-A-3G)[‡£] | 1 (7.1) |
| Unconscious/ Fainting (31) | 5 (12.5) | Fainting episode(s) and alert ≥35 years[¥] (31-A-1) | 5 (100.0) |
| | | Fainting episode(s) and alert <35 years[€] (31-A-2) | 0 (0.0) |
| | | Fainting episode(s) and alert <35 years[¥] (31-A-3) | 0 (0.0) |
| Abdominal Pain (1) | 2 (5.0) | Abdominal pain (1-A-1) | 2 (100.0) |
| Hemorrhage/ Lacerations (21) | 1 (2.5) | Not dangerous hemorrhage (21-A-1) | 1 (100.0) |
| | | Minor hemorrhage (21-A-2) | 0 (0.0) |

EMD=Emergency Medical Dispatcher. [β]This Chief Complaint Protocol has 10 ALPHA-level non-priority complaints: 2=Blood pressure abnormality, 3=Dizziness/Vertigo, 4=Fever/Chills, 5=General weakness, 6=Nausea, 7=New onset of immobility, 8=Other pain, 9=Transportation only, 10=Unwell/Ill, 11=Vomiting. *Upper arm, Elbow, and/or Knee—with deformity.
[£]On the ground or floor. [†]No priority symptoms. [‡]No injuries and no priority symptoms. [¥]Without cardiac history. [€]With cardiac history.

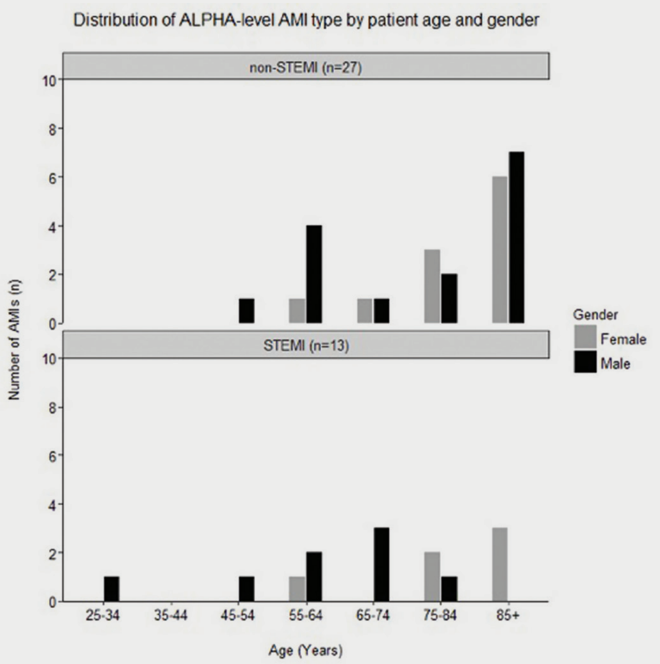
**Table 2.** AMIs categorized by EMD-Identified Chief Complaint, and Determinant Code

Overall, an ECG was performed by EMS on 11 (27.5%) of the ALPHA-level AMI patients (Table 5). Of those who received an ECG, a 54.5% (n=6) majority reported a fall, followed by 27.3% (n=3) who complained of feeling 'sick'. However, there was no observable symptomatic difference among the patients who received an ECG via EMS compared to those who did not. Interestingly, of the patients who were given an ECG, a 54.5% majority (n=6) presented with no discernible abnormalities, while 45.5% (n=5) presented with abnormal findings. Of the five cases with abnormal findings, only one had a clear indication of likely AMI (recorded by the paramedic as "12 lead ST-elevation in 2, 3, and AVF"). Other abnormalities included 2 cases with ST elevations in one lead only, one with premature ventricular contractions (PVC, or a slight irregular heartbeat), and one in which the ECG "implied anterior ischemia," but the "patient had bundle branch blockage," which can affect the appearance of the ECG reading and make AMI identification less clear.

Overall, 67.5% (n=27) of all ALPHA-level AMI cases were non-STEMIs, and 32.5% (n=13) were STEMIs (Fig. 3). The findings showed that male patients had a considerably higher percentage of ALPHA-level AMIs regardless of AMI type compared with their female counterparts (non-STEMI: 57.7% and 42.3%, STEMI: 57.1% and 42.9%; respectively). Male STEMI findings began at a much earlier age of 25-34 and were more prevalent up to age 65-74, whereas female STEMIs were more prevalent starting at age 75-84. However, the proportion of both STEMIs and non-STEMIs substantially increased for patients age 55 years and older. Those age 85 years and older were found to be the highest percentage in both STEMI and non-STEMI conditions (50.0% and 21.4%, respectively). Interestingly, of males age 85 and older, 100.0% (n=7) had a non-STEMI, whereas 33.3% (n=3) of females age 85 and older had STEMIs compared with 66.7% (n=6) having non-STEMIs.

## DISCUSSION

Overall, very few AMIs are assigned to the low-acuity ALPHA priority level; only 40 cases of hospital-confirmed AMI were handled in the ALPHA level, out of 8,007 total ALPHA-




AMI=Acute Myocardial Infarction. STEMI=ST-Elevation Myocardial Infarction.

**Figure 3.** STEMIs and non-STEMIs categorized by patient age and gender.

| EMD-described caller problem | | (N =40) n (%) |
|---|---|---|
| Chest pain | Yes | 2 (5.0) |
| | No | 38 (95.0) |
| Abdominal pain | Yes | 4 (10.0) |
| | No | 36 (90.0) |
| Shoulder pain | Yes | 2 (5.0) |
| | No | 38 (95.0) |
| Jaw/Neck pain | Yes | 1 (2.0) |
| | No | 39 (98.0) |
| Nausea | Yes | 3 (7.5) |
| | No | 37 (92.5) |
| Vomit | Yes | 4 (10.0) |
| | No | 36 (90.0) |
| Dizzy | Yes | 6 (15.0) |
| | No | 34 (85.0) |
| Breathing issues | Yes | 2 (5.0) |
| | No | 38 (95.0) |
| Changing color | Yes | 2 (5.0) |
| | No | 38 (95.0) |
| Sweating | Yes | 2 (5.0) |
| | No | 38 (95.0) |
| Sick | Yes | 9 (23.0) |
| | No | 31 (77.0) |
| Weak/Trouble walking | Yes | 6 (15.0) |
| | No | 34 (85.0) |
| Fell | Yes | 17 (43.0) |
| | No | 23 (57.0) |
| Breathing diagnostics performed | Yes | 2 (5.0) |
| | No | 38 (95.0) |
| Heart history | Yes | * |
| | No | 40 (100.0) |
| Still on floor | Yes | 6 (15.0) |
| | No | 34 (85.0) |
| Unresponsive | Yes | 1 (2.0) |
| | No | 39 (98.0) |
| Chills | Yes | 1 (2.0) |
| | No | 39 (98.0) |
| Shaking | Yes | 1 (2.0) |
| | No | 39 (98.0) |

EMD=Emergency Medical Dispatcher. Note: Patients may present with multiple symptoms. *no calls.

**Table 4.** Distribution of EMD-described caller problems.

level calls (0.50%) and 606 total AMI cases (6.6%). In general, then, the MPDS is effective in triaging AMIs into the appropriate higher-acuity priority levels. However, the hospital discharge destinations of the ALPHA-assigned AMI cases, few though they are, do indicate that they are of higher acuity than other ALPHA calls and more likely to be true emergencies. As compared to the overall set of ALPHAs, the AMI cases were more than three times as likely to be discharged to another medical facility and only one-third as likely to be discharged to home or self-care. Thus, any characteristics that can be used to identify these cases, out of the much larger set of ALPHA-level calls, may be of value in ultimately moving them into higher triage categories.

One such differentiator was the age of patients. Patients with AMI had a median age more than 24 years older than the median age for all ALPHA-level patients, with female AMI patients on average older than males. In fact, the majority (60%) of the ALPHA-coded AMIs occurred in people age 75 or older, as compared to only about one-third of the overall population of AMI patients handled by EMDs.[12] Such a finding is consistent with previous studies that have shown higher percentages of missed or "silent" AMIs in older populations, especially women.[7-9]

Although the overall population of ALPHA-coded patients were found across 22 Chief Complaint protocols, the ALPHA-coded AMIs appeared in only five. The most common was the Sick Person Chief Complaint Protocol, which is not surprising, given that the known symptoms of missed and silent AMIs include both generalized feelings of sickness (such as nausea) and dizziness or lightheadedness.[7,9] More specifically, what have been described as

| Distribution of EMD-described caller problems where EMS performed an ECG | | (N =11) n (%) |
|---|---|---|
| Chest pain | Yes | 1 (9.1) |
| | No | 10 (90.9) |
| Abdominal pain | Yes | * |
| | No | 11 (100.0) |
| Shoulder pain | Yes | 2 (18.2) |
| | No | 9 (81.8) |
| Jaw/Neck pain | Yes | * |
| | No | 11 (100.0) |
| Nausea | Yes | * |
| | No | 11 (100.0) |
| Vomit | Yes | * |
| | No | 11 (100.0) |
| Dizzy | Yes | 2 (18.2) |
| | No | 9 (81.8) |
| Breathing issues | Yes | * |
| | No | 11 (100.0) |
| Changing color | Yes | * |
| | No | 11 (100.0) |
| Sweating | Yes | 1 (9.1) |
| | No | 10 (90.9) |
| Sick | Yes | 3 (27.3) |
| | No | 8 (72.7) |
| Weak/Trouble walking | Yes | 1 (9.1) |
| | No | 10 (90.9) |
| Fell | Yes | 6 (54.5) |
| | No | 5 (45.5) |
| Heart history | Yes | * |
| | No | 11 (100.0) |
| Still on floor | Yes | 2 (18.2) |
| | No | 9 (81.2) |
| Unresponsive | Yes | * |
| | No | 11 (100.0) |
| Chills | Yes | * |
| | No | 11 (100.0) |
| Shaking | Yes | * |
| | No | 11 (100.0) |

EMD=Emergency Medical Dispatcher. EMS=Emergency Medical Services. ECG=Electrocardiogram. Note: Patients may present with multiple symptoms.*no calls.

**Table 5.** AMIs where EMS performed ECG assessment on scene.

"flu-like symptoms" have often been correlated with silent AMI,[13,14] and our findings do suggest that certain flu-like symptoms, including nausea, vomiting, sweating, weakness, and body aches and pains do appear in the symptoms identified by the EMDs handling these ALPHA-level AMI patients. None appeared more than a few times, though, and no symptom showed any particular correlation with the AMI outcome. A more likely explanation of the (relatively) high number of "missed" AMIs in the Sick Person ALPHA level is that these may have been cases in which typical AMI symptoms did not appear until later. Because the outcome data are hospital diagnoses assigned at discharge, it is conceivable that some AMIs may have occurred in the hospital. Such cases are not accurately described as being missed at dispatch; rather, the early warning signs of an impending AMI were most likely reported by the caller as lower-acuity symptoms. Some of these cases may even fall into a separately-defined condition known as slow-onset acute coronary syndrome, which tends to present with less-typical symptoms that develop more slowly and are often overlooked.[15]

Nonetheless, the fact that some AMIs appeared in the 26-ALPHA-1 determinant code, which represents a low-acuity call with "no priority symptoms" and no symptoms from a provided list (which include "unwell/ill," "nausea," and other broadly-inclusive categories), indicates that EMDs may not have correctly captured or recorded the symptoms that were presenting. An ongoing study looks at this code in particular and should provide more information about why, and when, EMDs are selecting it in lieu of a more specific symptom-based descriptor.

Chest pain and history of heart problems were very rare in this population—which is an indication that the protocol system is working as designed. When a patient presents with a primary problem of chest pain, the EMD is trained to use the Chest Pain Protocol to rule out symptoms of AMI and other cardiac conditions. The fact that only two patients in the ALPHA-level AMI population had an EMD-recorded symptom of chest pain, and none had a history of heart problems, indicates that while there may be recognizable AMIs in the patients assigned to lower priority levels, the EMDs do not appear to be missing many obvious, or classic, AMI presentations. Moreover, none of the ALPHA-coded AMI patients appeared in the Chest Pain Chief Complaint, which is specifically designed to identify AMIs; the questioning sequence on that Protocol appears to be very effectively separating AMIs (and other serious cardiac complaints) from true lower-acuity cases.

Fall cases may represent one opportunity for capturing atypical AMIs, especially given the older median age of the population captured in this study. Ground-level falls in elderly people are strongly correlated with cardiac causes, and often with unrecognized cardiac causes,[16] and in this study, the most common determinant codes containing AMIs in the Falls Protocol were those that indicate non-recent falls, falls without serious injuries, and ground-level falls in which the patient is still on the ground. Some combination of this information with the age of the patient might allow EMDs to capture AMIs reported as falls; for example, a higher-acuity code could be assigned for patients over 75 who report falls that are triaged into any of these codes.

It is important to remember, though, that any increase in sensitivity (the ability to "capture" all high-acuity cases) may result in over-triage and unnecessary response. Of the 40 AMI cases reported here, only 11 were given ECGs by responders, suggesting that nearly 75% did not appear to be cardiac problems to the paramedics on scene, either—and of those that did receive ECGs, only 5 showed any abnormalities. Also, two-thirds of the ALPHA-coded AMIs were non-STEMIs, which typically have less-traditional symptom presentations and less risk of mortality, at least in the short term.[17] It is difficult to know just how many of these cases could have been identified at the dispatch point, and how many could even have been accurately characterized as AMIs at that point.

AMIs made up only 0.69% and 0.74% of the total ALPHA-level Sick Person and Falls cases, respectively—and made up only 0.50% of all ALPHA-coded cases. Thus, while further evaluation of certain cases may be useful, any change to the triage process for these calls must take into account their rarity and the fact that they do not appear to have any recognizable AMI symptoms or any common characteristics that predict that they are or will become AMIs.

### Limitations

This study was limited by its small sample size. However, that sample size is the direct result of the correct assignment of almost all AMI cases to higher-acuity dispatch codes and thus is a sign of effective EMD triage. Similarly, the study is limited by the fact that it reviews AMI calls handled only by the MPDS, meaning that generalizability to other systems may be limited.

The methods of data collection also introduce some limitations. Only those symptoms recorded by the EMD or EMS provider can be evaluated, and on the EMD's side, only those symptoms reported by the caller can be recorded. Hospital discharge data may introduce a different type of limitation, in that the diagnostic code used to identify AMI outcome was likely assigned at the time of hospital discharge, meaning that the AMI could have occurred in the hospital or at some other time after the initial call to 911.

## CONCLUSIONS

Overall, the number of AMI cases assigned to the ALPHA priority level is very low and is confined to very few Chief Complaint Protocols. No specific sets of characteristics appear to differentiate these calls from other ALPHA-level calls or to identify them as AMIs, with the possible exception of older median age. Cases assigned to some specific codes, especially the Sick Person and Falls ALPHA-level codes, may benefit from further study to identify whether additional symptom or demographic information (such as age) could identify AMIs without introducing significant over-triage. In general, the ALPHA-coded AMIs in this study showed characteristics very consistent with missed or silent AMIs described in other healthcare settings.

## ACKNOWLEDGMENTS

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