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Original article

An analysis of the descriptors of acute myocardial infarction used by South Africans when calling for an ambulance from a private emergency call centre

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ABSTRACT

Introduction: Acute myocardial infarction (AMI) is a time sensitive emergency. In resource limited settings, prompt identification and management of patients experiencing AMI in the pre-hospital setting may minimise the negative consequences associated with overburdened emergency medical and hospital services. Expedited care thus, in part, relies on the dispatch of appropriate pre-hospital medical providers by emergency medical dispatchers. Identification of these patients in call centres is challenging due to a highly diverse South African society, with multiple languages, cultures, and levels of education. The aim of this study was therefore, to describe the terms used by members of the South African public when calling for an ambulance for patients suffering an AMI.

Methods: In this qualitative study, we performed content analysis to identify keywords and phrases that callers used to describe patients who were experiencing an advanced life support (ALS) paramedic-diagnosed AMI. Using the unique case reference number of randomly selected AMI cases, original voice recordings between the caller and emergency medical dispatcher at the time of the emergency were extracted and transcribed verbatim. Descriptors of AMI were identified, coded and categorised using content analysis, and quantified.

Results: Of the 50 randomly selected calls analysed, 5 were not conducted in English. The descriptors used by callers were found to fall into three categories; **Pain: Thorax**, **No pain: Thorax** and **Ill- health**. The code that occurred most often was no pain, *heart related* (n = 16; 23.2%), followed by the code describing pain in the chest (n = 15; 21.7%).

Conclusion: South African callers use a consistent set of descriptors when requesting an ambulance for a patient experiencing an AMI. The most common of these are non-pain descriptors related to the heart. These descriptors may ultimately be used in developing validated algorithms to assist dispatch decisions. In this way, we hope to expedite the correct level of care to these time- critical patients and prevent the unnecessary dispatch of limitedly available ALS paramedics to inappropriate cases.

African relevance

- Acute myocardial infarction is a life-threatening, time sensitive emergency requiring rapid identification, initiation of care and ultimately reperfusion to decrease morbidity and mortality.
- In resource limited settings, efficiency of resource allocation is paramount to ensure these patients receive the highest level of care possible.
- Over and under-triage in the emergency contact centre can be mitigated by emergency medical dispatchers using validated screening tools. based on a reference of terms and phrases used by callers when describing acute myocardial infarction,
- This is especially important in settings where multiple languages are spoken.

Introduction

Acute myocardial infarction (AMI) is a time sensitive emergency, where even minimal delay in the time from onset of symptoms to receiving definitive management is associated with increased mortality [1]. Globally, cardiovascular diseases (CVD), including ischemic heart disease (IHD), such as AMI, are a leading cause of morbidity and death

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[2]. In the Sub-Saharan African population, CVD incidence is rising [3]. In South Africa, non-communicable diseases accounted for 57.4% of natural deaths in the year 2016. IHD was among the top 10 contributors to this figure, steadily rising as a cause of death since 2014 [4].

Approximately 50% of AMI related mortality occurs in the pre-hospital environment [5]. Indeed, for every 10-minute delay in reaching definitive care from the time the call to the emergency medical services (EMS) is placed, the mortality of patients at one year increases by 30% [6]. To address this increasing burden of CVD, it is not always feasible to adopt the health system strategies that are effective in high-income countries [7]. The timely dispatch of appropriate EMS resources, capable of initiating advanced life support on the scene and *en* route to an appropriate receiving facility, may improve the outcome of these patients [8]. However, resource-limited settings face unique challenges in this regard, in part due to the unequal coverage of EMS and inadequate access to definitive care [9].

Expedited care of patients experiencing an AMI in the pre-hospital environment can be facilitated by emergency medical dispatchers (EMD) operating in an EMS call centre, achieved by recognising potential AMI through the descriptors used by members of the public when calling for help [10].

EMD in South Africa face unique challenges in recognising high priority emergency conditions. The description of the nature of a medical emergency may occur in one of 11 official languages, and there is substantial variation in literacy and level of education within the population [11]. This language discordance is not a uniquely South African problem as increases in immigration, recreational travel and migration create broadening communities worldwide, with increasing numbers of languages spoken in addition to the officially recognised languages of a country [12].

In addition, there is a shortage of advanced life support (ALS) paramedic resources available within the EMS for EMD to dispatch to priority scenes. Interventions within the scope of these professionals, found to decrease mortality by minimising the delay to identification and initiation of care, range from the possession of the equipment and knowledge to perform and interpret 12 lead electrocardiograms that may be sent via telemetry to the receiving facility from scene, to the administration of analgesic, vasodilatory and thrombolytic medication [5]. The latter being of importance in rural areas where access to a percutaneous coronary intervention capable facility within the recommended time frame (or at all) is not possible [9]. At the time of this study, there was one ALS paramedic trained to recognize, diagnose and manage AMI, registered under the Health Professions Council of South Africa, for every 18,000 persons [13]. However, given that many of these paramedics are not in operational roles or have emigrated, this is likely an overestimation of available resources [14].

At the time of this study there was no published literature detailing the terms and phrases South Africans use to describe patients experiencing an AMI when calling for an ambulance. The speed and accuracy with which these calls are identified may be improved through the development of a triage algorithm featuring a reference of terms used by callers to describe this emergency in this setting [10].

This study therefore seeks to identify the key words and phrases that are commonly used by members of the South African public to describe a patient experiencing an AMI when calling a national, private EMS call centre to request an ambulance.

Methods

In this descriptive, retrospective study, we performed content analysis at the manifest level to identify and quantify keywords and phrases that callers used to describe patients who were experiencing an AMI [15].

Study setting

The study was conducted in a private EMS call centre based in the Gauteng province of South Africa. The health care system in South Africa is currently separated into private and public sectors, servicing 16% and 84% of the public, respectively. Access to healthcare in the private sector is determined by an individuals' ability to pay for services, while access in the public sector is limited by overcrowding, geographic inequities to access, and limited healthcare resources and personnel [9,16]. Although this private EMS predominantly services citizens with medical insurance, this national call centre is available to all people residing in South Africa. In this EMS call centre, EMD act as call takers and dispatchers, deciding on the level of care resources to send to the scene based on what they have interpreted the nature of the caller's emergency to be. While all fluent in English, these staff also communicate in other South African vernacular. EMD have medical training and experience in EMS operations, ranging from basic to intermediate life support qualifications. On average, the call centre receives approximately 1200 calls per day nationally. Of these, an estimated 40 calls per day relate to cardiac emergencies (Personal communication: S Van Heerden, 2019).

Data collection

Over an eight-month period (January to August 2016), patient report forms (PRFs) that were categorised as acute emergency (primary) cardiac cases (ICD I21.0-I23.8) were extracted from this EMS database and screened against the stipulated inclusion and exclusion criteria. Using Microsoft Excel (Microsoft Corp. Washington, United States), 50 random numbers were generated and the corresponding PRF was evaluated to validate the diagnosis of AMI. This sample size was chosen based on a previous study using similar methods [17,18]. In this service, PRFs detail the events surrounding the emergency call; patient information (anonymised prior to data extraction), medical history, clinical and diagnostic findings, and patient management. The study was retrospective and did not affect the level of care experienced by the patients. The PRF and voice recordings were anonymised by redacting identifying information from the transcript so that patients and callers remained anonymous. For this reason, a waiver of consent was sought and received. This study was conducted with the approval of the University of Cape Town Human Research Ethics Committee (Ref number 637/2017).

For the purposes of diagnostic evaluation, AMI was defined according to the inclusion criteria of primary emergency cases with an ALS paramedic diagnosis of AMI; this includes the description of S-T elevation myocardial infarction, non-S-T elevation myocardial infarction or unstable angina as the provisional diagnosis [19]. The diagnosis was evaluated together with the findings on the 12-lead electrocardiogram (or a written description of this), vital signs, medical history and presentation of the patient, as well as management by the paramedic. This evaluation was done by the first and senior authors, who possess clinical qualifications and experience in the identification of signs and symptoms of illness, during frequent debriefing sessions. PRFs were excluded if the patient was being transferred between hospital facilities, if the call had not gone through the call centre (self-dispatched calls), if the patient was in the presence of a medical professional at the time of the call (at a doctors rooms/nursing home) or if the patient was a minor (< 18 years of age).

Using the PRF case number, original audio recordings between the caller and EMD at the time of the emergency were extracted. All calls in English and Afrikaans were transcribed verbatim by the researcher. The audio recordings of the other four vernacular calls were examined by the researchers during a process of consensus judgement described below.

Data analysis

The transcribed calls were subjected to content analysis at the manifest level. Firstly, transcriptions were parsed into meaning units by noting the unprompted phrases used by the caller to describe the nature of the patient's medical emergency.

Using Creswell's five steps for Qualitative Data Analysis [21], the identified meaning units were coded into clinical symptoms and categorised using NVivo12 Pro qualitative data analysis (QSR International Pty Ltd., Australia). The frequency at which the codes occurred within each category was then quantified.

To ensure qualitative rigour and trustworthiness, the following provisions described by Shenton were made to ensure credibility, confirmability and dependability [22];

- Credibility was ensured by extracting data from randomly selected PRFs to prevent researcher bias via the purposive selection of cases for review, and through the identification of meaning units describing the nature of the emergency based on the clinical knowledge of the first and senior authors. Further, frequent debriefing sessions were held between authors during the content analysis process, and member checks during the consensus judgement process involving the authors, two experienced senior contact centre agents, and the collaborating team from the Health Communication Research Unit of the University of the Witwatersrand.
- Confirmability was ensured through investigator triangulation related to the evaluation of the randomised calls, content analysis and consensus judgement process.
- The dependability of the data gathering process was subject to the analysis of PRFs completed by appropriately trained ALS paramedics. The first and senior authors were part of each consensus judgement process, to ensure the process was uniformly conducted. Consensus between the first and senior authors regarding coding and category development was employed, based on the background of experience and medical theory possessed by both.
- The transferability of this data is subject to its use in settings like that of the study - a private EMS service within South Africa. Transferability will be extended to other settings at a later stage, using the same methodology in different EMS settings (public and private) within South Africa, servicing a broader demographic of patients.

A separate process of consensus transcription, translation and judgement was used for analysis of calls in vernacular. Two senior EMS call centre agents, who were experienced in both call taking and dispatching responsibilities and who speak the vernacular of the specific calls, assisted by transcribing the call in the vernacular. Consensus translation was achieved by the two agents as to the most accurate translation of these phrases to English. These senior agents, as well as the other agents in the call centre, are considered real-world experts in the content of this data. Due to the nature of their daily work, they are regularly exposed to phrases spoken by callers with various first languages, requiring experience and the development of adaption techniques to facilitate the dispatch of resources based on what they have interpreted the nature of the call to be. Consensus judgement was reached among these agents and three of the authors confirming the unprompted phrase that was used to describe the nature of the patients' emergency. This process of consensus judgement has been successfully employed in previous work of a similar nature [20].

Results

Of the 197 acute emergency cardiac PRFs eligible for consideration, a total of 50 PRFs were randomly selected and confirmed to meet the stipulated inclusion and exclusion criteria. Table 1 provides information on the patients corresponding to these PRFs.

Table 1
Demographic descriptors of patients included in the emergency calls analysed.

	Total patients (n = 50)
Mean (SD) age (years)	59.7 ± 16.2
Male sex; n (%)	34 (68)
Population group; n (%)	
White	30 (60)
Black African	10 (20)
Coloured	4 (8)
Indian	3 (6)
Other	1 (2)
Unknown	2 (4)
Chronic medical history; n (%)	
Cardiac disease	28 (56)
Hypertension	21 (42)
Diabetes	12 (22)

SD: Standard deviation. Clinical and demographic information extracted from patient report forms.

In 90% of the included calls, callers spoke in English. In the remaining five calls, callers spoke in Afrikaans (n = 1), Sesotho (n = 2), Setswana (n = 1) or isiZulu (n = 1). Callers were immediate family members to the patient in 58% of the calls, strangers to the patient in 12%, the patient themselves in 10%, work colleagues in 8%, and of unknown relation to the patient in 12% of the calls. In 84% of the calls, the caller was in direct proximity to the patient.

A total of 69 meaning units were identified from the 50 calls following transcription (Appendix A, supplementary attachment). These meaning units were condensed into nine codes and three categories during content analysis. An analysis of the coded and categorised meaning units shows that callers most frequently described the category of **No pain: Thorax** (39%) with the codes *heart related*, *difficulty breathing*, and *chest related* when calling the emergency contact centre (Fig. 1). This was followed by the category **Pain: Thorax** (33%) with the codes *chest related*, *heart related*, and *in the arm* and the category **Ill health** (28%) which was described with the codes *mobility problems*, *vomiting/nausea* and *non-specific ill health*.

When analysing codes on a per call basis (Table 2), the *heart related* (**no pain**) predominantly described by the meaning unit "heart attack" was used most frequently (20%). This was followed by the code *chest related* (**pain**), described by the meaning unit, "chest pain" (16%). The codes *chest related* (**pain**) and *vomiting/nausea* occurred most frequently in combination (6%). In fourteen (28%) calls, no pain, heart or chest related codes were given, only the codes *mobility problems*, *difficulty breathing*, *non-specific ill health* or *vomiting/nausea*, in isolation or in combination. Notably, majority (88%) of the meaning units used by callers are accounted for by the codes *heart related* (**no pain**), *chest related* (**pain**), *mobility problems* and *breathing difficulty*.

Discussion

In the current study, the codes *heart related* (**no pain**) and *chest related* (**pain**) were the most frequently used descriptors by callers to describe a patient experiencing an AMI. The meaning units represented by these codes were the descriptors of a patient experiencing a "heart attack" and/or "chest pain", respectively.

A suspected AMI requires ALS paramedic dispatch. Due to the shortage of ALS paramedics in South Africa, this scarce resource needs to be dispatched appropriately to priority emergencies.

Unfortunately, the use of either of these descriptors by callers does not represent a patient experiencing an AMI; it must be considered that the reported accuracy of "self-diagnosis" varies [24,25]: Patients who have experienced an AMI before may be more likely to accurately identify its reoccurrence, as seen in this study in one example where the caller stated, "My wife is having another heart attack". Further, over-triage is a risk when relying on the descriptor of "heart attack" alone [25]. Similarly, the

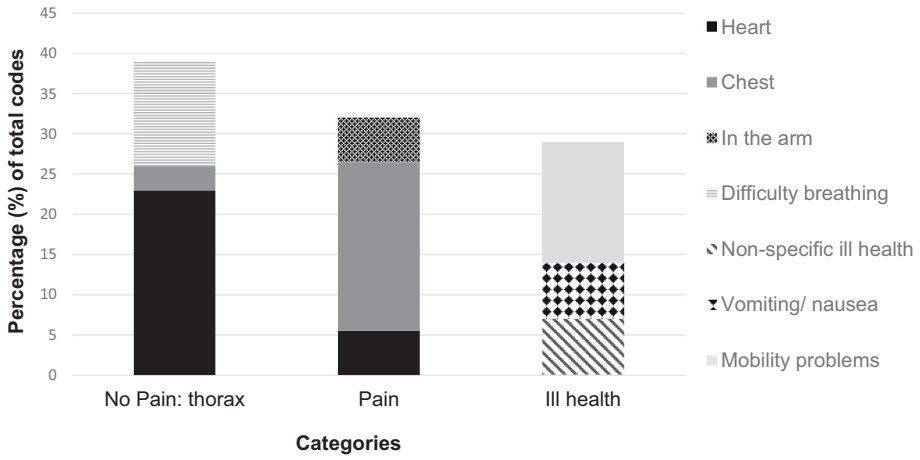

Fig. 1. Coded and categorised meaning units used by callers to describe patients suffering an acute myocardial infarction.

Table 2
Frequencies of codes identified in the content analysis process and combinations of codes that occurred.

Code combination	n	Percentage of total calls (%)
One code:	**32**	**64.0**
Heart related (**no pain**)	10	
Chest related (**pain**)	8	
Mobility problem	6	
Difficulty breathing	4	
Non-specific ill health	1	
Heart related (**pain**)	1	
Non-cardiac descriptor	1	
No descriptor given	1	
In the arm (**pain**)	0	
Vomiting/nausea	0	
Chest related (**no pain**)	0	
Two codes:	**16**	**32.0**
Chest related (**pain**) + vomiting/nausea	2	
Difficulty breathing + chest related (**no pain**)	1	
Chest related (**no pain**) + mobility problem	1	
Difficulty breathing + mobility problem	1	
Difficulty breathing + heart related (**no pain**)	1	
Chest related (**pain**) + in the arm (**pain**)	1	
Heart related (**no pain**) + mobility problem	1	
Heart related (**no pain**) + non-specific ill health	1	
Non-specific ill health + mobility problem	1	
Heart related (**no pain**) + chest related (**pain**)	1	
Heart related (**pain**) + chest related (**pain**)	1	
Vomiting/Nausea + difficulty breathing	1	
Chest related (**pain**) + difficulty breathing	1	
In the arm (**pain**) + heart related (**no pain**)	1	
In the arm (**pain**) + heart related (**pain**)	1	
Three codes:	**1**	**2.0**
Chest related (**pain**) + vomiting/nausea + non-specific ill health	1	
Four codes:	**1**	**2.0**
Heart related (**pain**) + vomiting/nausea + in the arm (**pain**) + heart related (**no pain**)	1	

description of “chest pain”, when used alone, has a low specificity as an indicator of AMI [2]. This is despite “chest pain” being considered the cardinal symptom in patients experiencing an AMI [26]. Additional information related to the nature of the patient's chest pain, such as descriptors of the quality of the chest pain, its location, and the presence of radiation should therefore be sought [27]. Additional symptoms, such as nausea, vomiting, weakness, sleep disturbance, diaphoresis, fear and anxiety, are also useful in triaging the patient's chest pain [28,29]. In our study of unprompted descriptors, some callers provided such additional information to describe the patients' chest pain, and the combination of chest pain, nausea and vomiting descriptors was seen.

In some examples in our study, callers did not use descriptors of typical AMI symptomatology- descriptors of pain to the heart or of the chest. This atypical AMI presentation may be as a result of the patient's gender, ethnicity or comorbidities. The female sex in particular has been associated with atypical AMI symptomatology [30,31]. Similar findings were not observed in the current study however, it must be noted that the sample of patients in this study are predominantly white males. Chronic conditions such as diabetes may also result in atypical cardiac symptoms, and these patients may describe syncope, weakness and gastrointestinal symptoms rather than chest pain [32,33].

To facilitate the identification of AMI patients and improve call triage, the results of this study should be supplemented with additional symptom descriptors and patient medical history, attained through targeted information gathering techniques by EMD.

The provision of detailed patient descriptors is best done when calls are made by either the patient or when callers are in direct proximity to the patient, as was the case in this study. In these cases, the EMD can implore various information gathering techniques to facilitate problem identification [10]. One-such technique is scripted, clinically based algorithms, which are recommended to facilitate closed loop communication, negotiation of atypical symptoms, encouraging communication techniques, appropriate questioning and a structured approach to the call [10,23].

Problem identification and triage accuracy is improved further by ensuring that EMS call centres are able to match the cultural and linguistic needs of the caller with an appropriate EMD, particularly in the diverse South African context [34]. The benefit of this matching was evident in the consensus judgement process of this study, where the senior EMS call centre agents were able to identify not only the type of medical emergency being described, but also the location of the caller based on their language, pronunciation and greeting style. This was possible through both their medical knowledge and cultural familiarity with the caller's description techniques. This approach, rather than a third party translator, may mitigate the cost of hiring interpreters and the time delay involved in translating the ongoing call [12].

This study has a few limitations. Firstly, this study included a small sample of 50 calls made to a private EMS call centre. As such, the sample was skewed towards those of a higher socioeconomic status who possess medical insurance. Further, the patients were predominantly white males. This was unavoidable, due to the randomisation of the data gathering process. This limits the applicability of these results to a more diverse setting. Future research needs to be conducted in both the private and public EMS sectors using a more purposively selected sample.

A second limitation to the study is the limited number of vernacular calls included in the data analysis. Again, this was unavoidable, due to the randomisation of the data gathering process, and the gap in our

understanding of the impact of language discordance on patient management in the EMS remains. Language discordance and the subsequent poor EMD/caller interactions result in inaccurate identification of the nature of the callers' emergency [12]. Research in the South African setting found that bias against certain ethnic groups and unwillingness of EMD to accommodate language shifts are barriers to EMS call centre functioning [34]. As a result, limited conclusions can be made regarding how vernacular callers describe AMI when calling for an ambulance. Stratified randomisation in future studies may address these two limitations.

Lastly, it was beyond the scope of the study to describe the relationship between the meaning units used by callers and the in-hospital diagnosis of the patient. With the goal of optimising dispatching practices through the creation of an AMI triage algorithm in the South African setting, this sample of ALS paramedic-diagnosed and managed AMI cases was considered an example of appropriately dispatched resources, and thus was deemed sufficient on which to base our study. Additional research which applies the results of this study and evaluates the degree of over- and under-triage that arises is needed.

Despite these limitations, this data can inform the development of future algorithms that take preferred language into account. Furthermore, this study provides a methodological approach that can be repeated in different language groups to identify language specific descriptors, in this and many other settings.

In conclusion, callers in this study predominantly use a consistent set of descriptors when requesting an ambulance for a patient experiencing ALS paramedic diagnosed AMI. The most common of these are non-pain descriptors related to the heart and pain descriptors related to the chest. However, not all patients experiencing an AMI will be identified by descriptors of “heart attack” or “chest pain” alone. Thus, the development of validated algorithms which optimise additional information seeking and call facilitation techniques, considerate of atypical presentations and patients in the unique South African setting, is needed to assist dispatch decisions. In this way, over- and under-triage in emergency call centres may be mitigated.

Authors' contributions

The authors contributed as follows to the conception of the study, study design, data collection, transcription, data analysis and consensus judgement process, interpretation, and manuscript preparation: CB contributed 40%, CS 20%, WS 30% and JW 10%. All authors approved the final manuscript for submission.

Dissemination of results

The results of this study were shared with the private emergency services call centre management team from which the data was extracted. The results were also shared during a local research symposium and conference.

Declaration of competing interest

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Data sharing statement

The data used in this study was extracted from ER24 patient report forms following ethical and organisational research approval. Similar data may be obtained following ethical approval on application to the ER24 Emergency Care Research Unit.

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