PREHOSPITAL CARE

Does telephone triage of emergency (999) calls using advanced medical priority dispatch (AMPDS) with Department of Health (DH) call prioritisation effectively identify patients with an acute coronary syndrome? An audit of 42 657 emergency calls to Hampshire Ambulance Service NHS Trust

C D Deakin, D M Sherwood, A Smith, M Cassidy

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See end of article for authors' affiliations

Correspondence to: Dr C D Deakin, Hampshire Ambulance Service NHS Trust, Highcroft, Romsey Road, Winchester SO22 5DH, Hampshire, UK; charlesdeakin@doctors.org.uk

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Introduction: The National Service Framework for Coronary Heart Disease requires identification of patients with an acute coronary syndrome (ACS) to enable prompt identification of those who may subsequently require pre-hospital thrombolysis. The Advanced Medical Priority Despatch System (AMPDS) with Department of Health (DH) call prioritisation is now the common triage tool for emergency ('999') calls in the UK. We retrospectively examined patients with ACS to identify whether this triage tool had been able to allocate an appropriate emergency response.

Methods: All emergency calls to Hampshire Ambulance Service NHS Trust (HAST) from the Southampton area over an 8 month period (January to August 2004) were analysed. The classification allocated to the patient by AMPDS (version 10.4) was specifically identified. Data from the Myocardial Infarct National Audit Project) were obtained from the receiving hospital in Southampton to identify the actual number of patients with a true ACS.

Results: In total, 42 657 emergency calls were made to HAST from the Southampton area. Of these, 263 patients were subsequently diagnosed in hospital as having an ACS. Of these 263 patients, 76 presented without chest pain. Sensitivity of AMPDS for detecting ACS in this sample was 71.1% and specificity 92.5%. Positive predictive value was 5.6% (95% confidence interval 4.8 to 6.4%), and 12.5% (33/263) of patients with confirmed ACS were classified as non-life threatening (category B) incidents.

Conclusion: Only one of approximately every 18 patients with chest pain has an ACS. AMPDS with DH call prioritisation is not a tool designed for clinical diagnosis, and its extension into this field does not enable accurate identification of patients with ACS.

Coronary heart disease accounted for more than 95 000 deaths in England in 2002, making it the commonest cause of death and a major source of long term disability. Financially, the associated £7.1 billion annual costs make it Britain's most expensive illness. Prompt thrombolysis for appropriate patients suffering a myocardial infarction (broadly described as an acute coronary syndrome; ACS) can make a significant improvement to both mortality and morbidity with associated cost savings. Pre-hospital thrombolysis can halve mortality from acute myocardial infarction.[1]

In 2000, the UK Department of Health (DH) introduced a series of standards for the National Health Service for the management of specific diseases; the first of these being the National Service Framework for Coronary Heart Disease (NSF CHD).[2] Prior to this, ambulance paramedics in the UK were restricted in the clinical care they could deliver to patients suffering an ACS. Interventions were limited to the administration of oxygen, aspirin, morphine, and glyceryl trinitrate. With recognition of the benefits of early thrombolysis, the need to deliver thrombolytics in the pre-hospital environment was recognised. The NSF CHD strategy sets standards through the DH (England) requiring the administration of thrombolysis within 60 minutes of calling for professional help.[2] From an initial baseline of 38% of patients being treated within 60 minutes, the Priorities and Planning Framework 2003–6 set a target of a 10% increase each year in the proportion of thrombolysis eligible patients who receive thrombolysis within 60 minutes.[3] The expectation for England is therefore that at least 58% of patients should receive treatment within 60 minutes by the end of March 2005. Pre-hospital thrombolysis is playing a significant role in meeting this progressive target.

Unlike the majority of Europe, most patients in England do not benefit from the routine involvement of doctors in pre-hospital emergency care, and implementation of pre-hospital thrombolysis has therefore had to be achieved through legislative changes and major training programmes to enable paramedics to undertake administration of thrombolytic agents.[4]

The chain of delivery of pre-hospital thrombolysis requires accurate identification of patients with an ACS at the time of telephoning for an ambulance. In England, almost all

Abbreviations: ACS, acute coronary syndrome; AMPDS, Advanced Medical Priority Despatch System; DH, Department of Health; EMD, emergency medical dispatcher; HAST, Hampshire Ambulance Service NHS Trust; IAEMD, International Academy of Emergency Medical Dispatch; MINAP, Myocardial Infarct National Audit Project; NSF CHD, National Service Framework for Coronary Heart Disease

ambulance Trusts achieve this through telephone triage using Advanced Medical Priority Dispatch System (AMPDS) software to deliver a series of structured questions. AMPDS then determines whether the emergency call is immediately life threatening (category A). Since April 2002, all ambulance trusts have then been using prioritisation of emergency calls to ensure that immediately life threatening cases receive the quickest response. Ambulance services are expected to reach 75% of these life threatening (category A) calls within 8 minutes.

Efficient triage of the 5.3 million annual emergency calls to the ambulance trusts in England[5] is vital if performance targets are to be met and clinical resources are to be appropriately matched to clinical need. This is even more necessary as ambulance services stretch their resources further with increasing rates of emergency calls. AMPDS has a specific classification of chest pain (table 1), which triggers a category A response. It is this classification that is considered to identify patients with an ACS, on whom pre-hospital thrombolysis resources should be focused. Local data available from the Myocardial Infarction National Audit Project (MINAP)[6] has enabled examination of the records of hospital patients with known ACS and a comparison made with the diagnostic label and clinical priority allocated through the AMPDS triage system. This has enabled us to examine the diagnostic accuracy of telephone triage in identifying patients with ACS in the pre-hospital environment.

MATERIALS AND METHODS

AMPDS software (version 10.4; Priority Dispatch Corp, USA) was used to triage all emergency calls to Hampshire Ambulance Service NHS Trust (HAST). Using this software, the patient's condition is allocated a chief complaint from the information provided by the caller. This then allows the call taker to ask more condition specific pre-determined questions in order to identify the clinical condition of the patient. From this information, a code is allocated to the call, which has a resource/priority level assigned to it. In AMPDS, there are over 300 possible codes that can be allocated. Data from all calls are recorded to a mainframe computer.

All emergency calls to HAST from the Southampton area over an 8 month period (January to August 2004) were analysed. Patients classified as having a chief complaint of chest pain (table 1) by AMPDS were specifically identified.

MINAP data were obtained from the acute hospital in Southampton (Southampton University Hospital NHS Trust) to identify patients admitted with a true ACS. The ambulance record of these patients was then examined to determine the coding calculated by the AMPDS software at the time of the emergency call.

There are various definitions of ACS and myocardial infarction. The definition of an ACS encompasses Q-wave myocardial infarction, non-Q-wave myocardial infarction, and unstable angina. The definition of myocardial infarction (Q-wave and non-Q-wave) used for this study was based on that set out in the consensus statement of the Joint European Society of Cardiology/American College of Cardiology Committee for the redefinition of myocardial infarction.[8] The definition of myocardial infarction within this statement is an acute, evolving or recent myocardial infarct (acute coronary syndrome) as a typical rise and gradual fall (troponin) or more rapid rise and fall (CK-MB) as biochemical markers of myocardial necrosis with at least one of the following: (*a*) ischaemic symptoms; (*b*) development of pathological Q-waves on the ECG; or (*c*) ECG changes indicative of ischaemia (ST segment elevation or depression).

The definition of unstable angina used for this study was a changing pattern of angina that had distinctly worsened in severity and frequency compared with the patient's previous pattern. The diagnosis in all patients was confirmed after review by a consultant cardiologist.

Using a web based statistical software calculator (www.hutchon.freeserve.co.uk/EPRval.htm), data were analysed for sensitivity and specificity. Data were classified as: (*a*) true positive (patients classified by AMPDS as having chest pain with confirmed ACS); (*b*) true negative (patients classified to an AMPDS criteria other than chest pain who did not have an ACS); (*c*) false positive (patients classified by AMPDS as having chest pain but without evidence of an ACS); and (*d*) false negative (patients classified to an AMPDS criteria other than chest pain who were subsequently proven to have an ACS).

The design, conduct, and analysis of this study were carried out in accordance with the STARD initiative.[9]

Table 1 AMPDS classification of chest pain showing determinant descriptors and coding

Pain	Descriptor	Code
Chest pain	Abnormal breathing	10C02
Chest pain	Cardiac history	10C04
Chest pain	Cocaine	10C03
Chest pain	Breathing normally >35 breaths/min	10C01
Chest pain	Severe respiratory distress	10D01
Chest pain	Non-alert	10D02
Chest pain	Clammy	10D03
Chest pain	Nausea or vomiting	10D04

RESULTS

In total, 42 657 emergency calls were made to HAST from the Southampton area over the eight month period. Of these, 3368 patients were categorised by AMPDS as having chest pain. Of the 42 657 calls, 263 patients were subsequently diagnosed in hospital as having an ACS. Of the 263 patients with ACS, 76 presented without chest pain. AMPDS call categorisation for all 263 patients with ACS is shown in table 2.

In total, 87% (230/263) of patients with confirmed ACS were classified as requiring a category A, 8 minute response by AMPDS with DH call prioritisation. The remainder were allocated to a category B, 19 minute response. None of the patients allocated to a category B response presented with chest pain as a chief complaint.

Sensitivity of AMPDS for detecting ACS was 71.1% and specificity 92.5%. Positive predictive value of AMPDS for detecting ACS was 5.6% (95% confidence intervals 4.8 to 6.4%). Results are summarised in table 3.

DISCUSSION

In 2003–4, ambulance services in England received a total of 5 340 000 emergency calls, an increase of 7.7% on the preceding year.[5] These calls undergo telephone triage, mostly using AMPDS with DH call prioritisation software algorithms, to determine clinical priority and appropriate level of response. All but five of the UK ambulance trusts use AMPDS software for telephone triage. Most ambulance services in the UK are in the process of moving from AMPDS version 10.4 to version 11.2, but the new software algorithms in relation to diagnosis of ACS are essentially unchanged.

Having ascertained the location and telephone number, the software directs the emergency medical dispatcher (EMD) to ask a series of structured questions, commencing with the patient's chief complaint, age, level of consciousness, and presence or not of breathing. If the EMD receives information consistent with a cardiac or respiratory arrest, the highest

Table 2 AMPDS (version 10.4) classification of 263 patients with ACS.

Symptom	Descriptor	Code	Cat.	No. of patients
Chest pain	Abnormal breathing	10C02	A	14
Chest pain	Breathing normally >35	10C01	A	39
Chest pain	Severe respiratory distress	10D01	A	1
Chest pain	Non-alert	10D02	A	2
Chest pain	Clammy	10D03	A	139
Chest pain	Nausea or vomiting	10D04	A	12
Chest pain	Uncoded			4
Breathing problems	Difficulty breathing	06C01	B	5
Breathing problems	Cardiac history	06C03	B	2
Breathing problems	Severe respiratory distress	06D01	A	12
Breathing problems	Sweaty or changing colour	06D03	B	3
Cardiac arrest	Suspected cardiac arrest	09D01	A	2
Heart problems	Unknown symptoms (third party)	19B01	B	1
Heart problems	Cardiac history	19C02	B	2
Diabetes	Unconscious	13D01	A	2
Falls	Non-recent injuries (>6 hours)	17A02	B	1
Sick person	No priority symptoms	26A01	B	5
Sick person	Not alert	26C01	B	3
Sick person	Cardiac history	26C02	B	1
Traumatic injury	Possibly dangerous injuries	30B01	B	1
Unconscious	Single fainting episode and alert (age >35 years)	31C01	B	2
Unconscious	Conscious with abnormal breathing	31C04	B	2
Unconscious	Unconscious (at end of interrogation)	31D01	A	3
Unconscious	Severe respiratory distress	31D02	A	1
Unconscious	Not alert	31D03	A	3
Unknown problems	Standing, sitting up, moving, or talking	32B01	B	1

DH prioritisation is also shown and requires that category 'A' (life threatening) calls receive a response within 8 minutes and category 'B' calls (urgent) a response within 19 minutes. Cat., category.

priority response is sent immediately. If the patient is breathing, a further series of key questions are asked to determine the nature of the problem. The call is then triaged to a specific category. The ambulance response to each of these categories is defined by the DH, who set the level of response for each category. Those that are considered life threatening are allocated to an 8 minute (category A) response. Those that are considered to require urgent assistance but are not life threatening are allocated to a 19 minute (category B) response. Of the 5.3 million calls in 2003–4, approximately 1.15 million were classified as life threatening, requiring an ambulance response within 8 minutes.[5]

Introduction of AMPDS and similar software was a significant advance in emergency call handling and enabled ambulance dispatch according to clinical priority. Since the inception of AMPDS in the USA in the 1970s, the system has been continually developed by the International Academy of Emergency Medical Dispatch (IAEMD)[7] with input from UK users. However, with the increasing numbers of emergency calls and the development of more appropriate care pathways for patients requesting an emergency ambulance, AMPDS with DH call prioritisation is inevitably being used as a tool to ensure that the clinical need is matched with clinical response and direct patients down appropriate pathways. AMPDS with DH call prioritisation was not designed as a clinical diagnostic tool and its ability to perform as such is unknown.

Table 3 Summary of 42 657 emergency calls according to confirmation of ACS

Patients	Number
Patients with ACS	
True positive	187
False negative	76
Total	263
Patients with ACS	
False positive	3181
True negative	39 213
Total	42 394
Total emergency ('999') calls	42 657

True positive, patients classified by AMPDS as having chest pain with confirmed ACS; true negative, patients classified to an AMPDS criteria other than chest pain who did not have an ACS; false positive, patients classified by AMPDS as having chest pain but without evidence of an ACS; false negative, patients classified to an AMPDS code other than chest pain who were subsequently proven to have an ACS.

Sensitivity and specificity of call triage results from clinical data fed into algorithm pathways. There are at least six components in the triage/response category assigned to an individual patient:

1. AMPDS call categorisation
2. DH recommended response prioritisations
3. Changes in DH prioritisations made by individual ambulance Trusts
4. Compliance of the call taker to the AMPDS scripted protocols
5. Information given by the caller to the dispatcher
6. Often the information given by the patient to the caller

All of these should be considered as potential weak links in the chain of arriving at an accurate call prioritisation. Ambulance services that use AMPDS are regularly audited by the IAEMD to ensure compliance with verbal questioning and patient instructions. HAST exceeds the IAEMD minimum standards for compliance. The call taker must interpret the information given by the caller or patient, which may not always be accurate, particularly in stressful situations. The patient may not understand the actual questions or may be too unwell to concentrate on accurate answers. In many cases, the call may be made by a friend, relative, or bystander who does not have all the details requested. Carefully structured questions aim to minimise this variability, but inevitably, there will be a subjective element in this link which may affect the allocation of chief complaint and subsequent call prioritisation.

Analysis of the chest pain category of AMPDS has found that of every 18 patients determined to have potentially life threatening chest pain, only one subsequently transpired to have an ACS. The absence of chest pain increased the likelihood of the patient being triaged to a non-life threatening (category B; 19 minute) response. The sensitivity of the current triage pathways requires that thrombolysis trained paramedics together with vehicles fitted with appropriate hardware (12 lead ECG and data transmission) be dispatched to all chest pain calls to attend the 5% with ACS, some of who may require thrombolysis.

We acknowledge that AMPDS with DH call prioritisation was never intended as a diagnostic tool for specific clinical conditions and it has not evolved to specifically detect patients with ACS. Chest pain alone is recognised as a poor indicator of ACS, and without the additional benefit of other clinical markers, will always limit the ability of telephone triage to accurately identify ACS. We were interested, however, to assess whether the capabilities of AMPDS with DH call prioritisation could be extended as a tool to further refine our clinical response. At the time that this study was undertaken, HAST, as with most other ambulance trusts, was using AMPDS version 10.4. Since then, most trusts have moved to version 11.1, which is very similar in terms of questions and structure and is likely to produce similar results. In order to deliver pre-hospital thrombolysis, a degree of over-triage to maintain a wide safely margin will be needed to deliver pre-hospital thrombolysis to all eligible patients. Approximately 13% of patients with ACS are triaged to a category B, 19 minute response, all without chest pain as a chief complaint. This group of patients are particularly challenging to detect by telephone triage. The incidence of pain free (silent) myocardial ischaemia is as high as 50% in some studies, and symptoms in this group of patients need studying further if the detection rate in these patients is to be improved.[10]

While acknowledging that AMPDS is not a diagnostic tool, it has inevitably been used to guide the appropriate level of clinical response. Further work is required to identify the sensitivity and specificity of symptoms reported by patients with ACS if the ability of current triage pathways to identify these patients is to be improved. Clinically based algorithms may improve the ability of ambulance services to target appropriate resources to appropriate patients, but considerably more work is needed in this important area.

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Authors' affiliations

C D Deakin, D M Sherwood, M Cassidy, Hampshire Ambulance Service NHS Trust, Highcroft, Romsey Road, Winchester, Hampshire, UK
A Smith, British Heart Foundation Acute Coronary Syndrome nurse, Wessex Cardiothoracic Centre, Southampton University Hospital NHS Trust, Southampton, Hampshire, UK

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