



# Ambulance call triage outcomes for patients reporting pain: a retrospective cross-sectional analysis of pain score versus triage level

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## ABSTRACT

**Objective:** To identify any association between the response priority code generated during calls to the ambulance communication centre and patient reports of pain severity.

**Methods:** A retrospective analysis of patient care records was undertaken for all patients transported by paramedics over a 7-day period. The primary research interest was the association between the response code allocated at the time of telephone triage and the initial pain severity score recorded using a numeric rating scale (NRS). Univariate and multivariate logistic regression methods were used to analyse the association between the response priority variable and explanatory variables.

**Results:** There were 1246 cases in which both an initial pain score using the NRS and a response code were recorded. Of these cases, 716/1246 (57.5%) were associated with a code 1 ("time-critical") response. After adjusting for gender, age, cause of pain and duration of pain, a multivariate logistic regression analysis found no significant change in the odds of a patient in pain receiving a time-critical response compared with patients who had no pain, regardless of their initial pain score (NRS 1–3, odds ratio (OR) 1.11, 95% CI 0.7 to 1.8; NRS 4–7, OR 1.12, 95% CI 0.7 to 1.8; NRS 8–10, OR 0.84, 95% CI 0.5 to 1.4).

**Conclusion:** The severity of pain experienced by the patient appeared to have no influence on the priority (urgency) of the dispatch response. Triage systems used to prioritise ambulance calls and decide the urgency of response or type of referral options should consider pain severity to facilitate timely and humane care.

Pain is a commonly encountered patient complaint in paramedic practice.<sup>1,2</sup> The importance of early and effective management of pain has been recognised by the Emergency Medical Services Outcomes Project (EMSOP) in the USA, with the authors finding that the relief of pain and discomfort may be "the most important task EMS providers perform for the majority of their patients."<sup>3</sup>

The timely and effective management of pain requires the appropriate triage of calls for an ambulance. However, triage algorithms used to prioritise ambulance response are designed to identify complaints known to be associated with an immediate threat to life.<sup>4</sup> Pain, unless associated with body regions such as "chest pain", which is itself indicative of a potential time-critical emergency, is not considered a time-critical problem. Failure to identify severe pain as a patient complaint at the point of the emergency call may

constrain attempts to provide appropriate care for patients with pain if this results in a delayed response or inappropriate referral of the patient to other agencies.

In this study setting the medical priority dispatch system (MPDS; Priority Dispatch Corp, Salt Lake City, Utah, USA), is used to triage and prioritise the response to calls made to the ambulance dispatch centre. The call taker uses scripted questions to interrogate the caller in order to generate a complaint-based code and response priority, known as a response determinant. At the time this study was conducted MPDS version 10.2 used response determinants alpha, bravo, charlie and delta. The delta determinant represents cases that are immediately life threatening, with the lowest level of urgency represented by an alpha determinant. The MPDS determinants are translated into a locally established three-category response priority code (codes 1–3) that governs the urgency of response and the clinical capabilities of the responding ambulance crew. All code 1 and 2 triage categories result in an emergency ambulance response, with advanced life support the base level of clinical care. A more advanced level of response, known locally as a mobile intensive care ambulance, is also responded to some code 1 cases that are predicted to require a higher level of clinical care, such as suspected cardiac arrest or chest pain associated with severe respiratory distress. Analgesic options for advanced life support are methoxyflurane or morphine, with a mobile intensive care ambulance having an additional agent in the form of fentanyl. Patients assigned a code 3 triage category may be referred to a privatised "non-emergency" transport provider whose staff lack the capability to administer opioids. Patients assigned to this response category may wait up to one hour for an ambulance to arrive.

This study sought to identify any association between the priority (urgency) of the response code generated during calls to the ambulance communication centre and patients' reports of pain severity during initial assessments performed by the attending paramedic.

## STUDY DESIGN AND SETTING

This study is part of a larger research project investigating the epidemiology of pain in patients transported by ambulance paramedics. It was conducted in a major urban centre (Melbourne, Australia) where one organisation provides emergency ambulance response to a population of

**Table 1** Agency response code and target response times with examples of MPDS determinants

Agency response priority code	Definition <sup>a</sup>	Target response times (90th percentile)	Example of MPDS determinant
Code 1	A time-critical (urgent) case	13 minutes <sup>b</sup>	All delta, eg chest pain associated with severe respiratory distress (10D1)
Code 2	Acute non-time-critical (non-urgent) case	25 minutes	Charlie and bravo, some alpha, eg, headache, sudden onset of severe pain (18C4)
Code 3	Non-acute or routine case	60 minutes	Mostly alpha, eg, sick person no priority symptoms (26A1)

For the purposes of analysis, pain severity was collated into four categories (see table 2). MPDS, medical priority dispatch system.

approximately 3.9 million people. In 2005, when the data were collected, the service responded to approximately 253 000 emergency calls and transported 202 143 patients.<sup>5</sup>

A retrospective analysis of anonymous patient care records (PCR) was undertaken for all adult patients with a Glasgow coma scale score greater than 12 transported by paramedics over a 7-day period. This convenience contiguous dataset of PCR was selected using an arbitrary commencement date in August 2005. For cases involving documented reports of pain, data for case response code, as well as the cause, duration and region of pain and initial pain severity scores recorded by the treating paramedic were extracted. The study was approved by the Monash University Standing Committee on Ethics in Research Involving Humans (protocol no 2004/754) and by the Metropolitan Ambulance Service Research Committee.

The research question was "In calls to the emergency ambulance service in Melbourne, Australia, what is the relationship between the dispatch response priority code and the patient's initial pain score?"

## DATA COLLECTION AND PROCESSING

All PCR generated for patients transported by paramedics in the study setting between 16 August and 22 August 2005 were reviewed. Cases involving children (aged less than 15 years) or cases in which the initial Glasgow coma scale score was less than 13 were excluded, as different approaches to pain measurement are required when assessing children or patients with cognitive impairment. The remaining cases were searched for evidence of pain assessment or reports of pain. Cases were included in this study if a description of pain was entered by the treating paramedic in the history section of the PCR and a rating of pain severity was recorded. The most common pain severity assessment tool used by paramedics in this study setting is the numeric rating scale (NRS), which requires the patient to rate their pain severity between 0 and 10, with 0 meaning no pain and 10 the worst pain imaginable. This tool has been validated in the emergency department for the assessment of acute pain,<sup>6,7</sup> and is recommended for use in the prehospital setting.<sup>3</sup>

The MPDS determinant for each call is assigned an agency response priority code based on a predetermined matrix linking MPDS determinants with three possible outcomes. An example

**Table 2** Pain score categories

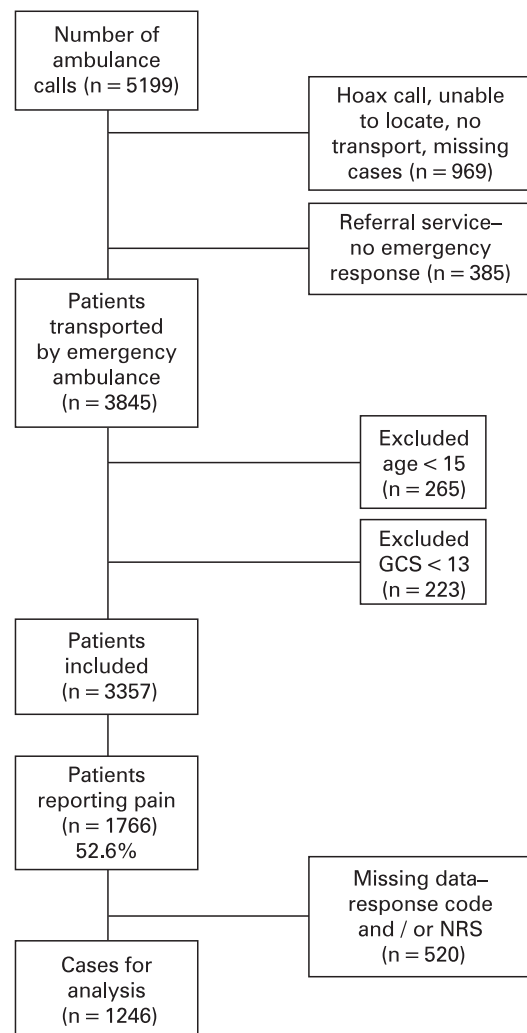
Pain category	
0	No pain, NRS 0
1	Mild pain, NRS 1–3
2	Moderate pain, NRS 4–7
3	Severe pain, NRS 8–10

NRS, numeric rating scale.

of MPDS determinants along with corresponding agency response codes and performance percentiles are listed in table 1.<sup>8,9</sup>

## Primary data analysis

Data were manually transcribed from the PCR to an Access database (Microsoft Corp, Redmond, Washington, USA). The primary research interest was the association between the response code and the initial pain score. The outcome variable was the ambulance service response priority code assigned to the case following the initial call. Code 2 and code 3 cases were

**Figure 1** Flow chart showing case and excluded data. GCS, Glasgow coma scale; NRS, numeric rating scale.

combined in order to permit the reporting of a binary outcome—either “time-critical” (response code 1) or “non-time-critical” (response codes 2 or 3). Explanatory variables included age, gender, pain severity (as recorded by the paramedic during patient assessment), pain cause and duration of pain. Descriptive statistics and univariate and multivariate logistic regression methods were used to analyse the association between the response variable (response priority code) and the explanatory variables. Odds ratios (OR) and their associated 95% CI were calculated accordingly. All statistical analyses were considered to be significant at the 0.05 level. Stata version 9 was used to undertake the statistical analysis, with the exception of differences in proportions that were analysed using StatsDirect version 2.6.4 (StatsDirect Ltd, Altrincham, UK).

## RESULTS

A total of 3357 patients was transported by paramedics during the study period, with 1766 (53%) reporting pain (fig 1). The median age of these transported patients was 61 years (interquartile range 39–79). Fifty-two per cent were women. There were 1246 cases in which both an initial pain score using the NRS and a response priority code were recorded. Of these cases, 716/1246 (57.5%) were associated with a code 1 (“time-critical”) response. Code 2 ( $n = 467/1246$ , 37.5%) and code 3 ( $n = 63/1246$ , 5%) cases were combined to give a total number of 530/1246 (42.5%) “non-time-critical” cases. These cases were combined as the sample size of the code 3 group was not large enough to provide sufficient power to detect a difference between the two non-time-critical groups.

An analysis of the relationship between the response code and the initial pain category (table 3) showed that patients with the most severe pain (NRS 8–10) account for approximately 52% of urgent responses and approximately 48% of non-urgent responses.

Table 3 shows statistically significantly greater proportions of patients being assigned to time-critical responses for all grades of severity of pain, with the exception of severe pain, in which there is no significant difference between response priorities assigned. However, as the 95% CI of the pain severity groups do not overlap, it can be stated that although almost all patients are more likely to be assigned a time-critical response than not, this is equally true of patients experiencing no pain as it is of patients experiencing mild, moderate or severe pain in this study (fig 2). This implies that a factor other than the severity of pain influences the response priority code assigned.

Throughout the analysis detailed below the odds (likelihood) of a patient with one of three levels of severity of pain receiving a time-critical response is compared with the odds of a patient with no pain receiving a time-critical response.

A univariate logistic regression analysis found no statistically significant difference in the odds of a patient in pain receiving a time-critical response compared with patients who had no pain, regardless of their initial pain score (NRS 1–3, OR 1.04, 95% CI

0.7 to 1.6; NRS 4–7, OR 1.16, 95% CI 0.7 to 1.8; NRS 8–10, OR 0.77, 95% CI 0.5 to 1.2). After adjusting for gender, age, cause of pain and duration of pain, a multivariate logistic regression analysis also found no significant change in the odds of a patient in pain receiving a time-critical response compared with patients who had no pain, regardless of their initial pain score (NRS 1–3, OR 1.11, 95% CI 0.7 to 1.8; NRS 4–7, OR 1.12, 95% CI 0.7 to 1.8; NRS 8–10, OR 0.84, 95% CI 0.5–1.4).

The cause of pain (in general terms) was, however, found to be statistically significant in predicting the response code priority assigned. The proportion of cases assigned a code 1 response was higher if paramedics reported a cardiac cause for pain 174/192 (91%) as opposed to a traumatic aetiology 213/555 (38%) (95% CI for difference 46% to 58%,  $p < 0.001$ ) or pain from other causes (561/957 (59%), 95% CI for difference 26% to 37%,  $p < 0.001$ ). A univariate logistic regression confirmed that patients with cardiac pain were more likely to be assigned to a time-critical response category than patients with pain arising from a traumatic injury (OR 14.5, 95% CI 8.2 to 25.6). However, further sensitivity analysis found that when the cardiac cause of pain was dropped from the multivariate logistic regression analysis there was still no significant difference in the odds of a patient in pain receiving a time-critical response compared with patients who had no pain, regardless of their initial pain score (NRS 1–3, OR 1.0, 95% CI 0.6 to 1.7; NRS 4–7, OR 0.94, 95% CI 0.6 to 1.6; NRS 8–10, OR 0.73, 95% CI 0.4 to 1.2).

## DISCUSSION

In this study the severity of pain experienced by the patient appeared to have no influence on the level (priority) of the dispatch response. This result may be expected as, with one exception—MPDS protocol number 18 (headache)—the call prioritisation system does not seek information about pain severity.

MPDS is used to assess the caller’s complaints to assign an appropriate response code based on an assessment of the immediate threat to life. The main objective of prioritising dispatch is to send the right resources to each call within the right time interval.<sup>10</sup> This aims to ensure that timely response of the most appropriate clinical level of practitioner is achieved while ensuring that finite ambulance resources are effectively and efficiently deployed.

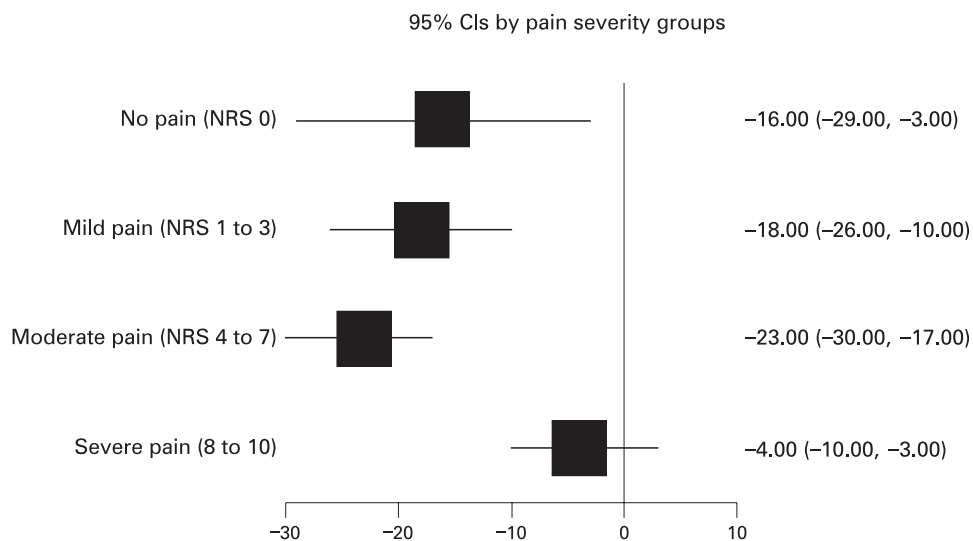
Non-urgent cases (most MPDS alpha categories) or routine patient transfers may be referred to non-emergency transport agencies if the patient meets low acuity criteria.<sup>11</sup> A call referral service was introduced by the metropolitan ambulance service in Melbourne in 2003 to manage low acuity “no priority symptoms” cases that do not necessarily need an ambulance. Callers with no priority symptoms may be provided “over the phone” self-care advice or referral to an alternative healthcare provider, including locum medical services, mental health practitioners, nurses and outreach workers.<sup>5</sup> Approximately

**Table 3** Difference in proportions of patients coded as time-critical or non-time-critical by pain severity

Pain category	Time-critical response (%)	Non-time-critical response (%)	Difference in proportions (95% CI, p)
No pain (NRS 0) $n = 105$	61/105 (58%)	44/105 (42%)	–16% (–29 to –3%, $p = 0.02$ )
Mild pain (NRS 1–3) $n = 266$	157/266 (59%)	109/266 (41%)	–18% (–26 to –10%, $p < 0.001$ )
Moderate pain (NRS 4–7) $n = 456$	281/456 (62%)	175/456 (38%)	–23% (–30 to –17%, $p < 0.001$ )
Severe pain (NRS 8–10) $n = 419$	217/419 (52%)	202/419 (48%)	–4% (–10 to +3%, $p = 0.30$ )
Totals	716/1246 (58%)	530/1246 (43%)	–15% (–19 to –11%, $P = 0.02$ )

NRS, numeric rating scale.

**Figure 2** Comparison of differences in proportions of patients assigned to non-time-critical versus time response priority codes by pain severity groupings. NRS, numeric rating scale.



5% of emergency calls are classified as low priority and these do not generate an emergency ambulance response but are instead referred to alternative service providers.<sup>12</sup>

In this study setting, the ambulance service clinical practice guidelines that inform paramedic care list “severe undiagnosed pain” as a time-critical medical emergency.<sup>13</sup> However, this study found that pain severity does not influence dispatch priority coding. As such, patients with severe pain could be classified as a non-acute (response priority code 3) case and referred to a non-emergency transport agency. As an example, patients with a complaint of a hip injury following a fall at ground level are classified as having a “not dangerous” injury and may be assigned a low acuity MPDS determinant (17A1) if they are alert and breathing normally. The MPDS advice to the call taker is that “ground-level falls in elderly patients commonly result in hip fractures, which are **not pre-hospital emergencies**” (original emphasis).<sup>14</sup> Such patients may consequently be triaged to a response priority code 3, which may result in a response time of an hour and an unnecessary delay before the provision of analgesia. In addition, clinical protocols approved for use by non-emergency ambulance providers do not allow for the administration of opioids for severe pain.

Although it appears reasonable to triage calls to decide whether the call can be referred to another health agency, attempts to do this in the UK have highlighted the significant number of referrals that are returned to the referring ambulance service. In a study of the benefits of managing selected low priority calls by referring these to NHS Direct nurse advisers, the presence of pain and pain severity was reported as a symptom that patients considered inappropriate for referral and which influenced patient satisfaction with the referral service.<sup>15</sup>

An extended range of ambulance response codes that consider pain severity may help to triage patients to ensure that threats to life continue to receive the highest priority and most urgent response, whereas those with emergencies such as severe pain are triaged to receive timely care by the most appropriate agency. This would involve review of the way that MPDS determinants are reclassified at a local level to determine the urgency and nature of the ambulance response. However, this would require careful planning to predict the effect this may have on ambulance availability, as well as the likely influence on the agency’s ability to respond ambulances within locally agreed or mandated response times. Critics may highlight the difficulty

of estimating pain when the caller cannot be seen as an obstacle, particularly as call takers may not be medically trained. The use of an NRS to estimate the patient’s pain severity may provide important information to guide ambulance response and can easily and quickly be taught to a caller. Unfortunately, however, currently available call prioritisation systems are not designed to gather information regarding pain severity.

#### Limitations

This was a retrospective, observational study that used a convenience sample of PCR. Response codes were transcribed from the PCR. This code is transmitted to the responding crew and the paramedic providing the patient care documents the response code on the PCR. This process may have produced transcription errors. Second, only 63/1246 of the cases in this study were coded as response category 3. These cases represent those that may have been managed by emergency ambulance crews due to the unavailability of referral services such as non-emergency transport. This study design precludes an analysis of patient reports of pain that were referred to other agencies, representing a weakness in the study design. Third, the process of matching the MPDS determinant with the appropriate response is locally determined, and as such the results may not be generalisable to other practice settings. Finally, the pain score used as a comparator to the level of response was that documented by paramedics after they had arrived on the scene. It is therefore possible that the severity of pain experienced by patients at the time the call was made was greater or less than that experienced when paramedics arrived on the scene. As no sample size calculation was performed prospectively, it is possible that our failure to detect significant differences in OR for pain severity as a predictive factor of response priority code was due to type II errors.

#### CONCLUSION

Triage and decision-support systems used to prioritise calls and decide the level of ambulance response or referral options need to factor in pain severity as a significant variable that should be considered as part of the prioritisation process. Despite the importance of the rapid provision of analgesics as a humane intervention, in this study pain severity did not influence the triage category and ambulance response priority. Further research in the form of a qualitative study of patients’ and

carers' perceptions about delayed pain management may encourage revisions to dispatch systems to provide timely pain control.

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**Competing interests:** None.

**Ethics approval:** The study was approved by the Monash University Standing Committee on Ethics in Research Involving Humans (protocol number 2004/754) and by the Metropolitan Ambulance Service Research Committee.

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## Images in emergency medicine

### Late-diagnosed diaphragmatic hernia in an 8-year-old girl

An 8-year-old girl presented to the emergency department with left-sided flank pain. Her abdomen examination was normal, but she was pale, dehydrated, tachycardic (116 beats per minute) and tachypnoeic (28 breaths per minute). Her right hemithorax was hyperexpanded. Over the left hemithorax she had decreased air entry, hyperresonant percussion and increased vocal resonance. Chest x ray revealed a left-sided Bochdalek diaphragmatic hernia (fig 1). Placement of a nasogastric tube relieved her symptoms and the diagnosis was confirmed at surgery the next day. The colon, stomach and spleen were within the thorax and the spleen was considerably bigger than the hernial orifice.

Presentation of Bochdalek herniae outside the neonatal period is rare.<sup>1</sup> Our case demonstrates that abdominal organs can remain within the hemithorax for prolonged periods without causing symptoms. This case reminds emergency physicians to consider the diagnosis to prevent incorrect, possibly fatal, treatment.<sup>1</sup>

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**Figure 1** Chest x ray showing left-sided diaphragmatic hernia.

**Competing interests:** None.

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