

Emergency priority dispatch systems—a new era in the provision of ambulance services in the UK

Jon Nicholl, Patricia Coleman, Gareth Parry, Janette Turner, Simon Dixon

Abstract

Objectives—To evaluate the safety and reliability of two priority dispatch systems operated by ambulance services in the UK.

Methods—Using data collected from the dispatch systems of two ambulance services, the patient report forms completed by the ambulance crew at the scene, and the records of the receiving accident and emergency (A&E) departments, a stratified random sample of 600 emergency 999 calls received in each area were assessed by a five member “expert” panel. Those exceptional cases where the priority assigned by the dispatch system was low and that of the panel was high were reviewed in detail.

Results—The panel judged that there were just four cases taken to the A&E department who were assigned a low priority by the systems but which in their opinion warranted a high priority (serious head injury; child with meningococcal meningitis; cardiac arrest; unconscious in the street after hypoglycaemia). Underprioritisation could not have been avoided in only one case (cardiac arrest), which resulted from misinformation from the caller. The estimated risk of serious underprioritisation was one in 2200 emergency calls.

Conclusion—The Department of Health ambulance service performance standards steering group’s recommendation that low priority C calls should be responded to “as soon as possible” rather than “immediately” should be implemented. The risk of serious underprioritisation of calls that should have been assigned a high priority would be far outweighed by the reduction in risk for the one in three patients with high priority conditions who continue to be responded to in over eight minutes.

(*Pre-hospital Immediate Care* 1999;3:71-75)

Keywords: priority dispatch systems; ambulance services; communication; telephone triage

During recent years there have been several significant changes in emergency ambulance services including a 4% increase each year since 1987 in the volume of patients carried to hospital by emergency “999” ambulance, the implementation of an emergency ambulance service operating paramedic units, and the development of new system technologies such as priority dispatch.

Against this background the Department of Health recently undertook a review of ambulance response time standards.¹ These standards, developed in 1975 by Operational Research Consultants and often referred to as “ORCON standards”, had been for a 14 minute (urban) or 19 minute (rural) response to emergency 999 calls in 95% of cases, and within eight minutes in 50% of cases, irrespective of how critical the incident was. The inequity of a different standard for urban and rural services reflected the fact that these standards had been derived in the light of what was achievable rather than what was desirable.

The new standards recommended by the Department of Health steering group were for a response to 90% of potentially life threatening incidents (A calls) within eight minutes, to 95% of serious incidents (B calls) within 14 or 19 minutes, and response “as soon as possible” to other (C) calls. These recommendations depended for their implementation on the use of priority dispatch systems able to safely and reliably categorise emergency 999 calls as A, B, or C.

Priority dispatch systems link the type of response required to medical need by the use of structured protocols and systematic questioning of the caller. They may lead to a more efficient use of resources. For example, ambulances may not be dispatched immediately to calls assigned a “low” priority when no cover is available and this can release ambulance resources to respond more quickly to calls assigned a higher priority. In addition, priority dispatch systems can assign the type of crew required (advanced life support or basic life support), though currently this is of little relevance in the UK since all or nearly all ambulance crews have advanced life support skills. Control staff can also provide pre-arrival advice and instructions to callers. The major challenge is to minimise the risk of inappropriate underprioritisation of calls. The results of an independent study examining the safety and reliability of two different priority dispatch systems operated by two ambulance services in the UK are reported here.

The systems studied were the criteria based dispatch (CBD) system,² and the advanced medical priority dispatch (AMPD) system.³ The CBD system is based on guidelines and permits the dispatcher to use a wider element of discretion and interpretation of the calls than does the AMPD system, which relies on scripted questions and protocols predetermined by the ambulance service using the system. For the purposes of the ORCON performance standards the services in both areas

Medical Care Research Unit, ScHARR, University of Sheffield
J Nicholl
P Coleman
G Parry
J Turner

Sheffield Health Economics Group, ScHARR, University of Sheffield
S Dixon

Correspondence to:
Patricia Coleman, Medical Care Research Unit, ScHARR, University of Sheffield, Regent Court, 30 Regent Street, Sheffield S1 4DA (e-mail: p.coleman@sheffield.ac.uk).

Accepted 9 January 1999

were designated as "rural" but they were selected because both had been using their particular dispatch systems for some time and staff were fully trained and experienced in their systems. When the study was undertaken, adherence with the ORCON standards was still required and the systems operated in each area in "shadow" form only.

Methods

ASSESSMENT OF SAFETY AND RELIABILITY

The study used a five member review panel to assess the relative priority with which an emergency ambulance should have been dispatched to a sample of 999 calls that had been prioritised by the two priority dispatch systems.

In both dispatch systems studied there is the flexibility for an ambulance service to determine what response is to be assigned to each priority category and how they are referenced internally. For this study, the review panel's categories were defined as:

A—high priority; immediate response with lights and sirens.

B—medium priority; immediate response without lights and sirens.

C—low priority. Response made as soon as possible but within one hour.

AMPD classifies calls into four categories according to the urgency and level of response needed. For purposes of comparison with the panel we have reconfigured the AMPD classification into three levels: alpha which is the lowest priority of response, delta which is the highest priority of response (A), and other charlie and bravo calls which have been assigned to medium level response (B). CBD uses three levels of response priority that has been compared directly with the panel's three categories.

In each area a stratified random sample consisting of 250 low priority, 250 medium priority, and 100 high priority 999 calls received from the public during the period February to July 1995 and which resulted in an ambulance response at the scene were investigated. General practitioner "urgent" calls were not included. For each call, a verbatim transcript of the 999 call was sought from the ambulance service, and dispatch details from the computer aided system, including the priority dispatch code assigned. Data was also collected from the patient report form completed by the ambulance crew at the scene, and from the receiving accident and emergency (A&E) department.

The review panel consisted of three consultants (in A&E medicine, cardiology, and anaesthesiology), and two ambulance service paramedics, one of whom is a control room manager. The panel's assessment was made in three stages using the information available to the dispatcher at the time the call was received, the additional information collected at the scene by the crew which might have been available to the dispatcher if it had been requested, and at stage 3 the further information available from the examination, history, and initial diagnosis in the A&E record. Comparisons re-

ported here are between the system assigned priorities and the panel's priority assessed at stage 3. The panel's final assessment was determined by the majority opinion, followed by collective review of cases that had been assigned a low priority by the dispatch systems but high priority by the panel.

The study was not designed to compare the performance of the two systems, but rather to assess both in the light of the panel's assessment of the appropriate response. The panel was not asked to assess the priority that would have been appropriate using the categories which at the time were being considered by the Department of Health's review of response time performance standards.¹ Nor was the group asked to judge whether the priority assigned by the system was the right one or not. Rather the process was used as a filter to identify those calls assigned a low priority by the systems but which might have needed a high priority. Thus at a final stage, all such "filtered" cases were rereviewed in detail by the panel together with the research team to assess the potential seriousness of any underprioritisation, and to identify any possible ways in which the systems might be adjusted and improved.

DESCRIPTIVE STUDIES

The two systems, CBD and AMPD, employ very similar initial ("vital") questions which it is mandatory to ask in AMPD. The explanatory notes for CBD also say the questions "should be considered as mandatory", although this is open to a degree of interpretation as the CBD questions are generally referred to as guidelines rather than scripted protocols. Simple random samples of 62 calls with complete verbatim call transcripts were selected from each area and were examined to assess whether the questions that were asked by the call takers conformed to these dispatch protocols.

Results

STUDY NUMBERS

Data from ambulance services and A&E departments was collected on 1200 incidents. Because of duplication (28), missing information (31), and cases later found to be doctor's urgent calls (15), the priorities assigned to 1126 calls were examined by the expert panel (table 1).

PANEL ASSESSMENTS

In terms of the panel's assessment of priority based on all available relevant information, the

Table 1 Numbers of 999 emergency calls examined in the study

Dispatch priority	No (%) incidents in survey period	No of incidents assessed
Area 1 CBD		
High (A)	25224 (32.7)	97
Medium (B)	34900 (45.2)	237
Low (C)	17084 (22.1)	237
Area 2 AMPD		
High (delta)	11622 (32.9)	94
Medium (charlie, bravo)	18198 (51.5)	224
Low (alpha)	5510 (15.6)	237

Table 2 Agreement between system assigned priorities and panel assessments

System priority	Panel priority			All
	High	Medium	Low	
Area 1 CBD				
High (A)	39	52	6	97
Medium (B)	49	161	27	237
Low (C)	13	173	51	237
Area 2 AMPD				
High (delta)	19	27	1	47
Medium (charlie or bravo)	102	151	18	271
Low (alpha)	11	178	48	237

sensitivity of CBD to the panel’s assessment of the need for “high” priority dispatch was 39% (39/101) with a positive predictive value of 40% (39/97), and the sensitivity of AMPD was 14% (19/132) with a positive predictive value of 40% (19/47) (table 2).

Most of the apparent underprioritisation implicit in these sensitivities was due to the systems assigning a medium priority, rather than a high priority as preferred by the panel. In area 1 95% of the panel’s high priority cases were assigned a high or medium priority by CBD, and 98% by AMPD in area 2.

Thus only a small part of this underprioritisation was due to the systems assigning a low priority to calls the panel felt needed a high priority response. Based on all the available information including A&E records, the panel initially judged that there were 10 patients taken to A&E who had needed a “high” priority response but had been assigned a low priority by CBD (4/237) or AMPD (6/237). On review by the panel collectively only four of these 10 cases of underprioritisation were judged to have been potentially serious. Details of these cases are shown in table 3. One appeared to have been due to a software or system error (case 1), one was either an instance of incorrect information from the caller or of the patient deteriorating rapidly between the call and the arrival of the ambulance when the

Table 3 High priority cases, prioritised low

Case 1	Male, age 35, 10.18 hours Main problem recorded: PD category assignment: Actual condition: Problem:	Convulsions/fits 12A01—convulsions/fits Unconscious in public place after hypoglycaemic episode Software or operator error
Case 2	Male, age 85, 02.34 hours Main problem recorded: PD category assignment: Actual condition: Problem:	Fallen out of bed ? injuries 17C04—sick unknown. Patient assistance DoA of paramedics at the scene from cardiac arrest Probably misinformation
Case 3	Male, age 28, 15.08 hours Main problem recorded: PD category assignment: Actual condition: Problem:	Head injury from fall 25C01—head injury. Bumps/lacerations Assaulted by hammer. Described in transcript as “bleeding to death”. Fractured skull and mandible. Lacerations. Admitted for neurosurgery Assessing severity of head injuries
Case 4	Female, age 4, 07.27 hours Main problem recorded: PD category assignment: Actual condition: Problem:	Small bruises/headache 26A01—sick person. No priority symptoms “Absolutely covered in little tiny bruises”, headache, “sky-high” temperature, slept for 36 hours constantly. Meningococcal meningitis. Intensive care unit—survived EMD systems are not diagnostic. No separate protocols for small children

PD = priority dispatch.

Table 4 Hospital admission by system assigned dispatch priority

Priority	Admitted	Not admitted	All assessed
Area 1 CBD			
High (A)	26.5	73.5	97
Medium (B)	24.3	75.7	237
Low (C)	21.0	79.0	237
Area 2 AMPD			
High (delta)	65.3	34.7	47
Medium (charlie or bravo)	52.3	47.7	271
Low (alpha)	36.0	64.0	237

patient was found dead (case 2), one was the result of the way in which head injuries are classified by CBD (case 3), and the fourth was a case of meningococcal meningitis in a child (case 4). This latter call might have been classified as immediate if the dispatcher had asked different questions and not led the caller into implying that the child was alert, but it would not have been classified as high priority. Thus it was judged that potentially four calls were seriously underprioritised but this could be revised to just one (in the case of the incorrect information) if appropriate measures could be taken to eliminate all remediable causes. In this case, after taking account of the stratification, it was estimated that only one call in 2200 may be potentially seriously underprioritised.

Two deaths were not assigned a “high” priority. One patient had died some time previously and clearly did not warrant a “high” response, and the other was the patient referred to above (case 2) who may have deteriorated after the original 999 call. The systems’ priority assignment was only weakly related to the likelihood of hospital admission (table 4). Whether this reflects a fault in the systems or the fact that hospital admission is only weakly related to risk is unclear. Predicting admission is not of course a function that the systems have been designed to carry out, and probably, therefore, not one by which they can be judged.

The AMPD system dispatchers followed the initial mandatory protocol asking about location, age, sex, and breathing and consciousness in 95% of calls (table 5). However, we did find some instances when the questions had been asked but the answers wrongly entered into the system and in over half the cases (55%) leading questions had been asked (for example “but she is alert now, isn’t she?”). With the CBD system questions about breathing and consciousness were asked in 50% of calls. Plainly in the CBD system, earlier questions relating to the main complaint meant that these questions were often considered redundant, and it is difficult to make any judgment about whether

Table 5 Frequency with which questions were asked

	Area 1 CBD (n=62 calls)	Area 2 AMPD (n=62 calls)
Vital questions		
Age and sex	50 (80.6)	60 (96.8)
Breathing and consciousness	31 (50.0)	60 (96.8)
Other questions		
Severity of condition	32 (51.6)	51 (82.3)
Leading questions	18 (29.0)	34 (54.8)

their omission was a failure of the system or reflected the success of having a more flexible approach.

Discussion

Considerable discrepancy was found between the expert panel and the priority dispatch system assessments of priority for 1126, 999 calls. However, this was mainly due to the fact that the panel felt a high priority should be given to many calls to which the systems assigned a medium priority. Since there is some evidence that lights and sirens may make only a small difference to response times, at least in urban areas,⁴ this difference though possibly of some importance to the public, may be of little practical importance. The difference probably reflects the particular sensitivity of the panel to risk, rather than a failure of the systems, or the fact that both systems assign a priority based on the level of response needed (advanced life support or basic life support) as well as the urgency of response needed, while the panel were asked to assign priority based only on the perceived urgency of response needed. Furthermore, this study did not aim to compare the performance or the effectiveness of the two systems the reliability of which are discussed elsewhere. For example, an American study of the accuracy of pre-dispatch triage of 1080 consecutive calls prioritised by the emergency medical dispatch program (a version of AMPD) found "... minimal error for under-triage".⁵ Although the 35 calls excluded from this particular sample (see p 266) may have implications for the reported accuracy, a previous study found a 0.3% dispatch error in calls assigned to a low priority that subsequently required urgent medical attention.⁶ A review of a pilot study of 230 calls prioritised by paramedic ambulance staff in Glasgow, UK, using the CBD system concluded "... No cases of genuine need would suffer were a properly-conducted CBD system introduced".⁷

In our study, in four calls a low priority was assigned by the systems to incidents the panel felt warranted a high priority.

HEAD INJURIES

One of these four cases, and several borderline cases that were discussed at panel meetings, revolved around head injuries. In the CBD system if the patient is conscious and breathing and the main complaint is identified as "head injury" then the classification of the injury "bumps and lacerations" leads to a low response (CBD category C). The patient with a fractured skull and mandible, and bleeding from head and neck (case 3) was prioritised "low" as was another "head injury" patient discussed extensively by the panel, who had a 20 cm scalp laceration. In the latter case the panel decided that an immediate response without lights and sirens would have been appropriate since the patient's life was not at risk, but the panel were unanimous that a "low" prioritisation was inappropriate. Head injury patients who "talk and die" for whom immediate but not low priority might be appropriate are also

not uncommon.^{8,9} Perhaps in recognition of these difficulties there is no category for "head injury" as the main complaint in the AMPD system, and following several alternative routes for main complaints relating to trauma, AMPD always categorises head injuries as "high" or "medium".

CHILDREN

A second case (number 4) was a 4 year old child with meningococcal meningitis. Several other cases discussed by the panel involved children in pain and distress—including a child aged 1 with febrile convulsions and two children with facial burns. After discussion the panel felt that an immediate medium priority response was appropriate in these latter cases, but that a low priority response was clearly inappropriate.

It is perhaps surprising that the prioritisation systems CBD and AMPD do not have separate but parallel prioritisation schedules for children. Some aspects of the priority setting process such as language, the significance of particular signs and symptoms, the rate of progression and risks associated with particular diseases, and the capacity for causing pain and distress in others at the scene, are very different for adults and children.

MAIN COMPLAINT

A third source of potentially serious underprioritisation occurred with choosing the "main complaint". After establishing that the patient is conscious and breathing, and therefore does not automatically warrant a lights and sirens response, in both systems the dispatcher must establish the patient's main complaint. This is a discretionary element relying on the dispatcher's judgment based on appropriate questioning. In some instances, and particularly in the case of trauma, there may be several complaints (injuries), and choosing the main complaint will often determine the level of response.

As in any such instance there are two possible approaches that can be taken and these are broadly reflected by the CBD and AMPD systems. Either a rigid protocol or rule based approach such as is taken by AMPD can be followed, or a flexible and investigative approach can be adopted.

Problems with the first approach occur either when the rules are not universally applicable or they are not followed when they are applicable. The main complaint of a young woman described by the caller as having "slashed her wrist" and to be "bleeding badly" was identified as laceration, and when it was established that the bleeding was controlled, a low response priority was assigned. However, if the main complaint had been identified as "emotional/psychiatric" an immediate response would have been assigned.

The advantages of the alternative flexible approach lie in being able to weigh up the evidence as more information becomes available, or indeed to pursue more than one complaint, before deciding on the appropriate response. The other side of the coin, of course, is the

need for experienced and well trained dispatchers able to make more responsible decisions.

In either case, identifying the "main complaint" is a critical step in priority dispatch, requiring thorough training, audit, and quality control.

INCORRECT INFORMATION OR CHANGES IN PATIENTS CONDITIONS

No system of priority dispatch can overcome the problem of incorrect information. The caller reporting that his father had fallen out of bed when in fact he had probably had a cardiac arrest is one example of how this can arise.

In this instance it is also possible, though less likely, that the father had fallen out of bed but that between the 999 call being made and the arrival of the ambulance the patient had had an arrest. This is unlikely in this case because the ambulance, dispatched immediately, arrived in five minutes. Nevertheless, it serves to point out the fact that between call and arrival patients' conditions may deteriorate and this may argue again for the need for an immediate response in all cases to minimise the risk of this occurring. In a sense this can be considered a case of "incorrect information". However, our study shows that this is a numerically rare event.

Conclusions

Priority dispatch systems have the potential to enable life threatening emergency calls to achieve faster responses by focusing resources on them, and in this way they could help save lives and result in benefits for patients. No priority system can be expected to identify such cases without also wrongly identifying some calls as life threatening emergencies, and also failing to identify some possible life threatening emergencies. We have estimated that approximately one in 560 999 calls to ambulance services may have been underprioritised in this way by the emergency medical dispatch systems CBD and AMPD, but after eliminating remediable causes this should mean that just one in 2200 calls may be potentially serious underprioritisations.

If the response times could be reduced to eight minutes for 90% of high priority calls as recommended by the Department of Health steering group, it is likely that the potential risks associated with one in 2200 emergency calls being potentially seriously underprioritised would be far outweighed by the reduction in risks for the one in three patients with high

priority conditions who are currently responded to in over eight minutes.

At present the steering group's recommendations have not been fully implemented, and instead the standards are for 75% of A calls to be responded to in eight minutes, and 95% of all other calls, medium and low priority, to be responded to within 14 or 19 minutes. However, any improvement in A call response times will be difficult to achieve without reduction in C call response times.

In order to eliminate remediable causes of underprioritisation we suggest that consideration should be given to:

- Assigning all trauma in which a head injury is the main complaint to a high or medium response category.
- Assigning all incidents involving children under 5 to a medium priority response category, or a higher category as appropriate, rather than all children under 2 to a high priority category as in the current standards.
- The need to emphasise the importance of identifying the main complaint in the training and audit dispatchers implementing the systems.
- Whether the systems should take circumstances other than the patient's immediate clinical prognosis into account before in assigning a "low" or "medium" priority.

The authors would like to thank members of the expert panel who assessed the priorities assigned by the two dispatch systems: Dr P Baskett, Dr A Macintosh, Mr P McDermott, Mr J Wardrope, and Mr A Withers.

We would also like to thank the officers and staff of the ambulance services, particularly those involved in the operation of the control rooms and our colleagues Elaine Allen and Shirley Brewer who helped us with this study.

Conflict of interest: none.

Funding: this study was commissioned by the Department of Health. The views expressed are those of the authors and not necessarily those of the Department of Health.

- 1 Department of Health. *NHS Executive review of ambulance performance standards*. Final report of steering group. London: Department of Health, July 1996.
- 2 Culley LL, Henwood DK, Clark JJ. Increasing the efficiency of emergency medical services by using criteria based dispatch. *Ann Emerg Med* 1994;24:867-70.
- 3 Clawson JJ, Martin RL, Hauert SA. Protocols vs guidelines. Choosing a medical-dispatch program. *Emergency Medical Services* 1994;23(10):52-60.
- 4 Hunt RC, Brown LH, Cabinum ES, *et al*. Is ambulance transport time with lights and siren faster than that without? *Ann Emerg Med* 1995;25:507-11.
- 5 Stratton SJ. Triage by emergency medical dispatchers. *Prehospital and Disaster Medicine* 1992;7:263-9.
- 6 Marsden AK. Getting the right ambulance to the right patients at the right time. *Accident and Emergency Nursing* 1995;3:177-83.
- 7 Slovis CM, Carruth TB, Seitz WJ, *et al*. A priority dispatch system for emergency medical services. *Ann Emerg Med* 1985;14:1055-60.
- 8 Reilly PL, Graham DI, Adams JH, *et al*. Patients with head injury who talk and die. *Lancet* 1975;ii:375-7.
- 9 Marshall LF, Took BM, Bowers SA. The national traumatic coma data bank. Part 2: Patients who talk and deteriorate: implications for treatment. *J Neurosurg* 1983;59:285-8.