

## RESEARCH

## The appropriateness of emergency medical service responses in the eThekweni district of KwaZulu-Natal, South Africa

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**Introduction.** Emergency medical services (EMS) are sometimes required to respond to cases that are later found not to be emergencies, resulting in high levels of inappropriate responses. This study evaluated the extent to which this occurs.

**Methods.** All cases dispatched over 72 hours by the eThekweni EMS in Durban, South Africa, were prospectively enrolled in a quantitative descriptive study. Vehicle control forms containing dispatch data were matched and compared with patient report forms containing epidemiological and clinical data to describe the nature and extent of inappropriate responses based on patient need. Data were subjected to simple descriptive analysis, correlations and  $\chi^2$  testing.

**Results.** A total of 1 385 cases met the study inclusion criteria. Marked variations existed between dispatch and on-scene priority settings, most notably in the highest priority 'red-code' category, which constituted >56% of cases dispatched yet accounted for <2% at the scene ( $p<0.001$ ). Conversely, >80% of 'red-code' dispatches required a lower priority response. When comparing resource allocation according to patient interventional needs, >58% of cases required either no intervention or transport only and almost 36% required basic life support intervention only ( $p<0.001$ ). Moreover, <12% of advanced life support dispatches were for patients found to be 'red code' at the scene.

**Conclusion.** There is a significant mismatch between the dispatch of EMS resources and actual patient need in the eThekweni district, with significantly high levels of inappropriate emergency responses.

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Emergency medical services (EMS) attend cases involving patients who have been classified as having time-critical life-threatening illnesses or injuries. An EMS unit will typically respond to these cases on the basis of information provided by a caller to the EMS provider's emergency medical communications centre (EMCC). Before the unit is dispatched, the caller, who may or may not be the patient, is routinely questioned by an emergency medical dispatcher, who ascertains the level of EMS response required based on the answers provided. When the responding EMS unit arrives at the scene, however, it is frequently found that many of these patients do not in fact represent an emergency; high levels of inappropriate EMS responses may therefore be occurring. Furthermore, many of the patients who are transported do not have a clearly defined need for EMS intervention,<sup>[1]</sup> yet there is an expectation that they must be taken to a medical facility. When these mismatches occur, the response may be deemed to be inappropriate.

A response may be inappropriate in several ways,<sup>[2]</sup> i.e. when an EMS provider:

- commits an underutilisation of resources for critical patients, resulting in an unmet need
- commits an overutilisation of resources for persons with needs not ideally addressed by higher levels of EMS care
- commits an overutilisation of resources for persons with needs not ideally addressed by EMS at all, and/or
- commits resources to a response utilising 'emergency response procedures' to non-time-sensitive acute illness or injury.

The reasons for inappropriate responses are not fully understood and are thought to be complex and varied. Reasons cited include public ignorance or misunderstanding relating to the use of EMS systems, poor or unavailable alternative public transport, inaccessible or distant primary healthcare facilities, deliberate misrepresentation or exaggeration of need, and malicious hoax calls.<sup>[3]</sup>

Whether responses to calls are appropriate or inappropriate, the potential for vehicle or pedestrian collisions is often present. The unnecessary use of emergency driving procedures with lights and sirens may expose responding EMS crews and members of the public to an increased risk of serious injury or even death.<sup>[4]</sup> Moreover, once the responding unit arrives at the scene, the EMS crew is compelled to transport the patient to hospital, irrespective of his or her condition. This results in the unit being tied up in a system with already limited resources, frequently leaving no more units available to respond to further incoming calls.

Studies conducted in developed countries suggest that widespread inappropriate use of EMS systems has been evident since the 1970s and that up to 52% of all requests for an EMS response are later found to be inappropriate.<sup>[5]</sup> Three studies have been undertaken in South Africa (SA). Frank and De Villiers<sup>[6]</sup> showed that up to 68% of the cases transported by the Caledon EMS in Overberg, Western Cape Province, were not emergencies and that the inappropriate use of EMS units resulted in unnecessary costs. McFarlane *et al.*<sup>[7]</sup> highlighted high levels of inappropriate use of EMS vehicles in the greater Johannesburg area, which overwhelmed a system that was already severely under-resourced, and Meents and Boyles<sup>[8]</sup> showed that 16.7% of all EMS requests in the Eastern Cape Province were never dispatched.

In KwaZulu-Natal Province (KZN) there have been no studies relating to the possible inappropriate use of EMS resources, and there is a paucity of evidence relating to EMS in general. The studies mentioned in the preceding paragraph cannot be generalised to either KZN or the eThekweni district owing to differences

in demographics, disease profiles, geography, and EMS operating systems and procedures.

## Objective

To evaluate the appropriateness of EMS responses in the eThekweni district of KZN by asking whether the various levels of response assigned on dispatch adequately and routinely met the clinical needs of patients in terms of resource allocation.

## Methods

### Research setting and population

The study was conducted in the eThekweni health district of KZN, one of the province's 11 health districts, encompassing the greater Durban area. The population of eThekweni was last recorded in the 2007 community census at almost 3.5 million people and the population density is estimated at 1 394 people per km<sup>2</sup>, with approximately 10% living in underdeveloped informal settlements.

The study population comprised all EMS responses undertaken by the KZN Department of Health within the eThekweni health district, which according to unpublished statistical data averaged in excess of 400 daily.

### Sample

Purposeful sampling comprised emergency calls to the eThekweni health district EMCC placed, logged and physically responded to over a busy 72-hour month-end period, 24 hours of which included a weekend peak period. By spreading the sampling over this period, the data collected gave a fair representation of the different categories of cases responded to and of the rates and frequencies of these responses.

Data were collected over the period 24 - 26 November 2011, the first available period as described above immediately following ethical and organisational approval. Altogether 1 689 responses were recorded, of which 1 385 met the study inclusion criteria. A total of 304 records were excluded because data were incomplete or a dispatch did not actually occur (e.g. cancelled or duplicated cases).

### Data collection and analysis

Computerised dispatch logs were accessed through the EMCC's Zetron DCS-5020 digital console system, from which vehicle control forms were generated. Data extracted comprised the dispatch priority setting and the initial level of resource allocation. These were then matched and compared with the corresponding EMS unit patient report form, from which data relating to the on-scene priority setting and the required level of patient interventions were extracted.

Dispatch and on-scene priority settings were categorised using a standardised triage scale, and the resource allocation and patient interventions were categorised against the capabilities of the responding emergency care providers as defined by the Health Professions Council of South Africa.<sup>[9]</sup>

Data were then entered into IBM Statistics SPSS version 21 and, in consultation with a statistician, subjected to simple descriptive analysis, correlations and  $\chi^2$  testing.

### Ethical considerations

Ethical approval was granted by the Durban University of Technology's Institutional Research Ethics Committee (ref. FHSEC 009/11) and the KZN Department of Health Research and Knowledge Management sub-component (ref. HRKM 159/11).

## Results

There were more female than male patients ( $n=699$  (50.5%) and  $n=645$  (46.6%), respectively). The gender of the patient could not

be established in 41 cases (2.9%). Patients ranged in age from newborn to 99 years old (mean 32.5 years for males and 33.1 years for females).

Marked variations existed between dispatch and on-scene priority settings, which were most notable in the highest-priority, life-threatening 'red-code' category. This category constituted >56% of cases dispatched yet accounted for <2% at the scene ( $p<0.001$ ). These figures represent an over-triage rate of >93% (Fig. 1). Similar albeit less notable results were seen in the yellow-code (urgent but non-life-threatening) category, with an over-triage rate of just over 13% and an under-triage rate of <2%. The green-code (non-urgent) category, however, showed a disturbing under-triage rate of >82%, with almost 1 in 10 patients being found to be red code by responding crews once at the scene (Table 1).

When comparing resource allocation according to patient interventions, >58% of cases attended required no intervention or a means of transport only and <36% required basic life support (BLS) intervention ( $p<0.001$ ). Patients requiring intermediate life support (ILS) and advanced life support (ALS) interventions comprised 4.0% and 1.4%, respectively. When BLS resources were dispatched, <2% of patients required intervention at a higher level. Conversely, when ALS resources were dispatched, almost 61% of patients required either no intervention or a means of transport only, with <15% actually requiring an ALS intervention (Table 2). Moreover, <12% of ALS dispatches were for patients found to be red code at the scene, with >80% of dispatches being for patients who were coded either yellow or green at the scene (Table 3).

Patients were transported and delivered to a health institution in a total of 970 (70.0%) of the 1 385 cases in which EMS were dispatched. Patients who were not transported, irrespective of whether they received any intervention or not, totalled 415 (30.0%). This figure included 271 patients who were never located, leaving the total number of EMS patient contacts at 1 121.

### Discussion

The disagreement rates demonstrated by the high levels of over-triage across the red- and yellow-code categories in this study compare unfavourably with modest rates as low as 26% reported elsewhere.<sup>[10]</sup> Under-triage rates, particularly in the green-code category, also compared unfavourably with rates of between 4% and 7% reported elsewhere.<sup>[11]</sup>

Similar disagreements were evident when comparing the interventional requirements at the scene with the levels of dispatch. In the majority of cases in which ALS resources were dispatched, patients required no intervention or a means of transport only, leaving less than 2 in 10 patients actually requiring an ALS intervention. Although this mismatch has been evident in EMS systems elsewhere, such high levels of inappropriate ALS dispatch to lower-priority patients have not been seen. Surprisingly, >95% of patients required nothing more than a BLS-level intervention.

It is clear from the results presented that appropriate allocation of resources aimed at meeting patient needs is not being achieved and that needs cannot be met effectively owing to the high levels of inconsistencies reported. Of particular concern is the high proportion of cases in which EMS resources are routinely dispatched to cases that either require no intervention or a means of transport only. Such cases represent almost 6 out of 10 dispatches by the eThekweni EMS. This figure is similar to that in one of the studies conducted in SA,<sup>[6]</sup> with international studies reporting rates of between 11% and 52%.<sup>[5]</sup>

There is undoubtedly an urgent need for

the eThekweni EMS to review its existing strategies relating to decisions made on the allocation of resources based upon patient need. Adopting evidence-based alternatives to the traditional dispatch of emergency ambulances and the transportation of patients to primary admitting centres may be a way to achieve this.<sup>[12-14]</sup> Two important strategies that may be considered are computer-aided dispatch, such as the Medical Priority Dispatch System (MPDS), and alternative routing of patients.

### The Medical Priority Dispatch System

The MPDS is designed to accurately highlight and prioritise patients into order of clinical need, and involves protocols that assign different levels of response based on caller answers to a set of standardised questions. Additionally, pre-arrival or post-dispatch instructions can be offered to the caller if, for example, a lifesaving intervention is needed immediately. This is generally achieved through the use of complex algorithmic computer programs that utilise protocol-based, scripted interrogation processes. The MPDS has been developed through evidence-based research, and the literature shows that

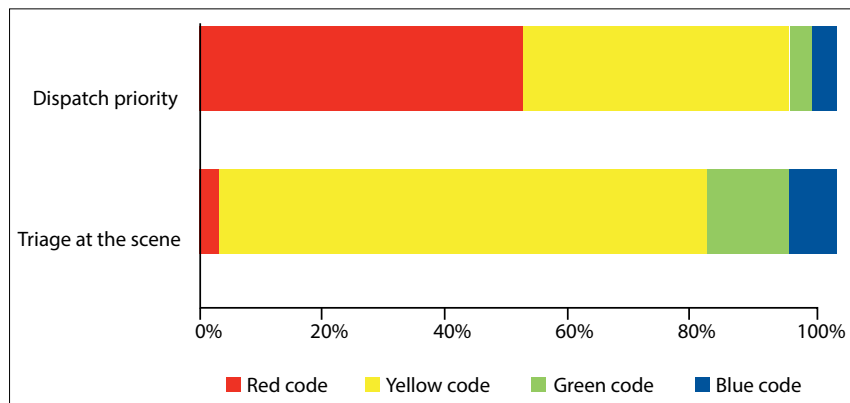


Fig. 1. Comparison of dispatch priority v. triage code at the scene.

Table 1. Comparison of priority/triage allocations between dispatch and at the scene, n (%)

	Triage code at the scene				Total
	Red code/ priority 1	Yellow code/ priority 2	Green code/ priority 3	Blue code/ priority 4	
Triage code on dispatch					
Red code/ priority 1	14 (2.4)	469 (79.8)	68 (11.6)	37 (6.3)	588 (100.0)
Yellow code/ priority 2	7 (1.4)	407 (82.6)	75 (15.2)	4 (0.8)	493 (100.0)
Green code/ priority 3	3 (7.5)	30 (75)	7 (17.5)	0 (0.0)	40 (100.0)
Total	24 (2.1)	906 (80.8)	150 (13.4)	41 (3.7)	1 121 (100.0)

**Table 2. Qualification level of emergency care provider v. intervention at the scene, n (%)**

	Nature of intervention					Total
	None required	Transport only	BLS	ILS	ALS	
Emergency care provider qualification						
BLS	178 (25.4)	216 (30.8)	294 (41.9)	9 (1.3)	4 (0.6)	701 (100.0)
ILS	164 (26.7)	213 (34.6)	193 (31.4)	39 (6.3)	6 (1.0)	615 (100.0)
ALS	39 (56.5)	3 (4.3)	9 (13.0)	8 (11.6)	10 (14.5)	69 (100.0)
Total	381 (27.5)	432 (31.2)	496 (35.8)	56 (4.0)	20 (1.4)	1 385 (100.0)

**Table 3. Qualification level of emergency care provider v. triage code at the scene, n (%)**

	Triage code at the scene				Total
	Red code/ priority 1	Yellow code/ priority 2	Green code/ priority 3	Blue code/ priority 4	
Emergency care provider qualification					
BLS	9 (1.6)	480 (85.9)	61 (10.9)	9 (1.6)	559 (100.0)
ILS	10 (1.9)	396 (76.3)	84 (16.2)	29 (5.6)	519 (100.0)
ALS	5 (11.6)	30 (69.8)	5 (11.6)	3 (7.0)	43 (100.0)
Total	24 (2.1)	906 (80.8)	150 (13.4)	41 (3.7)	1 121 (100.0)

where priority dispatch systems are used, and compliance and quality assurance controls are in place, the system is more effective at triaging calls correctly than an emergency medical dispatcher.<sup>[14]</sup>

The eThekweni EMS currently does not make use of a recognised MPDS, and the system in use has few procedures in place to ensure the thorough and structured interrogation of callers. Additionally, only three levels of dispatch priorities are routinely allocated and callers are offered little in terms of pre-arrival instructions. It is important to note that this system is not limited to the eThekweni district but is in widespread use throughout KZN.

**Alternative routing of patients**

The need to match patient need to limited EMS resources more efficiently has driven many EMS systems to consider safe alternatives to traditional response methods. At the point of dispatch, these may include referral to non-emergency access numbers, such as the NHS 111 number in the UK, or alternative appropriate services or facilities.<sup>[12]</sup> Additionally, if patients can be identified as suffering from minor illness or injury once an EMS unit reaches the scene, it may be possible to offer alternatives to emergency ambulance transportation.<sup>[13]</sup>

These alternatives, based on patient presentation, may include a straightforward refusal to transport, treatment at the scene and/or referral to a further care facility by other transportation means, or on-scene treatment and discharge. However, caution should be advised, as few rigorous trials have been reported and the evidence of the safety and efficacy of alternative responses is conflicting and weak.

At present, unless the patient specifically refuses to be transported, the eThekweni EMS transports all patients to hospital irrespective of their condition. Patients with relatively minor illness or injury are frequently transported over extended distances, often bypassing facilities that may be more appropriate. This is also common practice throughout KZN, and arguably wastes expensive and limited resources that could be utilised better elsewhere. Moreover, patients transported directly to hospital may overburden already under-resourced emergency departments.

**Study limitations**

There were three main limitations to the study: the cross-sectional design did not take into account seasonal changes in patient need; the sample size was relatively small considering the population; and the

population was restricted to the urban and periurban districts of eThekweni. The results might have been slightly different had the study been conducted longitudinally, over an extended period of time, and within the greater SA geographical context.

**Conclusions**

The study findings clearly confirm that there is a significant mismatch between the dispatch of EMS resources and actual patient need in the eThekweni district of KZN, with significantly high levels of inappropriate emergency responses. This situation is likely to continue unless strategies designed to optimise the use of limited resources are employed. Further research and development in the areas of medical priority dispatch systems and alternative routing of patients in a wider SA context are needed and encouraged.

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