

Audit of an emergency ambulance service: impact of a paramedic system

ABSTRACT—The purpose of this survey was to assess the workload of an emergency ambulance service, to describe the use of paramedic skills by those staff with full extended training, and to predict the impact upon the provision of pre-hospital care of deploying a paramedic on every emergency ambulance. Accordingly, a week-long survey was undertaken of all urgent and emergency calls received by an ambulance service covering a mixed urban and semi-rural area of 187 square miles with a population of 396,000. Of the total 682 emergency calls 351 (51.5%) originated from the '999' system: 291 of these patients were taken to hospital where 51% were thought to have minor conditions and 141 were admitted. General practitioners made 236 (34.6%) emergency calls: 234 patients were taken to hospital where 76.4% were thought to have potentially serious conditions or an acute risk to life and 217 were admitted. There was no difference in the type or severity of conditions attended by paramedic or non-paramedic crews. Time spent on-scene was significantly longer when paramedics were present (mean 11.0 min, 95% confidence interval 9.54–12.46 min v 8.31 min, 7.49–9.13 min) ($p < 0.01$). Extended skills were used by paramedics in 42 (23.6%) of their patients, most of whom were medical cases. One patient was resuscitated from cardiac arrest. The presence of a paramedic on every emergency ambulance increases the time spent on-scene and offers advanced pre-hospital skills to patients who need them. Care should be taken to ensure that the benefits of time spent on-scene using such skills outweigh the disadvantage of delayed hospital admission.

The development of extended training in ambulance aid dates from the early 1970s when certain enthusiastic medical and ambulance personnel devised local schemes to improve pre-hospital care [1]. The introduction of further schemes was delayed because of scepticism regarding the effectiveness and impact of ambulance staff with extra skills. However, such schemes were eventually authorised in 1984 without

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giving health authorities clear responsibility to proceed [2].

In 1986, the South Glamorgan Ambulance Service began training its staff in drug administration, intubation, fluid replacement, and defibrillation. At present some vehicles are manned by qualified staff capable of giving basic life support, and others by fully trained ambulance 'paramedics'. There is no specific allocation of duties to either of these types of crew: the nearest or next available vehicle and crew respond to an emergency call.

South Glamorgan has a population of about 396,000 and covers an area of approximately 187 square miles. A central control officer dispatches crews from one of three ambulance stations. Patients are taken either to a teaching hospital or to one of three district general hospitals (one of which is in Mid Glamorgan).

The Secretary of State has now decided that by 1996 all emergency ambulances should have at least one crew member with extended training [3], who should have been trained in accordance with the National Health Service Training Authority syllabus published in 1987 [4].

This study aims to assess the present use of an emergency ambulance service comprising crews with and crews without extended skills, and to predict the likely impact of a full paramedic emergency service on pre-hospital care.

Method

We analysed all calls received at the control room of South Glamorgan Ambulance Service for the week beginning 2 August 1989. All resulting ambulance journeys were recorded, with particular attention to response times, time spent at the scene, transport times to hospital, and whether the attending vehicle was manned by a qualified ambulance person or a paramedic.

The ambulance crews were asked to make an initial diagnosis and grade the severity of the patient's condition in terms of risk to life, using the following categories: 'minor', 'potentially serious', 'acute risk to life', 'cardiac arrest', 'dead'.

The initial hospital diagnosis and severity of condition was recorded using casualty cards, hospital admission books, and occasionally by telephone interview with admitting doctors.

The use of extended skills was assessed by referring to ambulance report forms completed by paramedics after each patient journey.

Table 1. Origins and outcomes of urgent and emergency calls and distribution between ambulance crews.

Origin of call	Paramedic	Non-paramedic	Total	Transported	Admitted
'999' system	110 (31.3)	241 (68.7)	351 (100)	291 (82.9)	141 (40.2)
General practitioner	72 (30.5)	164 (69.5)	236 (100)	234 (99.2)	217 (91.9)
Hospital transfer	41 (43.2)	54 (56.8)	95 (100)	95 (100)	95 (100)
Total	223 (32.7)	459 (67.3)	682 (100)	620 (90.9)	453 (66.4)

Figures in parentheses are percentages.

Data were stored in an Atari microcomputer and the various ambulance times analysed with the unpaired *t* test; 95% confidence intervals were calculated and *p* values of <0.05 taken as significant in all analyses.

Results

During the study week, 43 shifts involved vehicles manned by a paramedic and 91 shifts had crews with basic emergency skills only. There were 682 emergency calls, 620 patient journeys, and 453 subsequent admissions to hospital.

Distribution of calls (Table 1)

Half the emergency calls originated from public use of the '999' system, one-third from general practitioners, and the remainder from hospitals requesting urgent interhospital transfer. Of these latter cases, 35 of 95 patients had been brought to the requesting hospital by an emergency ambulance within the previous six hours. Paramedics responded to one-third of all calls.

Thirty-four (9.7%) of '999' calls proved to be false calls. Furthermore, some patients attended by the ambulance crews subsequently refused to travel to hos-

pital. Occasionally an emergency call resulted in more than one patient travelling to hospital. Therefore the number of calls does not equal the number of patients transported.

Ambulance times

Considering calls originating from the '999' system (which automatically require an immediate response), there was no difference in response times between the two types of crew. The mean response time for paramedics was 7.93 min (95% CI 7.25–8.61 min), and for non-paramedics it was 8.36 min (95% CI 7.28–9.44 min).

Time spent with the patient at the scene was significantly longer (*p* < 0.01) for the paramedic crews—mean 11.0 min (95% CI 9.54–12.46)—compared with non-paramedic crews—mean 8.31 min (95% CI 7.49–9.13) (Table 2). This difference in on-scene time remains significant if only cases with an initial hospital diagnosis of cardiovascular disease are considered. If cases where extended skills were used are excluded there is no difference in on-scene times between the two types of crew.

Transport times to hospital were not significantly

Table 2. Comparison of on-scene times for paramedic and non-paramedic ambulance crews.

Category	Paramedic crews		Non-paramedic crews	
	Total	Mean time (min) (95% CI)	Total	Mean time (min) (95% CI)
'999'+GP*	178	11.0 (9.54–12.46)	347	8.31 (7.49–9.13)
Paramedic skill used	42	15.1 (12.6–17.6)	0	—
No Paramedic skills	136	8.97 (7.65–10.29)	347	8.31 (7.49–9.13)
Trauma	56	9.93 (7.95–11.91)	109	8.25 (7.01–9.49)
Neurological	29	10.76 (8.30–13.22)	38	11.7 (6.84–16.56)
Cardiac*	17	13.9 (10.0–17.8)	23	7.52 (6.05–8.99)
Respiratory	15	13.2 (5.47–20.93)	32	9.34 (7.46–11.22)
Surgical	29	8.55 (5.89–11.21)	54	7.46 (6.24–8.68)
Obstet./Gynaecol.	9	6.33 (3.71–8.95)	23	4.97 (3.65–6.29)
Psychiatric	20	7.25 (5.22–9.28)	57	8.0 (6.88–9.12)
Unknown time (incl. overdose)	3	—	11	—

Figures in parentheses are 95% confidence intervals.

* *p* < 0.01, unpaired *t* test.

different: mean paramedic transport time 11.82 min (95% CI 10.72–12.92), mean non-paramedic transport time 12.93 min (95% CI 12.17–13.69) ($p > 0.05$).

Disease severity

There was no difference between patients transported by paramedic and non-paramedic ambulances in terms of the severity of illness judged by the admitting doctor (Table 3). Overall, almost one-half of patients transported to hospital following '999' calls were judged to have 'minor' conditions, whereas three-quarters of patients carried following a call by a general practitioner were classified as having a 'potentially serious' condition or 'acute risk to life'.

The paramedic ambulance assessment of disease severity was the same as the initial hospital assessment in 61% of cases, more severe in 8%, less severe in 23%, and not recorded in 8%. For non-paramedics the figures were: 69% same severity, 7% more severe, 22% less severe, and 2% unrecorded.

Use of extended skills

Paramedic ambulance crews initiated extended skills in treating 42 patients (23.6%) transported to hospital from the community. All these patients underwent cardiac monitoring in the ambulance. In 30 patients intravenous cannulae were inserted through which fluid was infused on three occasions, and drugs administered on a further three occasions. Two patients were given defibrillatory shocks and two had endotracheal tubes inserted by the paramedic.

The initial hospital diagnosis of these 42 patients was: cardiovascular disease 17; neurological disease 12; syncope of unknown cause 4; cardiac arrest 4; non-cardiac chest pain 2; and one in each of the following categories: surgical, infection, trauma. One patient with a witnessed cardiac arrest was later discharged from hospital.

Discussion

In spite of the availability of extended skills and increased clinical education of ambulance paramedics,

there was no significant difference between the two types of ambulance crews in terms of the severity of illness of patients arriving at hospital or in the likelihood of agreement between the ambulance and initial hospital assessments. The data also suggest that there was no allocation of paramedic crews to particular types of call, except perhaps for interhospital transfers.

Paramedics only used their extended skills in 23.6% of cases, mainly for medical conditions, including only four cardiac arrests. It can be assumed that the remaining 76.4% of patients could have been managed adequately by basic ambulance aid. Moreover, given that there was no allocation of crews to calls, about one-quarter of patients attended by non-paramedic crews may have been more suitably managed by personnel with extended training.

A more effective deployment system might be one that enables the dispatching ambulance control officer to send crews with advanced training to cases where their skills are more likely to be of use and to be practised, such as cardiac arrests, chest pain, or syncope. This ideal would be difficult to achieve for '999' calls, where only 40% of calls warrant hospital admission. Although medical training of ambulance dispatchers is helpful in reducing inappropriate use of the service [5], it is our experience that it is sometimes impossible to obtain sufficient clinical information from the general public to allow likely ambulance requirements at the scene to be predicted.

Over 90% of general-practitioner calls lead to hospital admission, three-quarters because of potentially serious conditions. General practitioners are well placed to assess the need for pre-hospital extended skills, and have been shown to use the emergency ambulance service efficiently [6]. They could therefore identify which patients require paramedic attention and which need basic aid.

In order to provide extended skills for all patients that may require them, all emergency ambulances will carry a paramedic in five years time [3]. Given that this full paramedic system will lead to 120 patients receiving extended aid each week in South Glamorgan, one must ask if this will improve pre-hospital morbidity and mortality?

The present study is too small to answer this ques-

Table 3. Initial hospital assessment of illness severity for each origin of call.

Origin of call	Total	Minor	Potentially serious	Acute risk to life	Cardiac arrest	Unknown
'999' system	291	150 (51)	119 (41)	7 (2.4)	4 (1.4)	11 (3.8)
General practitioner	234	51 (22)	171 (73)	8 (3.4)	0	4 (1.6)
Hospital transfer	95	24 (25)	65 (68)	5 (5.3)	0	0
Total	620	225 (36)	355 (57)	20 (3.2)	4 (0.6)	15 (2.4)

Figures in parentheses are percentages.

tion. Paramedic systems undoubtedly improve survival rates from out-of-hospital cardiac arrest [7, 8], though the use of defibrillators appears to be the most important skill in this regard [9, 10], and the contribution of drug administration and endotracheal intubation is unclear. Patients with acute myocardial infarction complicated by hypotension do better when attended by paramedics than by ambulance personnel with basic skills only [11], although the protocols for treating hypotension in this American study included the use of anti-shock trousers and dopamine infusions. There is also evidence that extended skills are beneficial in the pre-hospital management of patients with hypoglycaemia [12] and acute asthma [13].

The use of extended skills in the pre-hospital care of trauma cases is more controversial. A study from Scotland reported that of over 20,000 patients admitted to accident and emergency departments, 50 patients died due to trauma, and predicted that only one of these deaths might have been prevented by the use of extended skills [14]. Some authors view the concept of pre-hospital stabilisation of such patients as detrimental [15], particularly in urban areas where the time taken to gain venous access and replace fluid volume is longer than transport time to the nearest hospital.

The present study demonstrates that paramedic ambulance crews spend more time on-scene (mean 15.1 min) when they practise their extended skills. We have previously shown that staff with extended training spent a mean 30.7 min treating 35 episodes of hypoglycaemia. As a result, 27 patients improved at the scene and only 11 required hospital admission [12].

American paramedics spent a mean 25.8 min evaluating and treating patients with chest pain, including performing electrocardiography [16]. Although there was no obvious clinical benefit at the scene, pre-hospital diagnosis caused significant reductions in in-hospital delays to thrombolytic therapy. However, another American study demonstrated that vein cannulation prolonged on-scene times (from 6.9 min to 19.6 min) without improving the patient's condition or the likelihood of that patient receiving intravenous medication on arrival in hospital [17].

We predict that the provision of paramedic personnel on every vehicle will increase the total ambulance service on-scene time and may reduce the ready availability of vehicles for other emergency work unless more vehicles are available on each shift.

The provision of a full paramedic service will save lives owing to greater success in the management of cardiac arrests. It is important that future studies clarify what skills, in what circumstances, are likely to lead to improvements in pre-hospital emergency care, and that the use of these skills does not unduly delay hospital admission.

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