ORIGINAL ARTICLE

A rural emergency medical retrieval service: the first year

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Emerg Med J 2006;23:679–683. doi: 10.1136/emj.2006.034355

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Accepted for publication
24 May 2006

Introduction: We describe the first year of operation of a rural emergency medical retrieval service (EMRS), staffed by emergency medicine and anaesthetic consultants and providing air based retrieval of critically ill and injured patients from general practitioner led community hospitals in rural west Scotland.

Methods: Data were collected on all patients referred to the service, both those subsequently transported and those where transport by the service was not indicated, for a period of 1 year from 1 October 2004 to 30 September 2005. Data collected included information on demographics, physiology, and medical interventions. Detailed data were collected regarding advanced airway care and any complications relating to transfer.

Results: Forty patients were attended and advice was given on a further 21 patients. Twenty one of the 40 patients (53%) required rapid sequence intubation prior to transfer. The median Injury Severity Score (ISS) for trauma patients was 26 (range 2–59). The median Acute Physiology and Chronic Health Evaluation (APACHE) II score for all patients was 11 (range 2–37).

Conclusion: Our data show a high level of acuity among this patient group and a need for advanced medical intervention to ensure safe transfer.

In October 2004 a rural emergency medical retrieval service (EMRS) was set up by a group of clinicians, including the authors of this paper, to support rural community hospitals.¹ This service is unique within the United Kingdom. Argyll & Clyde Health Board funded this collaborative effort with the Scottish Ambulance Service (SAS).

Providing emergency care and safe transfer of seriously ill and injured patients presenting to these community hospitals in remote areas is a significant challenge. The care of these patients is complicated by limited critical care skills and facilities at the initial point of care coupled with prolonged transfer times to definitive care. Many of these transfers are effected by air, adding further challenges to delivery of care.

Deficiencies in the care and transfer of critically ill and injured patients have been repeatedly identified^{2–4} in recent years. Comprehensive guidelines now exist regarding standards of care for this group of patients.^{5–8}

The NHS Argyll & Clyde Health board area is geographically extensive with numerous inhabited islands. Much of its population live in remote locations far from an emergency department and specialist hospital care. Patients with injuries and illnesses are assessed and initially treated by general practitioners in community hospitals before being transferred to larger urban hospitals in Glasgow or Paisley.

The EMRS was set up to address the challenges of providing rapid access to critical care for 32 700 patients living in remote parts of the health board area whose health care needs were supplied by five remote community hospitals. A comparative table is given below showing the distance/time to each of the community hospitals by land and air from the two base hospitals.

A national paediatric retrieval service already exists. Consultants in emergency medicine, intensive care, or anaesthesia staff the EMRS together with a flight paramedic from the SAS. A specialist registrar in emergency medicine supports them to ensure that future consultants in emergency medicine have skills in retrieval medicine.⁹

We describe the activity of the service during the first 12 months.

METHODS

Data were collected prospectively on all patients referred to the service for the duration of the 12 month pilot service from 1 October 2004 to 30 September 2005 using a unique data collection sheet for each patient. The data were entered onto a Microsoft Access database and analysed using Microsoft Excel. Data were also collected for all patients where advice was sought from the service regarding retrieval but the patient was not attended by the EMRS.

Patients attended by retrieval service

In addition to demographic data, data were also collected on physiological parameters and interventions performed for patients transported by the EMRS. As a minimum the age, sex, and location of the patient were recorded on a dedicated data sheet. Also as a minimum, physiological measurements including end tidal capnography were recorded on arrival of the EMRS, prior to departure from the rural hospital, and on handover to the receiving hospital.

Patients who were intubated had details of the reason for intubation, adjuncts used, Cormack and Lehane grade,¹⁰ number of attempts, final outcome, and incidence of complications such as hypotension or desaturation recorded. In addition, doses and details of drugs used to facilitate intubation were recorded along with maintenance sedation and paralysis drugs. Details of any other invasive procedures performed by the EMRS were also recorded as was drug and fluid administration by EMRS staff.

As a measure of quality, three objective standards set in the ICS 2002 guidelines⁹ were selected and audited for patients attended by the retrieval service (appendix 1). Staff were unaware which standards were being assessed.

Abbreviations: APACHE, Acute Physiology and Chronic Health Evaluation; EMRS, emergency medical retrieval service; ISS, Injury Severity Score; SAPS, Simplified Acute Physiology Score; SAS, Scottish Ambulance Service; RSI, rapid sequence intubation; TISS, Therapeutic Intervention Scoring System

Table 1 Comparison of times and distances from community hospitals

Hospital	Land transfer distance (miles)	Ferry crossing duration (min)	Total land/ferry transfer time (min)	Land/ferry transfer possible at night	Transfer time using helicopter	Transfer time using fixed wing aircraft
Campbeltown	132	N/A	305	Yes	23	38
Islay	105	140	401	No	30	35
Lochgilphead	81	N/A	171	Yes	25	N/A
Mull	101	46	229	No	40	N/A
Rothesay	37	35	89	No	15	N/A

For trauma patients, the Injury Severity Score (ISS)¹¹ was used with AIS-90 definitions. Inclusion and exclusion criteria were as described in the original paper.

For all critically ill and injured patients, Acute Physiology and Chronic Health Evaluation (APACHE) II¹² and Simplified Acute Physiology Score (SAPS) II¹³ scores were calculated. These scores were calculated in the standard manner from physiological and laboratory parameters once patients reached their destination hospital. Patients were excluded from APACHE II and SAPS II analysis if they did not fit the criteria for inclusion as described in the original papers.

For all patients, the Therapeutic Intervention Scoring System (TISS)¹⁴ was also calculated as a measure of the level of intervention required for each patient. The TISS was calculated on interventions performed by EMRS staff prior to arrival at the destination hospital.

Advice only patients

Data were also collected for patients where advice was sought from the EMRS but the patient was not subsequently attended by the EMRS. This information included basic demographic data and the specific reason for non-activation. Telephone follow up was conducted for all these patients within 72 h.

If the patient was transferred, then evidence of any adverse incident during transfer was specifically sought. An adverse incident during transfer was defined as any of the following: physiological derangement, respiratory or cardiac arrest, or death. Physiological derangement was defined as any incidence of: systolic blood pressure less than 90 mm Hg, respiratory rate less than 6 or greater than 30, or oxygen saturations less than 90%. Patient death or ICU admission within 24 h of transfer was also defined as an adverse incident.

RESULTS

The EMRS attended 40 patients over the 12 months from 1 October 2004 to 30 September 2005. Of these patients, 34 were transferred by the EMRS. Of the remaining six patients, two were deemed not to require advanced medical intervention, senior medical escort, or transfer and were left at the original healthcare facility. Three patients died within 4 h of

the team arriving at the remote healthcare facility. In all of these patients, after initial assessment and resuscitation, a decision was made that transfer of the patient and intensive care unit admission would not be in their best interests. A further patient died while the team were en route to the community hospital. Details of these four patients are given in table 2.

In addition, advice was given on a further 21 patients who were subsequently not attended by the EMRS.

Demographics

The total number of patients attended and treated over the 12 month period was 40 of whom 77% were male. The median age of the group was 45 years (range 15–82 years). The case mix was 55% medical emergencies and 45% trauma. Missions were undertaken on three different types of aircraft: ambulance service EC135 helicopter (57%), ambulance service Islander plane (35%), and Royal Navy search and rescue helicopter (8%). No missions were declined due to poor weather.

The times and days of the week of activation of the EMRS are given in table 3.

Procedures

Twenty one of the 40 (53%) patients attended by the EMRS required rapid sequence intubation (RSI) and ventilation. All 21 patients were successfully intubated although one of these 21 (4%) patients encountered complications associated with the RSI. This patient required three attempts at intubation; this was associated with one episode of desaturation <90%

Table 3 Time of day and day of the week of EMRS activation

Time of request	Frequency
Monday to Friday, 0800 to 1800	32%
Weekends and public holidays, 0800 to 1800	19%
Weekday nights, 1800 to 0800	23%
Weekend and public holiday nights, 1800 to 0800	26%

Table 2 Characteristics of patients who died at original healthcare facility

	Age	Diagnosis	Best SBP	Best sats	Best RR	Interventions performed by the EMRS	Time from arrival time to death (min)
Patient 1	81	Complete heart block secondary to acute myocardial infarction	110	98%	10	RSI, adrenaline infusion, external pacing	225
Patient 2	77	Abdominal sepsis	U/R	U/R	U/R	None	5
Patient 3	78	Septic shock secondary to urinary sepsis	60	U/R	6	RSI, adrenaline infusion, fluid resuscitation	40
Patient 4	64	Stroke	NA	NA	NA	Not applicable	Died prior to team arrival

RR, respiratory rate; RSI, rapid sequence intubation; sats, oxygen saturations; SBP, systolic blood pressure; U/R, unrecordable (no value of this parameter could be recorded).

Figure 1 Clinical indication for RSI in 21 patients. Twenty three of 40 patients (57%) required a procedure other than RSI. A summary of these patients is given in fig 2. GCS, Glasgow Coma Scale.

during RSI. There were no other adverse events during intubation. A summary of the reasons for intubation is given in fig 1. The category of “transfer safety” relates to patients who are deemed to be at high risk of compromising aircraft safety due to disturbed behaviour. This is a subjective assessment made by the retrieval consultant and is based on several factors including type of aircraft, underlying diagnosis, and geographical location.

One patient in the study period, with a head and facial injury, had an emergent airway problem and was anaesthetised by the rural general practitioner before the retrieval team arrived. This patient is not included in the above figures.

Physiology

A summary of physiological parameters of transported patients is given in table 4.

Outcome

Of the 34 patients transported by the service, two patients died within 24 h of arrival at the destination hospital.

APACHE II and SAPS II scores for patients transported by the service are given in table 5. This is based on APACHE II and SAPS II criteria being assessed from the arrival of the patient in the destination critical care facility. The four patients who died prior to or shortly after the arrival of the team are excluded from this analysis, as are the two patients who remained at the original healthcare location. One patient died within 8 h of arrival at the destination critical care facility and was not given an APACHE II or SAPS II score. A further six patients were classed as CCU patients and were ineligible for SAPS II scoring.

ISS was calculated for 17 patients who had a primary diagnosis of trauma, with 13/17 (76%) patients having an ISS greater than 15.

TISS scores were calculated for 34 patients who were transported by the service, with 26/33 (79%) patients having a TISS greater than 10.

The data for ICS standards are given in appendix 1. The EMRS met the first two standards set. Two of 34 patients failed to meet the standard of not being hypotensive prior to transfer. The systolic blood pressures for the two patients who did not meet this target were 88 and 89, respectively.

Advice calls

A total of 21 patients were discussed with the retrieval service where advice was given regarding management and the suitability of the patient for transfer. A summary of the reasons for non-activation of the EMRS is given in fig 3.

Figure 2 Invasive procedures undertaken by the EMRS in 23 patients. Thirty one of 40 patients (78%) required administration of a drug outside current paramedic protocols. This includes 13/40 (28%) patients requiring non-anaesthetic drugs. Administration of morphine is not included as it was assumed to be within current paramedic protocols although this was not universally the case among SAS paramedics during the timescale of this pilot service.

DISCUSSION

The challenge of providing critical care to patients in rural and remote settings has occurred in other countries around the world.^{15–18} Many of these problems are similar to those facing healthcare professionals in Scotland.¹⁹ Centralisation of services, recruitment issues in rural areas, high patient expectations, and difficulty in retention of critical care skills are common factors across the globe. Due the nature of its geography and population demographics, Australia has been the forerunner in developing medical retrieval teams. Similar systems also exist in Canada, New Zealand, and Scandinavia.

The establishment of a dedicated team to deliver critical care in remote locations and provide safe and effective transfer for patients is a potential solution to many of these issues. Data from our EMRS pilot service demonstrate a need for this service in remote and rural areas of west Scotland. The incidence of critical illness or injury within our population of 32 700 requiring our service is approximately 1 per 800 population per annum. Extrapolation to the 250 000 people in Scotland who live in remote and rural areas suggests that there are approximately 300 people per year who could benefit from a Scottish national remote area adult retrieval service.

Our data show that there is high acuity among the patients transported by the EMRS. The median ISS was 26 with 13/17 (76%) patients having an ISS >15, generally accepted as being the definition of major trauma. The median APACHE II score was 11 (range 2–37). Over 90% of patients required

Table 4 Physiological parameters of patients transferred by the EMRS

	Number of patients with SBP < 90 mm Hg	Number of patients with RR < 6 or > 30 per minute	Number of patients with GCS ≤ 14
On arrival of EMRS team	5/34	3/34	21/34
Prior to departure of EMRS team	2/34	0/34	All intubated
On handover of patient to receiving hospital	0/34	0/34	All intubated

GCS, Glasgow Coma Scale; RR, respiratory rate; SBP, systolic blood pressure.

Table 5 APACHE II, SAPS II, ISS, and TISS scores for EMRS patients

	Number of patients	Median value	Interquartile range
APACHE II	33	11	6–19
SAPS II	27	24	15–50
ISS	17	23	16–34
TISS	34	23	10–26

GCS, Glasgow Coma Scale.

either advanced airway care and ventilation, other procedure, or drug administration outside paramedic protocols. The median TISS score was 23 (range 4–35). Twenty six of 33 patients (79%) had a TISS of 10 or more which is often taken to indicate of a level of care requiring a critical care environment.

This relatively high specificity for rural practitioners in identifying patients with critical illness seems not to be at the expense of sensitivity. Throughout the pilot period we operated an informal “missed retrieval” system in the receiving hospitals. We identified any patients arriving from the catchment area of the EMRS with critical illness whom EMRS staff had not been informed about. To our knowledge this only occurred on two occasions during the year. Clearly, patients who went to hospitals other than the hospitals directly involved in the EMRS or were not transported at all are not accounted for and this limits the validity of this conclusion.

In the UK, controversy continues to surround the issue of non-anaesthetists performing RSI.^{20–22} A mixture of anaesthetists and non-anaesthetic specialists staff the EMRS and our practice is consistent with UK guidelines for non-anaesthetists.²³ Although our numbers are small, our complication rate of 4% is comparable with similar datasets for non-anaesthetists within²⁴ and outside^{25–26} the UK.

As in the original SAPS II paper, coronary care patients were excluded from our analysis of SAPS II patients. Our case mix is broadly similar to national patterns and the historical datasets used for APACHE II and SAPS II. Our patients include a higher proportion of non-operative patients and, by definition, our operative patients are emergency cases. APACHE II and SAPS II have been validated in the Scottish

population of critically ill and injured patients within intensive care facilities.²⁷ SAPS II²⁸ and a modified TISS²⁹ have also been specifically validated in intermediate care facilities such as high dependency units to which some of our patients were admitted.

The quality of our service is a more difficult concept to judge. Our team met two of the three ICS 2002 standards assessed for the transport of critically ill patients. The standard was not met for correction of hypotension prior to transfer. Our definition of hypotension was systolic BP less than 90 mm Hg, although this definition is not made in the ICS 2002 guidelines. In the two patients this applied to, the systolic blood pressure was within the error of measurement of blood pressure.

Due to the relatively small numbers, it has not been possible to produce statistically robust results regarding patient outcomes. The authors anticipate that in the future it will be possible to compare the actual and predicted outcomes of EMRS patients using historical datasets such as APACHE II and SAPS II, and TRISS methodology.^{30–31}

CONCLUSION

Our data from the 12 month pilot period of the EMRS support the concept of medical retrieval in remote and rural areas of Scotland. The severity of illness and injury in cases included in this study clearly demonstrates a clinical need for rapid access to specialist and advanced medical interventions for patients in remote community hospitals. Prior to the introduction of the EMRS, such patients with life threatening conditions were often transferred by air without pre-transfer stabilisation, most importantly without definitive airway maintenance and protection. This level of care and transfer should no longer be acceptable for critically ill patients. Although limited as regards numbers, the results demonstrate that the combined skills of a consultant and paramedic retrieval team have potentially life saving benefits for patients with critical illness and injury in remote and rural areas of Scotland.

Providing equity of access to advanced levels of medical care in remote and rural areas supplied by community hospitals is a significant and very real challenge for the NHS in Scotland. This study demonstrates that establishment of a national remote area emergency medical retrieval service would play a significant role in tackling this challenge.

Figure 3 Outcomes for advice only patients. Consultant anaesthetists in a rural general hospital referred the three patients in the “inter ICU transfer” group. The call was re-directed to the Shock Team (Western Infirmary, Glasgow) who provide a transfer service between ICUs in the west of Scotland. No patient who was transferred in this group had an adverse incident during transfer or during the first 24 h.

ACKNOWLEDGEMENTS

The authors acknowledge the support and help of their medical and nursing colleagues in the Emergency Department of the Royal Alexandra Hospital, Paisley and the Emergency Department and Intensive Care Unit at the Southern General Hospital, Glasgow in providing this service during the pilot period. The authors also acknowledge the help and support provided by the Air Wing of the SAS and Argyll & Clyde Health Board in setting up this service. Dr David Young, Department of Statistics and Modelling Science, University of Strathclyde provided statistical advice.

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Funding: funding for providing medical equipment for the EMRS was provided by Argyll & Clyde Health Board. Medical staff time was provided on a voluntary basis

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APPENDIX 1

Table 1A Performance of the EMRS against ICS 2002 guidelines

Standard	Target	Achieved
End tidal carbon dioxide (ETCO ₂) monitoring in all ventilated patients	100%	21/21 (100%)
Continuous, invasive blood pressure measurement, through an indwelling arterial cannula should normally be used (ventilated patients)	75%	16/21 (76%)
Patients who are hypotensive should not be moved until stable	100%	3/5 (60%)