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ORIGINAL ARTICLE

The impact of a new regional air ambulance service on a large general hospital

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Background: Helicopter air ambulance crews are influenced in their selection of the destination hospital for their patients by several factors including: distance from the scene; facilities, on site specialties, and senior cover of the receiving hospital; and the proximity of the helicopter landing area to the emergency department (ED). Only a limited number of hospitals have landing sites adjacent to the ED from which patients can be taken directly into the department (primary landing sites). Helicopter crews will often elect to over fly hospitals that do not have primary landing sites because secondary land transfers will add delays in delivering patients. Birmingham Heartlands Hospital has an elevated helideck adjacent to the ED. In October 2003, the Warwickshire and Northamptonshire Air Ambulance (WNAA) service was launched; the hospital sits on the western periphery of the area served by the service.

Methods: Prospective data was collated on all patients brought by WNAA to Heartlands Hospital between 1 October 2003 and 31 August 2004.

Results: In the 10 month period after the launch of the service, the helicopter delivered 83 patients to the ED; 74 of these were "off patch". This additional workload generated 163 ward days, 19 operative procedures, and 85 intensive care unit, high dependency unit, or coronary care unit days. The direct costs of this additional workload approached £160 000.

Conclusions: In future discussions on the cost effectiveness of air ambulances, it will be important to consider both the direct and indirect costs to the receiving hospitals arising from the redistribution of emergency workload.

The air ambulance has its origins in the conflicts of the 20th century, and has only become established in civilian practice over the past 20 years. The first helicopter air ambulance service in the UK was established in Cornwall in 1987. There are now 17 services covering most of the UK, all but one of which (Scotland) remain charity funded.¹ The deployment, funding, efficacy, and overall cost effectiveness of the air ambulance in this country remain contentious issues.²

Air ambulance crews' choice of destination hospital depends on several factors including: distance from the scene; facilities, on site specialties and senior cover of the receiving hospital; and the proximity of the helicopter landing area to the emergency department (ED).³ Helicopter accessibility varies between hospitals. Three hospitals in the UK have elevated helidecks with direct access to the ED. Other hospitals have helipads in close proximity to ED (primary landing site) where patients can be transferred from the helicopter into the department on a trolley, while others use a landing site at some distance from the ED, necessitating a secondary transfer by land ambulance.⁴ Secondary land transfers often add considerable delays to the delivery of the patients to hospital. In particular, when a patient is severely injured, unwell, or unstable, the air crew may choose to fly directly to a hospital with a primary landing site, over flying hospitals that require a secondary land transfer.

Birmingham Heartlands Hospital is a large general hospital with approximately 100 000 new patients attending the ED each year. An elevated helipad was built adjacent to the ED. The ED has five resuscitation beds and round the clock senior cover. There is 24 hour access to computed tomography. All specialties apart from neurosurgery and plastic surgery are present on site. There are paediatric wards, including a high dependency unit.

Prior to October 2003, the occasional patient was delivered to Birmingham Heartlands Hospital by the West Midlands County Air Ambulance (WMCAA). A new regional air ambulance service, the Warwickshire and Northamptonshire Air Ambulance (WNAA), became operational on 1 October 2003. It was established to cover both counties for emergency work during daylight hours. Birmingham Heartlands Hospital lies on the western periphery of the region served by WNAA and on the south eastern periphery of the region served by WMCAA.

The WNAA crew (which routinely includes a doctor) is tasked to the entire spectrum of trauma, medical, cardiac, and paediatric emergencies, and covers a large mixed rural and urban area. The new WNAA service resulted in a dramatic increase in helideck activity at Heartlands Hospital. The impact on the hospital and the financial implications of this additional workload is quantified.

METHODS

Prospective data was collated on all patients brought by WNAA to Heartlands Hospital between 1 October 2003 and 31 August 2004. The location of the scene from where each patient was collected was plotted on a regional map. Distance arcs from Heartlands Hospital were marked. The location and helicopter access arrangements of all the other hospitals in the region were plotted on the same map.

The Trust's Service Development Unit provided the direct costs of emergency department attendances, hospital admissions, and surgical procedures for these helicopter delivered

Abbreviations: ED, emergency department; HDU, high dependency unit; HEMS, helicopter emergency medical service; ICU, intensive care unit; ISS, injury severity score; WNAA, Warwickshire and Northamptonshire Air Ambulance; WMCAA, West Midlands County Air Ambulance

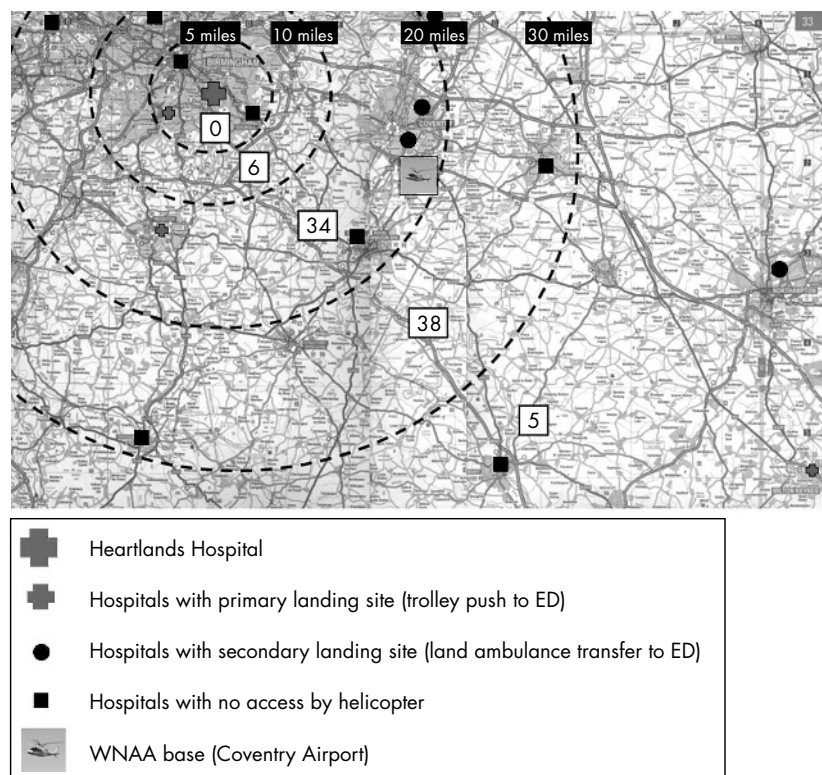


Figure 1 Hospitals serving the WNAA area of operations. The numbers of patients delivered to Heartlands from each distance band from the hospital are shown.

patients. These were determined by clinical coding. Indirect costs (blocked beds, cancelled operations, and others) were not calculated. The financial implications created by this additional workload are presented.

RESULTS

During the period from 1 October 2003 to 31 August 2004, 84 patients were delivered to Birmingham Heartlands Hospital by WNAA. Of these, 83 were brought to the ED and one was an urgent pre-arranged transfer to the delivery suite. Of the 83 ED patients, 74 (89%) were "off-patch"—that is, they would almost certainly have been taken to another hospital had a land ambulance attended the scene instead of a helicopter (fig 1). The distribution of these additional 74 patients by admitting specialty is presented in table 1.

These patients generated 74 ED attendances, 12 admissions to the observation unit, 163 ward days, and 85 intensive care unit (ICU), high dependency unit (HDU), or coronary care unit days. Of these 74 patients, 19 underwent operative procedures. Of these, 12 were orthopaedic, 2 general surgery (laparotomies), and 5 primary angioplasties for acute myocardial infarction.

The additional costs incurred by these "off patch" patients were determined by the Trust's Service Development Unit using average costs by clinical coding and are presented in table 2. These are direct costs and do not take into consideration indirect costs, including bed blockage and list cancellations.

During the same period, 16 patients were delivered to Heartlands by WMCAA. For nine of these patients, information on the location of incident was not available. Of the remaining seven, six were "off patch". Three of these patients underwent orthopaedic procedures.

DISCUSSION

Much of the debate on the evolving role of air ambulances in the UK has been on the benefit to patients, in terms of survival and quality adjusted life years. Nicholl *et al*³ observed no effect on overall survival rates when comparing trauma patients taken to hospital by land or by air ambulance. There was, however, some indication that the deployment of the air ambulance to major trauma (patients with an injury severity score (ISS) >16) was associated with decreased mortality and the authors went as far as to predict that 13 additional

Table 1 Breakdown of additional workload generated by WNAA (October 2003 to August 2004)

| Status | Trauma | Cardiology | Medicine | Paeds | Surgery | Total |
|---|--------|------------|----------|-------|---------|-------|
| Discharged home from ED | 15 | 0 | 0 | 0 | 0 | 15 |
| Observation unit admissions | 11 | 0 | 0 | 0 | 0 | 11 |
| Transferred from ED | 2 | 0 | 0 | 0 | 0 | 2 |
| Ward admissions | 22 | 2 | 5 | 1 | 1 | 31 |
| ITU/HDU/CCU admissions | 7 | 4 | 0 | 1 | 0 | 12 |
| Died in department | 3 | 0 | 0 | 0 | 0 | 3 |
| Total | 60 | 6 | 5 | 2 | 1 | 74 |
| Transfer out of Observation unit/Ward/ITU | 10 | 1 | 1 | 0 | 0 | 12 |

Table 2 Calculated direct costs of the additional 74 patients

| Status | Trauma | Cardiology | Medicine | Paeds | Surgery | Total |
|---|--------|------------|----------|-------|---------|-------|
| Discharged home from ED | 15 | 0 | 0 | 0 | 0 | 15 |
| Observation unit admissions | 11 | 0 | 0 | 0 | 0 | 11 |
| Transferred from ED | 2 | 0 | 0 | 0 | 0 | 2 |
| Ward admissions | 22 | 2 | 5 | 1 | 1 | 31 |
| ITU/HDU/CCU admissions | 7 | 4 | 0 | 1 | 0 | 12 |
| Died in department | 3 | 0 | 0 | 0 | 0 | 3 |
| Total | 60 | 6 | 5 | 2 | 1 | 74 |
| Transfer out of Observation unit/Ward/ITU | 10 | 1 | 1 | 0 | 0 | 12 |

major trauma patients could survive each year if the helicopter emergency medical service (HEMS) was in attendance. The same authors examined disability 6 months post-injury and found no significant difference between the land and air cohorts.⁶ Other authors^{7,8} have reported no significant difference in times to hospital between the land and air cohorts unless standardised for distance. Studies from abroad have been generally inconclusive, but a number of authors have reported that the presence of a doctor on board correlates with a significant reduction in the mortality of trauma patients.⁹ Others, however, contest this view.¹¹⁻¹³

Schaub¹⁴ found that an air ambulance service may have a significant impact on admissions to a US trauma centre. Over a 1 year period, 192 admissions occurred through the air ambulance system. Of these, it was thought that 126 (66%) would not have gone to the studied trauma centre without the helicopter service. This would indicate that a HEMS service would have a substantial impact on an individual institution.

Williams and Harris¹⁵ examined the impact of air ambulance admissions to a UK level 2 trauma centre over a 7 year period. A fivefold increase from 18 to 93 emergency admissions per annum was noted. The largest single group of admissions were orthopaedic admissions. Total in patient stay for these admissions was 638 days, of which 145 days were in the ICU or HDU. The total cost of theatre time, operative items, and hospital beds was estimated at £600 000, which did not include staffing costs and follow up care.

Staffing of a HEMS service may be an important factor. Studies have reported lower mortality in physician staffed helicopters compared with paramedic only crews.^{10,16} All of these studies showed that the patients attended to by doctors had more medical interventions, which may have contributed to the improved survival results. A more recent German study, though, indicates no extra benefit is added when a physician is part of the crew.¹⁴

Chappell *et al*¹⁷ looked at the impact of withdrawing a HEMS service on a single institution. They found a 9% reduction in total admissions over 2 years and a reduction in severely injured (ISS>15) patient admissions of 17% over the same period.

Three hospitals in the UK have built elevated helidecks. The Civil Aviation Authority requires the presence of at least two appropriately trained firefighters for each aircraft movement, and maintenance of an elevated helipad is costly. Each fire officer requires training, and individual safety clothing and equipment to a cost of approximately £1000 each. The helipad, including its firefighting and rescue equipment are maintained at a cost of approximately £12 000 per year. A salaried fire team may be employed, or voluntary fire fighters used. We have been able to staff the firefighting team with pager carrying volunteers from NHS estates, portering, and security departments, who are able to respond within minutes. Where volunteers are used, responding to aircraft

movements may impinge on their regular working day and so may incur indirect costs.

For several reasons, the new WNAA service has generated a significant additional workload. Most of the patients who were brought to Heartlands by air ambulance would have been taken to other hospitals had a land ambulance been dispatched. The helicopter brought them to Heartlands on occasions when the nearest appropriate hospital had no landing facility, it would have involved a lengthy secondary transfer, or because the medical air crew decided that Heartlands was best suited to serve the patients' needs. In each case, the decision to fly patients to Heartlands was taken by the paramedic and doctor crewing the aircraft. Their decision took into account proximity to the scene, the patients' needs in terms of services provided by the hospital, and the advantage of a primary landing site. A number of head injured patients requiring resuscitation are taken to Heartlands because the regional neurosurgical centre does not have a helicopter landing facility, but some will over fly Heartlands to the South Birmingham Trauma Unit at Selly Oak Hospital, which is close to the regional neurosurgical centre.

The direct costs amounted to nearly £160 000 over a 10 month period. This figure does not include the indirect costs including blocked beds and cancelled operations. Heartlands Hospital has managed this increased workload and many have welcomed the new service. However, in further discussions on the cost effectiveness of air ambulances, it will be important to consider both the direct and indirect costs to the receiving hospitals arising from the redistribution of emergency workload.

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