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Air transport by the Wellington Flight Service: a descriptive analysis of interhospital transfers over a 5-year period in the Wellington region of New Zealand

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Abstract

Aim To describe and characterise the interhospital transport workload of a New Zealand based flight service over a 5-year period.

Method Wellington Flight Service database records from 1 November 2005 to 31 October 2010 were reviewed. Details of mission purpose, timings, transport type, severity of illness, clinical service requesting the transfer, and medical crew in attendance, were examined.

Results The Flight Service completed 4046 transport missions over 5 years. The median mission duration was 4.5 hours, but 9% of missions took 8 hours or more. Fixed wing aircraft were used for most transports (70%) with the trend for helicopter use decreasing steadily (from 23% down to 13%). High proportions of transfers were requested by cardiac services (25%), neurosurgery (14%) and ICU (9%), and 72% of those transported were critically (Category A) or seriously ill (Category B). A doctor accompanied a specialist flight nurse for Category A transports but for only 14% of Category B transports. 26% of missions began after 4pm and a further 6% began after midnight. Missions undertaken during the night were usually transfers of the critically or seriously ill (90%), with most (70%) being retrieved to Wellington Hospital for tertiary care.

Conclusion The Wellington Flight Service undertakes 2.2 interhospital transfers per day. Further examination of clinical outcomes in this cohort of patients transported to tertiary care is required to fully evaluate these services.

Air transport is used routinely in New Zealand for transfer of patients with serious illness or injury who require retrieval to a tertiary centre for definitive care. It is also sometimes used to return more clinically stable patients to their local hospital for ongoing care, or in rare circumstances to transport a patient back to their home for withdrawal of treatment and palliative care.[1]

Interhospital transfer refers specifically to transports between medical facilities, as distinct from primary retrieval which denotes the transport of patients from an initial scene of accident or illness to the primary medical care facility.

The Wellington Flight Service (WFS) is based in the Wellington Regional Hospital and works in conjunction with Life Flight Trust, Air Ambulance and Wellington Free Ambulance primarily to provide interhospital transport in the lower North Island and upper South Island of New Zealand. Wellington Hospital is the tertiary referral hospital for this area providing tertiary level neurosurgical, cardiothoracic, vascular, paediatric, intensive care, oncological and haematological services.

Burns and plastic surgery services are provided in an adjacent smaller hospital in the Wellington region. A comprehensive database is maintained to record details of all secondary or interhospital transfers undertaken by the Wellington Flight Team.

There is inherent risk associated with air transport of patients with most patients acutely ill and requiring high levels of clinical care in what is an extremely challenging environment.[2–6] The recommendation is that dedicated transfer teams should be used for interhospital transport of patients,[6–8] and this is the role that the WFS undertakes.

To date, the workload characteristics for the WFS or other similar services around New Zealand have not been examined. Developing an understanding of current service utilisation and workload patterns would inform planning for future service and care delivery, both regional and tertiary, as well as contributing towards research evidence for Air Transport practice in New Zealand, and is an important prelude to examining patient outcomes.

A 2008 report of the New Zealand Air Ambulance Reference Group highlighted both the absence of consistent and reliable data on which to base service planning long-term, and the limited New Zealand research evidence available to inform their work on clinical matters,[9] suggesting a clear need for this type of work to be undertaken.

This study aimed to describe and characterise the workload for the Wellington Flight Service over a 5-year period, and to identify any trends over that time.

Method

All missions undertaken by the WFS during the 5-year period from 1 November 2005 to 31 October 2010 were retrospectively reviewed. For each mission we extracted the time of mission, duration of mission, type of transfer, category of patient, service the patient was being transferred to/from and the medical crew in attendance. The study protocol was reviewed by the Central Regional Ethics Committee and found to conform to the New Zealand standards for observational health research.

The WFS operates out of Wellington Hospital, which provides tertiary cover for public hospitals at Blenheim, Nelson, Masterton, Kenepuru, Hutt, Whanganui, New Plymouth, Hastings and Palmerston North.

The current population for this region at June 2010 was 1,108,230 people.[10] Transports are undertaken by fixed wing aircraft or helicopter though in some circumstances road ambulance, or very occasionally commercial flights, will be employed. At times aircraft are unavailable due to maintenance or mechanical failure, or in adverse weather conditions due to airport closure.

Road transports are undertaken by the flight service over relatively short geographic distances when patients are critically ill and requiring advanced clinical care during the transfer, for example between Hutt and Wellington intensive care units (ICUs). Sometimes a transport started by air may be diverted and completed by road into Wellington.

Very occasionally situations occur where tertiary care is required but emergent air retrieval is not possible, so a road retrieval with an expert tertiary team is initiated despite the associated time delays. The goal in this situation is retrieval to Wellington as soon as possible because the risk of significant morbidity or death is high if they stay where they are, meaning the relative risk of transfer is less in context.

For the purposes of this review, the missions analysed in detail were those where it was the Wellington flight team who transported the patient from origin to destination, and where this was the primary purpose of their mission. A mission was designated to the 2006 review period if it occurred during 1 November 2005and 31 October 2006, or designated to the 2007 period if it occurred during 1 November 2006 and 31 October 2007 and so on. Missions were defined as “retrievals” when the patient was being transported to Wellington Hospital, or “transfers” where they were being transported away from Wellington Hospital or between two other hospitals.

Mission time was calculated from "start mission" to "finish mission" times as entered in the flight service database. 'Start mission' referred to the time that the Flight Nurse began direct preparation for that specific retrieval such as phone calls co-ordinating Life Flight, ambulance, hospitals, calling in a doctor (out-of-hours), checking equipment and obtaining necessary paperwork. 'End mission' referred to the time that the retrieval team had handed over the patient to the receiving team, completed their paperwork and equipment restocking, and were available to commence another mission.

Missions excluded from the review were those for which the WFS was involved in a more logistic capacity, including missions where a non-acute patient was transported on the empty leg when an aircraft was already assigned to an acute transport (*backload*), the mission was referred on to another flight service *(refer on)*, it was an elective transfer under the National Travel Assistance policy (*NTA assist)*, assistance was provided to arrange transport (*assistance*), or the mission was aborted (*aborted*) for reasons which might include death of the patient before the transport team arrived, weather changes or irretrievable mechanical failure.

Illness severity was categorised in order of severity from A to D. Category A patients were those in critical condition requiring invasive ventilation or other means of advanced life support such as pacing, vasoactive medication or an intra-aortic balloon pump: these patients required both an ICU flight nurse and a doctor with full and continuous monitoring during transfer.

Category B patients had generally undergone an acute incident requiring intensive care or specialist treatment but would not be ventilated or on advanced life support, but at risk of deterioration to the level where these may be required. Examples include patients with acute myocardial infarction, subarachnoid haemorrhage, spinal injury or multi-trauma. This group of patients required an ICU or specialist flight nurse although use of a doctor was viewed as discretionary.

Category C patients were usually post-treatment or investigation and not requiring intensive clinical care during flight. This patient group were usually accompanied by a Transit Care flight nurse. Category D would essentially be repatriation patients, accompanied by a flight nurse but only because they were with another patient.

Results

Over the 5-year period reviewed the WFS completed 4046 transport missions, although they were contacted regarding a total of 7635 missions, averaging 1527 per year (Figure 1).

On average 2.2 missions a day were completed, with the proportion of missions for which the flight service were contacted but not primarily involved in transport increasing from 40% in the 2006 review period to 51% in the 2010 period. The proportion of retrievals to transfers was equal overall, with the trend for lower rates of retrievals from 2006 to 2009 reversing in 2010 when 58% of transports were retrievals to Wellington Hospital.

Fixed wing aircraft were used to transport 70% of all patients, helicopters 18% and road ambulances for 11% of all completed transports. Commercial flights were used less than 1% of the time. Over the 5-year period reviewed, helicopter transports steadily decreased from a high of 23% of all transports undertaken for the 2006 period down to 13% for 2010 (Figure 2).

Figure 1

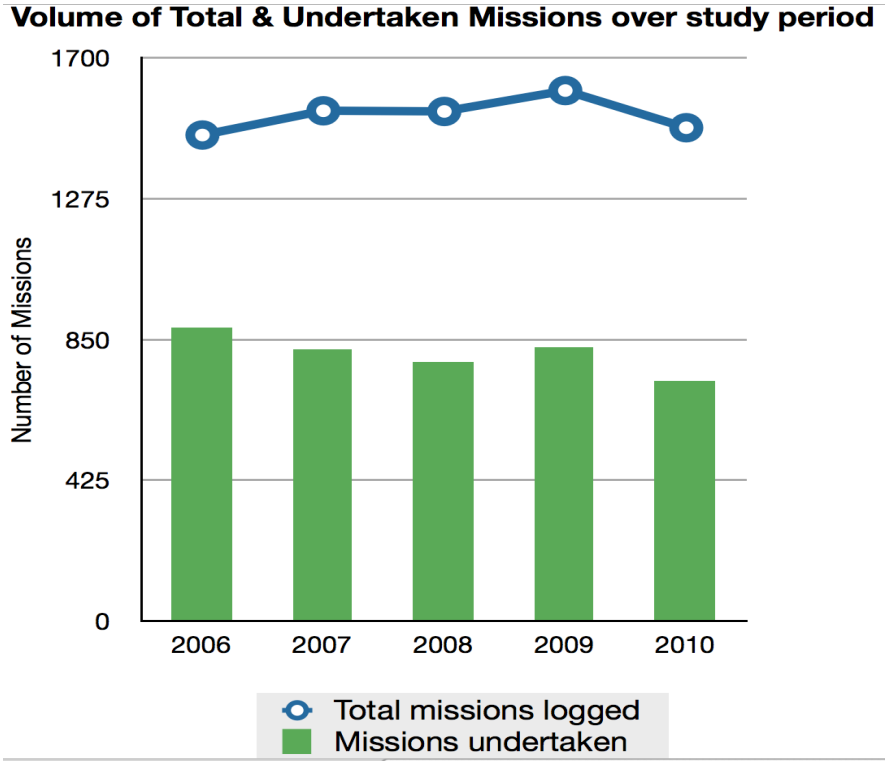
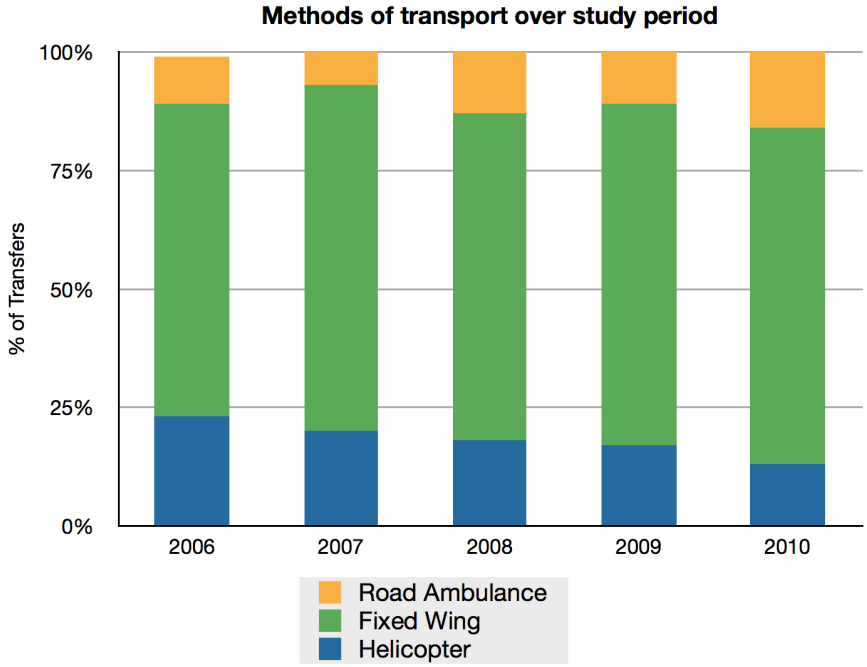


Figure 2



*In the 2006 period commercial transports accounted for 1% of overall transports.

For logged missions where it was not a WFS primary transport the numbers were fairly consistent, except for missions carried out as a backload, with 5% of missions aborted, 17% elective transfers carried out by someone else under a national travel assistance policy and 5% referred on to another service. Missions that were designated as backloads increased steadily going from 9% in the 2006 period up to 25% for 2010.

The characteristics of the transported patients are outlined in table 1. Most patients were 25 years or older (81% in total). They were residents of the greater Wellington area and adjacent regions (96% in total) with the single largest transported group being those usually domiciled in the Nelson/Marlborough region (44%).

Cardiology services requested 16% and cardiothoracic 9% of transports, with transfers and retrievals in fairly even proportions. Other services had high proportions of retrievals including ICU which accounted for 9% of transported patients overall (71% were retrievals), neurosurgery at 14% of transports (64% were retrievals); and obstetrics with 7% of transports (65% were retrievals).

Table 1.

Age range		DHB domicile		Service/DRG (transfers and retrievals)	% of overall transports	% for the service which were retrievals
< 12 months	3%	Taranaki	5%	Cardiology	16%	53%
1 – 4 years	3%	Hawke's Bay	2%	Cardiothoracic	9%	50%
5 - 17 years	5%	Whanganui	4%	Gen Medicine	7%	28%
18 - 24 years	7%	Mid Central	7%	Gen Surgery	6%	48%
25 – 49 years	23%	Capital Coast	13 %	Intensive Care	9%	71%
50 – 74 years	42%	Hutt Valley	9%	Obstetrics	7%	65%
75 years plus	16%	Wairarapa	11 %	Neurosurgery	14%	64%
		Nelson-Marlborough	45 %	Orthopaedics	6%	31%
		Canterbury	1%	Paediatrics	6%	50%
		South Canterbury	1%	Other	19%	37%

Twenty-one percent of transported patients overall were in critical condition (category A), 17% requiring invasive ventilation, and 51% not classified as critical but nonetheless requiring intensive clinical care (category B). The trend for category A critical transports and ventilated patients gradually increased over the 5 years reviewed from 16% up to 26% and 13% up to 21% respectively, while proportionately it was the category C non intensive clinical care transports decreasing from 34% down to 19% over the 5-year period

Category A: Most Category A transports were retrievals (81%) under the care of intensive care (33%) or neurosurgery (26%), with other services represented including cardiology (5%), cardiothoracic (7%), general medicine (6%) and general surgery

(6%). Compared to the figures for all transports, a higher proportion of critically ill patients were transported by helicopter (28% versus 18% overall) and road (29% versus 11% overall), and only 43% by fixed wing aircraft (versus 70% overall).

Category B: The highest proportions of Category B patients (59% retrievals) were under the care of cardiology (24%), obstetrics (12%), neurosurgery (10%), cardiothoracic (8%) and paediatrics (8%). The mode of transport was similar to the proportions for overall transports at 71% fixed wing, 20% helicopter and 9% road.

The median mission time for all transports was four hours and 30 minutes (IQR 3h29m to 6h). A higher proportion of transports occurred on weekdays (between 14 and 17%) than weekends (10 and 11%) and this trend remained constant over the 5 years reviewed. A high proportion of missions (69%) started between the hours of 7am and 4pm, but 26% started between 4pm and midnight, and 6% between midnight and 7am. Of those starting after midnight a high proportion (71%) were retrievals to Wellington Hospital, and most (90%) were critically ill or requiring intensive care (category A or B patients).

Overall 9% of missions took 8 hours or longer from the logged start time to logged final completion. 11% of the missions undertaken by fixed wing aircraft lasted 8 hours or more compared to only 3% of road transports and 1% of helicopter transport missions.

Proportionately, 75% of these long missions were category A or B patients, and 55% of the patients were under 50 years of age. In terms of clinical services 16% were under the care of paediatrics and 9% under the care of orthopaedics although these services accounted for only 6 % of overall transports each.

Conversely 12% were under the care of cardiology, 10 % under neurosurgery, and 4% under cardiothoracic specialities but respectively these services accounted for 16 %, 14%, and 9% of overall transports. When the services are considered individually 22% of all paediatric 14% of all orthopaedic and 11% of general medicine transfers took 8 hours or more.

A doctor accompanied the patient in 34% of overall transports, the trend showing a steady increase from 28% in the 2006 period up to 43% of transports in the 2010 period. Over the period of review a total of 18 Category A patients were transferred without a doctor present, and 13 of these patients were ventilated during this transport. In 8 cases the patient was being transferred back to a secondary hospital for withdrawal of treatment and palliative care.

A doctor was involved in the transfer of 14% of category B cases during the study period, and less than 1% of Category C cases. A midwife was present for 4% of overall transports.

Discussion

This is the first published data which describes and characterises the workload of a New Zealand-based flight service and its role in interhospital transfer. It is limited by the fact that it utilises a retrospective data-set and does not explore patient outcomes. Nevertheless it provides an overview of the nature of the workload, and the

characteristics of patients who are transported between hospital facilities by a dedicated tertiary transfer team.

Over a 5-year period the Wellington Fight Service completed an average of 2.2 missions per day, the median mission time of 4.5 hours indicating that around 9 hours a day is spent undertaking interhospital transfers. A significant and steadily increasing volume (proportionately) of transferred patients were critically ill (Category A), and requiring advanced care from intensive care clinicians during transport. A high proportion of transports were for cardiology/cardiothoracic or neurosurgical related care, which reflects the tertiary nature of services provided by the receiving hospital.

The disparity between total missions logged and missions undertaken (figure 1) should be considered in light of a funding allocation change in 2006 when the District Health Board of domicile (DHBod) became responsible for all transfer costs associated with tertiary level care for their patients rather than just retrieval costs. The impact of this may have been an increasing focus by some DHBods on establishment and greater use of in-house transfer teams.

There are relatively few descriptions of flight services, with a number of publications restricting the focus to those patients who were critically ill,[8] or mechanically ventilated at the time of transport.[11–13] Despite this, a case mix of neurosurgical, cardiac, respiratory and trauma patients is generally described in adult patients,[11,12] with paediatric transport described in distinct studies.[14]

Overall fixed wing aircraft were used for 70% of transports and the trend for helicopter use showed a steady decline over the 5-year period. However for the critically ill Category A patients helicopters were used for 28% of transports, which may reflect efforts to minimise delay through a 'hospital to hospital' transport rather than including the extra 'hospital to airport' road transports necessary when fixed wing aircraft are used. The relative safety of fixed wing aircraft compared to rotary wing has not been systematically examined,[13] but this may be an important issue given the greater use of rotary wing aircraft for Category A patients.

While virtually all (99.6%) category A patients were managed by both a doctor and a flight nurse, the majority of category B patients were managed by an intensive care flight nurse alone (86%). All flight nurses in the service are current ICU nurses who have trained additionally in flight nursing. While this provides a high level of skill, accurate triage of patients into category A or B is essential given the difference in level of staffing that this classification results in. There are no published guidelines or standards defining acuity and adequate level of staffing for air transportation in New Zealand.

The policy for Wellington ICU is that all subarachnoid haemorrhage patients (Category B) are accompanied by a doctor even if they have a Glasgow Coma Score (GCS) of 15 because their risk of re-bleed in the first 24 hours is high. There is also a recognition that discrepancies of GCS scoring sometimes occur or that this may change rapidly either whilst awaiting arrival of the transfer team or during transfer, so a doctor may be transported as a precaution.

The rates of major adverse events in the transportation of critically ill patients remain very low,[11-13] and there are significant difficulties in determining what proportion of the minor adverse events that occur are a product of the underlying pathophysiology

as compared to the product of stresses introduced by flight transportation.[13,15] In this study we have not examined clinical outcomes, or adverse events and these areas do require further investigation.

Work carried out late at night (from midnight to 7am) predominately transferred high acuity patients (90%), most of whom were coming to Wellington Hospital for tertiary care (70%). Given the increased risk of flying at night, the circadian effects on both medical staff and patients during these missions and the difficulties for the receiving hospital of dealing with new patients in the early hours of the morning,[13,16] this is an appropriate caution. However despite this caution, on average 45 missions a year occurred in this midnight to 7am time frame, and careful examination of the necessity of night-time transport for each of these cases should be examined.

Overall a significant number (9%) of missions took 8 hours or more, and missions of this duration have the potential for staff fatigue to compromise patient safety. The patients involved in these long missions tended to be somewhat younger and higher numbers were under the care of paediatrics and orthopaedics. This is not unexpected in light of the fact that younger people requiring emergent transfer to a tertiary centre are often critically ill and in an age-group over represented in trauma statistics where greater levels of pre-transfer stabilisation and preparation may be required.

Tertiary care for paediatric and spinal trauma patients may also require transfer over greater distances to specialist facilities located in Auckland and Christchurch respectively, and logistically patients may be transferred from services which do not provide pre-transport patient preparation or dedicated coordination of local ground transport.

Closer examination of the component times of each mission, looking at time from referral to the team arriving at the transporting hospital, time from arrival at referral hospital to departure (patient preparation time), departure from the referral hospital to arrival at the receiving hospital (transport time) and from arrival at the receiving hospital to the receiving department have all been advocated as key performance indicators of flight services but these are not routinely collected or reported. [17]

Limitations—This is a retrospective analysis of workload of a single flight service, and we have limited analysis to work undertaken. Further prospective analysis including patient outcomes is required to fully characterise the workload of this service and to examine both the appropriateness with which this service is utilised and the risks that are associated with air transport of these patients. Given the high cost associated with the operation of this type of service, and the severity of illness of many of the patients transported, these are issues that do require close investigation.

Conclusion—The Wellington Flight Service completes 2.2 interhospital transfers a day, the median duration for each transfer being 4.5 hours. Twenty-one percent of patients transferred are in critical condition (category A), with a further 51% having significant clinical problems (category B). While virtually all ventilated patients are transported by a physician and a nurse, the majority of other transfers are undertaken by a nurse alone. A significant portion of this work occurs after hours and overnight, and 9% of missions are of longer than 8 hours duration. Further examination of the clinical outcomes in this cohort of patients transported to tertiary care is required to fully evaluate these services.

Competing interests: None declared.

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References:

1. Ryder-Lewis M. Going home from ICU to die: a celebration of life. Nurs Crit Care. 2005 May-Jun;10(3):116-21.
2. Durairaj L, Will JG, Torner JC, Doebbeling BN. Prognostic factors for mortality following interhospital transfers to the medical intensive care unit of a tertiary referral center. Crit Care Med. 2003 Jul;31(7):1981-6.
3. Essebag V, Halabi AR, Churchill-Smith M, Lutchmedial S. Air medical transport of cardiac patients. Chest. 2003 Nov;124(5):1937-45.
4. Flabouris A. Patient referral and transportation to a regional tertiary ICU: patient demographics, severity of illness and outcome comparison with non-transported patients. Anaesth Intensive Care. 1999 Aug;27(4):385-90.
5. Flabouris A, Hart GK, George C. Outcomes of patients admitted to tertiary intensive care units after interhospital transfer: comparison with patients admitted from emergency departments. Crit Care Resusc. 2008 Jun;10(2):97-105.
6. Warren J, Fromm RE Jr, Orr RA, et al. American College of Critical Care Medicine. Guidelines for the inter- and intrahospital transport of critically ill patients. Crit Care Med. 2004 Jan;32(1):256-62.
7. Bellingan G, Olivier T, Batson S, Webb A. Comparison of a specialist retrieval team with current United Kingdom practice for the transport of critically ill patients. Intensive Care Med. 2000 Jun;26(6):740-4.
8. Wiegersma JS, Droogh JM, Zijlstra JG, et al. Quality of interhospital transport of the critically ill: impact of a Mobile Intensive Care Unit with a specialized retrieval team. Crit Care. 2011 Feb 28;15(1):R75.
9. Report of the Air Ambulance Reference Group to the ACC and Health Ministers. 28 February 2009. Available from http://www.moh.govt.nz/moh.nsf/indexmh/report-air-ambulance-reference-group
10. Statistics New Zealand. Browse for statistics. Population. Estimates and projections. Subnational population tables. 30 June 2010. http://www.stats.govt.nz/
11. Fan E, MacDonald RD, Adhikari NK, et al. Outcomes of interfacility critical care adult patient transport: a systematic review. Crit Care. 2006 Feb;10(1):R6.
12. Seymour CW, Kahn JM, Schwab CW, Fuchs BD. Adverse events during rotary-wing transport of mechanically ventilated patients: a retrospective cohort study. Crit Care. 2008;12(3):R71.
13. Shojania KG, Duncan BW, McDonald KM, et al., eds. Making Health Care Safer: A Critical Analysis of Patient Safety Practices. Evidence Report/Technology Assessment No. 43

(Prepared by the University of California at San Francisco-Stanford Evidence-based Practice Center under Contract No. 290-97-0013), AHRQ Publication No. 01-E058, Rockville, MD: Agency for Healthcare Research and Quality. July 2001. Available from http://archive.ahrq.gov/clinic/ptsafety/

14. Gregory CJ, Nasrollahzadeh F, Dharmar M, et al. Comparison of critically ill and injured children transferred from referring hospitals versus in-house admissions. Pediatrics. 2008 Apr;121(4):e906-11.
15. Flabouris A, Hart GK, George C. Observational study of patients admitted to intensive care units in Australia and New Zealand after interhospital transfer. Crit Care Resusc. 2008 Jun;10(2):90-6.
16. Gander P, Purnell H, Garden A, Woodward A. Work patterns and fatigue-related risk among junior doctors. Occup Environ Med. 2007 Nov;64(11):733-8.
17. Ramnarayan P. Measuring the performance of an inter-hospital transport service. Arch Dis Child. 2009 Jun;94(6):414-6.