Critical care transfers: core principles and logistics

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Learning objectives

After reading this article, you should:

- understand the requirement for critical care transfer
- be able to define and categorise the different types of critical care transfer
- understand the risks of transfer and outline strategies to minimise these risks
- understand the importance of a systematic approach to transfer

Abstract

In the UK over 11,000 critically ill patients are transferred between hospitals each year. In addition, a significant number of critically ill patients are transferred to hospital from locations outside hospital such as rural general practice surgeries or the community. While specialist teams are available for some transfers, the majority are conducted by teams from the referring hospital. The aim of this article is to give an overview of the principles of critical care transfer, transfer platforms and the importance of a structured approach.

Keywords Critical care; hazards; logistics; principles; retrieval; transfer

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Introduction

In the United Kingdom over 11,000 critically ill patients are transferred between hospitals each year.[1,2] In addition, a significant number of critically ill patients are transferred to hospital from locations outside hospital such as rural general practice (GP) surgeries or the community. While specialist teams are available for some transfers, the majority are conducted by teams from the referring hospital.

Types of transfer and definitions

Language around transfer can be confusing. There are a number of ways to describe the movement of critically ill patients and some common terms are defined in Table 1.

The need for transfer

Patient transfer is normally indicated for either clinical or capacity reasons. A clinical transfer is indicated when the needs of the patient cannot be provided for in their current location, while capacity transfer will occur when numbers of beds or staffing is not adequate to accommodate the patient in their current location. Ideally capacity transfers should be kept to a minimum, due to the additional risk to the patient and the potential distress caused to relatives.[3]

The urgency of transfer will depend on the clinical condition of the patient, risk of deterioration and the likely benefit of a higher level of care or specialist intervention. It is not necessarily the case that a patient requiring a higher level of care will require a more urgent transfer.

Geographical location and logistical concerns such as weather, road conditions and ferry times may also be factors in deciding the need and urgency of transfer. In rural parts of the UK such as north-west Scotland and north Wales, the distances involved in patient transfer may be very long and involve transfer over water. This may reduce the threshold for transfer to a higher level of care, for example from rural district general hospitals without intensive care units, in order to avoid the

Transfer terminology[1]

Transfer	The movement of a patient from one place to another
Inter-hospital transfer	The movement of a patient between hospital facilities
Intra-hospital transfer	The movement of a patient within a hospital facility, e.g. to a CT scanner or operating theatre.
Retrieval	The movement of a patient from a lower level of care to a higher/specialist level of care. Usually implies the use of a specialist team to conduct the transfer, and the requirement for ongoing treatment en route
Primary retrieval	The treatment and movement of a patient from the community to the appropriate hospital
Secondary retrieval	Treatment and movement of a patient from a hospital without critical care facilities to a hospital with critical care facilities
Tertiary retrieval	Treatment and movement of a patient from a general critical care unit to a specialist critical care unit (e.g. ECMO transfers)

Table 1

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potential of a deteriorating patient who cannot be moved. The overriding principle of equity of access to healthcare should be adhered to, and additional resources provided to ensure that people living in remote and rural communities are able to receive as good care as those living in cities wherever possible.

Triage

In the UK, healthcare services are broadly organised into primary (GP and community based), secondary (general hospital care) and tertiary (specialist hospital care) levels. Networks broadly based on geographical location allow movement of patients up and down levels of care in a pre-arranged fashion. Critical care Operational Delivery Networks (ODNs) exist between critical care units in order to allow a smooth flow of patients between units where necessary, with financial arrangements between trusts to allow for the movement of resources required.[4] In some areas, referrals for different specialties will normally be made to different secondary or tertiary units because of existing agreements.

In critical care transfer, it is vital that the end destination of the patient is agreed before commencing the transfer. It may be that the destination unit is not the geographically closest. Occasionally in time critical transfers, especially by air, the usual receiving unit will not be accessible in a timely fashion due to weather or other factors therefore ad hoc referrals to other centres may be required. This should be conducted by consultant to consultant discussion as there may be service or financial implications. Very rarely it may be necessary to change destination in transit or return to the base hospital, for example, due to bad weather, vehicle failure or patient deterioration. It is therefore important that clinicians conducting transfers have a good knowledge of the services available in their area and the immediate surrounds (including along the intended route) and have a contingency plan for problems during the transfer.

Transport platforms (Table 2)

Key to any successful transfer is selection of the most appropriate transport platform. The transport modality is influenced by clinical urgency, resource issues, weather, geography and distance. An appreciation of the benefits and limitations of the commonly employed platforms is essential to providing safe patient care. It must be remembered that the risk of transport is real and should not exceed any potential benefit the patient may receive from the retrieving centre.

In most systems, ground transport and air (rotary and fixed wing) and maritime platforms are the most frequently used.

EMRS operates both fixed wing and rotary airframes. Figure 1 demonstrates the patient and crew configuration for Helimed 5 (Airbus H145 T2) operated by Babcock and Figure 2 the Beechcraft Kingair 200c operated by Gamma Aviation.

Risks and hazards

Risks and hazards leading to adverse events have been reported in up to 62% of transfers.[5] Such incidents may be categorised as being patient, equipment or team related (Table 3).

As many as 31% of incidents during transfer are classed as significant and up to 79% of these require intervention.[5] It has been shown that the majority of these (52–91%) may be preventable and as such having robust governance structures and a culture of incident reporting are key to safer patient care.

Transport platform comparison

	Ground	Rotary	Fixed wing
Access	Point to point	Point to point	Secondary transfer
Distance		100–350 km	>350 km
Speed	60–120 km/hr	200–300 km/hr	320–800 km/hr
Capacity	1 stretcher +1 sitting	1 stretcher >1 if large aircraft	1–2 stretchers more if large aircraft
Equipment	Basic but capacity for additional	Restricted capacity Dedicated equipment	Dedicated equipment, more capacity than rotary
Availability	Common but in high demand 24 h operating	Less common Aviation restrictions 'Night HEMS'	Less common 24 h operating
Limitations	Traffic dependent Relatively slow Weather/road conditions	Weather Terrain/high ground Trained aviation staff De-icing availability	Weather (<rotary) Requires runway Trained aviation staff Limited diversion possibilities
Transport effects	Acceleration Deceleration Motion sickness	Noise Vibration	Altitude effects Pressurisation
Altitude	Ground level	0–10,000 feet Unpressurised	0–35,000 feet Pressurised
Patient access	Limited but can stop for intervention	Limited, not 360 degree (unless large aircraft)	Limited, dependant on aircraft size
Cost	Low	Very High (3-4x FW)	High

Table 2

Patient related

Any potential complication of the ongoing disease process which may occur in hospital should be anticipated during transfer. Removal of patients from a static care environment into the transfer arena elevate these risks and as such, careful patient selection by experienced clinicians is essential.[7]

Depending on the transfer platform and due to patient packaging, clinical assessment is often limited to data interpretation from equipment. The stethoscope, for example is unlikely to yield any diagnostic value during a noisy rotary transfer.

Equipment related (Table 4)

Equipment failure is common, it may account for nearly half of all reported incidents.[5] Retrieval teams should therefore be

Figure 1 SAS Helimed 5 Airbus H145 T2 patient/crew positioning.

Figure 2 SAS King Air 200c patient/crew positioning].

intimately familiar with their equipment and able to troubleshoot common problems promptly. Simulation of such incidents is advisable to ensure teams are well rehearsed in the event of crisis. Equipment checks should be rigorous. Defective or absent equipment during a transfer can be catastrophic. Equipment checks are ideally carried out by two people using a 'check and response' to reduce observer bias in single person checks. Checklists are championed in transfer and retrieval medicine, being a reliable marker of consistency and tool to assist cognitive offloading. Table 4 denotes known hazards, their recognition and appropriate management.

Oxygen requirement during transfer

- For non-ventilated patient, hourly oxygen requirement calculated by:

  Oxygen flow per minute × 60
- For the ventilated patient, hourly oxygen requirement calculated by:

  (FiO_2 × minute volume + bias flow) × 60
- Bias flow dependent on ventilator (e.g. Draeger Oxylog 3000 uses 0.5 l/min)
- Hourly oxygen requirement is multiplied by anticipated duration of transfer to estimate oxygen consumption.
- Anticipated transfer time should account for loading/unloading patient.

Incidents

	Medical		Equipment
	Cardiovascular	Respiratory	
Incidence	6–24%	0–15%	9–36%
Common events	Hypo-/hypertension	Inadequate ventilation	Power failure
	Brady-/tachycardias	Oxygen desaturation	Gas supply problems
	Dysrrhythmias		Absent, defective equipment

Adapted from Droogh 2015[6]

Table 3

Recognized equipment hazards

Hazard	Sign	Intervention
Oxygen supply failure	Hypoxia Low pressure alarm	Confirm supply, connections, tubing. Source alternative, O_2/ventiate manually Consider plan to divert
Loss of airway	Hypoxia, capnography, visual displacement	Facemask ventilate and follow SOP to secure airway
Ventilatory failure	Hypoxia, ventilator alarm, capnography	Back-up ventilator Bag- valve ventilation
IV access failure	Infusion failure, alarm	Replace IV/IO, pressure bag to replace infusion pump
Monitor failure	Artefact/erroneous reading	NIBP, clinical signs (pulse) use alternative
Power failure	Battery alarm/screen blackout	Confirm battery status, consider plan to divert to nearest facility

Table 4

- **DOUBLE** the anticipated oxygen requirement is universally accepted as the safest practice.

Team related

Above all else, the safety of the team is paramount. A robust governance structure is essential to ensure this and is reinforced by national and international standards.[8] Regular risk assessment for team members should be carried out with the necessary occupational health checks to minimise the impact of potential hazards to staff.

Team welfare and safety is not only an individual members responsibility but rather part of a wider organisational framework. When considering the hours of work and nature of the work undertaken, individual and team fatigue has deleterious effects on both patient care and staff wellbeing. A useful tool, first developed by the Federal Aviation Administration (FAA) for pilots is the 'I'M SAFE Checklist' (Box 1) which is designed to assess both the overall readiness of the individual to work and their fitness to work. To ensure safety, retrieval teams should adhere to a fatigue policy.[9]

'I'M SAFE checklist'

Illness — Do I have symptoms?

Medication — Have I been taking prescription drugs that may interfere?

Stress — Am I under psychological pressure from the job? Am I worried about financial matters, health problems, or family problems?

Alcohol and drugs — Have I been drinking, consuming drugs recently?

Fatigue — Am I tired and not adequately rested?

Emotion — Am I emotionally upset?

Box 1

Conduct of transfer

Stabilisation and pre-emptive intervention

During transfer, the environment can make even the simplest procedure extremely challenging. It is therefore essential that the transfer team anticipate and perform any interventions required before packaging and moving the patient (Table 5).

Sedation

Sedation may be required to allow for the safe assessment, treatment and transport of a patient. During transport sedation may need to be increased to counter the physiological effects of increased noise, vibration and movement. The clinician should

Common pre-transfer interventions

Intervention	Comments
Clinical handover and patient assessment	Establishes a shared mental model and helps to identify the interventions that are required to make the patient safe for transfer
Intubation + ventilation	Threshold for intubation should be lower to avoid deteriorating ventilation or a compromised airway in transit The use of a transfer ventilator enables good control of patient physiology as well freeing up hands of the team
Invasive arterial BP monitoring	Important due to the limitations of non-invasive blood pressure monitoring with vibration and increased monitor battery usage Provides real-time information, thus increasing the ability to detect any deterioration
Central venous access	Allows safe use of vasoactive drugs. Less likely to fail in transit than PVC. Multiple lumens are useful when multiple infusions required
Peripheral IV/IO access	Must be adequate and secure
Drug infusions	Establishing infusions of inotropes/ vasoconstrictors, sedation, opioids to allow control during transfer. Consider suspending non-essential infusions for the duration of transfer
Investigations	Where they will improve safety in transit e.g. chest X-ray to assess for pneumothorax prior to air transfer
Other interventions	Finger or tube thoracostomies, blood transfusion, specific treatment, e.g. antibiotics, anti-emetics in awake patients

Table 5

be familiar with the sedative agent and have experience of using it prior to transfer. When planning for the transfer, teams should ensure they have enough drugs for the duration plus any unforeseen circumstances. The use of infusion pumps helps to reduce the risk of accidental awareness and offloads the cognitive burden of remembering to give sedation boluses.

Monitoring

Monitoring should be swapped over to the transfer equipment as soon as practical in order to ensure equipment is functioning correctly and that you are getting similar readings to previous monitoring. Monitoring and monitors should:

- follow the AAGBI standard and should include blood pressure (both invasive and non-invasive if indicated), ECG and heart rate, SPO_2, $ETCO_2$) invasive temperature.
- be securely attached to patient and/or designated brackets.
- have illuminated screens and both audible and visual alarms.
- have sufficient power resilience with back up batteries or mains power supply sufficient for double the anticipated duration of transfer.
- include back up equipment such as portable $ETCO_2$ and SPO_2 monitors.
- be operated only by those trained in their use. All staff should be competent to problem solve and correct equipment alarms and faults.

Packaging

By packaging in a uniform and systematic way we provide our patients with both comfort and safety. Risks of poor packaging include:

- avoidable patient harm, e.g. pressure sores, eye damage, hypothermia, injury.
- snagging of lines/tubes potentially leading to accidental extubation or loss of IV access.
- difficulty accessing patient for ongoing assessment/intervention
- difficulty moving and handling patient
- loss of patient dignity.

Figure 3 demonstrates one solution to patient packaging.

Team preparation

The transfer team must be adequately trained and equipped to conduct a safe transfer without causing additional risk to themselves and the patient.

The AAGBI advises that 'all doctors and other personnel undertaking transfers should have the appropriate competencies, qualifications and experience … it is highly desirable that this should include attendance at a suitable transfer course'.[7] Demonstration of competence in this field is part of the curriculum for trainees in anaesthesia, emergency medicine and intensive care medicine. Following the creation of Critical Care Networks (CCNs) throughout the UK a plethora of courses are now available to supplement

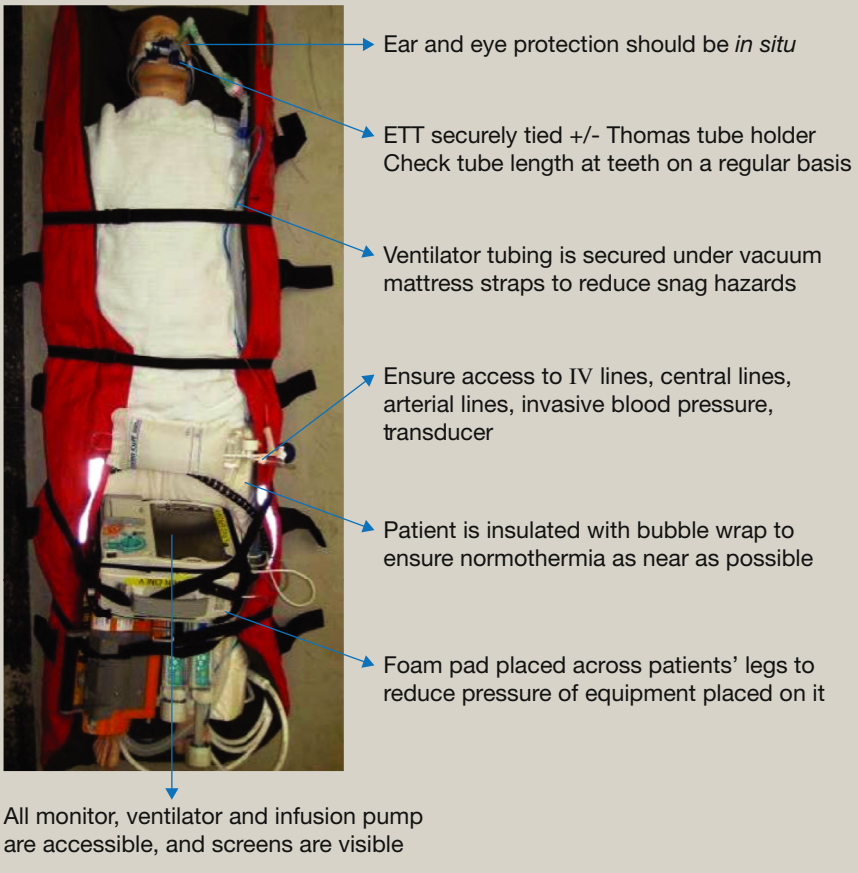

Figure 3 An example of patient packaging.

knowledge and skills. A recognised qualification in the form of the Diploma in Retrieval and Transfer Medicine (DRTM) is available through the Royal College of Surgeons of Edinburgh in association with the Faculty of Pre-Hospital Care.

The exact composition and skill level of the team depends on a risk assessment of the individual patient and the circumstances of the transfer. This decision should ideally be made at a senior level

The following are some key elements of team and individual preparation that should be considered immediately before transfer.

- Individual preparation:
  - warm/waterproof outdoor clothing and footwear (theatre scrubs/shoes are not adequate for transfer in the UK in any season)
  - ensure 'full belly, empty bladder'
  - emergency cash/card in case of delays
  - snack and water (especially on long transfers)
  - photo ID (passport/drivers licence plus NHS ID if air transfer)
  - consider motion sickness prophylaxis.
- Equipment:
  - personal protective equipment (inc High visibility jacket, eye protection, ear protection and supply of clinical gloves and aprons).
  - mobile phone with numbers preloaded
  - TETRA radios or similar
  - pens and in-transit documentation
  - transfer bag containing range of medical equipment adequate to manage any problems in transit.

Communication and documentation

Clear communication is essential to a smooth and safe transfer. The transfer team should ensure that the receiving hospital are contacted before departure. Key clinical information regarding the patient's condition, medication (especially infusions) and likely interventions required on arrival will allow the receiving unit to plan for handover and ongoing care. An estimated time of arrival is also important, although delays are common and should be anticipated. The transfer team should ensure they have the ability to communicate in transit with both the referring and receiving unit. Teams should be familiar with the use of any communication devices carried.

A full set of clinical notes including all investigations (copies or originals) should move with the patient. In the most time-critical situations this may be significantly abbreviated, however a plan should be in place to ensure full notes follow the patient in a timely fashion. The transfer team should also maintain a contemporaneous record of the transfer.

On arrival at the receiving unit, a structured handover must occur to ensure clear passage of key information. A 'hands off' handover in all but the most unstable patients is a good way of achieving this.

Before leaving on a transfer, the team should also ensure the know how they will be repatriated to their base, and who to contact if there are any problems.

Checklists

Critical care retrievals and transfers are a high-risk activity which can place team members under a great deal of stress. As procedures and patients become more complex and the equipment list required to carry out these procedures increases so does the cognitive load on each individual. It is important to implement aids to reduce this cognitive load and to assist the clinician with decision making during high pressure situations.[10]

Many specialist retrieval services employ checklists to improve the safety and quality of specific activities, for example in emergency anaesthesia, blood transfusion, and equipment checks.

A checklist should not be looked upon as a weakness. They are developed and used to assist the team during times of high stress and when things can be easily missed. They are in place to provide protection for not only the patient but the team as well.

Specialist teams and special circumstances

There are a number of special circumstances where dedicated teams, specialist equipment or both are required to conduct a safe transfer.

Critical care retrieval

In 2018, the Scottish Specialist Transfer and Retrieval Service (ScotSTAR) conducted a total of 249 adult, 280 paediatric and 1350 neonatal critical care transfers and retrievals. In addition, dedicated trauma teams assisted in the primary retrieval of around 850 injured patients.[11] Similar dedicated services exist across the United Kingdom. Dedicated teams also exist for highly specialised transfers such the retrieval of patients on ECMO. Many of these services offer fellowships which offer an excellent opportunity for specialty trainees interested in critical care retrieval. ◆

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