North of England Critical Care Network

T4T

COURSE MANUAL

NHS
Operational Delivery Network

NoECCN

North of England Critical Care Network

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West Yorkshire Critical Care And Major Trauma Operational Delivery Network

Contents

Chapter 1 - Objectives of the Course

By the end of this course you should understand:

- The hazards of the transfer environment
- How to prepare various types of patient for transfer
- When a patient is ready to be transferred
- How to use all of the Network transfer equipment
- How to calculate how much oxygen to take
- What to take and what to leave behind
- The importance of effective communication during critical care transfers
- The ethical and legal aspects of critical care transfers
- The principles of human factors and their application to critical care transfers
- The different types of transport that may be used
- The physiology of head injuries and how that may be applied during the transfer situation

"If it can go wrong...sooner or later it will go wrong"

Chapter 2 - Introduction

Transfer of the critically ill patient is a fact of life. It is estimated that over 11000 critically ill patients are transferred in the United Kingdom each year and this may well rise in the future.

Of course this figure refers primarily to transfers of intensive care and high dependency patients traveling between hospitals, often from one critical care unit to another. It takes no account of the even more numerous transfers that occur on a daily basis within the hospital itself, for example from the Intensive Care Unit to the CT scan room. It also ignores the transfer of many other sick medical and surgical patients from one hospital to another that may not have been regarded as 'critically ill'.

Transfer of patients is not something that should be undertaken lightly. Patients should be meticulously resuscitated and stabilized prior to transfer. It is extremely difficult to perform any sort of procedure whilst on the move, be it in the back of an ambulance or in a hospital lift. Preparing a patient for transfer is all about making sure that intervention is rarely required en route.

The Training for Transfer course will provide you with the structure and rationale with which to approach this.

Critical Care Networks

Critical Care Networks are made up of all the critical care units within a geographical area. Networks are responsible for the coordination and development of inter-hospital transfer services within their own geographical area.

The North of England Critical Care Network (NoECCN) comprises all acute hospitals within the northern region, covering a population of 3.2million. The network is split geographically into transfer groups (Table 1) to try and avoid long transfer times wherever possible.

Table 1. North of England Critical Care Transfer Groups

Non Clincal Transfer Groups (Transfering Hospital)	Receiving Hopsital: Royal Victoria Infirmary NE1 4LP	Freeman Hospital NE7 7DN	Sunderland Royal Hospital SR4 7TP	South Tyneside District Hospital NE34 0PL	Queen Elizabeth Hospital NE9 6SX	Northumbria Specialist Emergency Care Hospital (NSECH) NE23 6NZ	Cumberland Infirmary, Carlisle CA2 7HY	West Cumberland Infirmary, CA28 8JG	University Hospital of North Durham DH1 6HX	Darlington Memorial Hospital DL3 6HX	James Cook University Hospital TS4 3BW	Univeristy Hospital of North Tees TS19 8PE	Dumfries and Galloway DG2 8RX	Furness General Hospital LA14 4LF
Royal Victoria Infirmary 0191 2824616		3	14	11	5	21	59	98	19	38	43	38	N/A	N/A
Freeman Hospital 0191 2231014	3		16	12	6	15	62	100	21	40	46	40	N/A	N/A
Sunderland Royal Hospital 0191 5699745	14	16		8	12	27	73	111	13	31	34	28	N/A	N/A
South Tyneside District Hospital 0191 4041030	11	12	8		8	21	70	109	17	37	10	34	N/A	N/A
Queen Elizabeth Hospital 0191 4452007	5	6	12	8		23	66	104	14	33	41	32	N/A	N/A
Northumbria Specialist Emergency Care Hospital (NSECH) 0191 6072011	21	15	27	21	23		69	110	26	46	47	32	N/A	N/A
Cumberland Infirmary, Carlisle 01228 814114	59	62	73	70	66	69		39	70	80	100	93	34	N/A
West Cumberland Infirmary, 01946523443	98	100	111	109	104	110	39		109	104	121	115	72	49
University Hospital of North Durham 0191 3332019	19	21	13	17	14	26	70	109		22	32	22	N/A	N/A
Darlington Memorial Hospital 01325 743212	38	40	31	37	33	46	80	104	22		19	14	N/A	N/A
James Cook University Hospital 01642 282680	43	46	34	10	41	47	100	121	32	19		26	N/A	N/A
Univeristy Hospital of North Tees 01642 624562	38	40	28	34	32	32	93	115	22	14	26		N/A	N/A

Reason for Transfer

There are various reasons for transferring patients. Primary transfer refers to the initial into hospital, from home, place of injury or illness. It is vital that critically ill or injured patients are treated injuries. However, there are several instances when such management may be followed by further (secondary) transfer to another hospital. It is these types of transfer that we are concerned with on this course.

Reasons for inter-hospital transfer include:

Clinical Transfer / Tertiary Transfer	Transfer of a patient to another hospital for care or facilities that are not available within the referring hospital.
Repatriation	When a patient is transferred back to the host hospital when a suitable bed has become available and/or specialist care is no longer required.
Non- clinical Transfer	Transfer of a patient due to insufficient bed capacity in the referring unit, includes transfers between different hospitals within the same Trust.

The first two reasons for transfer will all be of some benefit to the patient. However, transfers due to lack of capacity in the referring hospital is unfortunately common, particularly during the winter months. Such transfer is clearly of no benefit to the patient and indeed may even be of detriment

Transfers for non-clinical reasons (e.g. bed pressures) should only occur within the network specified North / South transfer group. Any transfer for non-clinical reasons outside the transfer group is regarded as a critical incident. Senior management at the referring hospital has to be informed and a critical incident data form should be completed.

Transferring patients due to lack of bed capacity can involve difficult decisions being taken. A common practice is to move a stable patient to make room for someone who is critically ill. Even with stable patients, a critical care transfer can have significant impact. Haji-Michael (2005) suggests a non-clinical transfer of this nature results in extended length of critical care stay for the stable patient being moved. Therefore, the decision to transfer patients should never be taken without great thought.

It is essential that meticulous attention to detail is applied to every transfer so that the patient comes to no harm, and arrives in the best condition possible. Patients may deteriorate during the journey by becoming cold, being subjected to the forces of acceleration, and critical incidents such as having lines and tubes dislodged can occur. Good communication between the transferring and the receiving team is crucial. Poor communication of patient information may result in essential information not being passed on to the receiving team to the detriment of patient care.

Transfer of patients, who should do them?

Inter-hospital transfer of patients is the ultimate in unsupervised work. The patient to be moved may often be one of the sickest in the hospital. It is essential that the staff transporting a critically ill patient are suitably experienced to do so. NoECCN have developed a Transfer Risk Assessment tool (appendix 1) that should be used as a guide to determine who should transfer the patient. It is the referring consultant’s responsibility to ensure that the transferring team have the necessary skills, the doctor or practitioner must have the appropriate airway skills to do so.

The transfer team must also be familiar with any other organ support such as ventilation or inotropic support required by the patient. Ideally they should have had supernumerary experience in inter-hospital transfer before undertaking it alone. They must be familiar with all of the transfer equipment in use. A nurse or operating department practitioner will frequently accompany the Doctor or Advanced Critical Care Practitioner (ACCP) to transfer a patient. They must also be appropriately experienced in transferring patients and be familiar with the patient and transport equipment. The National Competency framework for Registered Nurses in Adult Critical Care (STEP 1 &2) provides Intra & Inter Hospital Transfer Competencies for Nurses (appendix 4). The royal Collage of Anaesthetist Core Level Competencies for CCT in Anaesthesia can also be found in Appendix 5

Intra-hospital transfer is somewhat less "unsupervised", with help usually being quickly available if needed. Such transfers will give trainees, and junior members of staff, the opportunity to learn the principles of safe transfer under various levels of supervision, and allow them to demonstrate competencies in this area, before they are required to transport patients unsupervised between hospitals.

Retrieval Teams

Some regions or centres use their own retrieval teams to go out to referring hospitals and transfer patients back to the receiving hospital. Such teams are more commonly used in specialist areas such as paediatric and neonatal critical care, but adult retrieval teams also exist. There is some evidence to suggest that patient outcome may be improved where a specialist transfer team undertakes transfer. The North of England Critical Care Network has a specialized team for the retrieval and transfer of paediatric patients (NECTAR – Northern England Children Transfer and Retrieval). In the future this service may extend to adult and neonatal retrieval and transfers.

The advantages of such teams are:

- Teams can be made up of suitably qualified individuals with appropriate specialist skills
- Teams will be used to working together and will be familiar with their own transfer equipment
- Staff from the referring hospital will not become depleted.

The disadvantages of sending out a recovery team from the receiving hospital are that this will put increased staffing and financial pressures on the receiving centre and delays may occur if the team is not immediately available. Therefore, retrieval teams should be carefully planned and funded. Staff in referring centres may also potentially become deskilled in inter-hospital transfers, but there are usually enough intra-hospital transfers to maintain skills on the transferring of patients.

Guidelines

There are a number of published guidelines relating to the transfer of critically ill patients. You should make sure you are familiar with the content of these general guidelines and apply the principles and recommendations wherever possible.

AAGGI Safety Guidance - Interhospital Transfer (2009) The association of Anaethetists of great Britain and Ireland. https://anaesthetists.org/Home/Resources-publications/Guidelines/Interhospital-transfer-AAGBI-safety-guideline

Guidelines for the Provision of Intensive Care Services. (2019) Faculty of Intensive Care Medicine. www.ficm.ac.uk/standards-research-revalidation/guidelines-provision-intensive-care-services-v2

Guidance On: The Transport of the Critically Ill Adult. (2019) Faculty of Intensive Care Medicine https://www.ficm.ac.uk/sites/default/files/transfer_critically_ill_adult_2019.pdf

North of England Network Transfer Guidelines (2019) www.noeccn.org.uk/Transfer-Group-Guidelines-and-Resources

References& Further Reading

Haji-Michael, P (2005) Critical care Transfers – a danger foreseen is half avoided. Critical Care. 9,343

Chapter 3 - The Pathophysiology of Transfer

Critical Care patient transfers are guided by the Intensive Care Society and Faculty of Intensive Care Medicine – Guidance On: The Transfer of the Critically Ill Adult (2019) and within NoECCN the NoECCN Transfer Guidelines (2019). These standards state that to be able to safely transfer a critically ill patient the transfer team should receive training in transport medicine. This includes amongst others, the knowledge of physiology and appreciate the effects of the transfer process, including the effects of the forces and hazards which come into force during the event.

In health, the body will be capable of accommodating and compensating for any forces and hazards encountered during the transfer; however a standard critical care patient has reduced ability due to critically illness. Any increase in magnitude of forces experienced, combined with the severity of the patient condition can combine to cause significant physical alterations during the process. Hazards encountered during transfers consist of both static and dynamic, all of which should be avoided or minimized and prepared for.

Static Hazards

These hazards are the more obvious to understand and appreciate. Static hazards are those due to the hostile environment experienced on transfer. These include:

- Temperature
- Noise
- Vibration
- Lack of space
- Poor visibility
- Atmospheric pressure / altitude

The back of an ambulance is a difficult environment to work in. It is extremely cramped.

Vibration due to the motor vehicle makes it unsafe for staff to move around and perform anything other than simple tasks. Vibration may result in equipment becoming dislodged if it is not safely secured, and may interfere with monitoring such as non-invasive blood pressure readings and oxygen saturation. Vibration effects can be minimised by meticulous attention to padding, protecting and securing any venerable parts of either the patient of the attached monitoring.

Noise may impair the ability to appreciate alarms and the normal auditory cues we use to gauge that all is well. Communication between staff members may also be suboptimal.

Most forms of transport are cold and patients may become hypothermic if care is not taken to wrap them up well. Once again good preparation with packaging prior to transfer can reduce the hazard potential.

Poor visibility may be a problem during air transfers as lights may be dimmed. The effects of altitude will be described in the chapter covering modes of transport.

Dynamic Hazards

The dynamic forces exerted during transfer are perhaps the least appreciated. Acceleration and deceleration forces placed on the patient during transfer, be that along a hospital corridor or at 50mph in an ambulance, can have profound effects on the patient's physiology. Newton's 3rd Law states that "for every action there is an equal and opposite reaction".

Gravity and Acceleration

A form of acceleration familiar to us all is gravity. Acceleration forces solid organs and fluids (e.g. blood) to shift within the body in the direction opposite to the applied pressure force. Additional acceleration or deceleration during transfer will have superimposed effects. As most patients are lying on a trolley with their heads towards the direction of travel, acceleration from the ambulance will be directed along the long axis of the body towards the feet.

These forces may be of considerable magnitude. An ambulance braking hard may subject the patient to a force of 7-8 times that of gravity which is twice that experienced in a space shuttle taking off!

Acceleration Magnitude:

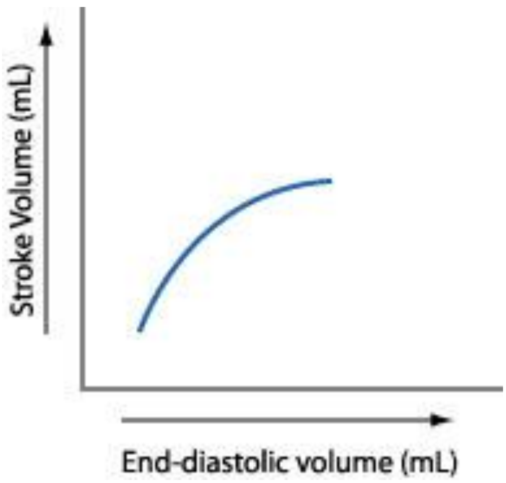
- Gravity - 1G
- Taking off in a commercial aircraft - 0.5G
- Taking off in a space shuttle - 3.4G
- Taking off in a fighter craft - 10-12G
- Braking hard in an Ambulance - 7-8G

Acceleration leads to physiological disturbance in the cardiovascular and respiratory system. The disturbance varies with rate of acceleration, duration and direction in which it is applied.

Effects on the Cardiovascular System

Acceleration in an ambulance with the patient usually supine and head in the direction of travel will tend to effectively force blood towards the feet. This is a similar phenomenon to the sensation of blood rushing to the feet when a lift accelerates upwards. This has the effect of decreasing venous return to the heart, reduction in cardiac output and reduction in blood pressure.

By virtue of Starling's Law, this fall in venous return will result in a reduction in cardiac output.



The greater the volume in the left ventricle the greater the stroke volume / cardiac output – up to the point of plateau

This will occur because the reduction in venous return or preload will result in a fall in the end-diastolic volume of the right ventricle. This will result in reduced stretch on the cardiac myofibrils, with a resultant fall in contractility and hence stroke volume. Starling's Law is illustrated graphically by the so-called Starling curve above. If the stroke volume of the right ventricle is reduced, then the venous return to the left side of the heart will also fall, and the left ventricular stroke volume will be reduced.

Since the cardiac output (CO) is dependent on the product of stroke volume (SV) and heart rate (HR), if the stroke volume falls but nothing else changes, then the cardiac output must fall. Similarly, as the mean arterial pressure (MAP) is governed by the product of the cardiac output and the systemic vascular resistance (SVR, how constricted the blood vessels are), then if the cardiac output falls but nothing else changes the blood pressure will fall.

CO = SV x HR

MAP = CO x SVR

Under normal circumstances the body would respond to a fall in venous return with an attempt to maintain its cardiac output and blood pressure. This is achieved by raising the heart rate and systemic vascular resistance by increasing the activity of the sympathetic nervous system.

Critically ill patients however are not able to mount these appropriate responses. The circulation is frequently dilated for example due to sepsis or an inflammatory response, the autonomic nervous system often does not work normally (dysautonomia), and many of the responses are obtunded by the use of vasodilating sedative drugs such as propofol. The venous return will also be further reduced in the ventilated patient due to the effects of positive intrathoracic pressure.

Thus, in the critically ill patient a fall in venous return will commonly lead to a fall in blood pressure. This result will be exacerbated if the patient is hypovolaemic and will be improved in the patient with a normal blood volume or slightly hypervolaemic patient.

“FULL” Patients Travel Better

Thus “full” patients travel better. Always ensure your patients are fluid resuscitated before setting off and that the blood pressure is adequate. If in doubt give fluid. If fluid resuscitation alone does not result in an adequate blood pressure, consider whether vasoconstrictors or inotropes may be needed.

Hypervolaemic patients are rare, but an example would be the patient with acute pulmonary oedema and elevated venous pressures. These patients should be sat up to reduce venous return. Diuretics and nitrates will act similarly and should be considered. The effects of acceleration in these patients may in theory be favourable, but deceleration during braking may increase venous return further and force the function of the ventricles further over the top of the Starling curve.

Although a patient may appear entirely stable while still stationary, transfer may exacerbate their precarious physiology.

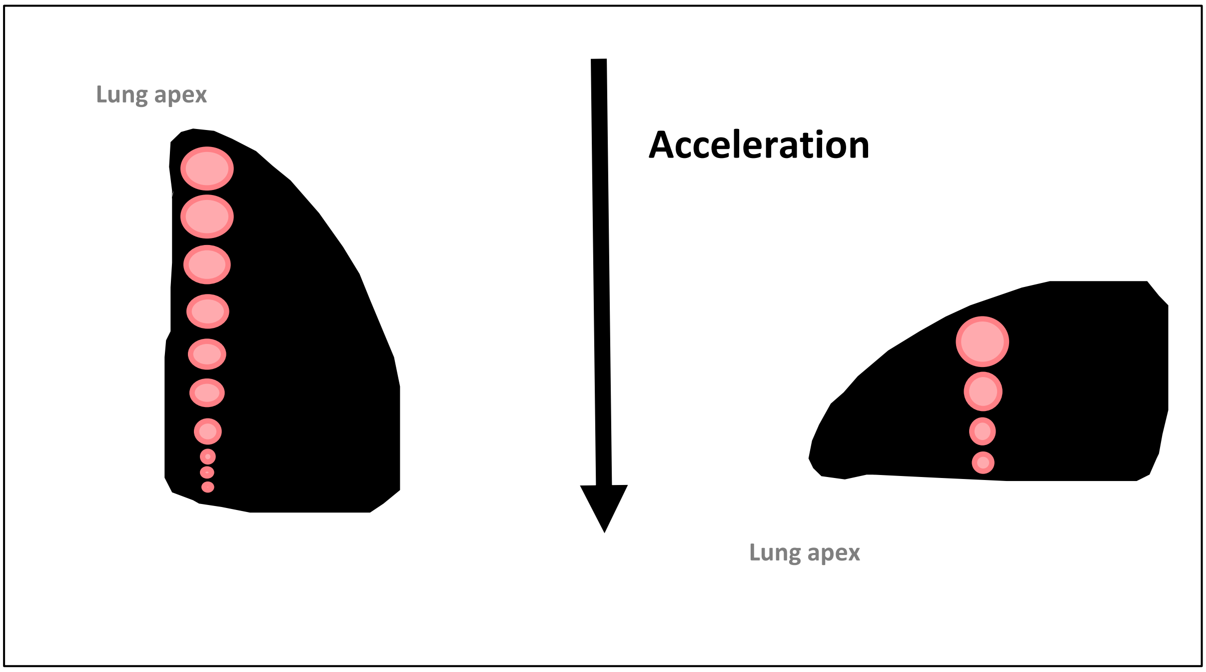
Prevention of the above potential hazards are best achieved by avoiding hard braking and the patient being 'head-up' during transfer. On the whole, physiological derangements from deceleration are greater than those from acceleration due to the greater forces being exerted. A head-up position limits the forces exerted on the thorax and head during linear acceleration and deceleration.

Autonomic Nervous System

Critically ill patients do not have a normal automatic nervous system; they suffer from dysautonomia which is a condition in which the autonomic nervous system malfunctions. This can often result in them having a labile blood pressure in response to movement and turning and also blunted responses to hypovolaemia and hypotension.

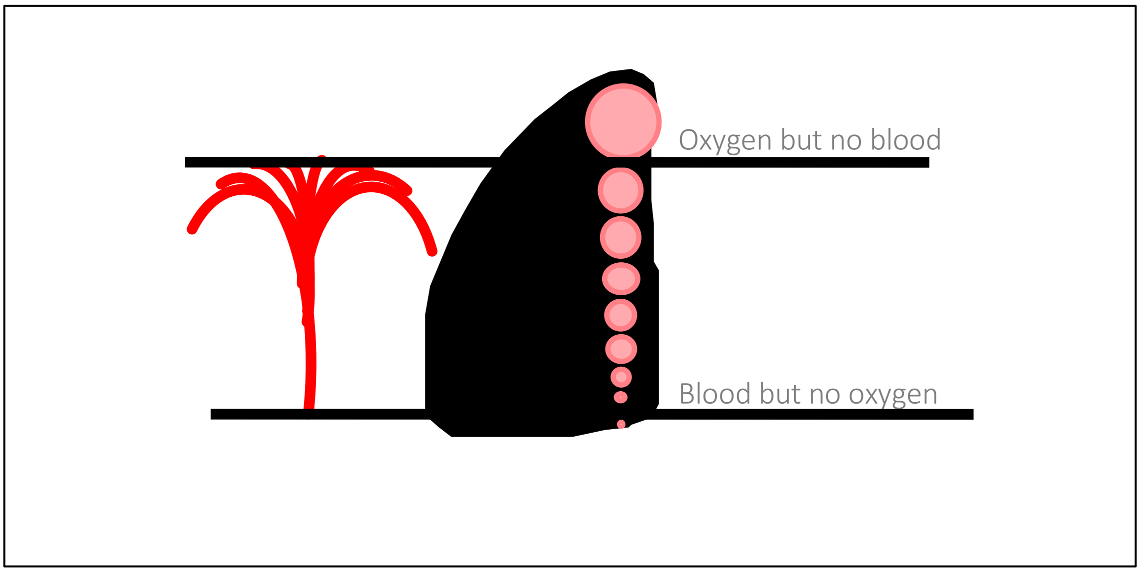
Effects on the Respiratory System

The lung may be likened to a sponge filled with water. The effects of gravity are such that the alveoli at the apices tend to be stretched open whilst those at the bases will be squashed shut.



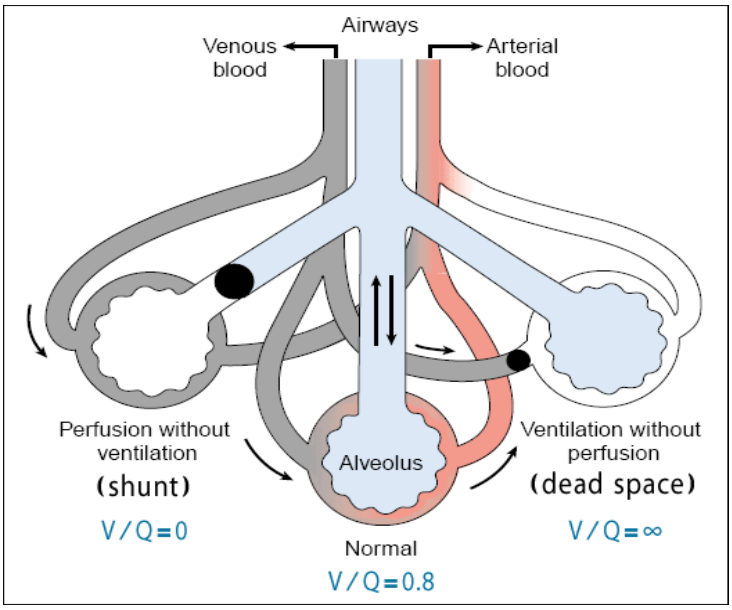
If the patient is lying supine, the distribution will be altered but still dictated by gravity with the dependent lung collapsed. If accelerative forces are superimposed upon this, then this will result in further areas of collapse in the direction of the force applied. This effect will be compounded by the inevitable basal and dependent atelectasis that develops in the intubated ventilated patient, caused in part by the upward pressure of the abdominal contents and diaphragm.

At the same time, gravity and acceleration have effects on pulmonary blood flow. Gravity will result in blood flow and lung perfusion being maximal in the dependent areas of the lung, whilst the apices or uppermost lung may have a fairly tenuous blood supply. Superimposed accelerative forces will simply exaggerate this effect, and if the acceleration is extreme then parts of the lung may not be perfused at all. These effects will be compounded by any fall in blood pressure, which will further reduce perfusion to the uppermost lung. We have already seen that acceleration may result in a fall in blood pressure, particularly in the hypovolaemic patient.



Subsequently, the net result is an increase in the proportion of lung with ventilation and no perfusion. This effect produces an increase on the **dead space** which will result in an increase in $PaCO_2$.

Similarly, there will be areas of lung with blood flow but no ventilation. This will produce an increase in **shunt** which will result in hypoxia.



Adequate gas exchange takes place in well perfused and well ventilated lungs. The aim of good ventilation and maintenance of good perfusion is to eliminate:

- **Dead space:** ventilated lung with no perfusion
- **Shunt:** well perfused but poorly ventilated lung

Shunt and dead space are exacerbated by hypotension and hypovolaemia.

Effects on the Central Nervous System

The effects on the neurological system may be difficult to assess during transfer due to many patients being sedated or unconscious during the event. They should, however be taken into consideration during the transfer particularly in patients with neurosurgical or neurological injuries. Both acceleration and deceleration forces are potentially detrimental. These effects may lead to alterations in venous drainage or blood supply to the brain. For example, hard braking in an ambulance may transiently impeded venous drainage resulting in an increase in cerebral blood volume, raising intracerebral pressure.

The pooling of blood in the lower limbs and feet may reduce and inhibit blood supply to the brain causing cerebral ischaemia. In a patient with critically elevated intracranial pressure this may precipitate serious neurological deterioration and even coning. In health, excessive acceleration forces may lead to loss of consciousness. Seizures have also been reported following return o blood supply to the brain following cessation of the acceleration/declaration forces. Although these symptoms may not be evident in the unconscious or sedated patient, it is important that they are considered, including the possibility of post transfer seizures.

Similarly, detrimental effects may result from tipping the patient head down, as may occur when moving up a ramp. Care should be taken to avoid this, and the head of the patient should be kept elevated to encourage cerebral venous drainage, once again excessive acceleration and deceleration should be avoided throughout the transfer.

Effects on the Gastrointestinal System

Acceleration / deceleration effects on the GI system present as gastro-oesophageal reflux during exposure to such forces. This is best prevented by inserting a naso-gastric tube to either empty the stomach of contents or to be left on free drainage to avoid vomit or aspiration. Transferring the patient in a head up position again is preferable.

Trauma Effects

The main traumatic injuries to be considered due to potential acceleration / deceleration effects are vertebral fractures. Instable fractures should be immobilised as much as possible and extreme forces avoided. Any fratures or traumatic injuries need to be considered and immobilised to aid pain management, cardiovascular stability and reduce further trauma.

In summary:

Accelerative forces during transport may result in:

- Decreased cardiac output
- Hypotension
- Increased dead space
- Increased shunt

Full Patients Travel Better:

- Correct hypovolaemia before setting off
- Correct hypotension before setting off:
- THINK VASOPRESSORS
- Anticipate the need for:
- Increased FiO_2
- Increased minute volume, consider invasive ventilation
- Avoid acceleration where possible (ambulance and hospital corridors
- Go slowly and steadily
- Rarely a need for blue light or running along the corridor
- Consider position of patient in relation to direction of travel

References & Further Reading

Guidelines for the Provision of Intensive Care Services. (2019) Faculty of Intensive Care Medicine. **www.ficm.ac.uk/standards-research-revalidation/guidelines-provision-intensive-care-services-v2**

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https://www.ficm.ac.uk/sites/default/files/transfer_critically_ill_adult_2019.pdf

North of England Network Transfer Guidelines (2019)
www.noeccn.org.uk/Transfer-Group-Guidelines-and-Resources

Chapter 4 - Pre-Transfer Stabilisation

This is an absolutely crucial part of any transfer, regardless of whether it is a simple trip to the CT scanner, or a long distance air transfer. Meticulous attention to detail is essential to minimise complications and potential deterioration en route. Time spent preparing the patient for transfer will be time saved in the long run.

This section is all about dotting the 'i's and crossing the 't's.

Getting to know your patient

If you have been actively involved in a patient's care already, for example in the resuscitation room in A&E or during their stay in critical care, you will have a good idea of the issues related to the patient that you are transferring. Occasionally however, you may be required to transfer a patient that you do not know well. There is never any excuse for announcing to the receiving team on your arrival that you do not know the patient and that you were simply called in to transfer them. It is your responsibility to know the patient that you are transferring: their history; examination; relevant investigations; and details for the transfer.

Begin by reviewing the history, both short and longer term. Examine your patient thoroughly, paying particular attention to the state of the airway, breathing and circulation.

Note what level of organ support the patient is receiving. Assess if this support is stable. If the patient has been deteriorating and their support has been increasing, you will need to address whether or not interventions to rectify this may be required before transfer. Review all investigations and note any abnormal results.

A- Airway

The airway must be both patent and protected for transfer. Intubation in the back of an ambulance will not be a pleasant experience. Therefore, if in doubt intubate the patient. They can always be extubated at the receiving hospital if all is well.

Indications for consideration of intubation include:

- GCS ≤ 8
- A GCS falling by 2 or more points, particularly if the deterioration has been in the motor score
- Seizures
- Facial injury
- Facial burns
- Inadequate oxygenation or ventilation

Patients with facial burns may appear to be safe at presentation; however they may rapidly develop airway and facial oedema over the next few hours making intubation extremely precarious. Any signs suggestive of airway burns such as a hoarse voice or singed nasal hair should be taken very seriously. If unsure request advice from the receiving Burns Unit.

If your patient is already intubated, check the size of the tube and what length it is at the lips and document. Check the tube is securely fastened. Make a note of the grade of laryngoscopy and whether any difficulties were encountered at intubation. Document if the endotracheal tube position has been checked on a chest X-ray.

B - Breathing

The spontaneously breathing patient

Assess your patient's respiratory system:

- What is their work of breathing?
- How much oxygen are they requiring and any recent increases?
- What is their oxygen saturation?
- What is the respiratory rate?
- Is the respiratory rate increasing or decreasing?

Are there any interventions or treatments that may improve respiratory function prior to transfer? These might include nebulisers, physiotherapy, chest drainage, diuretics, non-invasive respiratory support depending on the problem.

If the primary problem is respiratory and treatments have been initiated, assess if the patient has started to improve, or if they are deteriorating and showing signs and symptoms of exhaustion? **Do they require intubation/ ventilation?**

A blood gas should be done.

Ideally the gases should demonstrate that:

- PaO_2 > 13 kPa
- $PaCO_2$ < 5.5 kPa
- pH > 7.25

Clearly however this should be taken in the context of the patient, their presenting complaint, how much oxygen they are on, their age and comorbidity. A set of gases like this may never be achievable in the patient with COPD with chronic type 2 respiratory failure. Indeed, in such a patient it would be inappropriate to aim for such a high pO_2. Conversely, a young patient with acute severe asthma on high flow oxygen with these gases, who is starting to look exhausted, is clearly not yet fit to travel.

The ventilated patient

This patient will need to be stabilised on the transport ventilator. Set the ventilator with settings appropriate to the size and condition of the patient. If the patient is already on a ventilator in ICU for example, and their condition is stable, then attempt to match the settings as closely as possible on the transport ventilator.

It is important to take into account the physiological effects of transport on the respiratory system and err on the side of giving a higher inspired oxygen concentration and higher minute ventilation.

Once the patient has been on the transport ventilator for 20 minutes, check an arterial blood gas.

As with the spontaneously breathing patient ideally aim for:

- PaO_2 > 13 kPa
- $PaCO_2$ < 5.5 kPa
- pH > 7.25

Again, this must be taken in the context of the patient. A PaO_2 of only 13 kPa on 100% oxygen on a ventilator with high level of PEEP does not leave much room for manoeuvre. A lower $PaCO_2$ of 4.5-5.0 kPa should be targeted in head injury, and this will be discussed in the corresponding chapter.

Recheck the blood gases 20 minutes after any alteration has been made to the ventilator settings.

As with the unventilated patient, assess if there are any interventions that may improve respiratory function and gas exchange before transfer.

Chest drains

If the patient has chest drains in situ assess that are working and that their position has been checked on a chest X-ray.

If the patient does not already have drains in situ, assess the need for one. Drains may be indicated for pneumothoraces or large effusions. A ventilated patient with rib fractures should be considered for a chest drain even in the absence of a visible pneumothorax on chest X-ray.

During transfer, drains should be kept below the level of the patient, and should not be clamped at all for any reason.

C - Circulation

Assess the patient's circulation:

- Heart rate
- Blood pressure
- Peripheral perfusion
- Venous tone and filling
- Signs of shock:
- confusion
- oliguria
- poor capillary refill
- lactic acidosis

If signs of shock are present, establish the nature of the shock, hypovolaemic, vasodilatory, neurogenic, or cardiogenic, or a combination of these. As discussed in Chapter 2, hypovolaemic patients travel poorly. If in doubt, consider a fluid challenge and reassess the patient.

If signs of shock are still present after a reasonable fluid challenge, there should be an assessment as to if cardiac output monitoring may help and whether vasopressors and/or inotropes are indicated.

If cardioactive drugs are commenced prior to transfer, then consideration to delaying the transfer should be given until patient achieves stability on the infusion of these drugs.

Ideally the following conditions should be met before the patient is moved:

- Pulse 60-120
- BP > 100 systolic
- Sinus rhythm
- Capillary refill time < 2s
- Catheterised with UO > 0.5ml/kg/hour
- Normovolaemic
- Inotropes/ vasopressors stable

As with all such criteria, they should be taken in the context of the patient, and are merely a sensible guide.

Electrolytes and metabolic derangement

Major electrolyte disturbances should usually be corrected before transfer.

Potassium should ideally be in the range of 3.5 – 5.5 mmol/litre. If it is lower, it should be supplemented, and if it is higher it should be reduced, either by medical means or by renal replacement therapy depending on the situation.

If the **magnesium** level is low and the patient is cardiovascularly unstable then this should be supplemented before transfer.

Similarly, **ionised calcium** should ideally be > 1.0 mmol/litre.

Abnormalities of **sodium** should normally be corrected slowly at no more than 0.5 to 1.0 mmol/litre per hour. Attempts to correct rapidly before transfer should not be made as this may result in cerebral oedema or central pontine myelinolysis. An exception to this might be the patient with neurological sequelae of hyponatraemia such as seizures. In this situation it will be necessary to control the seizures before transfer, and this may require raising the sodium level to around 120 mmol/litre relatively quickly using agents such as hypertonic saline. Correction thereafter however should be slow, and transfer need not be delayed until this has been achieved.

Abnormalities of **phosphate** can usually be corrected after transfer.

Infusions of electrolytes should not usually be taken during transfer. These should be disconnected and recommenced following transfer as indicated.

D – Disability

Asses the patient's conscious level. If the patient is not currently intubated, ask again whether the airway is being maintained and protected. If the patient is being intubated for low conscious level, document the neurological findings prior to intubation including any focal or lateralising signs.

If there is any possibility of raised intracranial pressure, for example in the patient with a head injury then this must be managed appropriately, with particular attention paid to the prevention of hypoxia and hypotension and other causes of secondary brain injury.

Seizures should be controlled prior to transfer, even if this necessitates sedation and ventilation.

Sedation and analgesia should be administered via continuous infusion. Commonly used sedative drugs include propofol and midazolam, and analgesia is commonly provided with opiates.

Sedated patients are usually paralysed for transfer. Make sure that sedation is adequate before giving muscle relaxants. These drugs may be given as boluses to reduce the number of infusion pumps being transported.

Blood glucose

Always check the blood **glucose**. It must be > 4 mmol/litre. A significant and prolonged period of hypoglycaemia may cause irreversible brain damage and should be corrected immediately. Following correction avoid the possibility of recurrent hypoglycaemia during the transfer by running an infusion of 10% dextrose intravenously. It is difficult to check blood sugars whilst on the move, so it is safer to risk the blood sugar running a little high than to risk it becoming low during the journey, particularly in the sedated patient.

Patients in intensive care are commonly on insulin infusions to counteract the hyperglycaemia associated with critical illness. Insulin infusions should generally be discontinued for the transfer. Such infusions require careful monitoring of blood sugar which is impractical. There will always be a risk of hypoglycaemia, particularly as any enteral or parenteral feed that was running will be stopped for the transfer. An infusion of intravenous dextrose running separately to an insulin infusion is not a safe option either as the dextrose may inadvertently be stopped due to a dislodged cannula for example, leaving the insulin unopposed.

In the case of patients with type I diabetes, particularly one presenting with a diabetic ketoacidosis, insulin should not be discontinued. The safest means of administering insulin in this setting will be as a Glucose Ketone Index (GKI) infusion, where insulin and dextrose are given concurrently.

Cervical Spine

If the patient has been involved in trauma assess if the cervical spine has been cleared, documenting clearly how and by whom. The same assessment should apply for the thoracic and lumbar spines. If undertaking CT scan in an unconscious patient consider extending the CT cover the neck as well. Don't delay transfer to wait for a formal report of the c-spine, continue with immobilisation during transfer until the scan is reported.

If any doubt then cervical spinal immobilisation must be maintained with a hard collar, sand bags and tape or similar and the patient should be log-rolled at all times.

E – Exposure

Always ensure you fully expose the patient, particularly in the trauma setting, when a full secondary survey should be done to look for less immediately apparent injuries. This survey must be clearly documented.

Whilst it is important not to miss anything, it is also important to attempt to keep the patient warm, therefore exposure should be kept to a minimum and the patient kept covered as far as possible.

The transport environment is usually cold. Warm hypothermic patients to a safe level before you set off as they will only get cooler. Ensure patients are wrapped up well for the journey.

Monitoring and access

The patient to be transferred should have at least 2 points of wide-bore venous access which must be carefully secured.

ECG and blood pressure must be monitored. The latter may be done non-invasively, but may not be accurate due to the effects of vibration during transfer and will significantly deplete the transport monitor battery. An arterial line is prudent in all but the most stable patients, and will be essential if inotropes or vasopressors are being administered.

A central venous catheter (CVP) may have been sited to assist with fluid resuscitation and administration of cardiovascular drugs. A chest x-ray should be checked to exclude pneumothorax following the insertion of sub-clavian or jugular lines. Venous placement should also be confirmed by transducing the line or checking that a blood gas is venous.

Drains

If anything can be drained and it would improve the patient’s condition for transfer, then it should be.

Ventilated patients should have nasogastric tube in situ, aspirated and then left on free drainage. In the case of a possible base of skull fracture the orogastric route should be used.

Patients should usually be catheterised and urine output monitored.

Bleeding

Continuing blood loss should be stopped before transfer, by surgical means if necessary; fractures should be splinted or stabilised.

Occasionally this may not be possible, for example in the situation where the patient is being transferred for the purpose of actually stopping the bleeding. Examples include the patient with a leaking abdominal aortic aneurysm, penetrating chest trauma, intracranial haemorrhage, pelvic fractures requiring pelvic embolization, and similar scenarios. Such patients may never truly be stabilised before transfer and may have to be transferred in a **'scoop and run'** fashion (as opposed to the usual **'stay and play'**). These patients time critical and should be moved with the minimum of delay, and resuscitation continued en route as indicated. Such situations will be discussed in more detail in the lectures and scenario teaching on the course.

En route resuscitation sometimes requires blood components to be transferred between hospitals. It is essential for legal reasons (Blood Safety and Quality Regulations, 2015), that an accurate audit trail is maintained. If blood products are to be transported with the patient, the local transfusion laboratory must be informed where the products are going. This will ensure that the products are supplied in a specialised, sealed and insulated blood product transfer box. On dispatch of the blood components, the local transfusion laboratory will immediately contact the transfusion laboratory of the receiving hospital and inform them of the dispatch. The transferring team should leave the box seal intact and check the documentation on the outside of the container. Once opened, the contents will go out of temperature control and the transfusion must be completed within four hours. When blood products are requires either during the patients journey or immediately on arrival to the receiving hospital, (before local crossmatch can be performed), these should be checked and given in accordance with local policy. It is also essential that any unused products are returned to the receiving hospital transfusion laboratory as soon as practical to minimise any wastage.

Further information can be found on the "Blood Transfer Advice for Staff" sheet (Appendix 2)that is issued with the transfusion box.

References & Further Reading

AAGGI Safety Guideline – Interhospital Transfer (2009) The Association of Anaesthetist of Great Britain and Ireland. Section 5, Page 9 https://anaesthetists.org/Home/Resources-publications/Guidelines/Interhospital-transfer-AAGBI-safety-guideline

Davies, G & Chesters, A (2015) Transport of the trauma patient. *British Journal of Anaesthesia*, Volume 115, Issue 1, July 2015, Pages 33–37, https://doi.org/10.1093/bja/aev159

Guidance On: The Transport of the Critically Ill Adult. (2019) Faculty of Intensive Care Medicine https://www.ficm.ac.uk/sites/default/files/transfer_critically_ill_adult_2019.pdf

Chapter 5 - Monitoring

Transferring any patient in an ambulance can be a stressful experience. It is an isolated environment and offers little of the normal back-up systems that one can expect in a hospital setting.

Throughout the transfer, monitoring of the patient should be of at least the same standard as that which the patient would receive if he/she were not being transferred. In many cases levels of monitoring may even be higher during the transfer.

This chapter will look at factors to consider when deciding which parameters to monitor. There are various transfer monitors on the market and it is essential that you are familiar with the settings and functions of your particular monitor prior to setting off on the transfer. The monitor on the network transfer trolley at present is the Mindray™ iPM12 Monitor. This will be demonstrated in the workstations on the course.

A written record of patient status, monitored values and other information should be completed during the transfer. This should be documented on the NoECCN Adult Critical Care Transfer Checklist and Observation Chart.

Minimum monitoring standards for all patients

The minimum standards of monitoring during transfer as suggested by the Intensive Care Society in their Guidance On: The Transfer of the Critically Ill Adult are as follows:

- Continuous cardiac rhythm (ECG) monitoring
- Non-invasive blood pressure
- Oxygen Saturation (SpO_2)
- End-tidal carbon dioxide (in ventilated patients)
- Temperature

The patient should be connected to the transfer monitor prior to the commencement of the transfer to ensure that all monitoring parameters are working correctly. The monitor should be fully charged and should be kept plugged into the mains for as long as possible prior to starting the transfer and should be connected to the 12V socket in the ambulance in order to preserve the battery life. *Ensure the ambulance crew turn the inverter on; otherwise the ambulance sockets will not work. This has been a recurring problem in recent years.*

Monitoring must be continuous throughout the transfer and the monitor must be visible to accompanying staff at all times. Written records of the recorded parameters should also be made during the transfer.

All alarms on monitors, infusion devices and ventilators should be visual as well as audible as with the general ambient noise level of an ambulance, audible only alarms will be easily missed.

ECG Monitoring

ECG monitoring is essential on any transfer of a critically ill patient. Three-lead ECG monitoring is adequate in most cases, but 5-lead ECG monitoring is preferable as will be useful in the detection of myocardial ischaemia. Always ensure that the skin electrodes and leads are well secured before departure; if one becomes detached then the trace will be lost.

Intermittent non-invasive blood pressure measurement may be the most appropriate way of monitoring the stable patient's blood pressure when they are in a hospital environment. However, motion artefact caused by acceleration/deceleration of the ambulance, uneven road surface etc. means that recordings may be unreliable if they are obtained at all. Also, non-invasive blood pressure measurement is a significant drain on the battery life of the monitor. Manual recording of blood pressure in the back of a moving ambulance is almost impossible and should not be considered an option. In most cases it is more appropriate to have an indwelling arterial line for continuous recording of blood pressure throughout the transfer.

Blood Pressure Monitoring

Intermittent non-invasive blood pressure is unreliable in a moving vehicle as it is sensitive to motion artefact. In addition, the pump consumes a significant amount of power and can shorten battery life.

Continuous invasive blood pressure monitoring via an arterial line minimises these problems. This will necessitate the insertion of an indwelling arterial cannula. This must be connected to a pressurised bag of saline run through a giving set incorporating a flushing device. The pressure within the system is then transduced and the waveform displayed on the monitor. The level of the transducer needs to be secured at the level of the patient's right atrium, or pressure readings will be inaccurate.

The pressure bag should remain vertical, and if it is placed in a horizontal position the tap on the giving set must first be closed to prevent air embolism from the drip chamber during flushing of the line, or bubbles of air entering the giving set tubing. Both of these may dampen the waveform trace or worse still, enter the patient's vasculture and lead to air embolism.

During transfer the arterial line must be accessible and must be clearly labelled to avoid inadvertent intra-arterial injection. and causing damping of the blood pressure trace on the monitor.

Pulse Oximetry

Pulse oximetry relies on the fact that oxyhaemoglobin and deoxyhaemoglobin have different absorption spectra. The oximetry probe emits light of wavelength 660 nm and 940 nm and the amount of each wavelength absorbed is used to calculate the percentage of oxyhaemoglobin present.

Pulse oximetry has various shortcomings including inaccuracy in the face of hypotension, poorly perfused digits and irregular heart rhythms. Motion artefact during transfer may significantly disturb the function of this monitoring device and vibration may lead to the probe position becoming dislodged.

It must not be forgotten that pulse oximetry tells us only about arterial oxygen saturation and gives no information about the adequacy of ventilation. Hence the importance of using capnography in ventilated patients and checking arterial blood gases prior to departure.

Temperature

Temperature monitoring is important particularly in children, and ideally should be peripheral and central if the monitor has the facility. A nasopharyngeal probe may be used to monitor core temperature in the ventilated patient.

Monitoring of ventilated patients

In addition to the minimum monitoring requirements outlined above all ventilated patients also need continuous respiratory parameter monitoring.

- End tidal Carbon Dioxide ($EtCO_2$)
- Oxygen Supply
- Inspired oxygen concentration (FiO_2)
- Airway Pressures
- Ventilator settings

End-tidal carbon dioxide and capnography

A capnograph measures the amount of carbon dioxide present in the patient's inhaled and exhaled gases. The network transfer monitor uses a side-stream analyser which can be positioned in the patient's breathing circuit as close to the endotracheal tube as possible. A constant stream of gas is then drawn from the breathing circuit and analysed for CO_2. This is then displayed graphically on the monitor.

The CO_2 level will be seen to fluctuate with respiration, falling to zero during inspiration, and rising to a peak at the end of expiration. The latter value is the end-tidal CO_2 and if the patient has relatively normal lungs will usually be found to be approximately 0.5 kPa lower than the true arterial $PaCO_2$.

The capnograph can give us a lot of information:

- an early indication of ventilator failure or circuit disconnection
- adequacy of ventilation
- respiratory rate
- shape of the trace, such as a steep upslope to the expiratory trace may signify bronchospasm

Central Venous Pressure Monitoring

Central venous access may be required for delivery of inotropes or vasopressors during the transfer. An assessment of the fluid status of the patient should be made prior to the commencement of the transfer. Central venous pressure monitoring has limitations in the assessment of intravascular volume status but the trend obtained may be useful. Any abnormalities such as hypovolemia should be corrected prior to transfer (remember full patients travel better).

It is not usually necessary to monitor the central venous pressure during the transfer. If central venous monitoring is used during the transfer the same precautions regarding the pressure bag and transducer height should be taken as were described for invasive blood pressure monitoring.

Pulmonary Artery Catheter/ Cardiac Output Monitor

If a pulmonary artery catheter is in situ there are two options during the transfer. Either it should be withdrawn from the pulmonary artery to the right atrium or superior vena cava or should be continuously transduced such that the pulmonary artery pressure waveform is visible at all times to avoid unrecognised wedging.

The majority of alternative cardiac output monitors (Oesophageal Doppler, PICCO, LiDCO) are cumbersome, have multiple cables, and limited battery life. They will only be necessary for a transfer in exceptional circumstances and a senior clinician with appropriate expertise should accompany any patient that requires cardiac output monitoring during a transfer.

Intra-cranial pressure monitoring

This may be necessary in certain circumstances. Patients with intracranial pressure monitoring are usually those with head injuries or other intracranial pathology. The actual monitor is often quite bulky, and the readings may be subject to motion artefact during transfer.

References & Further Reading

Guidance On: The Transport of the Critically Ill Adult. (2019) Faculty of Intensive Care Medicine https://www.ficm.ac.uk/sites/default/files/transfer_critically_ill_adult_2019.pdf

Chapter 6 - Equipment

The Intensive Care Society (ICS) Guidance on: The Transfer of the Critically Ill Patient (2019) outlines the standards for both monitoring (see chapter 5) and equipment. These standards apply not only to patients transferred between hospitals but also to those patients moved between departments within a hospital. The North of England Critical Care Transfer guidelines mirror these closely and should be used in conjunction with the Training for Transfer manual.

In addition to this, there are also guidelines from the Committée Européen de Normalisation (CEN). CEN addresses essentially the standardisation through Europe and has published 2 standards that have subsequently been adopted by the British Standards Institute: BS EN1789 and BS EN 1865. These relate to ambulance design and ambulance equipment design. Their aim is to ensure, throughout Europe, that ambulances and the equipment they carry are constructed to the highest standards, increasing patient and staff safety through standardisation of equipment and improved crash protection.

For transfers between hospitals, The North East Ambulance Service (NEAS) has provided each Level 3 Critical Care Unit with a fully equipped transfer trolley to facilitate the safe transfer of critically ill patients in compliance with the quality and safety standards set out by the ICS and CEN.

This chapter will look at the general characteristics of transfer equipment design but will also cover the equipment specifically available on the NEAS transfer trolley for the inter-hospital transfer of critically ill patients. All of the equipment and the trolley functions will be demonstrated in the workstations on the course.

Some of the direct risks to the patient relate to the illness they are suffering from at the time. However, many risks are due to problems arising from equipment failure during the transfer e.g. battery failure in a monitor or syringe pump.

Since any transfer vehicle has a limited amount of equipment on board, this means that the transferring staff must ensure that they have adequate back-up systems in place to replace any malfunctioning equipment.

However, there is a balance between what you can be expected to take with you in the limited space of an ambulance.

General Characteristics of Transfer Equipment

The equipment used to transfer critically ill patients between or within hospitals must meet certain basic criteria to ensure it is fit for purpose. Much of the equipment available for transfer has been specially designed to meet the requirements of transfer. All staff involved in transfers should understand the principles of operation of the equipment they use, so reducing critical incidents to a minimum by problem identification and prevention.

Transfer equipment choice should be based upon the following factors:

- Weight of equipment with major contribution being from batteries and mechanical parts.
- Size of equipment, usually determined by the size of the incorporated screens
- Power supply of equipment. Battery life should be at least 4 hours. Lithium ion batteries are preferable. Ideally, it should be possible to change batteries without loss of equipment function. The equipment should also be mains compatible.
- Display size, resolution, screen type, different viewing angle availability are very important for monitoring screens. Clear illuminated display with wide viewing angle is the ideal.
- Number and type of available parameters in monitor and ventilator configurations are very important.

- ❖ Trend recording of parameters useful.
- ❖ Robustness. It is important to check if equipment has been drop-tested by the manufacturer.
- ❖ Alarm features must be clearly audible and visible on the screen.
- ❖ User friendliness
- ❖ Compatibility with other equipment
- ❖ Local preferences
- ❖ Cost

North of England Critical Care Network Transfer Equipment

Each Level 3 Critical Care Unit within NoECCN is equipped with the following:

- ❖ Ferno® CCT-M trolley with Bio-Safe harness and straps
- ❖ Ferno® vacuum mattress with pump
- ❖ Dräger Oxylog® 3000+ transport ventilator
- ❖ Mindray® iPM 12 monitor
- ❖ Alaris® Asena GH plus syringe drivers x 4
- ❖ Laerdal® portable suction unit

Ferno® CCT-M Bariatric Critical Care Trolley

This is a fixed-height Critical Care Trolley that allows the other medical equipment to be stored underneath the patient, increasing stability. The trolley incorporates the following features:

- ❖ Fully welded, AB –PR mattress
- ❖ Easily removed 4-point Bio-Safe torso harness which is fixed to the trolley at 6 points which must be positively engaged

- Bio-Safe leg straps x 2
- Removable/reversible headrest
- Head/backrest to 75 degrees via gas assistance
- Leg elevation to increase venous return – shock position
- Knee raise for the seated patient
- Polyurethane molded cot sides
- Side rails have ability to be retained at 90 degrees or folded down to side
- Push/pull handles at each end
- 2 cylinder holders with retaining mechanism – either 2 x E size (680 L each) or 2 x CD size (460 L each)
- Large 6" wheels, with roll and rotate locks
- Drip stand and IV bag holder
- 6-way extension socket attached to standard 3 pin plug which can be plugged into the ambulance power supply or for charging at base
- Paint is anti-bacterial powder coated which actively inhibits bacterial growth
- Earthing chain for electrical safety

Because of it is of fixed-height, there is no facility to put the patient into the head down position.

The trolley has been dynamically tested to 10G in 6 directions to comply with CEN standards/BS EN 1789 (2007), this being the compliance requirement for ambulance transport in the UK.

During the dynamic test, dummy loadings were used to simulate the inclusion of oxygen cylinders, monitor, syringe drivers and ventilator. It is 1918mm, 800 mm high and weighs 75 kg including mattress and restraints. It has a maximum load capacity of 250 kg with an extra 40 kg of equipment allowable.

UK ambulances equipped with the Lock+Load 2-part locking system will accommodate the Ferno CCT-SIX. All NEAS ambulances have this type of mechanism where the trolley can be positively engaged in position and will remain secure if the ambulance is involved in a motor vehicle accident. It is very important to check that the trolley is secure in its locking system before setting off.

The trolley should be kept on charge at base whilst not in use via the 3 pin plug and extension socket provided. The trolley’s equipment should be kept plugged in and charging where possible. All NEAS ambulances have at least one 3 pin plug socket often located on the right hand side of the ambulance about hip height and under a plastic cover. Check with the ambulance crew that the electrical supply in the vehicle has been enabled before use and ask for their assistance to plug the trolley during transfer.

Paediatric patients

Each trolley was originally provided with a Ferno® Pedimate 678 paediatric board/ harness. This is a 5-point harness that attaches to the standard trolley contour mattress and will positively engage if an impact occurs. It can be used for children in the 4.5 – 18.1 kg weight bracket. NEAS ambulance crews have access to additional harnesses if the local harness is not found as well as a harness for smaller children. This will have to be requested when booking the ambulance.

Ferno® Vacuum Mattress

The vacuum mattress helps to secure patients into position during transfer. It is essentially a PVC bean bag which usually also contains some air. The patient is first placed upon the mattress and it is then loosely wrapped around them. The air may then be sucked out using either the pump provided or a suction machine via a one-way valve.

Whilst removing the air the mattress is moulded to the contour of the patient and the colour-coded harnessing belts secured and tightened. Due to the one-way nature of the valve when closed, the shape of the mattress will be retained around the patient, holding them secure. To release the mattress and allow air back in, the valve may simply be opened by turning it anticlockwise.

The mattress has side carry handles, which may be used to lift the mattress and patient, and also to secure the mattress to the trolley itself using the trolley harness system.

The mattress may be used as an alternative to a spinal board in some trauma patients. It is more comfortable and causes less risk of pressure damage. It also has the advantage of keeping patients warm.

Dräger Oxylog® 3000+ Critical Care Transport Ventilator

The Dräger Oxylog® 3000+ Transport Ventilator is a ventilator specifically designed for the transfer of critically ill patients in and between hospitals. The ventilator is mounted under the patient head on a specially designed bracket which is shockproof and horizontally rotatable, to allow better screen visualisation.

The Oxylog 3000+ can work with either disposable or re-useable circuits. The Oxylog 3000+ on the critical care network transfer trolley uses disposable circuits and the use of re-usable circuits is no longer recommended.

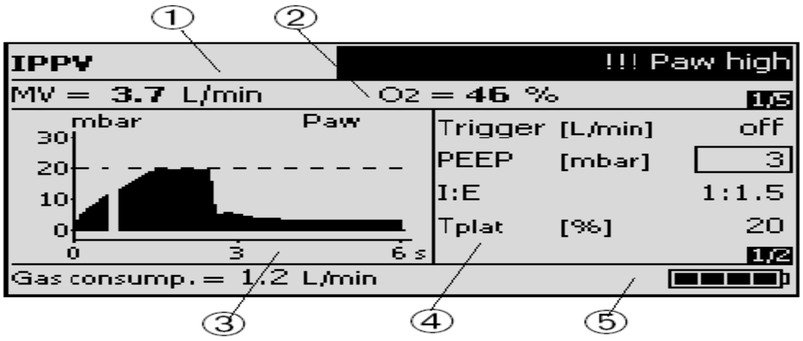
There are multiple ventilation modes available:

- IPPV
- SIMV (+/- ASB)
- BIPAP (+/- ASB)
- CPAP (+/- ASB)
- NIV

The ventilator also has the following features:

- Range of tidal volumes: 50-2000ml
- Range of frequencies: 2-60/min
- Oxygen blender allowing oxygen concentration which is adjustable from 40 to 100%.
- Inspiratory hold and 100% oxygen button
-

Clear flow and pressure curves are shown on a high-contrast display:



①Ventilatory mode and alarm message window

② Measured values window – can scroll through 5 screens to show 10 different values, e.g., tidal volume, frequency, using values button

③ Curves and measured values window – can change between large and small curves, and between pressure and flow curves using 'curves' button

④ Settings and alarms window – settings and alarms buttons are used to bring up screen and then values scrolled through in menus, highlighted and confirmed with rotary knob

⑤ Information window shows gas consumption for oxygen calculations and also battery life

Before use a formal device check should only be done with the approved test lung attached. This tests all the ventilators functions before use. If the incorrect test lung is used, the ventilator will fail it’s check. Failure of any test should be reported to NEAS immediately.

Mindray® iPM 12 Monitor

The transfer monitor is located below the head of the patient attached to a specially manufactured pole clamp.

The monitor is mounted on a swivel to allow view to the screen from the top and the side of the trolley.

Alaris® Asena GH Plus Syringe Drivers

Alaris® Asena GH Plus syringe drivers were chosen for the transfer trolley as they are very widely used throughout critical care units within the network area, resulting in familiarity with their use.

There are 4 syringe drivers mounted, with clamps, on 2 poles below the pelvis and legs of the patient. They employ easy to use menus for programming.

These syringe drivers include the following features:

- Drug names can be displayed
- Infusion Rates are 0.01-1200 ml/h in steps of 0.01 ml/1h.
- Battery Life of 4 hours at 5 ml/h when fully charge
- Range of syringe sizes: 5 - 50ml
- Bolus facility
- Rate lock facility- will display when infusion is started and will alert if not answered.
- Pressure display

Other Portable Equipment

Portable Suction Unit

It is envisaged that the suction unit will be the least used piece of equipment on the trolley. It usually has a battery life of over 45min on maximum suction when fully charged (check yours). It should be remembered that prior to leaving the parent unit there will be wall based suction available and whilst in the ambulance, suction will also be available to use.

Ambu Bag

This self-inflating bag – valve – mask assembly should be available for all transfers in case of ventilator failure.

Defibrilator

On the ambulance

Transfer bags.

Although the design may vary from unit to unit, they should be easily accessible and easily portable. The content of the transfer bag for inter- hospital transfers are standardised across NoECCN. It contains emergency airway, breathing and circulation equipment. The transfer bag and its contents must be checked regularly in line with your local unit/department policy and particularly prior to transfer. It must also be restocked immediately after use. The contents should not be changed without consensus opinion. Each bag should contain predominantly displayed contents list to enable restocking and familiarisation. The bag should enable you to solve problems quickly. Any drugs that you anticipate using should be carried in a separate pouch.

References & Further Reading

Guidance On: The Transport of the Critically Ill Adult. (2019) Faculty of Intensive Care Medicine https://www.ficm.ac.uk/sites/default/files/transfer_critically_ill_adult_2019.pdf

North of England Network Transfer Guidelines (2019) www.noeccn.org.uk/Transfer-Group-Guidelines-and-Resources

Chapter 7 - Drugs and Infusions

In this section we will look at the drugs we may need to take on transfer. Generally drugs may be administered as either boluses or as infusions. It is important that the number kept to a minimum. Anything that may be discontinued safely for the journey should be, and any drugs that may be given by bolus should ideally be given before departure.

Infusions

Infusions on transfer are generally administered by syringe driver. Volumetric pumps and gravity drips should be avoided if possible. The number of infusions should be kept to a minimum, and it will usually be possible to rationalise the infusions to **analgesia**, **sedation** and **vasoactive** medication. Any other drugs should be discontinued if possible or bolused intermittently.

Changing syringes in transit should be avoided at all costs, and the amount and concentration of drug in the syringe should be sufficient to last for at least **double the journey time** or a minimum of **one hour**. Consider doubling or quadrupling inotrope concentrations to avoid syringe changes. Drug infusion rates should ideally be stable before leaving the unit.

Infusion pumps should be fully charged before setting off and left plugged into the mains supply until departure. They must be carefully secured and should not rest upon the patient. Ideally infusions should be secured at around the level of the patient's heart or below. If the pump is placed above the level of the heart, there is a danger of free-flow or **siphonage** into the patient. This may result in serious overdosage of drug. This risk is reduced by using narrow or micro-bore extension sets rather than wide-bore.

Transferring personnel must be familiar with the functions of the syringe drivers in use.

Bolus Drugs

Most other drugs may be administered as boluses. It is essential that a **free port** for the administration of drugs is identified and accessible during the journey. The flush line on a central line is often useful for this, but it is important to ensure that the pressure bag and drip chamber on the giving set are held vertical when the flush is used to avoid air embolism.

Muscle relaxants should be bolused only after ensuring adequate sedation of the patient. A dose should be considered immediately before departure and extra taken for administration en route as necessary. It is probably safer to give too much relaxant rather than too little, to avoid the patient coughing during the journey, and reduce the potential for endotracheal tube dislodgement and barotrauma. This is particularly important for patients with brain injuries.

Any routine drugs that the patient may need, such as antibiotics, gastric protection or steroids, should be given prior to transfer.

Other drugs that should be taken on transfer in case of emergency will depend to an extent on the nature of the patient. Drugs to be considered will include emergency drugs such as adrenaline and atropine, mannitol, vasoactive drugs such as ephedrine or metaraminol, induction drugs and muscle relaxants for emergency use in the unlikely event of having to anaesthetise and intubate an, as yet, un-intubated patient.

What may be left behind?

Any infusions that may safely be discontinued and left behind for the duration of the trip should be. Disconnect **maintenance fluids** if possible, particularly where these are being administered by volumetric pumps; a bag of crystalloid run through a giving set may be taken on the journey to bolus if necessary.

Discontinue enteral or parenteral feeds. Aspirate the stomach and leave nasogastric tubes on free drainage. TPN port should be flushed and clearly identified.

Infusions that require close monitoring, and that would be particularly dangerous if bolused should be temporarily stopped. Examples include infusions of electrolytes and insulin. Many critically ill patients develop hyperglycaemia associated with their illness, steroid administration, feed composition etc. Insulin may be safely discontinued for transfer in these patients. Occasionally it may be undesirable to discontinue insulin, for example on a patient with diabetic ketoacidosis. In such a situation, insulin may be more safely administered as a Glucose-Potassium-Insulin (GKI) infusion.

References & Further Reading

AAGGI Safety Guidance - Interhospital Transfer (2009) The association of Anaethetists of great Britain and Ireland. https://anaesthetists.org/Home/Resources-publications/Guidelines/Interhospital-transfer-AAGBI-safety-guideline

Infusion Systems (2013) Medicines and Healthcare products regulatory Agency

Chapter 8 - Oxygen

Oxygen is a colourless, odourless, tasteless gas which cannot be liquefied above a critical temperature of -119°C. In other words, at room temperature it will always exist as a gas regardless of how much pressure is applied.

Oxygen is essential for life due to its role in the process of oxidative phosphorylation. It is always necessary to take oxygen on a transfer of any critically ill patient. We therefore need to understand how it is stored, and how to calculate how much to take with us.

Oxygen Storage

Our oxygen supply may either be derived from cylinders or from a piped medical gas system.

Oxygen cylinders

In the United Kingdom, oxygen is stored in black cylinders with a white shoulder. These cylinders are usually made of molybdenum steel, and oxygen is stored within them as a gas under pressure. A pressure gauge attached via the brass valve at the top of the cylinder will tell us what the pressure inside the cylinder is.

Regardless of the size of the cylinder, when full at room temperature it will have a pressure of 13,700 kPa or 137 Bar above atmospheric pressure. As the cylinder is emptied the pressure within it will fall in direct proportion to the amount of gas left inside. In other words, when the cylinder is only half full, the gauge will read approximately 6850 kPa. Helpfully, gauges are often clearly labelled with markers indicating that they are full, half full or nearly empty.

The type of gauge and connection that is attached to the cylinder will depend on how you intend to administer the oxygen; if it is to be used with a transport ventilator, a Schrader valve connection will be needed, whereas if oxygen tubing is to be attached, a fir tree nozzle connection will be required. These will be demonstrated in the course workshops.

Cylinders come in different sizes ranging from A to J, with J being the largest. Sizes D, E and F are those most commonly used in hospitals. Size E is the cylinder size commonly attached to our anaesthetic machines, whilst 2 size F cylinders will be found in most ambulances.

The contents when full in each of these cylinders are as follows:

Cylinder Size	Litres when full
D	**340**
E	**680**
F	**1360**

BOC have introduced a different class of cylinder that comprises of a lightweight structure with an integral pressure valve. These offer many advantages over traditional cylinders and details can be found at:

https://www.bochealthcare.co.uk/en/images/504370Healthcare%20Medical%20Oxygen%20Integral%20Valve%20Cylinders%20leaflet%2006_tcm409-54069.pdf

The most common size of these novel cylinders with integral pressure valves is the CD class. These are made of Kevlar hoop wrapped aluminium and only weigh around 3.5kg when full. They have a nominal pressure of 230 bar, contain 460 litres of oxygen, and feature both an integrated 4 bar pressure regulating Schrader valve, and a 6mm fir tree nozzle delivering 1-15 litres per minute.

Piped Oxygen Supply

This refers to the hospital supply of oxygen. It is delivered from a central supply point to various sites in the hospital via hidden copper pipe work. It is accessed via gas-specific white Schrader valves found on wall outlets or ceiling pendants. The oxygen cable from the transport ventilator will connect directly to this valve. Alternatively, a flow meter attachment may be attached to the valve so that oxygen tubing may be used. This is the type of attachment found at the bedside in most wards so that oxygen may be delivered via a face mask.

Whenever piped oxygen is available, this should be used in preference to your oxygen cylinders, simply to conserve your supply. Piped oxygen will be available in most ward areas, emergency departments, ambulances, and scan rooms. Switch from cylinder supply to piped supply as soon as possible after arriving in an area where piped gases are available

Although piped gases are usually available throughout the hospital, do not assume it will definitely be available. It is important to check in advance. In addition, it is also worth noting that the Schrader standard connector will not always available especially outside of the UK.

Oxygen Calculations

It is essential that you are able to calculate roughly how much oxygen you are likely to need for any given journey.

Always take sufficient oxygen to last for **twice** the expected journey or as a **minimum enough for one hour**. For example, for a 40-minute journey, take enough oxygen to last for 80 minutes, for a 15-minute journey take enough for one hour, (not just 30 minutes).

Spontaneously breathing patients on face masks

This is a simple calculation to make:

If you have a patient breathing oxygen via a face mask at 8 litres per minute undergoing a 20 minutes transfer, how much oxygen will you need?

For a 20 minute transfer you will need to take enough for 60 minutes.

You will therefore require:

You will therefore need at least 2 size D cylinders, or preferably a single size E. If possible, avoid changing cylinder during your journey and take a larger cylinder rather than multiple small ones.

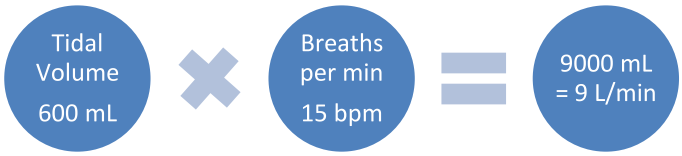
Ventilated patients

In this situation you will need to know the journey time, how much oxygen the patient is using, and also how much extra oxygen is needed to drive the ventilator.

Most transport ventilators are gas driven. The Oxylog 2000 uses around 1 litre per minute, whilst the more advanced Oxylog 3000 and Oxylog 3000+ use on average 0.5 litres per minute. The Oxylog 3000 and Oxylog 3000+ also rather helpfully displays exactly how much oxygen from the cylinder is actually being used at any one time which makes the calculations a lot easier, but you still need to understand the principles.

If you have a ventilated patient on for example an oxylog 2000 ventilator on 100% O2, ventilated with 600ml tidal volumes 15 breaths per minute, travelling on 1-hour transfer, what do you need to know to calculate how much oxygen to take?

How much oxygen is the patient using? For this we need to know the patient's minute ventilation (how much they are being ventilated each minute). This is equal to the product of the tidal volume (the size of each ventilator breath) and the frequency of ventilation.



As the patient is on 100% O2, then they will be consuming 9 litres of oxygen per minute. The ventilator also consumes around one litre per minute; therefore 10 litres per minute will be required.

We are going on a one-hour transfer and therefore we must take sufficient oxygen for 120 minutes.

This may be provided by taking either 2 size E cylinders, or a single size F cylinder.

Note that we have the option of giving patients air-mix on the Oxylog 2000. This is a 50:50 oxygen: entrained air mixture resulting in approximately 60% inspired oxygen. If the patient is on air-mix, then only half of the calculated minute ventilation will be drawn from the cylinder.

In the above example this would result in the patient requiring just 4.5 litres per minute of oxygen. The ventilator however still uses 1 litre per minute, and the total requirement will be:

When using the Oxylog 3000+, the ventilator will display the total oxygen requirement (for patient and ventilator) for the current ventilation parameters and oxygen percentage. This is expressed in litres per minute and need only be multiplied by the number of minutes required to calculate the total needed for the journey.

Non-invasive ventilation

The Oxylog 3000+ may be used to provide NIV with appropriate masks. The ventilator will compensate for any leakage of gas around the edges of the mask. Due to leakage of gas the requirements will be higher than if the ventilator were being used for invasive ventilation. However, the total gas being used will still be displayed on the ventilator screen to facilitate calculation.

It should be appreciated that some other means of administering non-invasive modes of respiratory support require very high gas flows, making them fairly impractical for transport. For example, the CPAP systems such as Whisperflow® may use as much as 140 litres of O2 per minute. For a 15-minute transfer, taking enough for one hour, you might need 8400 litres of oxygen or over 6 size F cylinders.

References & Further reading

Introduction to Medical Gases (2009) Anaethesia UK
http://frca.co.uk/article?articleid=100154

Chapter 9 - Are you ready for departure?

In this section we will review the final checks that should be made of the patient, equipment, drugs, and accompanying staff, plus the documentation and communication that must be made before coming to a final decision that the patient is ready for departure.

The Patient

This is the time to undertake a structured review of the patient's physiology. Are airway, breathing and circulation still stable and acceptable?

- ❖ The patient should be transferred and secured carefully on the transfer trolley, and adequately wrapped to prevent heat loss.
- ❖ The patient should be appropriately monitored on the transport monitor and stable on the transport ventilator, with adequate gas exchange confirmed on an arterial blood gas.
- ❖ The monitor and ventilator should be securely stowed and should not rest upon the patient. Ensure that the air inlet of the ventilator is not obstructed.
- ❖ The ventilated patient should usually be adequately sedated and muscle-relaxed before transfer.
- ❖ Ready access to both the arterial line and a port for administering drugs should be ensured.
- ❖ Have the receiving team requested any particular investigations or treatments prior to transfer. If so, have these been done?

The Transfer Team

For a critically ill patient at least two members of staff must travel. The members of the team will depend on the clinical needs of the patient and the skill sets of the available staff. Options include: doctors; Critical Care or Emergency Department nurses; Advanced Critical Care Practitioners; Paramedics; and operating department practitioner or similar. The important principle is that the team should be suitably experienced to deal with any crises that may arise, including airway problems during the journey. They should be familiar with the patient and with the transfer equipment that is being used.

A detailed **risk assessment** should be undertaken by an experienced clinician in order to determine the level of competency required by the transferring staff. This risk assessment should take into account the following:

- Patient’s current clinical condition
- Specific risks related to the patient’s condition
- Risks related to movement / transfer
- Likelihood of deterioration during transfer
- Potential for requiring additional monitoring / intervention
- Duration and mode of transfer

The ambulance service is not necessarily obliged to return the transferring staff and their equipment back to the referring hospital. This should be clarified in advance, and alternative arrangements made for the return journey if necessary. Staff should have some means of funding this return journey if required.

The transport environment is cold, and staff must ensure that they are adequately dressed in warm and high visibility clothing.

Transport services are not immune to being involved in accidents themselves. Staff should therefore wear seatbelts during the journey. If anything other than the simplest of clinical intervention is required during the journey, the ambulance should be stopped safely before the patient is attended to. Staff must also make sure that they are insured in the event of an accident outside the confines of the hospital (see Chapter Legal and Ethical Aspects of Patient Transfer).

Drugs and Equipment

The number of infusions should have been reduced to an essential minimum. These should be positioned ideally at the level of the patient or below, and should contain sufficient drug for double the transfer or at least an hour without needing to change the syringes.

All equipment including infusion pumps, monitors, and ventilator should be fully charged. They should be plugged into the mains until the moment of departure, and should be plugged into the ambulance power supply during the journey where this is available.

Any other routine and emergency drugs that may be required during the transfer should be prepared and checked. These will depend on the nature of the patient, but may include boluses of muscle relaxant, atropine, adrenaline, mannitol, vasopressors, etc.

A calculation of the amount of oxygen required for the journey should be made, and the appropriate cylinders obtained. The cylinders should be full, and should have an appropriate regulator attached. For example, a Schrader valve for use with the transport ventilator. A means of ventilating the patient in the event of a ventilator or oxygen failure, such as a self-inflating bag must be carried.

A transfer bag containing any other equipment potentially needed should be prepared. The contents of the bag must be checked and replenished after every use. The transferring team must be familiar with the contents and know where to locate equipment in an emergency.

Documentation

The reasons for transfer must be clearly documented in the notes, as should the name of the receiving consultant. Any discussions with the patient and family must be noted. The case notes, or a photocopy of these, plus all recent blood results, microbiology results etc. must accompany the patient. With modern picture archiving and communication systems (PACS) it is faster to "push" radiological images from the transferring hospital to the receiving hospital. The radiology department will facilitate this. It is also easier for the transferring radiology department to perform any complex processing of any large data files such as 3D reconstructions of the chest wall in thoracic trauma. A transfer letter documenting a concise summary of the patient's history to date, current level of support, and on-going problems will be invaluable to the receiving team. A checklist with suggestions as to the content of this letter may be found at the end of the chapter on communication.

A transfer document on which patient observations during the journey will be recorded should be prepared (see Communication Chapter P).

Finally

Communication must take place with the receiving doctor to confirm acceptance and that a bed is still available. Nursing and medical staff should also liaise with the receiving unit regarding the patient's level of support and ongoing problems, so that appropriate preparations may be made. The receiving unit should be contacted on departure and an estimated time of arrival given.

The ambulance service must be contacted to arrange an ambulance with appropriate equipment and crew. The urgency of the transfer must be made clear when arranging this transport. The current arrangements with NEAS are detailed on the North of England Critical Care Transfer Guidelines (www.noeccn.org.uk)

A charged mobile phone compatible with the transfer equipment should be provided with contact numbers to allow communication with the base and receiving units.

Checklist

The following checklist is incorporated in the NoECCN Adult Critical Care Transfer Checklist and Observation Chart. It should be completed and signed immediately before departure as a final check that preparations are complete.

WRITE OR ATTACH ADDRESSOGRAPH
Surname…………………………………………………
Forenames………………………………………………
DOB dd / mm / yyyy Age………………
Hospital number…………………………………………
NHS number……………………………………………

Locate and book a bed (Consultant to Consultant) Book Transport using Ambulance Booking Proforma		
E	Equipment	□ Establish on transfer ventilator □ Oxygen cylinders levels check □ Secure patient to the trolley □ Full monitoring to ICS Standards □ Emergency drugs and fluids available □ Transfer bag checked □ Consider spinal protection □ Specialist equipment □ Tracheostomy emergency equipment and spares inner tubes
S	Systemic Examination	□ Full ABCDE assessment □ Confirm airway secure □ Two working accessible IV cannulas
C	Communication	□ Transferring unit discharge summary □ Inform patient and family □ Confirm transfer, requirements and ETA with receiving unit □ Mobile telephone available
O	Observations	□ Commence transfer observation chart □ Full set of observations recorded □ Confirm patient stable for transfer
R	Recent Investigations	□ Handover documentation complete □ Recent investigation results, latest ABG □ Transfer radiological images
T	Team	□ Skill mix of transfer team appropriate □ Protective clothing / high visibility jacket □ Is it safe to leave the unit?

Chapter 10 – Communication

Sub optimal communication between healthcare professionals is widely recognised as a significant causative factor in incidents compromising patient safety and potential complaints. Communication regarding the transfer of critically ill patients is by no means an exception. Indeed, the opportunity for failure is potentially increased as individuals are required to communicate with a number of professionals of varied disciplines who are geographically separated.

It is essential therefore that effective communication is maintained throughout the entire transfer process with various methods adopted. While initial verbal discussions will be held face to face at the referring unit, much of the transfer process will later rely on effective telephone communication, supported with accurate and legible record keeping.

The transfer process is the joint responsibility of the referring and receiving clinicians. The main forms of communication we use are verbal and written. Many of the principles of good communication apply both, but it is worth noting that bad handwriting can be a major obstacle to good communication. When completing transfer documentation ensure your handwriting is legible.

The quality of communication between the referring and receiving hospital and Ambulance control can be enhanced using a structured communication technique, such as SBAR model shown later (Institute of Innovation and Improvement) and the Ambulance booking performa (Appendix 3)

Using a recognised structure like SBAR means that both the speaker and listener know what to expect. It helps to ensure that the speaker does not miss out any key communication. In addition the listener is able to assimilate the information more easily.

Situation	Confirm patient Identity Diagnosis Medical Plan Is patient / relatives aware of transfer
Background	Summary of patient inc. PMH / Date of admission / operations / medications / allergies / Infections / relevant investigation results
Assessment	Clinical Information Vital signs
Recommendation	Advice about what to do next Timeframe of transfer

Finding a Bed

The Directory of Services (D0S) is a central directory which is integrated with the ambulance service NHS pathways, providing the call handler with real time information about services available to support a particular patient.

It also provides a national adult critical care bed availability database which has been mandated by the Department of Health since October 2011. The system should be updated by individual units to record live bed activity and availability and is now a standard in D05 Critical Care Service Specification to be updated at least twice daily. The North East Ambulance Service (NEAS) adds a layer of resilience within NoECCN to ensure that the current bed status is updated regularly via phone calls to each unit at least four times a day at 0600h, 1200h, 1800h, and 2400h.

The DoS live database can be accessed electronically at www.pathwaysdos.nhs.uk where the national bed availability can be viewed. Each critical care unit has an individual login code and password.

The Northern England Children Transfer and Retrieval (NECTAR) services coordinate all critical care paediatric transfers and can be contacted on 0191 2826699. Consider using their referral template to ensure that you have all the required information available. This can be found at:

http://www.newcastle-hospitals.org.uk/downloads/NECTAR/DGH_acute_referral_form_V1.0.pdf

With further information about the NECTAR service available at:

http://www.newcastle-hospitals.org.uk/downloads/NECTAR/NECTAR_SERVICE_STANDARDS_20160110.pdf

Prior to Transfer

It is essential that the decision to transfer a patient is agreed between senior clinicians at the referring and receiving hospitals, and that an appropriate critical care bed is available to meet the patient's requirements. If the patient is being transferred for specialist care such as neurosurgery or liver transplant, then this transfer must also be agreed by the relevant consultant in that specialty.

Where patients are transferred for non-clinical reasons such as capacity (bed shortages), the parent team responsible for the patient must be informed. For example, this may be a medical or surgical team. It is important that the parent team hand over responsibility for the patient to an appropriate surgical or medical team at the receiving hospital prior to transfer.

Prior to transfer verbal communication between both medical and nursing staff in the referring and receiving units should take place. This initial handover will give the receiving unit staff the opportunity to ensure that any necessary preparations are made to take over the patient's care. The receiving unit should be contacted again immediately before departure to ensure that a bed is still available, and to give an approximate time of arrival.

The patient's case notes should either travel with them, or should be photocopied, along with all relevant investigations including microbiology, blood results and radiology. A transfer letter should be prepared documenting the relevant history, events, levels of support, and on-going problems. A checklist containing a suggested format for this letter will be found at the end of this section.

The patient and relatives must be informed of the transfer and the reasons behind it. If you cannot get in touch with them, frequently retry and document that you have each time. Ensure they have direct telephone number of receiving unit and if possible the name of a member to speak with. The provision of directions to the hospital will be helpful to them. It is vital that the family are instructed NOT to attempt to follow the ambulance for health and safety reasons. A Critical Care transfer leaflet is available for patients and relatives from the NoECCN website, www.noeccn.org.uk. All discussions should be clearly documented in the patient's notes.

If the transferring team have not previously been involved in the care of the patient, then a formal handover of information must occur between them and the usual medical or nursing staff prior to transfer.

Don't forget to tell your colleagues that your patient is being transferred. They may be able to lend a hand. Delegating tasks to other members of staff will make the preparation easier.

Arranging the ambulance

For information on how to arrange an ambulance through North East Ambulance Service, please refer to the most recent NoECCN Transfer Guidelines. See below the document used to arrange a critical care ambulance for an adult patient in a NHS hospital through NEAS. All these documents can be downloaded from the transfer resources section at www.noeccn.org.uk.

When a bed at the receiving hospital is confirmed, transfer the patient onto the critical care transfer trolley. All critical care transfer trolley in the NoECCN are now bariatric and can accommodate up to 250 Kg patients. Establish the monitoring and ventilation and ensure the patient is stable for transfer. When the checklist is completed and the patient is fully ready to go telephone NEAS and state that you require a Critical Care Transfer using the Transfer Trolley requiring a C2 response, a paramedic crew is not usually required **if** an ITU or Emergency Department nurse is accompanying the Doctor/Advanced Critical Care Practitioner. Use the transfer request proforma (as above) to document communication with NEAS. This form has proven very useful especially when transfer overlap with handover times in the units. Give NEAS full details of patient, main diagnosis, equipment, accompanying personnel, receiving hospital and department, oxygen requirement. By requesting a C2 response an ambulance should arrive within 18 minutes.

Note that for critical care transfers from the independent sector the procedure is different as the ambulance will need to collect a critical care transfer trolley prior to attend the transferring unit. There is specific guidance for this again at the NoECCN website. Transfers using other ambulance services such as Yorkshire Ambulance Service (YAS) for Northallerton or North West Ambulance Service (NWAS) for Cumbria will differ. Those units using these ambulance services should keep update information on how to organise an ambulance from them.

During the Journey

It is essential that the transfer team is able to contact either the referring or receiving units during the transfer if necessary. A mobile phone should be kept charged for this purpose and the transfer team supplied with relevant contact numbers which can be found on the NoECCN App

During transfer a record should be made of all appropriate patient observations at a frequency determined by clinical need, but at minimum of every 15 minutes. All drugs and fluids given and any other action or incidents must be documented on the transfer form (Appendix 1).

On Arrival

On arrival at the receiving unit a formal handover between both medical and nursing staff must occur. This handover should be both verbal and written. Until this handover has taken place, the patient remains the responsibility of the transferring team.

A standard operating procedure for critical care handover, endorsed by NoECCN, is included on Appendix 1. The standard operating procedure has been devised to incorporate human factors science into the organisation process and the systems used during transfer. It has embedded human factors principles, which will positively impact on patient safety by enhancing teamwork and improving communication. A video demonstrating a safe handover of a critical care transfer can be accessed through the transfer resources section on the NoECCN website.

After completing a critical care transfer please complete the online transfer audit form available on the NoECCN website and also available attached to the trolleys on a label as QR code, or through the network app if you use your smartphone. There is currently no password to access this audit.

Monitoring the number of transfers, identify difficulties and critical incidents is a mandatory requirement from NHS England. It facilitates the development of the service and the tracking and investigation of possible critical incidents.

In the event of a critical incident during the preparation or during transfer of a critical care patient you will need to follow your local trust reporting process as well as completing a network critical incident form Appendix 6 (available at NoECCN website) for further investigation and action.

References & Further Reading

SBAR Tool. Insitiute for Innovation and Improvement. www.ihi.org

Chapter 11 - The Head Injured Patient

Head injuries are extremely common, with over 1,000,000 hospital attendances per annum in the United Kingdom. Around 150,000 of these will require hospital admission, and 7,500 will require urgent neurosurgical attention. Many of these patients are now being transferred by paramedics or retrieval teams directly into an appropriate Major Trauma Centre such as the Royal Victoria Infirmary or the James Cook University Hospital. However, a small proportion of these patients will present to hospitals that do not provide neurosurgical care, and therefore will need to be transferred to another appropriate centre often some distance away.

Transfer of patients with head injuries is potentially hazardous. Patient may commonly have other injuries that may demand attention and stabilisation prior to transfer. If meticulous attention to detail is not paid then the patient's head injury may be made significantly worse during transfer, with detriment to outcome.

Primary brain injury describes the insult which occurs at the moment of impact. Examples of this form of insult include brain laceration, brain contusion, and diffuse axonal injury. This primary insult cannot be 'undone' once it has occurred. The patient's GCS at the scene may give a measure of the severity of this primary injury.

Following primary brain injury there are many subsequent insults which may exacerbate the original injury and worsen outcome. These insults are described as **secondary brain injury**, and include the following:

Hypotension	Hyperthermia
Hypoxia	Hyperglycaemia
Hypercapnia	Cerebral oedema
Excessive hypocapnia	Seizures
Haemorrhage such as intracerebral, subdural, and extradural	

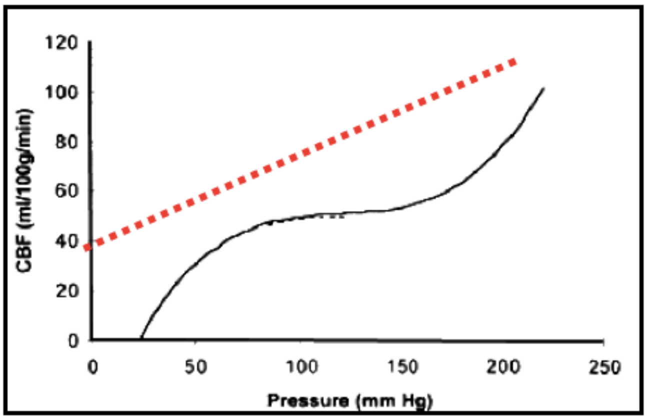
Many of the above are potentially avoidable or treatable. The first four are particularly relevant to the transfer setting and due attention must be paid to avoiding them.

In order to understand why these insults can exacerbate brain injury, there is a need to understand normal cerebral physiology.

Cerebral Physiology

Cerebral Blood Flow

Normal cerebral blood flow (CBF) is around 50 mL/100g tissue/minute, or roughly 750 mL/minute. This blood flow is remarkably constant over a range of blood pressures due to a process termed **autoregulation**. This is illustrated graphically below, where the unbroken black curve represents the normal brain, exhibiting a constant blood flow between a mean arterial pressure of approximately 60 mmHg and 160 mmHg.



This is important as the brain requires a constant supply of oxygen and glucose, without which cell death will occur after a matter of minutes. The brain is a very unforgiving organ. Auto-regulation ensures a constant supply of these substrates in the face of blood pressure fluctuations.

The injured brain unfortunately no longer exhibits auto-regulation and blood flow becomes **pressure dependent**. The broken line on the graph above illustrates this. This results in a cerebral blood flow that will drop if hypotension occurs, leading to cerebral hypoxia.

In addition to this, blood pressure must be higher than normal to ensure good cerebral perfusion, as any degree of **raised intracranial pressure** must be overcome.

In head injury, cerebral blood flow becomes governed by the **Cerebral Perfusion Pressure** or CPP. This pressure is equal to the mean arterial pressure (MAP) minus the intracerebral pressure (ICP).

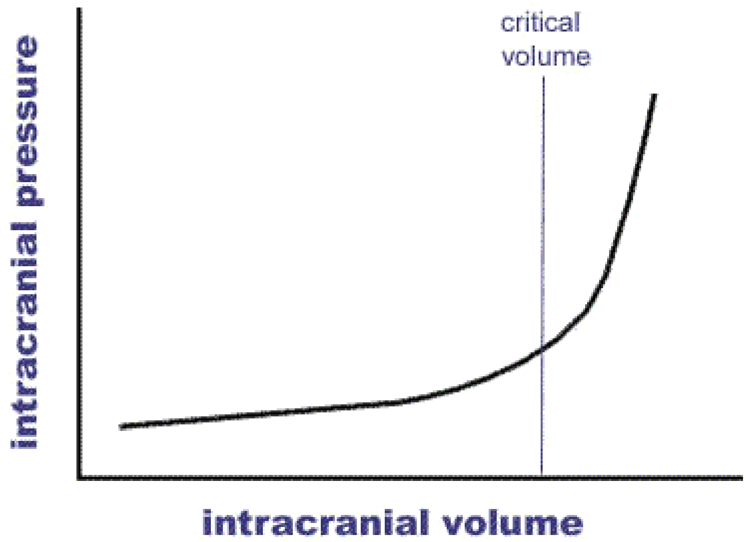
$$CPP = MAP - ICP$$

The normal ICP is 5-15 mmHg. In head injuries this pressure may become elevated. Clearly, we do not know the exact ICP without measuring it, but in head-injured patients with depressed conscious level, the ICP should be assumed to be elevated at greater than 20 mmHg. Measures should be taken to minimise any rise in ICP and these will be discussed later in this chapter. There is some evidence to suggest that CPP should be maintained at a minimum of 60 mmHg. This will therefore require a **MAP of > 80 mmHg.**

Intracranial Pressure

The skull is essentially a fixed box containing brain, cerebrospinal fluid (CSF), and blood (within blood vessels). There is very little room for anything extra, or any expansion of any of these components. This is known as the **Monroe-Kellie Doctrine**.

Any expansion within the skull will be accommodated initially by for example squashing the ventricles and thereby reducing the volume of CSF within the skull. These compensatory mechanisms are quickly exhausted and any further expansion will result in a sharp rise in ICP. This is illustrated below.



The only way this rise in pressure may be dissipated is by forcing the brain downwards through the foramen magnum. This will ultimately result in coning and brain stem death, and may be heralded by:

- Falling conscious level
- Bradycardia and hypertension (The Cushing Reflex)
- Cheyne-Stokes respiration in the spontaneously breathing patient
- Dilating pupils (3rd nerve palsy due to compression against the tentorium cerebelli).

Minimising Intracranial Pressure (ICP)

It is essential when managing the patient with head injury that steps are taken to minimise raised ICP, to avoid further brain damage and in a worst case scenario, coning and brain stem death.

This may be achieved by:

- ❖ Minimising brain tissue volume
- ❖ Minimising cerebral blood volume
- ❖ Minimising CSF volume
- ❖ Evacuating anything that shouldn't be there (e.g. Haematoma)

We have some influence on the first of these by administering Mannitol and most control over the second. The third and fourth are the domain of the neurosurgeons.

Minimising brain tissue volume

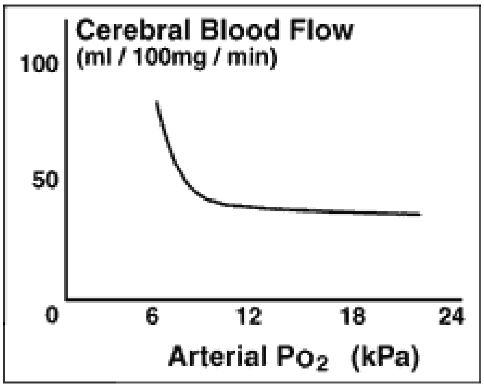
This may be achieved by administration of a bolus of Mannitol in a dose of 0.5 to 1 g/Kg or 2.7% Hypertonic Sodium Chloride in a dose 3-5ml/kg over 20 mins. These drugs are often given under the direction of the neurosurgeons prior to transfer depending on the results of a CT head, but should also be considered where there are signs of critically elevated ICP as listed above.

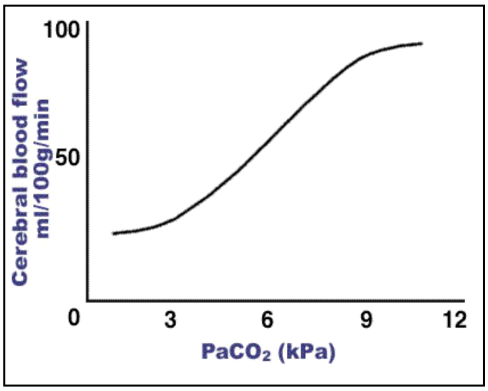
Minimising cerebral blood volume

This may be achieved by avoiding vasodilatation, by ensuring good venous drainage and minimising intrathoracic pressures.

Avoiding vasodilatation

Both **hypoxia** and **hypercarbia** cause marked cerebral vasodilatation. This is illustrated below.





It can be seen that cerebral blood flow will increase sharply below a pO_2 of 7 kPa. Cerebral blood flow also varies directly with pCO_2 between values of around 2 and 10 kPa.

Therefore, in head injury, hypoxia must be avoided and ideally a pO_2 of at least 13 kPa achieved. A pCO_2 at the low end of normal should be targeted. i.e. 4.5-5.0 kPa. Where there are signs of incipient coning as described above, pCO2 may be transiently dropped further by increasing ventilation to 4-4.5 kPa, but this may potentially cause brain ischaemia due to excessive vasoconstriction.

- Ensuring good venous drainage. This may be achieved by simple manoeuvres such as positioning the patient with a head up tilt, and the head in a neutral position. Jugular venous lines and ties around the neck should be avoided. Endotracheal tubes should be taped not tied.

- Minimising intrathoracic pressure. This may be achieved by careful choice of ventilatory parameters, avoidance of excessive PEEP, adequate sedation and paralysis to avoid any coughing and straining on the endotracheal tube.

Pre-transfer stabilisation of the brain-injured patient

Having outlined the physiological principles, we must now look at how this should be applied to the transfer situation. In addition to our usual goals we must endeavour to avoid secondary brain injury and provide a constant supply of oxygenated blood under adequate pressure to a slack brain.

Do not forget that the head-injured patient may well have sustained other injuries, and a full ATLS style primary and secondary survey should be undertaken. Airway, breathing and circulation must always be attended to first, before the head injury. There is no sense in setting off with a patient who is persistently hypotensive due to intra-abdominal bleeding; a laparotomy will be required first.

However, it is also important that the patient is resuscitated and stabilised without unnecessary delay. If a patient has an expanding intracranial haematoma such as an extradural, neurological outcome will be improved if that clot is removed sooner rather than later, and ideally within four hours.

CLOT ON THE FLOOR IN FOUR

A-Airway

As with all patients the airway must be patent and protected. Indications for consideration of intubation after head injury include the following:

- ❖ GCS of 8 or less
- ❖ A GCS falling by 2 or more points particularly if these points are motor
- ❖ Hypoxia (PaO_2 < 13 kPa)
- ❖ Hypercarbia ($PaCO_2$ > 6 kPa)
- ❖ Spontaneous hyperventilation (pCO_2 < 4.0 kPa)
- ❖ Seizures
- ❖ Copious bleeding into the mouth (e.g. from base of skull fracture)
- ❖ Bilateral fractured mandible

If in doubt the patient should be intubated. Secure the endotracheal tube with tape rather than ties so as not to impair venous drainage from the head.

B - Breathing

The intubated patient must be stabilised on the transport ventilator. Hand ventilation is unacceptable. Blood gases should be checked and demonstrate a **PaO_2 > 13 kPa** and a **$PaCO_2$ of 4.5-5.0 kPa**.

End tidal CO_2 should be monitored with a capnograph. The end tidal CO_2 is generally 0.5 kPa lower than the arterial pCO_2, and so an end tidal CO_2 of 4.0-4.5 kPa should be targeted.

Chest drains should be inserted if indicated e.g. for pneumothoraces or haemothoraces. Patients with rib fractures who are ventilated should have chest drains inserted even if no pneumothorax is evident.

C - Circulation

At least two sites of wide-bore peripheral venous access should be secured. The patient must be fluid resuscitated before transfer using appropriate clear fluids and blood products.

Dextrose-containing solutions should be avoided as these may be associated with increased cerebral lactate levels and acidosis.

Haemorrhage should be controlled. This may occasionally necessitate surgical intervention such as a laparotomy or external fixation of the pelvis before the patient is stabilised. Long bone fractures should be splinted.

An arterial line should be used to monitor blood pressure continuously. A **MAP of 80 mmHg** should be targeted. If this is not achieved despite adequate volume resuscitation, and all other causes of hypotension have been ruled out, then central access and vasoactive drugs may be required to drive the cerebral perfusion pressure. The internal jugulars should be avoided for central access as this may impede cerebral venous drainage. The femoral vein may be the safest and easiest option in this situation.

D - Disabiliy

The GCS prior to sedating and intubating should be documented. Once sedated, the only means of assessing the central nervous system will be by observing the **pupils**. This must be done regularly and documented

Patients should be adequately sedated and paralysed for the journey. Coughing and straining should be avoided. The patient should be positioned with a 20-degree **head up tilt** with the head in a neutral position.

Any patient who has had a seizure should be loaded with **phenytoin** before transfer. **Mannitol or Hypertonic Saline** should be administered if this has been requested by the neurosurgeons, or if signs of critically raised intracranial pressure develop such as the Cushing reflex or a dilated pupil.

Cervical Spine - Up to 6% of patients with a severe head injury will also have a cervical spine injury. Until the cervical spine has been cleared by an experienced senior clinician by appropriate clinical and/or radiological examination, then the spine must remain immobilised with a hard collar, sand bags and tape or equivalent, and the patient should be log-rolled.

E- Exposure

The patient should be catheterised and the stomach drained with an orogastric tube. Nasogastric tubes should be avoided in case of a base of skull fracture.

Monitoring

The following should be considered to be essential monitoring:

The continuous presence of appropriately trained staff

- ECG
- Invasive blood pressure
- Oxygen saturation
- Capnography
- Ventilator pressures and settings,
- Oxygen supply and concentration
- Pupil size and reactivity
- Temperature

Final Checks

A final review of the patient should be undertaken as described in chapter 9. Although the patient should be fully stabilised, the team should be constantly vigilant for possible complications due to other injuries.

The transfer team should be chosen appropriately and must be familiar with the patient. Drugs and equipment must be checked, and the ambulance organised. All documentation should be in order and appropriate communication with relatives and the receiving unit complete.

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Chapter 12 - Modes of Transport

Most transfers are undertaken by road, but occasionally patients may be moved by helicopter or fixed wing aircraft. Each of these modes of transport has its own advantages and disadvantages and these will be outlined below.

The choice of mode of transport will be governed by a number of variables. Including:

- the condition of the patient
- urgency of the transfer
- geography
- the distance to be travelled,
- availability of vehicles or aircraft and their mobilisation times
- staff training and experience
- weather conditions
- cost

Road Transport

The majority of inter-hospital transfers occur by road in the United Kingdom. The advantages of this mode of transport are that it is relatively familiar to hospital staff and is a somewhat less hostile environment compared with aeromedical transport. The ambulances in use are purpose-built to transport patients, carry basic equipment and oxygen, and are manned by trained personnel. There are very few weather restrictions to road travel and ambulances can generally transport patients door-to-door. Compared to aeromedical transport, road travel is relatively cheap and rapidly mobilised.

The main disadvantage to road transfer is that it can be extremely slow over longer distances and may be subject to constraints due to heavy traffic. Patients will be subjected to the effects of acceleration and deceleration as the vehicle repeatedly changes its speed and direction. Motion sickness is not uncommon and may affect both patients and staff. Access may be difficult over rough terrain.

Despite being purpose built, the ambulance environment remains challenging to staff caring for a critically ill patient. The transfer trolley has a fixed position within the vehicle with 3 seats available for transferring staff, one at the patient’s head and two at the side, parallel to the patient.

The seat at the head of the patient does not allow visual access to the patient monitor or infusions and we would recommend that staff sit in the seats parallel with the patient. Staff should wear safety restraints as directed by the ambulance crew and movement around the vehicle during travel should be kept to an absolute minimum.

Air Transport

Air transport may be either by helicopter or by fixed-wing aircraft. Air transport may be considered for longer journeys, or where road access is difficult. The recommendations of the Intensive Care Society are that fixed wing aircraft should be considered for distances of greater than 150 miles. Helicopter transport may be useful over distances of 50 to 150 miles.

These are specialised transport modes presenting unique hazards and challenges. Staff involved in air transport must have had specific training including aspects of safety and on board communication. They require a sound understanding of the physical and physiological stresses that patients and staff will be subject to.

Air transport may be rapid, particularly in fixed-wing aircraft over long distances. The perceived gain in speed however may be offset if the patient cannot be taken door-to-door. This may necessitate the patient being taken to and from the aircraft by road ambulance, significantly adding to the journey time and the potential hazards to the patient.

Air transport is expensive and may take time to organise and mobilise. Weather conditions may place significant restrictions to flight.

Helicopter transport

The usefulness of helicopter transport lies in the unique ability of this aircraft to take off and land vertically. This has advantages when retrieving patients in difficult to access areas, or where heavy traffic congestion may hamper attempts to move a casualty through an urban area. Helicopter transport may be rapid, although, in fact is considerably slower in flight than fixed wing air travel.

The helicopter environment is particularly hazardous. All staff must be aware of danger areas on the aircraft, and communication signals used by the crew. This is particularly important during take-off and landing, and when approaching the craft. Patients may be subjected to the physiological effects of tilting during loading and unloading. Tubes and lines may be vulnerable to being dislodged at this time and must be carefully secured and observed.

Inside the craft access to the patient will be extremely limited. Dim lighting and high noise levels may make monitoring and communication difficult. The patient's hearing should be protected with ear defenders if possible.

Significant vibration from the craft will increase the difficulty of performing any intervention during flight. Vibration will also result in significant motion artefact on monitoring, and may lead to equipment becoming dislodged if not safely stowed and secured. The environment will be cold; patients must be wrapped up well and staff dressed appropriately.

Fixed Wing Transport

The principle additional hazards placed by fixed wing flight relate to the effects of altitude. Aircraft are usually pressurised to between 6000 and 8000 feet above sea level, even though the flight altitude may be considerably greater. Some aircraft can pressurise to sea level (or the altitude of the take-off airfield), with advanced warning to the pilot (as increased pressurisation requires more fuel and slower cruising speeds). As such there are relatively few absolute contraindications to fixed wing moves. If extra pressurisation of the aircraft is not organised, in flight, the ambient pressure may be only around 75 kPa as compared to 101 kPa at sea level. This will be associated with a fall in the partial pressure of oxygen and an increase in oxygen requirements. On average a patient's oxygen saturation will fall by 4% at cruising altitude (compared on the ground). This may place restrictions on the transport of patients requiring high inspired oxygen concentrations.

The principle additional hazards placed by fixed wing flight relate to the effects of **altitude**. Aircraft are usually pressurised to 8000 feet above sea level, even though the flight altitude may be considerably greater. In flight the ambient pressure may therefore be only around 75 kPa as compared to 101 kPa at sea level. This will be associated in a fall in the partial pressure of oxygen and an increase in oxygen requirements. This may therefore place restrictions on the transport of patients requiring high inspired oxygen concentrations.

The fall in ambient pressure will also result in the expansion of gas-filled spaces:

- ❖ Pneumothoraces will expand; chest drains must be placed before flight if a pneumothorax is present or possible e.g., when rib fractures are present.

- Air within the bowel will expand. This may lead to abdominal pain, nausea, and splinting of the diaphragm with potential respiratory compromise. Nasogastric or orogastric tubes should be passed and left on free drainage. Air travel should be delayed for 10 days following abdominal surgery if possible as any residual pneumoperitoneum will expand. Bowel gas expansion may also apply stress to recent anastomoses.
- Intracranial air will expand and therefore recent neurosurgery may be a relative contraindication to flight.
- Patients with penetrating eye injuries may be at risk of vitreous expulsion. Recent vitreoretinal surgery incorporating injection of intraocular air or sulphur hexafluoride gas may preclude air travel.
- Staff or patients with blocked Eustachian tubes due to sinusitis or upper respiratory tract infection may be unable to equalise pressure across the tympanic membrane which may lead to perforation.
- Tracheal tube cuffs will expand on ascent and contract on descent. This may result in excessive mucosal pressure or leakage respectively. Air should therefore be removed from or added to the cuff as appropriate, or alternatively should be inflated with saline.

Tissue swelling may also occur during flight, and tight-fitting circumferential limb plasters should be split or bivalved. Altitude is associated with a significant fall in ambient temperature, and patients should therefore be wrapped up well.

As with helicopter transport, the environment may be noisy, dark and cramped, hampering access, monitoring and communication (as described above), as well as contributing to increased rates of fatigue. Motion sickness in both staff and awake patients must also be considered.

The Civil Aviation Authority (CAA) may place restrictions on the equipment that can be taken on board an aircraft, and this should be clarified before travel. Equipment may also not function with the same degree of accuracy at altitude and needs to be tests thoroughly before being used in the sky. Further information can be found at the CAA website:

http://www.caa.co.uk/Passengers/Before-you-fly/Am-I-fit-to-fly-/

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Chapter 13 - Legal & Ethical Aspects of Patient Transfer

Legal Issues

When considering patient transfer it should be recognised that this is a procedure with risks for a critically ill patient that are hopefully outweighed by benefits. If the reason for transfer is obviously to provide better care for a patient, even if it is because of lack of availability of beds, then legally the principles that apply are similar to any other treatment.

If a patient is conscious and deemed competent then it may be possible to discuss the implications of the transfer with them, and seek consent. If the patient is not awake then it would be good practice to seek assent form the relatives before transfer. Generally, discussion with the relatives is not likely to affect the transfer decision however there are situations where relatives input could be useful. For example, if a patient is being transferred to be closer to home the relatives may indicate that there would be better family support going to an area closer to another relative. It might be that a patient has previously expressed a strong desire not to be admitted to a certain hospital. If that were the case then arranging such a transfer would be the same as performing it without consent, with all the coincident ramifications. Conversations and risk assessment should be carefully documented.

Some critically ill patient transfers may have to be arranged when they are not in the individual patient's best interest. Such transfers may even be routinely planned. Examples can include, repatriation form a tertiary unit into a district general hospital, or transfer of a patient out of a critical care to another critical care because of bed pressures. The status of transfer that is not in the patient's best interest is questionable and would only be clarified if a case were taken to court.

When a patient is awake then their consent could be sought and obtained. The problem with this approach is that it implies that failure to achieve consent would mean the patient is not transferred. The status of relative assent in this situation is even more tenuous. There seems little point in seeking approval to transfer unless it is accepted that failure to achieve approval would be honoured. Guidelines from the Intensive Care Society and Faculty of Intensive Care Medicine currently recommend that “the patient, where possible, and their next of kin should be informed of the decision to transfer and an explanation given to them of the need to transfer”.

Clinicians have the responsibility to keep good quality contemporaneous records. This includes detailed vital signs information. Ideally this data will be stored electronically. On occasion it can be difficult keeping a record exactly at the time of the event, in which case creating a record as close in time to the event as possible is helpful as long as it is clear when the event occurred and when the record is made. There is no agreed acceptable frequency of observations for a patient being transferred. In the operating room most anaesthetists record vital signs every five minutes whereas most critical care nurses would update a paper record once an hour. In the case of the critical care unit it is understood that patients are being monitored continuously and any significant variation between hourly readings would be noted on the chart. Such an assumption would not be made once the patient leaves the unit on a transfer. Ideally patients during transfer should have their vital signs recorded at least every 5 minutes, preferably automatically as explained above. If this is not possible the vital signs data should be supplemented by relevant text-based explanations such as ‘patient stable throughout’ or ’oxygenation maintained within the range of 88-94%’ etc.

Clinicians have a duty of care to be sure that patients are only transferred to and from another place for good reason. If a patient is transferred from another place for an assessment or for a procedure that is not performed or needed; or if it would have been more reasonable for the assessor or procedure to have travelled to the patient rather than the other way around, then this would be a breach in duty of care. Such breaches should be internally investigated and responsibilities under the duty of care candour recognised.

Ethical Issues

The relative shortage of critical care beds in the UK means that patient transfer can raise a number of complicated ethical questions. The reason for this is that the needs of the individual may need to be balanced with the needs of others. This is unusual for clinicians used to considering that the individual's needs are paramount. There is frequently no clear right or wrong answer to ethical questions. The answer that is least likely to result in legal problems is not necessary the best ethically. An understanding of basic ethical principles together with a good process for decision making is the best way to protect the patients and clinicians involved. All clinical staff will be aware of, and understand the need to respect a patient's right to self-determination, to offer treatment whose aim is to do good and to avoid harm. It is the ethical concept of being 'just' or 'fair' when balancing needs of one group against another that creates most dilemmas.

It is important to realise that often it is not as simple as asking if a decision is ethical or not. For example, a situation might arise where a decision is being contemplated to transfer critically ill but stable patient from one unit to another to make way for a very unstable patient needing immediate transfer in. It might be suggested that it is unethical to transfer the stable patient as it is not in their best interests. This would be a clear breach of 'do no harm' from the point of the stable patient, so on the face of it would not be ethically sound. From the unstable patient's point of view it might not be feasible to transfer them at all, or the transfer could be very high risk when not absolutely necessary. Putting them at this extra risk could be considered unethical form their point of view. Usually it will be the principle of doing the most good for the most people that should win over the argument, while always accepting an unnecessary transfer is a last resort.

What about the decision-making process?

It is vital that those making decisions are fully informed and experienced enough to make a proper considered and balanced decision: senior decision makers should be involved and a named responsible consultant identified. Medical ethics are complicated and erroneous consideration of a simple ethical principle from one point of view could colour a decision in such a way the wrong choice overall is made. Whatever the seniority there is always the risk that an individual will fail to see all the implications of their decision. Such a problem can be alleviated by conferring with the multidisciplinary team, as long as all are free to express their view, it will increase the likelihood of a 'good' decision being made. If it is not possible for the team to agree, then colleagues can be consulted and the decision taken higher up in the organisation. It is important that the seriousness of this sort of debate is recognised.

So what are the answers to the questions about:-

- Transferring out a stable patient to make way for an unstable one?
- Transferring a patient in their best interests when their next of kin does not agree?
- Transfer of patient for tertiary care when there is reason to believe the patient would not have wished to receive this care, such as a well-documented suicide attempt?

Such questions can only be answered when considering not only the individuals directly involved but also any others that would be affected by the decision. It is possible to involve the courts in an impasse but taking this approach is never easy. It is worthwhile remembering that the courts should not be used as a way of sidestepping a difficult decision.

Decisions may later be challenged and if so, this could be from the point of view of any of those involved. Generally being open and fair, consulting with colleagues and relatives and not being afraid to seek additional help will result in the 'best' decision being made.

Transferring Staff Insurance and Indemnity

For NHS staff, carrying out patient transfers on behalf of their employing organisation and working within their scope of practice, normal NHS indemnity arrangements will apply. These are Trust specific and staff should check what local arrangements are in place. Staff carrying out transfers under any other circumstances, should ensure that they have appropriate indemnity cover in place.

Whilst safety is of paramount importance during transfer, there is always the possibility of an ambulance being involved in an accident. The NHS will provide cover for the staff involved in the transfer but this may be inadequate for some individuals and they may feel that additional personal accident insurance is a necessity. The Intensive Care Society, Scottish Intensive Care Society, and the Association of Anaesthetists of Great Britain and Northern Ireland have negotiated insurance for all their members (medical and nursing) involved in transport of critically ill patients. Details of which are available from the societies.

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Chapter 14 – Human Factors

What are Human Factors ?

"Human factors" is a term that encompasses all those factors that can influence people and their behaviour. In a work context, human factors are the environmental, organisational and job factors, including individual characteristics, which influence behaviour at work.

A widely accepted definition of human factors has been provided by the International Ergonomics Association Council.

"Ergonomics (or Human Factors) is the scientific discipline concerned with understanding of interactions among humans and other elements of a system and the profession that applies theory, principles, data and methods to design in order to optimise human well-being and overall system performance". (Russ et al, 2013)

Human factors help complement things that interact with people in terms of people's needs, abilities and limitations.

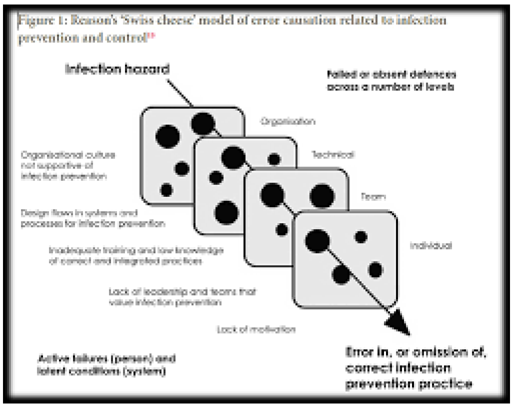
The science of human factors has grown out if the high-risk aviation industry, in recent years the approaches taken to manage risk has been adopted by the health sector.

How Errors and Incidents Occur

Healthcare professional like all humans are fallible. During working lives, we all make mistakes in the things we do, or forget to do, but the impact of these is often non-existent, minor, or merely creates inconvenience. However, in healthcare there is always the underlying chance that the consequences could be catastrophic. It is the awareness of this that often prevents such incidents as we purposefully heighten our attention and vigilance when we encounter situations or tasks perceived to be risky.

A fundamental principle of human factors thinking is that human error is not absolutely preventable and systems need to be designed that are resilient when human errors occur. Systems in healthcare must be designed with the capability to prevent error occurring, mitigate the harm of any error that cannot be prevented, and recognise the occurrence of errors such that actual harm to patients can be prevented – so error does not lead to catastrophe.

One of the most well-known illustrations of this thinking in healthcare is the Swiss Cheese Model of Organisational Accidents (Reason 1990). The Swiss Cheese Model assumes that in any system there are many levels of defence. Examples of the levels of defence would be checking of drugs before a critical care transfer or the completion of pre transfer check list. Each of these levels of defence has little “holes” In it which are caused by poor design, such as lack senior management decision- making, procedures, lack of training, limited resources etc. These holes are known as “latent conditions”. If latent conditions become aligned over successive levels of defence, they create a window of opportunity for a patient safety incident to occur. Latent conditions also increase the likelihood that healthcare professionals will make “active errors”. That is to say, errors that occur whilst delivering patient care. When a combination of latent conditions and active errors causes all levels of defences to be breached a patient safety incident occurs. This is depicted by the arrow breaching all levels of defence in figure 1.



When such incidents occur, it is uncommon for any single failure to be “wholly” responsible. It is far more likely that a series of seemingly minor events all happen consecutively and / or concurrently so on that one day, at that one time, all the “holes” line up and a serious event results.

On investigation it becomes clear that multiple failings occur and the outcome appears inevitable, but for those working in the system it can be shocking as they have often worked with the same environmental conditions and small errors or slips occurred regularly without harm ever occurring as a result. It is very rare for staff in healthcare to go to work with the intention of causing harm or failing to do the right thing. Therefore, we have to ask why there are many incidents where some of the latent conditions are caused by staff not doing the right thing. Many of the processes and policies in healthcare are complex or seam to create difficulties for busy staff thus creating the temptation to take shortcuts.

Developing a Safety Culture

Much has been written for healthcare organisations to create a positive safety culture (Department of Health 2000,2001) National Patient Safety Agency 2004, Reason 2000) and human factors research has also shown that senior management commitment is core to its development (Pidgeon, 1991: Reason 2000: Mearns et al. 20013: Flin et al, 2004; Waring, 1996). Mitigations risk is the responsibility of both organisations and individuals.

Element of Safety Culture	Characteristic
Open Culture	Staff feel comfortable discussing patient safety incidents and raising safety issues with both colleagues and senior managers.
Just culture	Staff, patients and carers are treated fairly, with empathy and consideration when they have been involved in a patient safety incident or have raised a safety issue.
Reporting Culture	Staff have confidence in the local incident reporting system and use it to notify healthcare managers of incidents that are occurring, including near misses • Barriers to incident reporting have been identified and removed – staff are not blamed and punished when they report incidents - they receive constructive feedback after submitting an incident report – the reporting process is easy
Learning Culture	The organisation – is committed to learn safety lessons – communicates them to colleagues – remembers over time
Informed Culture	The organisation has learnt from past experience and has the ability to identify and mitigate future incidents because it- learns from events that have already happened (for example, incidents reports and investigations)

Patient Safety First, 2010

Individual Responsibilities

Expertise, competence and hard work do not always safeguard against errors and omissions that result in harm. There are times when we can clearly see how a particular action results in an incident or near miss but often our actions merely breach layers of defence, creating unseen conditions of increased risk.

The first step is accepting that we all make mistakes or forget things regardless of our experience, technical ability, or seniority. It may be as simple as forgetting to contact the receiving unit before departure, or catastrophic, such as not checking you have sufficient drugs or oxygen supply to safely manage the patient during the length of transfer. Every one of us is human and that means we are never 100% perfect, all of the time.

The table below provides a list of factors that are known to contribute to patient safety incidents and possible methods of mitigating risk.

Factor	Characteristic
Cognition and mental workload	There are a number of factors that influence an individual's ability to perform and are linked to patient safety. • Stress – may be the result of personal factors or due to pressure exerted by our workload or an emergency situation. No matter the cause the results can lead to a lack of focus or concentration, or becoming overly focused on details at the expense of the wider context. • Self-awareness – If feeling stressed and having difficulty concentrating consider yourself at a greater risk of making a mistake. Focus on the high-risk tasks such as drug preparation prior to transfer and ensure checking procedures are rigorously followed. • Emergency situation – Follow recognised algorithms e.g. Resuscitation Guidelines; Difficult Intubation Guidelines • Reliance on vigilance and memory – When you have a large number of tasks or things to remember making lists and using checklists can be a helpful prompt or a reassuring check that you have done everything you needed to.
Distractions	Distractions are accepted as inevitable in busy healthcare environments. Where possible noise levels and interruptions should be minimised.
The physical environment	It is recognised that physical environment can influence safety. When undertaking critical care transfers staff are working in a strange environment with limited space. Therefore, it is suggested that staff: • Familiarise beforehand the layout of an ambulance • Only take equipment required to reduce clutter
Physical Demands	Demands exceeding capability: Most people at some time or another overestimate their abilities or underestimate their limitations. This may be in terms of technical skills, physical capability or ability to manage a particular workload or number of tasks. • Staff should be encouraged to regularly seek out consultant feedback • Encourage others to speak out if they feel something might not be right. Physical tiredness: • Mistakes are more prevalent when individuals are tired • Fatigue results in slower reactions, reduced ability to process information, memory lapses, absent- mindedness, decreased awareness, lack of attention, underestimation of risk, reduced coordination etc.
Service / product design	Healthcare equipment is often nor designed with human cognitive limitations in mind. Design creates error traps and is a frequent cause

	of patient safety incidents. Healthcare organisations also use large numbers of different medical devices which increases the risk that staff will make errors resulting from applying their understanding of how one device functions to another device. To mitigate this risk standardisation of equipment is advocated. For example; • Standardised transfer trolley • Standardised equipment list for transfer bag contents.
Teamwork	Multiple patient handovers, hierarchy, cultures the discourage challenge and stress responses can all contribute to poor outcomes. Furthermore, where team members do not feel that they can speak up and be listened to if a situation is unsafe there is an increased risk of patient harm. Approaches to improve safety are; • Briefing and debriefing • Safety Checklist • Communication tools such as SBAR (Situation, Background, Assessment and Recommendation) • Transfer Handover Document • Network Quality Audit (Survey Monkey)
Process design	Where healthcare processes are designed so that they involve complex task sequences there is an increased risk that critical safety steps will be omitted. It is important to ensure that clinical processes are simplified to reduce the potentially negative impact of memory limitations on human performance.

It is evident that many of the components of Human Factor theory can be translated and used in practices of safe transfer of the critically ill. It is clear that improving patient safety ultimately requires a collaboration between staff at all levels within organisations. It is also acknowledged that changes are well within the ability of a committed team of staff and where they are bit, the role of an organisation’s leaders in empowering and supporting them is crucial.

Being willing to share experiences with colleagues can help to create an environment that is more open about errors and begin to break down the myth that making mistakes or having near misses is a negative reflection on competence rather than human fallibility.

Appendix 1

NoECCN
North of England Critical Care Network

Adult Critical Care Transfer Check List

TRUST LOGO

TRANSFER RISK ASSESSMENT

The risk assessment is provided for guidance only.
Other factors not listed may influence the perceived risk.
It is the responsibility of the referring consultant to ensure that the transfer of a patient is managed safely.

LOW RISK	
Maintaining airway	$FiO_2 < 0.4$
GCS ≥ 14	Temperature = 35°C – 38.5°C
TRANSFER BY COMPETENT NURSE	

MEDIUM RISK	
Maintaining airway	$FiO_2 < 0.6$
GCS 9-13, but consider intubation, especially if fluctuating GCS	
Low to moderate dose cardiovascular support, e.g., Noradrenaline < 0.2 microgr/ kg/min	
Temperature >38.5°C or < 35°C	
TRANSFER BY COMPETENT PRATICTIONER ACCOMPANIED BY A DOCTOR / ACCP *If there is potential for the patient to deteriorate then doctor should have critical care and advanced airway skills*	

HIGH RISK	
Intubated and ventilated	$FiO_2 \geq 0.6$
Moderate to high dose cardiovascular support, e.g., Noradrenaline > 0.2 microgr/kg/min)	
Ongoing blood loss	
Major trauma head / chest / abdominal / pelvic injury	
TRANSFER COMPETENT PRATICTIONER ACCOMPANIED BY A DOCTOR / ACCP WITH CRITICAL CARE AND ADVANCED AIRWAY COMPETENCIES	

Level of Risk	Low ☐ Medium ☐ High ☐
Name	
Designation	
GMC/NMC/HCPC No	
Signature	
Date	Time

WRITE OR ATTACH ADDRESSOGRAPH
Surname..
Forenames...
DOB dd / mm / yyyy Age.................
Hospital number..
NHS number..

Locate and book a bed (Consultant to Consultant) Book Transport using Ambulance Booking Proforma		
E	Equipment	☐ Establish on transfer ventilator ☐ Oxygen cylinders levels check ☐ Secure patient to the trolley ☐ Full monitoring to ICS Standards ☐ Emergency drugs and fluids available ☐ Transfer bag checked ☐ Consider spinal protection ☐ Specialist equipment ☐ Tracheostomy emergency equipment and spares inner tubes
S	Systemic Examination	☐ Full ABCDE assessment ☐ Confirm airway secure ☐ Two working accessible IV cannulas
C	Communication	☐ Transferring unit discharge summary ☐ Inform patient and family ☐ Confirm transfer, requirements and ETA with receiving unit ☐ Mobile telephone available
O	Observations	☐ Commence transfer observation chart ☐ Full set of observations recorded ☐ Confirm patient stable for transfer
R	Recent Investigations	☐ Handover documentation complete ☐ Recent investigation results, latest ABG ☐ Transfer radiological images
T	Team	☐ Skill mix of transfer team appropriate ☐ Protective clothing / high visibility jacket ☐ Is it safe to leave the unit?

Person Arranging Transfer	
Unit Name	
Name	
Designation	
GMC/NMC/HCPC No	
Signature	

Person Accepting Transfer	
Unit Name	
Name	
Designation	
GMC/NMC/HCPC No	
Signature	

Transferring Team	
Doctor	
Name	
Designation	
GMC No	
Nurse / ODA / ACCP	
Name	
Designation	
NMC/HCPC No	

After Transfer

☐ Team debrief
☐ Restock/check transfer bag
☐ Restock/check trolley

Complete Network Audit

Use QR code on smartphone or go to:

www.surveymonkey.com/r/NoECCN_Transfer_Audit_Adults

January 2019 To be used for interhospital transfers to a critical care unit. This is a legal record of the patient transfer. Please give copy of the form to transferring team for their records.

Appendix 1

WRITE OR ATTACH ADDRESSOGRAPH
Surname___________________
Forenames___________________
DOB dd / mm / yyyy Age________
Hospital number___________________
NHS number___________________

Transfer Details
Transferring unit name
Recipient unit name
Date of Admission to hospital
Date of transfer
Departure time

Transfer From	□ Critical Care	Ward □	ED □	Other_____________	
Reason for Transfer	□ Upgrade of Care □ Repatriation	□ Non-clinical (no bed) □ Non-clinical (no staff)	□ Other		

HISTORY AND CLINICAL DETAILS

Patient normal BP / mmHg	Pre-sedation GCS /15	E	V	M
Allergies		Pupils	R	L
Main reason for critical care admission		Size		
		Reactive		

Stabilisation time	Time Commenced	Time Ready to Transfer
Ambulance Details	Job Number	

Time Ordered	Time Arrived Unit	Time Left Unit	Arrived at Destination

ABG when patient established on transfer ventilated prior to departure		
pH =	pO_2 =	HCO_3 =
Lactate =	pCO_2 =	Base Excess =

Airway	Monitoring	
□ Own airway	□ SpO_2	□ ECG
□ OETT *size*________ *length to lips*________	□ $ETCO_2$	□ NIBP
□ Nasal ETT *size*_____ *length to nostril*_______	□ IABP	□ Temp
□ Tracheostomy *size*_______ *type*___________	□ CVP	□ Other

Ventilation during transfer		Lines (size/location)	NG/OG tube (size /length)
☐ Spontaneous ☐ Mechanical ☐ Manual		□ Peripheral	
Mode	FiO_2	□ Arterial	Drains (type/location)
Peak Pressure	Volume (V_T)	□ Central	
Plateau Pressure	RR		
PEEP	Ratio		

Known Infection Risks

Transfer Observation Chart

Time / Drugs																	
MONITORING																	
SpO_2																	SaO_2
$ETCO_2$																	$ETCO_2$
200																	200
190																	190
180																	180
170																	170
160																	160
150																	150
140																	140
130																	130
120																	120
110																	110
100																	100
90																	90
80																	80
70																	70
60																	60
50																	50
FLUIDS																	
Urine Output																	

Please list any precautions taken for spine protection at any level

Transfer Doctor Comments / Incidents (to be reported to Trust / NoECCN)

Signature of Escorting Doctor GMC no.

Receiving Doctor Comments / Incidents (to be reported to Trust / NoECCN)

Signature of Escorting Doctor GMC no.

Please ensure the following sheet is issued to the member of clinical staff responsible for the transfer box when blood components are being transferred with a patient.

Blood Transfer Advice for Staff

The blood and blood components have been packed in this transfer box following blood transfusion laboratory guidelines.

PLEASE ENSURE THE BOX REMAINS SEALED UNTIL IMMEDATE TRANSFUSION OF THE PATIENT IS INDICATED

Before transferring the patient:

- Check to make sure the boxed component is for the patient you are accompanying
- Please ensure the patient has a wristband in situ stating the patient's hospital number (from the transferring hospital), date of birth and name (if known)
- If a decision is made NOT to transfer the blood components with the patient or to transfuse the patient onsite before transfer, contact the transfusion laboratory and return the transfer box immediately

During transfer:

- Blood components are suitable for transfusion until the time indicated on the transfer document provided the box remains sealed.
- Once opened temperature control is lost so transfusion of all the units must be completed **within 4 hours of opening the box** or the units may have to be discarded - the receiving laboratory will make this decision.
- If blood components are required during the patient's journey or on immediate arrival at the receiving hospital, please ensure they are checked and transfused in accordance with local policy.
- Please ensure the lid **REMAINS** on the box at all times. If blood components are removed for transfusion, please replace the lid **IMMEDIATELY!**

On arrival;

- When the patient arrives in the receiving clinical area, please ensure the blood transfer box is handed over to the **transfusion laboratory staff** immediately.
- Please state how many blood components were transfused during the journey and any adverse events (if occurred).

Blood Transfer Advice for staff version 3
Approved May 2017 Review May 2020

Appendix 3

North of England Critical Care Network

North East Ambulance Service NHS Foundation Trust

Adult Critical Care C2 Transfer Request Proforma	
Patient name	
Patient Number	
Consultant Requesting transfer	
Identify and confirm bed with receiving hospital and receiving Consultant	
Hospital:	
Unit:	
Consultant:	
When the patient is stable on the transfer trolley inform NEAS that you need a Critical Care transfer:	
0191 4143144	
"This is a Critical Care Transfer using the Transfer Trolley requiring a C2 response.	
A paramedic crew is not required"	
Dispatch NEAS job number:	
Time:	
Person Requesting Ambulance	Name:
Operator	Name:
Referring Department	
Picking up point	
Receiving Hospital	
Receiving Department	
Name of Patient	
Principle diagnosis	
Who is accompanying the patient.	
How much Oxygen is required	
Ambulance Arrived:	Time:
Ambulance Delayed – Follow-up Calls	
Time:	
Person Requesting Ambulance	Name:
Speak to Duty Manager	Name:
Problem - ETA	
Time:	
Person Requesting Ambulance	Name:
Operator	Name:
Problem - ETA	

NoECCN Transfer Group 24/10/17

Appendix 3

NoECCN
North of England Critical Care Network

North East Ambulance Service NHS
NHS Foundation Trust

Adult Critical Care C2 Transfer Request Proforma- Independent Sector	
Patient name	
Patient Number	
Consultant Requesting transfer	
Identify and confirm bed with receiving hospital and receiving Consultant	
Hospital:	
Unit:	
Consultant:	
"This is a Critical Care Transfer you will need to collect a Critical Care Transfer Trolley and Breathing Circuit *from – identify hospital*. A paramedic crew is not required"	
0191 4143144	
Dispatch NEAS job number:	
Time:	
Person Requesting Ambulance	Name:
Operator	Name:
Referring Department	
Picking up point	
Receiving Hospital	
Receiving Department	
Name of Patient	
Principle diagnosis	
Who is accompanying the patient.	
How much Oxygen is required	
Ambulance Arrived:	Time:
Ambulance Delayed – Follow-up Calls	
Time:	
Person Requesting Ambulance	Name:
Speak to Duty Manager	Name:
Problem - ETA	
Time:	
Person Requesting Ambulance	Name:
Operator	Name:
Problem - ETA	

NoECCN Transfer Group 24/10/17

National Competency Framework for Registered Nurses in Adult Critical Care - Transfer

STEP ONE COMPETENCIES PAGE 46

1.11 Intra & Inter Hospital Transfer

The following competency statement is about the effective coordination and management of intra & Inter hospital transfers for critically ill patients, it includes those individuals who require emergency transport to a different location for investigation, treatment, intervention or on-going care

1:11.1 Assisting in the preparation and transfer of the critically ill

You must be able to demonstrate through discussion essential knowledge of (and its application to your supervised practice):	Competency Fully Achieved Date/Sign
• Your role in the intra & inter hospital transfer of a critically ill patient	
• Indications for transfer from critical care	
• Expected sequence of events	
• Importance and implications of time critical transfers	
• Transfer process including the different considerations for transfer decisions: o Responsibility of care during transfer o Identification of correct patient o Consent o NMC Code of conduct o Competency and skills of transferring personnel o Physiological assessment and optimisation pre transfer o Patient history, treatments and diagnostic tests o Competency and skills of transferring personnel o Risk assessment of patient physiological requirements and maintenance of homeostasis during transit o Infection status o Calibration of appropriate equipment	
• Emergency equipment and transfer bag	
• Contingency planning/back up considerations	
• Drug administration during transfer	
• Documentation and audit	
• Methods, procedures and techniques for the portable monitoring and the types of equipment required during transfer (outline the calibration requirements and battery life expectancy/expiry date of each): o Mechanical Ventilator o Oxygen supply (including flow rates and journey time) o Vital signs monitor o Invasive lines o Infusion devices/syringe pumps o Suction equipment o Transfer bag o Spinal board	
• Implications of standardised monitoring techniques and explain the necessity/appropriateness of each during transfer: o Continuous ECG o Arterial blood pressure versus non -invasive blood pressure o SpO2 o Continuous capnography with wave form analysis o CVP o Temperature	

STEP ONE COMPETENCIES PAGE 47

1:11.1 Assisting in the preparation and transfer of the critically ill continued

You must be able to demonstrate through discussion essential knowledge of (and its application to your supervised practice):	Competency Fully Achieved Date/Sign
• Emergency situations that may arise on transfer: o Airway management o Alternative ventilation methods o Alternative monitoring techniques (non-invasive methods) o Basic and advanced life support o Interpretation of vital signs o Alteration of treatment plans to maintain homeostasis o Titration of medications to optimise condition	
• Process for preparing to transfer the critically ill patient: o Contents of the local emergency/transfer bag and identify the situations in which it may be required o Pharmacology requirements of the patient being transferred o Pre preparation considerations required for drug administration during transfer o Process and sequence of communication required prior to, during and following transfer o Safe moving and handling of the individual and equipment being transferred o Needs of family for information about transfer	
• Documentation that needs to be completed for intra & inter hospital transfer: o Transfer form o Physiological observation chart o Nursing evaluation o Reporting of clinical incidents o Audit tool	
You must be able to undertake the following in a safe and professional manner:	
• Assist in the physiological optimisation/stabilisation of the patient prior to transfer	
• Assist in the preparation of equipment and resources: o Airway management o Portable ventilation o Suction equipment o CV support o Vital sign monitoring o Fluid therapy & pharmacological requirements o Infusion devices/syringe drivers o Transfer bag o Psychological support	
• Assist in the location, calibration and safely set up monitoring and transfer equipment including: o Alarm parameters o Prepare electromechanical devices o Supplementary gases o Transportation o Establishing optimum level of stability on portable equipment prior to transfer	
• Assist in and maintain the safety and continued treatment of the critically ill patient during transfer	
• Assist in the care for the family of the patient being transferred	

2.7 Intra & Inter Hospital Transfer

The following competency statements relate to the preparation required prior to and the management of patients during intra & inter hospital transfer. It is intended that the competencies in this section will build on the knowledge and skills you gained in Step 1

2:7.1 Preparation and transfer of the critically ill

You must be able to demonstrate your knowledge using a rationale through discussion, and the application to your practice	Competency Fully Achieved Date/Sign
• Policies/procedure/guidelines related to the transport of the critically ill patient: o ICS guidelines o Regional standards o Risk assessment o Local policy o Bed management systems o Transfer audit documentation	
• Role of team members when arranging and carrying out an intra & inter hospital transfer	
• Complete a comprehensive risk assessment in collaboration with the MDT to ensure the patient is fit or suitable for transfer	
• Identify the potential risks associated with transferring critically ill patients	
• Indications for transfer from critical care including the: o Nature: repatriation, specialist treatment, investigation, continuing care o Sequence of expected event o Urgency and time critical transfers o Reasons for reviewing individuals' priorities, needs and the time frame with which this should be undertaken	
• Transfer process including the different considerations for clinical and non-clinical transfer decisions: o Communication with relatives and on-going updating of the situation as required o Ethical issues o Legal requirements o Local escalation policies o Bed management system o Referral to receiving hospital (including critical care and specialty consultants) o Responsibility of care during transfer o Indemnity insurance o Competency and skills of transferring personnel o Risk assessment of patient's physiological requirements and maintenance of homeostasis during transit o Contingency planning/back up considerations o Drug administration during transfer o Type of transport required, time critical issues, bariatric patients o Communication with receiving hospital prior to transfer o Documentation and audit	
• Differing types of transport available and make recommendations for which is the most appropriate	
• Process for organising the appropriate transport: o Ambulance service o Vehicle specification (including on board resources and equipment) o Ambulance equipment o Types of transfer trolley available o Storage of transport equipment in transit o Time critical transfer issues	

STEP TWO COMPETENCIES PAGE 19

2:7.1 Preparation and transfer of the critically ill continued	
You must be able to demonstrate your knowledge using a rationale through discussion, and the application to your practice	Competency Fully Achieved Date/Sign
• Process for preparing to undertake an intra / inter hospital transfer of a critically ill patient: o Gathering of extra battery packs, alternative equipment in case of malfunction o Clinical notes/radiology reports/recent blood profiles/investigations o Assessment of patient's physiological requirements during transfer o Accuracy of portable monitoring and equipment o Re assess safety/risk factors prior to transfer	
• Process and sequence of communication required for providing oral reports/discussions: o Information and informed consent in the conscious patient o Discussion with family members o Verbal referral and handover of patients condition to receiving unit/service o Handover of condition and physiological requirements to the transfer team/personnel o Sharing information with the team in relation to safety, risk assessments and contingency planning o Contact receiving unit/service on departure o Formal handover to receiving unit/service on arrival	
• Documentation that needs to be completed in an accurate, concise and systematic manner during a inter hospital transfer, with appropriate duplications: o Transfer form o Physiological observation chart o Nursing evaluation o Reporting of clinical incidents o Audit tool	
• Prepare the patient for transfer by assisting the wider MDT in the physiological optimisation/stabilisation o Assess potentially competing needs of the patient for pre-transfer optimisation and specialist care o Assess clinical condition of patient before leaving the critical care unit	
• Maintain the safety of the patient during transfer: o Assessment of the extra physiological stresses experienced by the patient during inter-hospital transfer o Anticipation of potential problems and planning to reduce the likelihood of their occurrence o Maintenance of situational awareness and readiness to respond to threatening situations if and as they occur	
• Demonstrate awareness of situational factors that could impact on the quality and safety of a critical care transfer	
• Identify areas in your own transfer practice that could be improved	
• Reflect on your own transfer experience	

Transfer Medicine

The learning outcomes and competencies listed are those necessary for the first 24 months of anaesthetic training. It is strongly recommended that CT 1/2 trainees complete this unit of training before undertaking intra-hospital transfer with distant supervision. Many of the competencies may be attained whilst gaining training and experience in intensive care.

Learning outcomes:

- Correctly assesses the clinical status of patients and decides whether they are in a suitably stable condition to allow **intra-hospital transfer [only]**
- Gains understanding of the associated risks and ensures they can put all possible measures in place to minimise these risks

Core clinical learning outcome:

- Safely manages the intra-hospital transfer of the critically ill but stable adult patient for the purposes of investigations or further treatment [breathing spontaneously or with artificial ventilation] with distant supervision

NB: All competencies annotated with the letter 'E' can be examined in any of the components of the Primary examination identified in the FRCA examination blueprint on page B-99 or in the Final examination identified in the Final FRCA blueprint on page C72 of Annex C.

Knowledge

Competence	*Description*	*Assessment Methods*	*GMP*
TF_BK_01	Explains the importance of ensuring the patient's clinical condition is optimised and stable prior to transfer	A,C,E	1,2
TF_BK_02	Explains the risks/benefits of intra-hospital transfer	A,C,E	1,2
TF_BK_03	Recalls/describes the minimal monitoring requirements for transfer	A,C,E	1,2,3
TF_BK_04	Lists the equipment [and back up equipment] that is required for intra-hospital transfer	A,C,E	1,2
TF_BK_05	Outlines the physical hazards associated with intra-hospital transfer	A,C,E	1,2
TF_BK_06	Explains the problems caused by complications arising during transfer and the measures necessary to minimise and pre-empt difficulties	A,C,E	1
TF_BK_07	Outlines the basic principles of how the ventilators used for transfer function	A,C,E	1
TF_BK_08	Indicates the lines of responsibility that should be followed during transfer	A,C,E	1,2,3

Knowledge			
Competence	*Description*	*Assessment Methods*	*GMP*
TF_BK_09	Outlines the consent requirements and the need to brief patients in transfer situations	A,C,E	1,2,3,4
TF_BK_10	Outline the issues surrounding the carrying/recording of controlled drugs during transfer	A,C,E	1,2,3
TF_BK_11	Describes the importance of keeping records during transfer	A,C,E	1
TF_BK_12	Outlines the problem of infection and contamination risks when moving an infected patient	A,C,E	1,2
TF_BK_13	Explains how to assess and manage an uncooperative and aggressive patient during transfer	A,C,E	1,2,3,4
TF_BK_14	Understands hospital protocols governing transfer of patients between departments	A,C,E	1
TF_BK_15	Outlines the importance of maintaining communication, when appropriate with the patient and members of the transfer team.	A,C,E	1,2

Skills			
Competence	*Description*	*Assessment Methods*	*GMP*
TF_BS_01	Demonstrates the necessary organisational and communication skills to plan, manage and lead the intra- hospital transfer of a stable patient	A,M	1,2,3,4
TF_BS_02	Demonstrates how to set up the ventilator and confirm correct functioning prior to commencing transfer	A,D	1,2
TF_BS_03	Demonstrates safety in securing the tracheal tube securely prior to commencing the movement/transfer	A,D	1,2
TF_BS_04	Demonstrates the ability to calculate oxygen and power requirements for the journey	A,D	1,2
TF_BS_05	Demonstrates safety in securing patient, monitoring and therapeutics before transfer	A,D	1,2,3,4
TF_BK_06	Demonstrates how to check the functioning of drug delivery systems	A,D	2,3
TF_BS_07	Demonstrates appropriate choices of sedation, muscle relaxation and analgesia to maintain the patient's clinical status during transfer	A,C,D,M	1,2
TF_BS_08	Demonstrates the ability to maintain monitoring of vital signs throughout transfer	A,D	1,2
TF_BS_09	Demonstrates the ability to maintain clinical case recording during transfer	C,M	1

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CRITICAL INCIDENT REPORT FORM INTERHOSPITAL TRANSFER OF CRITICALLY ILL PATIENT		
DATE / TIME INCIDENT REPORTED		
PERSON REPORTING INCIDENT	Name	
	Organisation	
	Contact Phone	
	Contact E-mail	
CRITICAL INCIDENT NUMBER (OFFICE USE)		
CRITICAL INCIDENT DATE / TIME		
LOCATION OF INCIDENT		
NEAS (or equivalent) TRANSFER NUMBER (if available)		
INCIDENT TYPE	☐ Delayed Ambulance ☐ Communication - Ambulance Staff (including ambulance control) ☐ Communication - Referring Staff ☐ Communication - Receiving Staff ☐ Equipment problem – Critical Care Transfer Trolley ☐ Equipment Problem – other ☐ Traffic Accident ☐ Out of *"Transfer Group"* transfer ☐ Other – Please explain below	
BRIEF DESCRIPTION OF INCIDENT		
STAFF INVOLVED WITH INCIDENT		

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SEVERITY OF INCIDENT	☐ No obvious harm / Near miss / Insignificant ☐ Low harm / Minor ☐ Moderate harm / Temporary harm / Additional intervention required ☐ Severe harm / Major permanent harm / Major intervention required ☐ Death / Catastrophic
LIKELIHOOD OF RECURRENCE OF AN INCIDENT	☐ Almost certain ☐ Likely ☐ Possible ☐ Likely ☐ Rare
ACTUAL EFFECT ON PATIENT	☐ None ☐ Other, please specify
ACTUAL EFFECT ON STAFF	☐ None ☐ Other, please specify
CONTRIBUTING FACTORS	☐ Patient factors ☐ Individual (Staff) factors ☐ Equipment factors ☐ Task factors ☐ Team factors ☐ Organisational factors ☐ Environmental factors Comments about contributing factors:
OWN TRUST CRITICAL INCIDENT FORM COMPLETED	☐ YES ☐ NO
CONTACT DETAILS FOR FEEDBACK	NAME TITLE / ROLE ORGANISATION TELEPHONE NUMBER EMAIL ADDRESS

Please email within **48 hours** of incident to:

Jan.malone@nhct.nhs.uk and/or Sarah.Tozer@nth.nhs.uk

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