

When place and time matter: How to conduct safe inter-hospital transfer of patients

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ABSTRACT

Inter-hospital transfer (IHT) of patients is often needed for diagnostic or therapeutic interventions. However, the transfer process carries its own risks as a poorly and hastily conducted transfer could lead to adverse events. In this article, we have reviewed literature on the key elements of IHT process including pre-transfer patient stabilization. We have also discussed various modes of transfer, physiological effects of transfer, possible adverse events and how to avoid or mitigate these. Even critically ill-patients can be transported safely by experienced and trained personnel using appropriate equipment. The patient must be maximally stabilized prior to transfer though complete optimization may be possible only at the receiving hospital. Ground or air transport may be employed depending on the urgency, feasibility and availability. Meticulous pre-transfer check and adherence to standard protocols during the transfer will help keep the entire process smooth and event free. The transport team should be trained to anticipate and manage any possible adverse events, medical or technical, during the transfer. Coordination between the referring and receiving hospitals would facilitate prompt transfer to the definitive destination avoiding delay at the emergency or casualty. Documentation of the transfer process and transfer of medical record and investigation reports are important for maintaining continuity of medical care and for medico-legal purposes.

Key words: Ambulance, inter-facility, inter-hospital, transfer, transport

INTRODUCTION

An inter-hospital transfer (IHT), also known as inter-facility or secondary transfer, is needed when the diagnostic and therapeutic facilities required for a patient are not available at the given hospital. IHT may take place from Emergency Department, ward or intensive care unit (ICU) of one hospital to that of another.^[1-4] Regionalization of specialized care and increased requirement of super-specialty treatment for trauma, burns, cardiac or neurology, etc., have contributed to an increase in IHT.^[5-9] IHT may sometimes also be needed for non-clinical reasons such as non-availability of bed

or issues of funding of medical treatment. Thus, IHT of patients is now an integral process and essential component of health-care system.

Optimal health and well-being of the patient is the underlying goal of IHT. Therefore, the decision to transfer is patient-centered and is undertaken when the benefits of transfer outweigh the risks.^[10] Choice of the destination hospital should be based primarily on infrastructure, availability of specialized care and proximity to the referring hospital, the aim being to seek transfer to a hospital nearby providing the highest quality care.^[11] Once the decision is made, the transfer process must be initiated and completed as soon as possible.^[12] Both the referring and receiving hospitals should thereafter focus on the continuity of medical care and not just on administrative procedures of discharge and re-admission. IHT carries its own risk and a poorly and hastily conducted transfer increases morbidity and mortality risk for patients.^[13-15] Therefore, a well-organized system with appropriate equipment and personnel is crucial for a safe IHT.

We conducted a search for literature on IHT available on Medline and Internet. The keywords used for the search

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were inter-hospital, inter-facility, transfer, transport, aero-medical, air-medical, helicopter and ambulance. In this article, we discuss the key elements of safe transfer, pre-transfer patient preparation and various modes of transfer, transport physiology and adverse events occurring during IHT.

KEY ELEMENTS OF SAFE IHT

Despite common usage of IHT these days, the organizational set up necessary for carrying out a safe and smooth transfer is often suboptimal. Besides the wide variation in time spent on arranging for IHT, there are inadequacies in equipment, monitoring and medical care during the transfer. All these have adverse impact on patient outcome and can lead to mishaps and adverse events; hence, the need for laying down minimum standards of care for IHT.^[16-21]

Recently, various international professional organizations including American College of Critical Care Medicine and Society of Critical Care Medicine, American College of Emergency Physicians, Australasian College of Emergency Medicine, Intensive Care Society and Faculty of Intensive Care of the Australian and New Zealand College of Anaesthetists have formulated guidelines to conduct IHT in sync with the health-care systems of their countries.^[22-25] The Paediatric Intensive Care Society has also laid the guidelines for the transport of the critically ill children.^[26] Majority of these guidelines have stressed pre-transport coordination and communication, qualified and trained accompanying personnel, appropriate transport equipment, standard monitoring and documentation as key elements of a safe transfer. These are briefly described below.

Pre-transport coordination and communication

Patients or their guardians should be involved in the decision for IHT and their consent should also be taken after thorough discussion of its risks and benefits. The destination hospital should be identified and its agreement to accept patient should be obtained in advance. The responsibility for the transfer primarily lies on the physician at the referring hospital until the patient is taken over by the medical personnel at the receiving hospital.

However, when a patient is transferred by a specialized retrieval team sent by the receiving hospital, the responsibility of care is taken over by the retrieval team.

There should be direct communication between the referring and receiving physicians. Important patient information that should be shared includes clinical condition of patient, treatment given, reasons for transfer,

risks of deterioration during the transfer, any treatment or investigations required before initiating transfer, mode of transport and approximate time-line of the transfer. Provision for feedback and communication between referring and receiving hospitals should exist.

Accompanying personnel

All doctors and other personnel undertaking the transfer should be appropriately trained, qualified and certified. In addition to the vehicle operator, minimum of two medical personnel should accompany critically ill-patients during IHT. They should be able to provide advanced airway management and intravenous (IV) therapy, identify and treat of arrhythmias and be skilled in basic and advanced life support.

Transport equipment

For transport of critically ill-patients, the transport ambulance should have all equipment needed for airway management, oxygenation, hemodynamic monitoring and all drugs for resuscitation. Besides, there should be regular checks of proper functioning of all equipment and the expiry and stock position of all drugs should also be checked.

Monitoring during transport

The minimum standards for monitoring during the transport of critically ill-patients include continuous pulse oximetry, electrocardiography, non-invasive blood pressure and respiratory rate. In addition, based on the patient's clinical status, additional monitoring such as capnography and invasive monitoring for arterial, central venous or intracranial pressure may be needed.

Documentation

Documentation of the decision to transfer should include the following details: Referring physician's name, designation, contact details; date and time at which decision to transfer was taken and reasons for transfer. Patient's clinical status and vital parameters before, during and after transfer should be documented, so also the medical management during the transport. Copy of patient's medical records and results of investigations should be given to the receiving hospital.

Finally, though key elements for IHT have been identified and recommendations for safe conduct of IHT laid down, these standards are often not met. Hence, the need to identify the lacunae in the system and ensure greater compliance with the guidelines.^[27] In a survey of IHT from Emergency Departments of Hospitals in the UK, a majority of physicians identified non-availability of trained accompanying personnel, appropriate transport and equipment for transferring critically ill-patients as a

major problem areas.^[28,29] A survey by Victorian Quality Council of IHT in rural communities of Australia noted inadequacies in exchange of clinical information, communication and documentation.^[30]

PRE-TRANSFER PREPARATION OF THE PATIENT

Meticulous pre-transfer preparation and stabilization of the patient is essential to prevent physiological decline and any other complications during the transfer. Therefore, before undertaking IHT, patient should be resuscitated and stabilized to the maximum extent possible without wasting undue time, keeping in mind that in some cases complete stabilization may not be feasible until definitive treatment at the receiving hospital.^[31-33] During the pre-transfer preparation, “ABC” or “airway, breathing, circulation” check should be performed to identify and correct any preventable problems. Often there are systemic inadequacies in patient preparation for the transfer, which may be corrected through physician education and use of a pre-transfer checklist like one described below.^[34-36]

Pre-transfer checklist

Airway: Is the airway patent and protected against aspiration?

- In case of any possibility of airway compromise during transfer (e.g., airway burns, severe head injury), elective endotracheal intubation should be undertaken. The endotracheal tube position should be noted and firmly secured.
- Gastric tube should be inserted to prevent aspiration in all critically ill-patients.
- When indicated, cervical spine should be immobilized with a cervical collar.

Breathing: Is the breathing adequate? Are the blood gases levels satisfactory?

- In case of any possibility of inadequate breathing during transfer (e.g., patient with frail chest), patient should be electively intubated and ventilated.
- For suspected pneumothorax, chest radiograph should be carried out and a chest drain inserted (particularly in patients transported by air ambulance).

Circulation: Does the patient have adequate IV access? Has hypotension been treated?

- Preferably the patients should have two peripheral wide bore IV cannulae inserted. If needed a central venous line should also be inserted and secured.
- External hemorrhage should be controlled. Shock should be treated with IV fluids and vasopressors. Foley’s catheter should be placed to monitor urine output. Fracture site should be immobilized to reduce pain and blood loss.

- If necessary, complete blood count should be carried out and cross matched blood kept available during transport.

Disability or neurological status: Is the evaluation for disability and neurological status done?

- Patient’s neurologic status, Glasgow Coma Score (GCS) and papillary response should be documented before initiating transfer or administering paralytic and sedative agents. Patient should be evaluated for head injury or focal neurological signs.
- When needed, patient’s head, cervical, thoracic and lumbar spine should be secured with immobilization devices.

Environmental condition: Have appropriate precautions been taken to protect the patient against possible adverse environmental conditions during transport?

- Suitable blankets and plastic sheets should be provided to protect patient from cold, rain or snow.

Investigation, monitoring and Infusions: Are the baseline investigations done? Are appropriate monitoring and necessary infusions in place before transfer?

- Baseline hematological investigation (blood count, urea, electrolytes and glucose) should be carried out.
- A chest radiograph and arterial blood gas should be carried out in all ventilated patients and those with breathing difficulty.
- Patient should be given adequate analgesia and sedation before transfer.

MODES OF TRANSFER

There are basically two modes of transfer in common use, ground transport and air transport.

Ground transport

Various types of ambulances are used for ground transport, these are categorized as:

1. Basic life support ambulance: Ambulance appropriately equipped and staffed to provide basic life support to patients. These are used for transporting patients with non-life-threatening medical emergencies.
2. Advanced life support ambulance: Ambulance appropriately equipped and staffed to provide treatment of life-threatening emergencies and advanced life support (e.g., endotracheal intubation, administration of drugs or IV fluids, cardiac monitoring and defibrillation). These ambulances are used for transport of critically ill and unstable patients.

3. Patient transport ambulance: Ambulance used for transport of stable patients for scheduled visits to hospital or clinics for treatment, physical examination or diagnostic investigations or for transfer from one hospital to another. These can be buses, vans or other vehicles.
4. Mobile intensive care units (MICUs) with specialist retrieval teams: IHT of critically ill-patients is often associated with physiological deterioration. Therefore, MICUs with specialist retrieval teams are being employed in several countries (UK, Netherlands, Australia, USA.) for transport of critically ill-patients. With MICUs, it is possible to safely transport unstable patients with severe respiratory and cardiovascular failure over long distances.^[37] Recent studies have indicated that MICUs with specialist retrieval teams have led to improved quality of critical care during transport and reduced risks of transfer for the critically ill, pediatric and trauma patients.^[38-40] Furthermore, MICUs have increased survival rates for patients with respiratory failure, improved acute physiology and chronic health evaluation III (APACHE III) scores and reduced early mortality in ICU.^[41,42]

Air transport

Across the world, there has been an increase recently in the use of air medical transport due to its advantages such as reduced transport time and increased care provided by specialized air medical crews. For some patients, such as those of ST-segment elevation myocardial infarction, ischemic stroke and trauma where prognosis depends on urgent access to timely medical intervention, availability of air transport is of critical importance.^[43-46] Usually, air ambulances are staffed with trained medical crew and equipped with specialized medical equipment allowing management of all types of medical emergencies on board. However at the same time, there are concerns over the cost and safety of air transport.^[47-50] The onboard life support equipment provided on the air ambulance should be compatible with the electrical specifications available in the aircraft. If portable medical equipment is carried into the aircraft, the battery time of these should be longer than the total of flight time and additional ground transport time.

Air ambulances can be classified as follows:^[51]

1. Rotor wing or helicopter air ambulance: Recommended for journeys of over 50 miles (80 km). Ideal if there is a helipad in the hospital and for remote locations with no airstrips.
2. Fixed wing or airplane air ambulance: Recommended for the journey of over 150 miles (240 km). These can be either jet or propeller driven aircraft. In comparison to rotor wing, fixed wing air ambulance has greater

speed, a pressurized cabin with more space, less noise and vibration. It is less weather dependent and more economical for long distance travel. However, it requires additional ground transport between hospital and airport. Fixed wing air ambulances are used for repatriation of ill or injured and transport for specialized treatment over long distances including across countries and continents.

Indications for use of air transport

The use of air ambulance for IHT is proving increasingly useful in overcoming time and geographical barriers to access to medical care. "An important step in defining the optimal criteria for air-medical dispatch is the determination of parameters that identify patients most likely to benefit from transport."^[46] According to guidelines for Air Medical Dispatch issued by American College of Emergency Physicians, air transport for IHT is indicated when factors such as time, distance and intra-transport level of care needed render ground transport unfeasible.^[52] The clinical scenarios include:

1. Severe injury or trauma: Trauma score >12, unstable vitals, multisystem injury, ejection from vehicle, penetrating trauma to chest, abdomen, pelvis; crush injury, age <12 or >55 year There is good evidence for outcome improvement from air transport in patients with trauma.
2. Cardiac: Acute coronary syndrome (urgent need for interventional therapy); cardiogenic shock with the need of intra-aortic pump or ventricular assist device; cardiac tamponade with hemodynamic compromise; mechanical cardiac disease (acute cardiac rupture, decompensating valvular heart disease).
3. Neurological: Central nervous system hemorrhage; evolving ischemic stroke (potential candidate for lytic therapy); spinal cord compression by mass lesion or status epilepticus.
4. Organ transplant: Organ recipient or brain dead patient for organ salvage.
5. Critically ill-medical or surgical patients: The transport period is an extremely high-risk interval for critically ill-patients; hence, the need for minimizing this time by using the fastest available mode of transfer. Therefore, air transport is preferred when the critical care support services needed are unavailable with ground transport or when distance and traffic conditions are likely to unduly prolong the transport time. The critical conditions where air transport is commonly used include patients on vasopressors, ventricular assist device or sophisticated ventilator support; patients in urgent need of hyperbaric oxygen therapy (carbon monoxide poisoning, vascular gas embolism) or toxicology services (severe poisoning, drug overdose)

or emergency dialysis; surgical emergencies such as aortic dissection or gastrointestinal hemorrhage with hemodynamic instability.^[53-56]

Patients at high risk for air transport

Patients with airway obstruction, respiratory distress, shock, reduced consciousness, significant head or facial injury are considered high-risk for air transport as they may suffer sudden life threatening decompensation during flight. As it may not be possible to identify and effectively manage these deteriorations during flight, appropriate critical care interventions (such as intubation, controlled ventilation, pleural decompression, external hemorrhage control, fluid resuscitation, inotrope support) should be performed before air transport. In the absence of resources to deliver such pre-transport critical care, it may be safer to use ground transport in spite of longer transport time.^[51,52]

Contraindications to air medical transport

In the following conditions, air transport of patients is contraindicated:^[51,52]

1. Hazardous environmental condition for flying based on the pilot's discretion, e.g, fog, high winds, low cloud base.
2. Aggressive/uncooperative patient who may place the aircraft and its crew at risk.
3. Patient contaminated with a chemical or noxious agent.
4. Untreated pneumothorax, penetrating eye injury.
5. Recent abdominal surgeries or immediate post-operative patients.

Deciding on the appropriate mode of transfer

Factors influencing the choice of transport include nature of illness and urgency of transport, availability of transport, mobilization time, distance, weather, traffic conditions and cost.^[3,51,52,57-59] Table 1 shows a comparison between ground and air transport. Questions that can help determine the most appropriate transport mode are:

1. Patient's physiological status: Does patient's clinical condition necessitate minimum time to be spent during transport?

2. Patient's illness or injury: Does the patient's condition need specific or time sensitive evaluation or treatment (e.g, trauma, stroke, acute coronary syndrome)? In case of critically ill and unstable patient, what mode of transfer would have the necessary critical care and advanced life support system?
3. Accessibility by road and air: Is the patient location inaccessible to ground transport? Is there a helipad or airport near the referring hospital?
4. Weather or Traffic conditions: Are these suitable for air or ground transport?
5. Total transfer time: What is the transport time by ground compared to that by air ambulance (including patient loading time, flight time and transfer time from helipad to the emergency department)? Transport from hospital helipad to the Emergency Department by ambulance is likely to increase total transport time by 15 min. Therefore, a transport time of 45 min or less by road is still likely to be quicker than transport by helicopter.

TRANSPORT PHYSIOLOGY

Ground and air transport impose several physiological changes on both patient and caregivers, which may complicate the medical transfer.^[60-63] The effects on patient can be minimized by adequate sedation and pre-transport stabilization. These include the following:

Vibration

The sources of vibration vary for different modes of transport. In ground transport, it arises from uneven road surface and vehicle's suspension; while in air transport, it arises from engines, air turbulence, gear box and rotors. Vibration frequencies between 0.1 Hz and 40 Hz are physiologically most harmful. The effects include:

- Discomfort and fatigue, nausea, headaches; impaired visual and motor performance; pain at the fracture site, aggravation of the spine and brain injuries; coning of the brain or internal hemorrhage in skull base fracture.

Table 1: Comparison of ground and air transport

Mode	Advantages	Disadvantages
Ground transport	Low cost Rapid mobilization Less weather dependent Easier patient monitoring	Longer transport time for long distances Dependent on traffic conditions
Air transport	Shorter response time to patients and shorter transport time Can access patients in topologically hard to reach areas, e.g., island, mountain terrains	Slow to mobilize Dependent on weather condition Landing site needed (helipad or airport) Need for additional ground transport between landing site and hospital Limited availability in comparison to ground transport More expensive

- Malfunction of activity sensing pacemakers and gravity led infusion systems, motion artefacts in electronic monitoring systems; disconnection or dislodgement of lines, tubes and catheter.
- Difficulty in palpating patient's pulse and carrying out procedures like IV cannulation or endotracheal intubation.
- The effects can be reduced by adequate energy absorbing mattresses on vehicle seats and stretchers, adequate padding at points of contact between patient and vehicle and by use of restraints for vehicle occupants.

Noise

Noise may be generated by the engine, road surfaces, external wind, helicopter rotor, aircraft propellers or monitoring equipments. Besides causing annoyance and inconvenience, noise may hinder auscultation of heart or breath sounds. Communication is rendered difficult; alarm and beep tones become inaudible. Protective head gear or earplugs can be used to lessen noise. The patient may not be able to convey problems experienced and the doctor may not be able to give advice or instructions.

Motion sickness

This occurs due to the difference in visual and vestibular sensory input and low frequency oscillation, which may produce nausea, retching or vomiting. A suction apparatus (portable or mechanical) should always be available. Antiemetic drugs prophylaxis may be given to patient and vehicle occupants at risk. If patient has wired jaws, a wire cutter should be kept handy or the wires may be replaced with elastic during the transfer.

Acceleration and gravitational forces

The body is exposed to linear and radial acceleration and deceleration forces during the transport. The cardiovascular system of critically ill-patients is more susceptible to these forces due to their compromised physiological reserves (hypovolemia, dilated peripheral vasculature). The magnitude and effect of these forces is greater during air transport especially during take-off and landing.

- Transient hypertension and dysrhythmias can occur due to sudden acceleration.
- Acceleration forces acting on the body over long durations cause shift in body organs and fluid compartments. This may lead to venous pooling in lower limbs with fall in cardiac output with tachycardia. There may be changes in intracranial blood volume and pressure too.

The actual effect of these forces will depend on the patient's positioning; the effect will be more severe if the patient's

stretcher is placed parallel to the long axis of the aircraft as opposed to sideways. It may be advantageous to transport hypovolemic and cardiac patients with their feet towards cockpit to prevent a fall in cardiac output and head injury patients with their head toward cockpit to prevent sudden rise in intracranial tension during aircraft ascent.

Temperature and humidity

Exposure to cold environmental temperature causes hypothermia. Neonates are particularly at risk and will need a transport incubator. During air transport, the atmospheric temperature and humidity drops with altitude. In air ambulance, the set temperature of the pressurized cabin may be lower than what is optimum for the patient, necessitating use of patient warming blankets. The low humidity of the cabin air also causes drying of secretions of mucus membranes, eyes and respiratory tract. To avoid these, humidified inspired air and lubricating eye drops should be used.

Altitude

Most rotor wing air ambulances fly at between 2000 ft and 5000 ft above sea level and fixed wing air ambulances at between 15,000 ft and 40,000 ft above sea level. However, flying at altitudes higher than 10,000 ft needs pressurized air cabin. Usually, the cabin pressure maintained equals atmospheric pressure at altitudes of 5000-7000 ft above sea level. While transporting critically ill-patients (i.e., ones already requiring 100 percent inspired oxygen at sea level), a sea level cabin pressure will need to be maintained during flight, which can be achieved with the fixed wing air ambulance flying at a lower altitude (i.e., 12,000 ft-15,000 ft), with greater fuel consumption. The physiological effects of high altitude are explained by Boyle's and Dalton's law. These include:

- Hypobaric hypoxia: The partial pressure of inspired oxygen decreases with altitude, which would aggravate hypoxia in patients with pre-existing cardiorespiratory problems. These patients may require higher inspired oxygen, which may be adjusted according to blood gas analysis if available onboard.
- Expansion of gas in body spaces (dysbarism): This causes ear pain, barosinusitis, ileus, increased gastric distension. High altitude flights are therefore contraindicated in patients with air trapped in pathological body spaces (e.g, untreated pneumothorax, pneumocephalus, recent abdominal surgery, gas gangrene and penetrating eye injury).
- Expansion of air in medical equipments: The endotracheal and tracheostomy tube cuff pressures should be constantly monitored; alternatively the cuffs can be inflated with sterile water. The use of glass fluid bottles should be avoided; all fluid bottles and fluid collection system should be vented. Chest

tube drain with Heimlich valve should be used. Air casts or pneumatic splints should be avoided to prevent limb entrapment.

- Third spacing: This is due to pressure changes and increase in vascular permeability causing fluid shift from intra-vascular to extra-vascular space leading to edema, dehydration and hypovolemia.

Disturbed circadian rhythm or Jet lag

This occurs on long haul east-west flights due to travel across several time zones. Its effects include excessive tiredness, sleep disturbances, loss of appetite, disturbed feeding and bowel habits. During long haul travel, additional care will be needed in timing the patient's medications. The easiest way is to keep a watch set according to time of the departure point and schedule all medications according to it throughout the journey.

ADVERSE EVENTS DURING IHT

Understanding various types of possible adverse events and risk factors predisposing patients to these is important for improving the safety of IHT.^[64,65] Transport impacts the patient via two main mechanisms, movement and its physiology and change from the environment and equipment of the initial care unit to that of the medical ambulance. These may lead to adverse events that can be either minor (i.e., greater than 20 percent change in physiological parameters from baseline) or critical (i.e., a life-threatening incident requiring urgent therapeutic intervention). The adverse events that may occur during transfer include:^[13-15,66,67]

- Medical:
 1. Cardiovascular: Severe hypotension or hypertension, arrhythmia, cardiac arrest.
 2. Respiratory: Hypoxia, aspiration, accidental extubation, selective intubation, bronchospasm, pneumothorax, patient ventilator dyssynchrony.
 3. Neurological: Agitation, intracranial hypertension.
 4. Hypothermia.
- Equipment malfunction or Technical: Electrical failure, uncharged batteries, gas failure, oxygen or IV line disconnection, monitoring equipment malfunction, vehicle breakdown.
- Human error: Drug error, patient mix up

Risk factors for adverse events

The risk factors can be categorized as follows:^[16-19,66-68]

- Equipment related (technical factors): The common equipment problems are related to mechanical ventilation, infusion pumps and drainage or monitoring lines. A technical understanding of functioning of

medical equipment and familiarity with the equipment used during transport is therefore important for identifying and resolving these problems.

- Transport team related or (human factors): Lack of training, lack of supervision. This can be minimized by transport team training programs and physician education.
- Transport organization related (collective factors): Inadequacies in communication and coordination between the referring and receiving teams can delay transfer process, increase total transport time and incidence of adverse events. Ideally, the IHT should be organized such that the patient bypasses the emergency department admission and directly reaches the intended destination like the operating room or ICU.
- Patient-related (including clinical instability): Increased severity of illness, hemodynamic instability and oxygenation failure are all risk factors. The risk can be reduced by patient stabilization before and during transfer.

There is paucity of studies evaluating the incidence of adverse events, mortality and risk factors associated with IHT.^[69] A retrospective study of IHT of critically ill-patients transferred using standard ground ambulance in the Netherlands reported a 34% incidence of adverse events. The researchers estimated that 70 percent of these events were due to poor patient preparation by referring hospital while the remaining 30 percent events were due to equipment or technical problems, many of which were avoidable.^[70] Later, another study in the same country carried out after induction of MICUs and specialist retrieval teams showed a decline in incidence of adverse events (i.e., 12.5 percent vs. 34 percent) during IHT. Most of these were caused by technical (as opposed to medical) problems and were not life-threatening.^[71] A retrospective study of inter-facility transfer of mechanically ventilated patients to University Hospital using rotor-wing air transport reported that major adverse events were rare; however, the incidence of minor adverse events was 22 percent, with patients needing vasopressors or transported over longer distances being particularly predisposed to such (minor) events.^[72]

There have been a few studies carried out to evaluate the outcome for patients admitted after IHT. Durairaj et al. reported significantly higher ICU mortality rates (25 percent vs. 21 percent) for post-IHT admissions as opposed to direct admissions.^[73] Another study showed that APACHE III scores, hospital and ICU mortality rates and duration of hospital or ICU stay were significantly greater for transferred patients as opposed to those directly admitted. However, when adjusted for the severity of illness, the ICU or hospital mortality were comparable for the two populations.^[74]

Risk score for IHT

The risk score for transport patients (RSTP) was designed by Etzebarria *et al.* based on patient's physiological parameters (hemodynamics, arrhythmias, respiration, GCS, prematurity) and the need for electrocardiogram monitoring, pacemaker, IV line, respiratory support or pharmacological medications.^[75] The score serves as a triage tool for assessing the risk of adverse events during IHT. A recent study by Markakis *et al.* found that patients with RSTP score ≥ 7 were at significant risk of critical events and subsequent mortality.^[76] The study identified shock as the most common problem encountered during the IHT of critically ill-patients. Besides this score, therapeutic intervention scoring system (TISS-28) and modified early warning score (MEWS) are also in use for predicting physiological deterioration during transfers. Lee *et al.* found that the MEWS is a more reliable predictor of physiological deterioration during IHT than TISS-28.^[77]

Mitigating the risks

The following are the protective factors for a smooth and safe IHT:

- Stabilization and preparation of critically ill-patients before IHT.
- Anticipating the adverse events and being prepared.
- Comprehensive training of the transport team members.
- Customized transport equipment and knowledge of their functioning.
- Standardized practices and protocols and adhering to the same.
- Checklists and scrupulous performance of all checks.

CONCLUSION

IHT is undertaken to obtain additional care for the patient after carefully weighing the risk benefit ratio. Rather than haphazardly following a “scoop and run” approach, IHT should be guided by a policy of “stabilize and shift,” keeping in mind that complete stabilization of the patient may be achieved only at the receiving end and until then, it is important to maintain continuity of care. The transport crew should be trained and skilled to anticipate and manage any technical and medical contingencies that may arise during the transfer. As IHT is often critical for making best possible medical care available to patients, there is a need to maximize its safety and efficiency. Hence, while several countries such as USA, UK and Australia have formulated guidelines to regulate and improve the standards of IHTs, most other countries particularly the developing nations are yet to do so.

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