T E Oh: Intensive Care Manual

Organization Aspects

Chapter 3: Transport of the Critically Ill

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Therapy and investigation of the Intensive Care patient may require movement, eg, to the operating room, CT Scanner, angiography suite, or another medical centre. The movement of a patient with complex therapy in progress presents major problems and risks. Consequently, the patient may lose vital haemodynamic and respiratory stability and be in poor condition for any planned procedure. Adequate care of the sick patient in motion remains a commonly neglected area of Intensive Care. The involvement of intensivists or anaesthetists in mobile Intensive Care is emphasized as unqualified or experienced staff perform poorly. Safe transfer of the critically ill is facilitated by defining the problems of the patient, the transport environment and those of staff. Factors which contribute to unsafe movement may be categorized as follows:

1. Difficulty in providing compact and portable life support and monitoring equipment which is also compatible with equipment at both ends of the journey.

2. Multiplicity of objects attached to the patient.

3. Increased possibility of mishaps (eg, endotracheal tube dislodgment).

4. Poor tolerance of the sick patient to abrupt movement, lifting and vibration.

5. Unfavourable climate and weather conditions encountered in transit, and other physical difficulties presented by inadequate corridors, lifts and vehicles.

6. Deficiencies in accompanying staff skills and numbers.

7. Failure to realize that the staff have two different roles and to co-ordinate these caring and moving teams.

Achieving Safe Movement

General principles in achieving safe transport are similar, whatever the location. They are:

1. Explaining to the patient (when communication is possible) what is planned.
2. Stabilizing the patient optimally before transportation.
3. Moving the patient in a planned, unhurried fashion.
4. Maintaining in transit the stability previously achieved.
5. Liaising adequately with the receiving staff.

There are differences in detail, depending on the type of movement being undertaken. It is thus helpful to consider the following key requirements to enable safe movement of the patient:

1. *Planning/communications.*

2. *Personnel:* the number and type of staff.

3. *Properties:* the equipment needed which may be divided into
   (a) the life support and other treatment devices, and
   (b) the monitoring systems.

4. *Procedures:* resuscitative or surgical, which may be required before transport.

5. *Passage:* the route and mode of transport and how it may affect the patient.

The different types of movement may be classified under the categories below:

1. *Intra-mural:* between departments or wards of a hospital.

2. *Extra-mural:* transport beyond the boundaries of a hospital; these may be three types:

(a) *Pre-hospital* or primary transport: when Intensive Care / Anaesthesia / Accident & Emergency staff combine with ambulance officers/paramedics to safely deliver a critically ill patient from an accident site to definitive care.

(b) *Inter-hospital* or secondary transport: when transfer to a second hospital becomes necessary, eg, from rural to city hospital. Another variant of inter-hospital transfer is:

(c) *International or long distance*, eg, greater than 5000 km. Evacuation over this distance may have additional requirements.

The term "retrieval team" has been applied to mobile Intensive Care teams provided by a major centre.

3. *Other types:* these are:

(a) Neonatal transport (usually inter-hospital).

(b) Hyperbaric transport (movement of a patient in a mobile recompression chamber).

(c) Movement of ICU patients from a fire threat.

(d) Counter disaster situations requiring attention to and evacuation of many patients on site (eg, a train crash).

Intra-Mural Movement

This is the commonest type of movement for ICU patients.

Planning

If possible, the patient should be shifted at a time and along a route likely to produce minimal delay. A team member is sent ahead to commander lifts and clear corridors. Plans are agreed with all parties beforehand to avoid delays (eg, waiting in a corridor until a CT scanner becomes available).

Personnel

Skilled medical and nursing staff should accompany patients on life support. There should be enough strong staff to physically move the patient. Lifting onto an operating table, for example, requires 5 people. Tasks are apportioned accordingly:

(a) Orderlies to push and steer the bed/trolley.

(b) Nursing and medical staff to supervise, continue therapy en route, and transfer care at the receiving end.

Procedures

Procedures to stabilize the patient (eg, intubation) must be carried out prior to transport.

Properties

Compact equipment is carried on the bed or by a staff member. Often, the mass of equipment may require a separate trolley. A trailing IV pole on wheels is unstable and should be avoided.

1. Life Support and Other Treatment Devices

(a) *Artificial Ventilation*

Manual ventilation is feasible for short periods. Lightweight or portable gas driven (eg, Oxylog, Bird Mk 14) or battery powered (Bear 33, LP 6) ventilators free staff for other tasks. However, they lack the versatility of ICU ventilators. (See Ventilators.) Hence patients with poor lung compliance or severe bronchospasm may suffer worsening gaseous exchange, if the transit or destination (eg, operating room) ventilator is less effective. Transit ventilators requiring both supplies of oxygen and air have obvious disadvantages. Using oxygen alone, with room air entrainment (eg, Oxylog), the restricted range of FIO_2 (1.0-0.5) is acceptable for short periods. A self-inflating bag and a spare ventilator exhale valve should be carried, in case the oxygen supply or breathing circuit fails. Humidification by heat and moisture exchangers is preferable to bulky, conventional humidifiers. Battery powered or a venturi-system suction devices are available. The latter is driven by compressed gas and may seriously deplete the supply needed for ventilation. Positive end expiratory pressure may be achieved by either spring loaded or ball valves; the latter, however, need to remain vertical to be effective.

(b) *Pleural drainage*

"Flutter" valves (eg, Heimlich) are the most compact but may not be suitable for situations other than transport. Underwater seal drainage (UWSD) systems are awkward to transport but allow pleural air leaks to be visualized. The reservoir has to be secured from tilting and at least 30 cm below the patient, to minimize aspiration of air and drainage fluid into the pleural cavity. Plastic should be used, as shattering of glass may cause loss of the seal. Staff should not clamp the drainage tube when lifting the patient, because of the risk of producing tension pneumothorax, especially if a bronchopleural fistula is present.

(c) *Urine and Wound drainage*

Any extensive diuresis or other fluid loss, especially on an extended absence from the ICU, should not go unattended.

(d) *Defibrillation*

Combined monitor/defibrillators are convenient for transport. Standard defibrillation procedures are discussed in Cardioversion and Defibrillation.

(e) *Pacemakers*

Transvenous types constitute an example of a cardio-invasive line (see below). External cutaneous pacing has possible short term emergency use. (See chapter 9, Cardiac Pacing.)

(f) *Intravenous Fluids*

Well secured, patent venous lines are essential, preferably away from wrists or elbows. Luer-lock junctions reduce the disconnection risk. For short trips, plastic infusion bags may be turned off and placed on the bed. However, when restarting flow, entrained bubbles need to be expelled. Glass bottles are hazardous because of shattering when dropped. Assured supply of fluids plus pressor infusion sleeve bags are necessary. If blood transfusion is anticipated, checking of available blood should be completed beforehand. Blood warming by water bath is impractical. A dry heat warmer is used if required.

Gravity feed IV systems cannot reliably infuse constant rates. An infusion pump should have spare charged batteries if battery endurance is less then twice the expected duration of the trip. The pump should be capable of operating on mains power and in any position (vertical or horizontal). In the event of battery failure, a method of reverting to gravity feed is desirable. Spring loaded or mechanical clockwork devices lack the range of infusion rates of electronic devices.

IV drugs should be checked, drawn up and labelled beforehand. To reduce the hazards of needlestick injuries, injection should be into an IV line, and not directly into a vein. Used needles should not be resheathed but discarded into a small rigid "sharps" container.

Abrupt cessation of concentrated glucose may result in profound hypoglycaemia. If parenteral nutrition cannot be continued during transport, 10% or at least isotonic glucose should be substituted and the blood sugar monitored (see below).

(g) *Dialysis*

Respiratory embarrassment may occur during transport if peritoneal dialysis is continued. caval lines in haemodialysis may be conveniently locked off and filled with heparinized saline during transfer. Continuous arterio-venous haemofiltration (CAVH) or haemodiafiltration (CAVHD) may be continued if necessary.

(h) *Counterpulsation*

This may be essential for patients being transferred to cardiac surgery. An arterial pressure display needs to be added to those machines without one. There has to be adequate compressed gas and lead-acid battery endurance for the machine.

(i) *Thermoregulation*

Protection against cold (eg, using a reflecting "space" blanket) and from rain may be required. The hyperthermic patient may require ice packs to be carried, plus specific medications, eg, dantrolene in malignant hyperpyrexia.

(j) *Emergency Pack*

A pack containing laryngoscopy, endotracheal tubes, IV cannules etc enabling mishaps en route to be managed, is essential.

2. Monitoring In Transit

(a) *Clinical Observation* remains pre-eminent. Visual observation and palpation (eg, of chest movement) is necessary when external noise and bright light overwhelm monitor alarms and screens. Documentation of variables remains important, but records necessarily need to be concise.

(b) *ECG* remains a coarse indicator of overall circulatory function. Its prime virtue is detecting catastrophic rhythmic disturbances. Many transport monitors, however, while having an audible QRS "beep" do not have rate alarms. Visual surveillance of the monitor is essential.

(c) *Blood Pressure Measurement*

(i) Non-invasive: clinical auscultation techniques are usually not practical in transit, so palpatory systolic measurement with an aneroid clock is common. Mercury column sphygmomanometers are cumbersome, need vertical positioning and have limited use. There are 3 types of pneumatic cuff BP transducers: piezo crystal microphone (eg, Copal); doppler generator; and the most commonly used, oscillotonometric transducers (eg, Dinamap, PhysioControl). In these, the display is digital, using easily read light-emitting diodes (LED). Most reliable devices are unfortunately considerably heavy.

(ii) Invasive: for indwelling arterial lines, lightweight battery operated display systems are best. A simple non-electronic alternative is to use a heparin filled line connected via a membrane isolator to the air in an aneroid clock. Continuous flushing devices add to the bulk of equipment and intermittent manual flushing may be used instead. Available equipment may not allow pulmonary artery and intracranial pressure to be monitored in transit.

(d) *Respiratory* - A ventilator disconnect alarm should have audible signals above extraneous noise. The small but fragile Wright respirometer remains the most convenient spirometer. There are light pulse oximeters suitable for transport. End tidal CO_2 monitoring is limited in use because of unsuitable models. Transcutaneous oxygen measurement currently is successfully used only in neonates, because of their reduced skin thickness.

(e) *Temperature* - The rectal or oesophageal thermistor probe connected to a digital display is suitable. Glass thermometers are inconvenient and hazardous.

(f) *Biochemical Monitoring* - Potassium and glucose are the principal considerations in short term transport. Reflectance equipment is compact and gives adequate results for glucose. The ECG is observed for changes of potassium abnormality. Biochemical information may need to be more precise in long distance transfer.

Electrical Energy Sources and Safety Considerations

Nickel cadmium rechargeable batteries are commonly used. However, they may fall prematurely because of a "memory" effect. This problem can be reduced by "exercise" (discharge) of the battery to exhaustion at intervals. Sealed lead-acid batteries have been substituted in some situations, because of their greater endurance. However, they are also subject to sudden failure of a different kind. Unlike NiCd batteries they should be kept fully charged and not undergo periodic exhaustion.

If the patient has invasive lines to the heart such as a Swan-Ganz catheter, transvenous pacemaker or central venous line, the risk of microshock arises once removed from the cardiac-protective (class A) or body-protective (class B) electrical isolation environment of the ICU or the operating rooms. Thus battery sources of electrical energy should be used and appropriate precautions taken, such as avoiding contact by staff between patient and a mains powered equipment casing. (See Chapter 75, Electrical Injuries.)

Passage

Hospital doorways, corridors and lifts may not allow movement of a hospital bed fully laden with equipment. Thus trolley transport will often be needed. Care must be taken to avoid injury to the patient and staff when shifting the patient from bed to trolley (or operating table). Coordination of the team, whether using manual, frame, slide or mechanical "crane" methods of lifting/transfer are vital. Particular care is given to patients with spinal injuries. (See chapter 70, Spinal Injuries.)

Extra-Mural Movement

1. Pre-Hospital Transport

Multiple trauma is the common problem requiring hospital based Intensive/Critical Care facilities in this phase. Others include drowning accidents, hypothermia and hyperthermia.

Planning: Acute hospitals, especially trauma centres, should have a radio link with the ambulance services to enable the hospital to prepare for impending arrivals and advise crew members in the field.

Personnel: Experienced medical and nursing staff are appropriate to work with ambulance staff in the field. Junior staff (interns and student nurses) have little place in field activities.

Properties: A complete *mobile intensive care kit* of resuscitation drugs and equipment (Table 1a, 1b) in 3-4 easily portable robust containers (total weight under 40 kg) should be readily available.

Passage: The safety of personnel is paramount. This includes safe transport, protective dress and headgear, identification (eg, "DOCTOR", "NURSE" marked on helmet), and environmental safety (eg, control of fire risks and protection from oncoming traffic).

Procedures: Minimum intervention compatible with expediting safe evacuation is the principle. Examination will be limited, but heavy clothing can conceal major injury. Endotracheal intubation in field conditions may be difficult. Pleural drainage should be effected in the second intercostal space, mid clavicular line, where it can be observed on a transport stretcher. The Heimlich valve is useful, connected to a simple wound drainage bag.

Volume expansion is best achieved with synthetic plasma substitutes in plastic bags (eg, Haemacel). Glass bottles are hazardous. Plastic fluid bags can be easily pressurized by placing under the patient's buttocks. Two or more wide bore IV lines are necessary with extensive blood loss. Group O negative blood may be required for major incidents.

Pneumatic Anti-Shock Garment (PASG) previously called the Military Anti-Shock Trousers (MAST), pneumatically splints the legs and abdomen in major abdominal and lower limb blood loss, to raise peripheral resistance and maintain perfusion pressure to vital organs. They should be used only as a short term measure and not inflated beyond 40 mmHg (5.3

kPa). Circulation to digits should be observed. Deflation should only occur when the patient is ready for immediate surgery as profound hypotension may follow.

Table 1a. *Mobile Intensive Care Equipment for Extra-Mural Transport - Drugs*

Circulatory Drugs
- Inotropes (alpha and beta)
- Alpha and beta blockers
- Atropine (anticholinergic)
- Neostigmine (cholinergic)
- Anti arrhythmics
- Antihypertensives.

Renal Agents
- Diuretics (loop and osmotic)

Allied Drugs
- Potassium
- Magnesium
- Sodium bicarbonate 8.4%
- Calcium chloride
- Glucose, hypertonic

Antibiotics
- Penicillin
- and others as needed

Coagulation Drugs
- Heparin
- Vitamin K1

Uterine Agents
- Oxytocics

Steroids

Respiratory
- Bronchodilators

Nervous System Drugs
- Narcotics
- Narcotic antagonists
- Anticonvulsants
- Sedatives
- Neuromuscular blockers
- Anti-emetics
- Local anaesthetic agents
- General anaesthetic agents (usually IV).

Appropriate intravenous, gaseous or regional analgesic methods are used according to circumstances. Gross angulated fractures with vascular compression should be corrected and splinted. In penetrating injuries, objects which impale the trunk should not be removed until immediate surgery is feasible, as massive haemorrhage may follow immediately.

2. Inter-Hospital Transport

The commonest conditions encountered are neonatal, traumatic and respiratory disorders of such severity that standard ambulance evacuation may not be safe.

Planning: Cooperation and continual communication between the referral and receiving hospitals and the ambulance authority is vital. Treatment advice to the referring doctor pending the arrival of the Intensive Care team may be life-saving.

Personnel: This will vary according to the local situation. Retrieval staff should not be prone to motion sickness, ear/sinus problems, or have difficulty working in confined transport vehicles. An obstetrician and paediatrician should be included in difficult obstetrical/paediatric retrievals. On returning, treatment requirements, eg, need for CT examinations should be relayed ahead.

Table 1b. *Mobile Intensive Care Equipment for Extra-Mural Transport - Equipment*

Respiratory
Airways (Guedel)
Ventilation bag (self-inflating) and masks
Ventilator (compact) and spare exhale valve
Simple spirometer
Intubation equipment:
- endotracheal tubes and adaptors
- introducer
- Magill forceps, artery forceps
- laryngoscopes, blades, globes, batteries
- bronchoscopes, rigid, battery handle type
- suction device, Yankauer handle and supply of catheters
- tracheostomy tubes; Mini-trach (or similar)

Pleural drainage:
- catheters and trocars, wide venous cannulae, scalpel
- Howard-Kelly forceps
- Heimlich valves
- wound drainage bags

Suture material with attached needle
Nebulizer

Circulatory
Monitor / defibrillator
Pulse oximeter
Sphygmomanometer cuff and clock
Electronic BP measurement (invasive/noninvasive)
Venous cannulae (peripheral and central)
IV fluids and pressurization sleeve
Arterial cannulae
Non distensible tubing; bubble isolator or transducer (if equipped for arterial monitoring)
Infusion pump
Giving sets (including those compatible with the pump)
Syringes, needles

Gastrointestinal
Nasogastric tube
Drainage bag

Renal
Urinary catheters and collecting bags

General
Nasal decongestant spray (ear clearance in aircraft)
Torch
Writing equipment, including skin crayon
Medication labels
Patient name labels
Clothing shears
Adhesive tape
Antiseptic (eg, povidone iodine)
Reflecting ("space") blanket.

Procedures: The principle is to stabilize as far as practicable, in the referring hospital before transportation. This includes confirming by X-ray, the position of endotracheal tubes, central lines and drains.

Some emergencies (eg, extradural/subdural haematoma) necessitate the retrieval team to be involved in surgery and anaesthesia prior to evacuation. Difficult obstetrical patients are best evacuated for delivery in a major centre, and are postured accordingly in transit to avoid the supine hypotensive syndrome. Occasionally, emergencies such as haemorrhage or obstructed labour may require rapid operative intervention. Burns patients require volume replacement, oxygenation, analgesia, prevention of hypothermia and coverage of burn areas.

Coverage with silver sulphadiazine is unnecessary and may make the assessment more difficult in the definitive centre. The most common problems in children are respiratory, eg, laryngotracheobronchitis and epiglottitis. Airway control is secured before transport. Potentially violent psychiatric patients are sedated and judiciously restrained before transfer by air.

Properties. Equipment considerations are as previously discussed. Loose equipment should be well secured during transit. The stretcher should be compatible with the aircraft or road vehicle use. It should be noted that mercury instruments and unsealed lead-acid batteries are not permitted in planes. Pulse oximetry will warn of unsuspected hypoxia at altitude, and conversely, end-tidal CO_2 monitors commonly give unreliable data.

Passage: Ideal requirements of any transport vehicle (road or air) are listed in Table 2. Vibration is a common problem in both road vehicles and aircraft. Natural frequencies under 20 Hz of significant amplitude may be deleterious to the patient. Other main physical limitations are altitude effects and dimensions.

Altitude affects -

(a) oxygen partial pressure and

(b) total ambient pressure in dysbaric illness (eg, gas embolism) and air filled cavities (eg, pneumothorax).

While this concerns aeromedical transport, road trips over mountainous terrain can also adversely affect such conditions. The total atmospheric pressure diminishes with altitude. PaO_2 will be reduced proportionately. Even in "pressurized" planes, cabin pressure is equivalent to 2000-2500 m altitude (ie, about 560 mmHg or 75 kPa). It is usually impractical to achieve a better (higher) cabin pressure. Some air ambulances and military transport (eg, Hercules) may achieve sea level pressure. This is at the cost of a lower, less efficient altitude and a possibly bumpier trip. Fortunately, most patients travel well at conventional cabin pressures. Precautions are thus undertaken to overcome the lower ambient pressure at altitude.

Table 2. *Ideal Requirements for A Transport Modality*

Physically safe.
No abrupt movements in any axis.
Sufficient room for at least one critically ill patient, with an attendant at the head end.
Adequate supply of energy and gases for life support systems.
Easy embarkation and disembarkation of patient.
Adequate lighting and internal climate control, including cabin pressurization.
Tolerable noise and vibration levels.
Adequate traveling speed.
Minimal secondary transport (eg, road transport in air evacuation).
Good communication systems.

(a) *Oxygen Supplementation:* is especially necessary if it has been required at sea level.

(b) *Intravenous Lines:* the higher pressured air enclosed in a drip chamber will cause a faster drip rate or retrograde flow up into the bag. The reverse will be seen on descent.

(c) *Endotracheal Tube Cuff:* will expand at altitude. If cuff pressure becomes excessive, cuff volume should be adjusted. The reverse change on descent may cause a cuff-seal leak, though it is not a common problem. Cuff inflation with water is not commonly practised.

(d) *Air in Enclosed Body Cavities:* an enclosed, compliant cyst may be calculated to increase its radius by 15% and its volume by 50% at 3000 m, where ambient pressure is approximately 500 mmHg (66.5 kPa). This effect of air-space expansion at altitude is reduced by denitrogenation, ie, washing out nitrogen, the principal gas of air, by breathing 100% oxygen before and during flight. Such attention is hence given to patients with, eg, gut distension, blocked sinuses, and intracranial air.

(e) *Penetrating Eye Injuries:* loss of vitreous and other contents can occur if intra-ocular pressure is raised above the ambient, eg, with vomiting, coughing, straining or hypoxia. Entrapped air may produce discharge of globe contents at altitude. These effects may be minimized by eye binding, antiemetics, sitting up the patient and breathing 100% oxygen.

Nitrous oxide analgesia should not be used in patients with decompressed sickness, as a counter-diffusion effect may enhance bubble size. Its prolonged use in patients with entrapped gas may similarly be hazardous. The inflation pressure of PASG suits increases at altitude. Worsening of regional compression should be watched for, and corrected if necessary. Plaster of Pairs encased limbs may swell during long distance aeromedical transport. It is prudent to carry plaster shears on such trips.

Transport Vehicles

(a) *Road Vehicles:* are the common mode for metropolitan and shorter trips under 150 km. Vehicular design should allow adequate room for patient care and the other requisites (Table 2). In elective transfers, speed is not a requirement, and drives should be thus informed.

(b) *Fixed Wing Aircraft:* The requisite qualities are outlined (Table 2). Fortunately, many such aircrafts are pressurized and the appropriate cabin pressure should be discussed with the pilot before departure. Intermediary road transport is inevitable, and adds to the total transit. Extra staff for the vital shift to and from the aircraft may be needed. There is little difference in positioning the patient head or feet first in the plane. Transverse positioning produces the least inertial change in body fluids but is usually not possible.

(c) *Rotocraft:* The advantage of the helicopter is mobility, enabling landing near an incident. This is lost if significant secondary road transport from helipad to destination is required. Their altitude is usually less than in fixed wing operations. The internal dimensions of commonly used civilian craft at the present time (Squirrel, Bell Long Ranger, BO-105) are less than those of fixed wing ambulance craft, and so prior stabilization of a patient for transport is especially necessary. Nevertheless, even a small craft may serve as emergency outbound transport of a medical team, who may return with their patient by other means.

3. International or Long Distance Transport

Planning: It is generally better to await major resolution of a disease or injury before evacuation. Good liaison between the foreign country's physicians and the retrieval team is necessary. The team should take over management formally at the foreign hospital and not at an airport. A secretariat is necessary to co-ordinate the complex arrangements before the flight. This includes the amount of equipment to be taken, availability of supplies en route, road transport, legal rights of the team on foreign soil including carriage of narcotics. Sufficient staff numbers are taken to enable conventional (8-12 hour) shifts to be worked.

Passage: The patient may be evacuated by a private aeromedical transport organization, military aircraft, chartered executive-style aircraft, or most commonly, commercial jet aircraft. One continuous route should be planned if possible. Up to 15 seats are needed with a complex case: 6-8 for the stretcher, 2 for equipment, 2 for medical gases (secured according to regulations), plus a seat for each of the team (up to 5).

Properties: Equipment considerations are similar to those discussed. A duplicate ventilator is essential in extended trips. Ability to use room air is desirable, to cope with a possible oxygen supply difficulty. Gas (oxygen) supplies need to be sufficient for twice the anticipated duration to cover unscheduled ground stops. Bridging junctions should be carried as foreign countries may have incompatible oxygen connections. Routine biochemical monitoring may become a priority in prolonged transport. Dry chemistry equipment and ion specific electrodes (eg, CHEMPRO 500, KODAK DT60) are useful. Commercial airlines commonly have 28v DC. However, during stopovers, aircraft electrical power may be shut down. Waste disposal of syringes, needles, excreta, etc, need to be considered.

Other Special Types of Transport

1. Neonatal

Specialized neonatal retrieval teams with life-support incubators are able to move sick neonates over long distances.

2. Hyperbaric Transport

The effect of altitude on dysbaric conditions may be countered with hyperbaric oxygen (HBO) using a transportable recompression chamber. On arrival, it is possible to transfer such patients under pressure to a large multiplace hyperbaric Intensive Care chamber without the need to interrupt HBO. Carbon monoxide intoxication victims may be similarly treated.

3. Movement of ICU Patients in a Fire Threat

The greatest cause of death in building fires is smoke inhalation, and poisoning by carbon monoxide and cyanide. Consequently, staff should first move the spontaneously breathing patients, leaving ventilated patients till last, by which time smoke infiltration may have subsided. Lifts should not be used in a fire.

4. Movement in a Disaster

A disaster may be defined medically as one which overwhelms the regional medical resources. It is not the total number so much as the rate of delivery of seriously ill patients from the site to hospital which overwhelms facilities. Acute hospitals must be prepared to mobilize a medical team as part of its response to a disaster. Because of the numbers of patients, counter disaster medicine is more basic. Hence equipment taken and procedures done are designed to do the greatest good for the greatest number.

On site medical teams have two distinct roles: triage, then treatment prior to transport. Triage (prioritisation) has similarities to the selection of patients for Intensive Care, though on a grander scale. Triage requires an experienced clinician to work with ambulance authorities to divide patients into such categories as:

(a) non or mildly injured;

(b) moderately injured to be evacuated by ambulance crews;

(c) severely injured and/or trapped;

(d) dead or mortally injured (eg, severe compound brain wound) to be left aside until later.

Treatment should proceed after triage so that resources can be best utilized. Group (c) which cannot be moved quickly, will benefit from on-site attention of medical teams, who should not duplicate the work of ambulance staff. These patients require measures such as IV therapy, narcotics, pleural drainage, and if necessary, surgery and anaesthesia for extrication or amputation of mangled, trapped limbs. In most situations, this group comprises a small percentage of the total.