Guidelines for the inter- and intrahospital transport of critically ill patients*

Jonathan Warren, MD, FCCM, FCCP; Robert E. Fromm Jr, MD, MPH, MS; Richard A. Orr, MD; Leo C. Rotello, MD, FCCM, FCCP, FACP; H. Mathilda Horst, MD, FCCM; American College of Critical Care Medicine

Objective: **The development of practice guidelines for the conduct of intra- and interhospital transport of the critically ill patient.**

Data Source: **Expert opinion and a search of Index Medicus from January 1986 through October 2001 provided the basis for these guidelines. A task force of experts in the field of patient transport provided personal experience and expert opinion.**

Study Selection and Data Extraction: **Several prospective and clinical outcome studies were found. However, much of the published data comes from retrospective reviews and anecdotal reports. Experience and consensus opinion form the basis of much of these guidelines.**

Results of Data Synthesis: **Each hospital should have a formalized plan for intra- and interhospital transport that addresses a) pretransport coordination and communication; b) transport personnel; c) transport equipment; d) monitoring during transport; and e) documentation. The transport plan should be developed by a multidisciplinary team and should be evaluated and refined regularly using a standard quality improvement process.**

Conclusion: **The transport of critically ill patients carries inherent risks. These guidelines promote measures to ensure safe patient transport. Although both intra- and interhospital transport must comply with regulations, we believe that patient safety is enhanced during transport by establishing an organized, efficient process supported by appropriate equipment and personnel. (Crit Care Med 2004; 32:256–262)**

KEY WORDS: intrahospital transport; interhospital transport; critical care; health planning; policy making; monitoring; standards

The decision to transport a critically ill patient, either within a hospital or to another facility, is based on an assessment of the potential benefits of transport weighed against the potential risks. Critically ill patients are transported to alternate locations to obtain additional care, whether technical, cognitive, or procedural, that is not available at the existing location. Provision of this additional care may require patient transport to a diagnostic department, operating room, or specialized care unit within a hospital, or it may require transfer to another hospital. If a diagnostic test or procedural intervention under consideration is unlikely to alter the management or outcome of that patient, then the need for transport must be questioned. When feasible and safe, diagnostic testing or simple procedures in unstable or potentially unstable patients often can be performed at the bedside in the intensive care unit (1, 2). Financial considerations are not a factor when contemplating moving a critically ill patient.

Critically ill patients are at increased risk of morbidity and mortality during transport (3–17). Risk can be minimized and outcomes improved with careful planning, the use of appropriately qualified personnel, and selection and availability of appropriate equipment (16–37). During transport, there is no hiatus in the monitoring or maintenance of a patient's vital functions. Furthermore, the accompanying personnel and equipment are selected by training to provide for any ongoing or anticipated acute care needs of the patient.

Ideally, all critical care transports, both inter- and intrahospital, are performed by specially trained individuals. Since there will almost certainly be situations when a specialized team is not available for interhospital transport, each referring and tertiary institution must develop contingency plans using locally available resources for those instances when the referring facility cannot perform the transport. A comprehensive and effective interhospital transfer plan can be developed using a systematic approach comprised of four critical elements: a) A multidisciplinary team of physicians, nurses, respiratory therapists, hospital administration, and the local emergency medical service is formed to plan and coordinate the process; b) the team conducts a needs assessment of the facility that focuses on patient demographics, transfer volume, transfer patterns, and available resources (personnel, equipment, emergency medical service, communication); c) with this data, a written standardized transfer plan is developed and implemented; and d) the transfer plan is evaluated and refined regularly using a standard quality improvement process.

This document outlines the minimum recommendations for transport of the critically ill patient. Detailed guidelines

*See also p. 305.

From Northwest Community Hospital, Arlington Heights, IL (JW); Baylor College of Medicine, Houston, TX (REF); Children's Hospital of Pittsburgh, University of Pittsburgh School of Medicine, Pittsburgh, PA (RAO); Suburban Hospital, Bethesda, MD (LCR); Henry Ford Hospital, Detroit, MI (HMH).

These guidelines have been developed by the American College of Critical Care Medicine and the Society of Critical Care Medicine. These guidelines reflect the official opinion of the Society of Critical Care Medicine and do not necessarily reflect, and should not be construed to reflect, the views of certification bodies, regulatory agencies, or other medical review organizations.

DOI: 10.1097/01.CCM.0000104917.39204.0A

targeted to the transport of infants and children have been published by the American Academy of Pediatrics (23). Institutions performing commercial or organized interhospital transports are required to function at and meet a higher standard, as the requirements for organized transport services are considerably more rigorous than the recommendations in this guideline (24, 38–41).

The references for this guideline were obtained from a review of Index Medicus (see key words) from January 1986 through October 2001 and are categorized according to the degree of evidence-based data employed. The specific category assigned to each reference is noted in the References at the end of this article. The letter *a* denotes a randomized, prospective controlled investigation; *b* denotes a nonrandomized, concurrent, or historical cohort investigation; *c* denotes a peer-reviewed "state-of-the-art" article, review article, editorial, or substantial case series; and *d* denotes a non-peer-reviewed opinion such as a textbook statement or official organizational publication. The asterisk symbol will follow a statement of practice standards. This indicates a recommendation by the American College of Critical Care Medicine that is based on expert opinion and is used in circumstances where published supporting data are unavailable.

INTRAHOSPITAL TRANSPORT

Because the transport of critically ill patients to procedures or tests outside the intensive care unit is potentially hazardous, the transport process must be organized and efficient. To provide for this, at least four concerns need to be addressed through written intensive care unit policies and procedures: communication, personnel, equipment, and monitoring.

Pretransport Coordination and Communication. When an alternate team at a receiving location will assume management responsibility for the patient after arrival, continuity of patient care will be ensured by physician-to-physician and/or nurse-to-nurse communication to review patient condition and the treatment plan in operation. This communication occurs each time patient care responsibility is transferred. Before transport, the receiving location confirms that it is ready to receive the patient for immediate procedure or testing. Other members of the healthcare team (e.g., respiratory therapy, hospital security) then are notified as to the timing of the transport and the equipment support that will be needed. The responsible physician is made aware of the transport. Documentation in the medical record includes the indications for transport and patient status throughout the time away from the unit of origin.

Accompanying Personnel. It is strongly recommended that a minimum of two people accompany a critically ill patient.* One of the accompanying personnel is usually a nurse who has completed a competency-based orientation and has met previously described standards for critical care nurses (42, 43). Additional personnel may include a respiratory therapist, registered nurse, or critical care technician as needed. It is strongly recommended that a physician with training in airway management and advanced cardiac life support, and critical care training or equivalent, accompany unstable patients.* When the procedure is anticipated to be lengthy and the receiving location is staffed by appropriately trained personnel, patient care may be transferred to those individuals if acceptable to both parties. This allows for maximum utilization of staff and resources. If care is not transferred, the transport personnel will remain with the patient until returned to the intensive care unit.

Accompanying Equipment. A blood pressure monitor (or standard blood pressure cuff), pulse oximeter, and cardiac monitor/defibrillator accompany every patient without exception.* When available, a memory-capable monitor with the capacity for storing and reproducing patient bedside data will allow review of data collected during the procedure and transport. Equipment for airway management, sized appropriately for each patient, is also transported with each patient, as is an oxygen source of ample supply to provide for projected needs plus a 30-min reserve.

Basic resuscitation drugs, including epinephrine and antiarrhythmic agents, are transported with each patient in the event of sudden cardiac arrest or arrhythmia. A more complete array of pharmacologic agents either accompanies the basic agents or is available from supplies ("crash carts") located along the transport route and at the receiving location. Supplemental medications, such as sedatives and narcotic analgesics, are considered in each specific case. An ample supply of appropriate intravenous fluids and continuous drip medications (regulated by battery-operated infusion pumps) is ensured. All battery-operated equipment is fully charged and capable of functioning for the duration of the transport. If a physician will not be accompanying the patient during transport, protocols must be in place to permit the administration of these medications and fluids by appropriately trained personnel under emergency circumstances.

In many hospitals, pediatric patients share diagnostic and procedural facilities with adult patients. Under these circumstances, a complete set of pediatric resuscitation equipment and medications will accompany infants and children during transport and also will be available in the diagnostic or procedure area.

For practical reasons, bag-valve ventilation is most commonly employed during intrahospital transports. Portable mechanical ventilators are gaining increasing popularity in this arena, as they more reliably administer prescribed minute ventilation and desired oxygen concentrations. In adults and children, a default oxygen concentration of 100% generally is used. However, oxygen concentration must be precisely regulated for neonates and for those patients with congenital heart disease who have single ventricle physiology or are dependent on a right-to-left shunt to maintain systemic blood flow. For patients requiring mechanical ventilation, equipment is optimally available at the receiving location capable of delivering ventilatory support equivalent to that being delivered at the patient's origin. In mechanically ventilated patients, endotracheal tube position is noted and secured before transport, and the adequacy of oxygenation and ventilation is reconfirmed. Occasionally patients may require modes of ventilation or ventilator settings not reproducible at the receiving location or during transportation. Under these circumstances, the origin location must trial alternate modes of mechanical ventilation before transport to ensure acceptability and patient stability with this therapy. If the patient is incapable of being maintained safely with alternate therapy, the risks and benefits of transport are cautiously reexamined. If a transport ventilator is to be employed, it must have alarms to indicate disconnection and excessively high airway pressures and must have a backup battery power supply.*

Monitoring During Transport. All critically ill patients undergoing transport receive the same level of basic physiologic monitoring during transport as they had

in the intensive care unit. This includes, at a minimum, continuous electrocardiographic monitoring, continuous pulse oximetry (44), and periodic measurement of blood pressure, pulse rate, and respiratory rate. In addition, selected patients may benefit from capnography, continuous intra-arterial blood pressure, pulmonary artery pressure, or intracranial pressure monitoring. There may be special circumstances that warrant intermittent cardiac output or pulmonary artery occlusion pressure measurements.

INTERHOSPITAL TRANSPORT

Patient outcomes depend to a large degree on the technology and expertise of personnel available within each healthcare facility. When services are needed that exceed available resources, a patient ideally will be transferred to a facility that has the required resources (45). Interhospital patient transfers occur when the benefits to the patient exceed the risks of the transfer. A decision to transfer a patient is the responsibility of the attending physician at the referring institution. Once this decision has been made, the transfer is effected as soon as possible. When needed, resuscitation and stabilization will begin before the transfer (46, 47), realizing that complete stabilization may be possible only at the receiving facility.

In the United States, it is essential for practitioners to be aware of federal and state laws regarding interhospital patient transfers. The Emergency Medical Treatment and Active Labor Act (EMTALA) laws and regulations (updated at intervals from the 1986 COBRA laws and the 1990 OBRA amendment) define in detail the legal responsibilities of the transferring and receiving facilities and practitioners. The American College of Emergency Physicians has published a book (48) that reviews the legal responsibilities of referring institutions as well as the ramifications of noncompliance with the COBRA/EMTALA regulations, and it is an excellent resource for any facility involved in patient transfers. In general, under COBRA/EMTALA, financially motivated transfers are illegal and put both the referring institution and the individual practitioner at risk for serious penalty (49, 50).

Current regulations and good medical practice require that a competent patient, guardian, or the legally authorized representative of an incompetent patient give informed consent before interhospital transfer. The informed consent process includes a discussion of the risks and benefits of transfer. These discussions are documented in the medical record before transfer. A signed consent should be obtained, if possible. If circumstance do not allow for the informed consent process (e.g., life-threatening emergency), then both the indications for transfer and the reason for not obtaining consent are documented in the medical record. The referring physician always writes an order for transfer in the medical record.

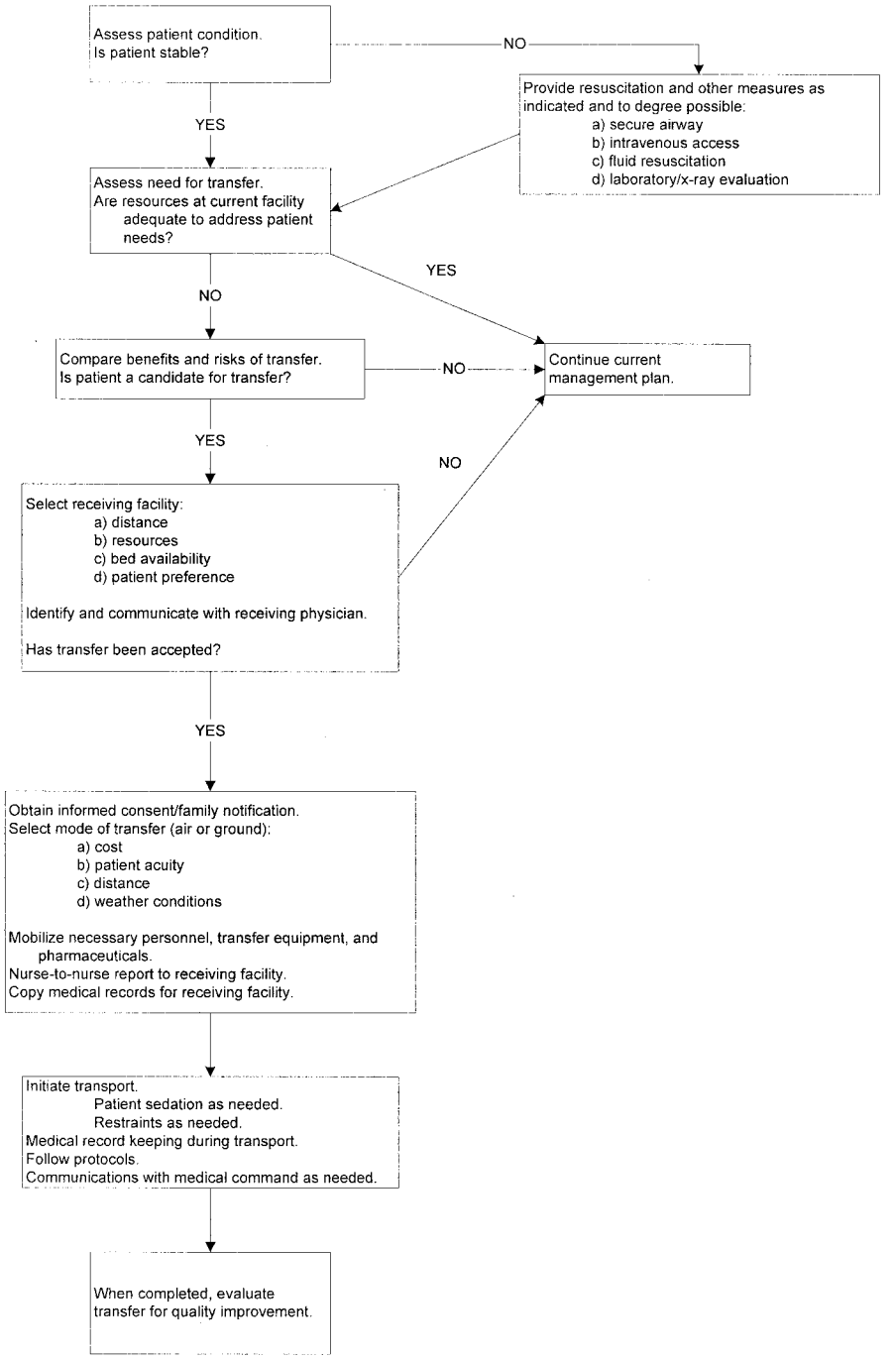

Figure 1. Interfacility transfer algorithm.

Several elements are included in the process of interhospital transfer, and all fall within minimum guidelines, as described subsequently. It is important to recognize that these process elements may frequently, and out of necessity, be implemented simultaneously, especially when stabilization and treatment are needed before transfer. An algorithm has been developed to guide prac-

Table 1. Recommended minimum transport equipment

- Airway management/oxygenation—adult and pediatric
  - Adult and pediatric bag-valve systems with oxygen reservoir
  - Adult and pediatric masks for bag-valve system (multiple sizes as appropriate)
  - Flexible adaptors to connect bag-valve system to endotracheal/tracheostomy tube
  - End-tidal carbon dioxide monitors (pediatric and adult)
  - Infant medium- and high-concentration masks with tubing
  - MacIntosh laryngoscope blades (#1, #2, #3, #4)
  - Miller laryngoscope blades (#0, #1, #2)
  - Endotracheal tube stylets (adult and pediatric)
  - Magil forceps (adult and pediatric)
  - Booted hemostat
  - Cuffed endotracheal tubes (5.0, 5.5, 6.0, 6.5, 7.0, 7.5, 8.0)
  - Uncuffed endotracheal tubes (2.5, 3.0, 3.5, 4.0, 4.5, 5.0)
  - Laryngoscope handles (adult and pediatric)
  - Extra laryngoscope batteries and light bulbs
  - Nasopharyngeal airways (#26, #30)
  - Oral airways (#0, #1, #2, #3, #4)
  - Scalpel with blade for cricothyroidotomy
  - Needle cricothyroidotomy kit
  - Water-soluble lubricant
  - Nasal cannulas (adult and pediatric)
  - Oxygen tubing
  - PEEP valve (adjustable)
- Adhesive tape
- Aerosol medication delivery system (nebulizer)
- Alcohol swabs
- Arm boards (adult and pediatric)
- Arterial line tubing
- Bone marrow needle (for pediatric infusion)
- Blood pressure cuffs (neonatal, infant, child, adult large and small)
- Butterfly needles (23-gauge, 25-gauge)
- Communications backup (e.g., cellular telephone)
- Defibrillator electrolyte pads or jelly
- Dextrostix
- ECG monitor/defibrillator (preferably with pressure transducer capabilities)
- ECG electrodes (infant, pediatric, adult)
- Flashlights with extra batteries
- Heimlich valve
- Infusion pumps
- Intravenous fluid administration tubing (adult and pediatric)
- Y-blood administration tubing
- Extension tubing
- Three-way stopcocks
- Intravenous catheters, sizes 14- to 24-gauge
- Intravenous solutions (plastic bags)
  - 1000 mL, 500 mL of normal saline
  - 1000 mL of Ringers lactate
  - 250 mL of 5% dextrose
- Irrigating syringe (60 mL), catheter tip
- Kelley clamp
- Hypodermic needles, assorted sizes
- Hypodermic syringes, assorted sizes
- Normal saline for irrigation
- Pressure bags for fluid administration
- Pulse oximeter with multiple site adhesive or reusable sensors
- Salem sump nasogastric tubes, assorted sizes
- Soft restraints for upper and lower extremities
- Stethoscope
- Suction apparatus
- Suction catheters (#5, #8, #10, #14, tonsil)
- Surgical dressings (sponges, Kling, Kerlix)
- Tourniquets for venipuncture/IV access
- Trauma scissors
- The following are considered as needed
  - Transcutaneous pacemaker
  - Neonatal/pediatric isolette
  - Spinal immobilization device
  - Transport ventilator

PEEP, positive end-expiratory pressure; ECG, electrocardiogram; IV, intravenous.

titioners through the transfer process (Fig. 1).

Pretransport Coordination and Communication. The referring physician will identify and contact an admitting physician at the receiving hospital to accept the patient in transfer and confirm before the transfer occurs that appropriate higher level resources are available. The receiving physician is given a full description of the patient's condition. At that time, advice can be requested concerning treatment and stabilization before transport. The appropriateness of transferring a patient from an inpatient setting (critical care unit) to an outpatient setting (e.g., emergency department) at a receiving institution must be cautiously examined. If a physician will not be accompanying the patient during transport (34), the referring and accepting physicians will ensure there is a command physician for the transport team who will assume responsibility for medical treatment during the transport. It may be appropriate for this individual to receive a medical report before the team departs.

In some instances (e.g., when a receiving institution provides the transport team), the receiving physician may determine the mode of transport. However, the mode of transportation (ground or air) usually is determined by the transferring physician, in consultation with the receiving physician, based on the urgency of the medical condition (stability of the patient), time savings anticipated with air transport, weather conditions, medical interventions necessary for ongoing life support during transfer, and the availability of personnel and resources (51, 52). The transport service then will be contacted to confirm its availability, to prepare for anticipated patient needs during transport, and to coordinate the timing of the transport.

A nurse-to-nurse report is given by the referring facility to the appropriate nursing unit at the receiving hospital. Alternatively, the report can be given by a transport team member at the time of arrival. A copy of the medical record, including a patient care summary and all relevant laboratory and radiographic studies, will accompany the patient. The preparation of records should not delay patient transport, however, as these records can be forwarded separately (by facsimile or courier) if and when the urgency of transfer precludes their assemblage beforehand. Under these circumstances, the most critical information is

Table 2. Recommended minimum transport medications

Adenosine, 6 mg/2 mL
Albuterol, 2.5 mg/2 mL
Amiodarone, 150 mg/3 mL
Atropine, 1 mg/10 mL
Calcium chloride, 1 g/10 mL
Cetacaine/Hurricaine spray
Dextrose 25%, 10 mL
Dextrose 50%, 50 mL
Digoxin, 0.5 mg/2 mL
Diltiazem, 25 mg/5 mL
Diphenhydramine, 50 mg/1 mL
Dopamine, 200 mg/5 mL
Epinephrine, 1 mg/10 mL (1:10,000)
Epinephrine, 1 mg/1 mL (1:1000) multiple-dose vial
Fosphenytoin, 750 mg/10 mL (500 PE mg/10 mL)
Furosemide, 100 mg/10 mL
Glucagon, 1 mg vial (powder)
Heparin, 1000 units/1 mL
Isoproterenol, 1 mg/5 mL
Labetalol, 40 mg/8 mL
Lidocaine, 100 mg/10 mL
Lidocaine, 2 g/10 mL
Mannitol, 50 g/50 mL
Magnesium sulfate, 1 g/2 mL
Methylprednisolone, 125 mg/2 mL
Metoprolol, 5 mg/5 mL
Naloxone, 2 mg/2 mL
Nitroglycerin injection, 50 mg/10 mL
Nitroglycerin tablets, 0.4 mg (bottle)
Nitroprusside, 50 mg/2 mL
Normal saline, 30 mL for injection
Phenobarbital, 65 mg/mL or 130 mg/mL
Potassium chloride, 20 mEq/10 mL
Procainamide, 1000 mg/10 mL
Sodium bicarbonate, 5 mEq/10 mL
Sodium bicarbonate, 50 mEq/50 mL
Sterile water, 30 mL for injection
Terbutaline, 1 mg/1 mL
Verapamil, 5 mg/2 mL
The following specialized/controlled medications are added immediately before transport as indicated
Narcotic analgesics (e.g., morphine, fentanyl) (59)
Sedatives/hypnotics (e.g., lorazepam, midazolam, propofol, etomidate, ketamine) (59)
Neuromuscular blocking agents (e.g. succinylcholine, pancuronium, atracurium, rocuronium) (60)
Prostaglandin E1
Pulmonary surfactant

Although both intra- and interhospital transport must comply with regulations, we believe patient safety is enhanced during transport by establishing an organized efficient process supported by appropriate equipment and personnel.

communicated verbally. It is strongly suggested that policies be established within each institution regarding the content of documentation and communication between personnel involved in the transfer.

Accompanying Personnel. It is recommended that a minimum of two people, in addition to the vehicle operators, accompany a critically ill patient during interhospital transport.* When transporting unstable patients, the transport team leader should be a physician or nurse (41, 53, 54), preferably with additional training in transport medicine. For critical but stable patients, the team leader may be a paramedic (41). These individuals provide the essential capabilities of advanced airway management, intravenous therapy, dysrhythmia interpretation and treatment, and basic and advanced cardiac life support. In the absence of a physician team member, there will be a mechanism by which the transport team can communicate with a command physician. If communication of this type becomes impossible, the team will have preauthorization by standing orders to perform acute lifesaving interventions. In the absence of a readily available external transport team, a transport team and vehicle may need to be assembled locally. The development of policies and procedures for such emergencies is strongly recommended.

Minimum Equipment Required. Tables 1 and 2 provide a detailed list of the minimum recommended equipment and pharmaceuticals needed for safe interhospital transport. Emphasis is placed on airway and oxygenation, vital signs monitoring, and the pharmaceutical agents necessary for emergency resuscitation and stabilization as well as maintenance of vital functions. Very short or very long transports may necessitate deviations from the listed items, depending on the severity and nature of illness or injury. Furthermore, advances in knowledge over time will result in periodic review and modification of these lists. All items are checked regularly for expiration of sterility and/or potency, especially when transports are infrequent. Equipment function is verified on a scheduled basis, not at the time of transport when there may be insufficient time to find replacements.

Monitoring During Transport. All critically ill patients undergoing interhospital transport must have, at a minimum, continuous pulse oximetry, electrocardiographic monitoring, and regular measurement of blood pressure and respiratory rate.* Selected patients, based on clinical status, may benefit from the monitoring of intra-arterial blood pressure (55), central venous pressure, pulmonary artery pressure, intracranial pressure, and/or capnography (56). With mechanically ventilated patients, endotracheal tube position is noted and secured before transport, and the adequacy of oxygenation and ventilation is reconfirmed.

Occasionally, patients may require specialized modes of ventilation not re-

producible in the transport setting. Under these circumstances, alternate modes of mechanical ventilation are evaluated before transport to ensure acceptability and patient stability with this therapy. If the patient is incapable of being maintained safely with alternate ventilator therapy, the risks and benefits of transport are cautiously reexamined.

Patient status and management during transport are recorded and filed in the patient medical record at the referring facility. Copies are provided to the receiving institution.

Preparing a Patient for Interhospital Transport There is no evidence to support a "scoop and run" approach to the interhospital transport of critically ill patients. Therefore, referring facilities will, before transport, begin appropriate evaluation and stabilization to the degree possible to ensure patient safety during transport. Unnecessary delays may be experienced if the transport team must perform lengthy or complex procedures to stabilize the patient before the transfer (57). Nonessential testing and procedures will delay transfer and should be avoided. Information and recommendations about this aspect of patient care generally can be requested from the accepting physician at the time of initial contact with the receiving facility.

All critically ill patients need secure intravenous access before transport. If peripheral venous access is unavailable, central venous access is established. If needed, fluid resuscitation and inotropic support are initiated, with all intravenous fluids and medications maintained in plastic (not glass) containers. A patient should not be transported before airway stabilization if it is judged likely that airway intervention will be needed en route (a process made more difficult in a moving vehicle). The airway must be evaluated before transport and secured as indicated by endotracheal tube (or tracheostomy).* Laryngeal mask airways are not an acceptable method of airway management for critically ill patients undergoing transport. For trauma victims, spinal immobilization is maintained during transport unless the absence of significant spinal injury has been reliably verified. A nasogastric tube is inserted in patients with an ileus or intestinal obstruction and in those requiring mechanical ventilation. A Foley catheter is inserted in patients requiring strict fluid management, for transports of extended duration, and for patients receiving diuretics. If indicated, chest decompression with a chest tube is accomplished before transport. A Heimlich valve or vacuum chest drainage system is employed to maintain decompression. Soft wrist and/or leg restraints are applied when agitation could compromise the safety of the patient or transport crew, especially with air transport. If the patient is combative or uncooperative, the use of sedative and/or neuromuscular blocking agents may be indicated. A neuromuscular blocking agent should not be used without sedation and analgesia.

Finally, the patient medical record and relevant laboratory and radiographic studies are copied for the receiving facility. In the United States, a COBRA/EMTALA checklist is strongly suggested to ensure compliance with all federal regulations regarding interhospital patient transfers. Items on this checklist will include documentation of initial medical evaluation and stabilization (to the degree possible), informed consent disclosing benefits and risks of transfer, medical indications for the transfer, and physician-to-physician communication with the names of the accepting physician and the receiving hospital.

REFERENCES

1. Porter JM, Ivatury RR, Kavarana M, et al: The surgical intensive care unit as a cost-efficient substitute for an operating room at a Level I trauma center. *Am Surg* 1999; 65:328–330 (c)
2. McCunn M, Mirvis S, Reynolds N, et al: Physician utilization of a portable computed tomography scanner in the intensive care unit. *Crit Care Med* 2000; 28:3808–3813 (b)
3. Waydas C: Intrahospital transport of critically ill patients. *Crit Care* 1999; 3:R83–R89 (c)
4. Blumen IJ, Abernethy MK, Dunne MJ. Flight physiology. Clinical considerations. *Crit Care Clin* 1992; 8:597–618 (c)
5. Olson CM, Jastremski MS, Vilogi JP, et al Stabilization of patients prior to interhospital transport. *Am J Emerg Med* 1987; 5:33–39 (c)
6. Braman SS, Dunn SM, Amico CA, et al: Complications of intrahospital transport in critically ill patients. *Ann Intern Med* 1987; 107: 469–473 (a)
7. Smith I, Fleming S, Cernaiana A: Mishaps during transport from the intensive care unit. *Crit Care Med* 1990; 18:278–281 (b)
8. Insel J, Weissman C, Kemper M, et al: Cardiovascular changes during transport of critically ill and postoperative patients. *Crit Care Med* 1986; 14:539–542 (b)
9. Ehrenwerth J, Sorbo S, Hackel A: Transport of critically ill adults. *Crit Care Med* 1986; 14:543–547 (b)
10. Andrews P, Piper I, Dearden N, et al: Secondary insults during intrahospital transport of head-injured patients. *Lancet* 1990; 335: 327–330 (b)
11. Gentlemen D, Jennett B: Audit of transfer of unconscious head-injured patients to a neurosurgical unit. *Lancet* 1990; 335:330–334 (c)
12. Kanter R, Tompkins J: Adverse events during interhospital transport: Physiologic deterioration associated with pretransport severity of illness. *Pediatrics* 1989; 84:43–48 (b)
13. Katz V, Hansen A: Complications in the emergency transport of pregnant women. *South Med J* 1990; 83:7–9 (c)
14. Martin G, Cogbill T, Landercasper J, et al: Prospective analysis of rural interhospital transfer of injured patients to a referral trauma center. *J Trauma* 1990; 30: 1014–1020 (b)
15. Valenzuela T, Criss E, Copass M, et al: Critical care air transportation of the severely injured: Does long distance transport adversely affect survival? *Ann Emerg Med* 1990; 19:169–172 (b)
16. Harrahil M, Bartkus E: Preparing the trauma patient for transfer. *J Emerg Nurs* 1990; 16: 25–28 (d)
17. LaPlant G, Gaffney T: Helicopter transport of the patient receiving thrombolytic therapy. *J Emerg Nurs* 1989; 15:196–200 (c)
18. Gore JM: Feasibility and safety of emergency interhospital transport of patients during the early hours of acute myocardial infarction. *Arch Int Med* 1989; 149:353–355 (b)
19. Weg JG, Haas CF: Safe intrahospital transport of critically ill ventilator dependent patients. *Chest* 1989; 96:631–635 (b)
20. Anderson C: Preparing patients for aeromedical transport. *J Emerg Nurs* 1987; 13: 229–231 (c)
21. Greco A: Development of an interfacility transport program for critically ill cardiovascular patients. *Clin Issues Crit Care Nurs* 1990; 1:3–12 (c)
22. Hackel, A: Critical care transport. *Int Anesthesiol Clin* 1987; 25:1–137 (c)
23. Task Force on Interhospital Transport: Guidelines for air and ground transport of neonatal and pediatric patients. American Academy of Pediatrics, 1999 (d)
24. American Academy of Pediatrics Committee on Hospital Care: Guidelines for air and ground transportation of pediatric patients. *Pediatrics* 1986; 78:943–950 (c)
25. Fromm RE, Dellinger RP: Transport of critically ill patients. *J Int Care Med* 1992; 7:223–233 (c)
26. Lee G: Transport of the critically ill trauma patient. *Nurs Clin North Am* 1986; 21: 741–749 (c)
27. Maxwell B, Miller B: Smooth the way for safe emergency transfers. *RN* 1988; 6:34–37 (d)
28. McCloskey K, King WL, Byron L: Pediatric critical care transport: Is a physician always

needed on the team? *Ann Emerg Med* 1989; 18:247–250 (b)
29. Larson D, Mellstrom M: Management of multiple trauma in a rural setting. *Minn Med* 1987; 70:43–45 (c)
30. Blumen I, Gordon R: Taking to the skies. *Emergency* 1989; 21:32–38, 54–55 (c)
31. Kruse D: Interhospital transfer. How to prepare your patient. *Nursing* 1991; 21:41 (c)
32. Runcie CJ, Reeve W, Reidy J, et al: Secondary transport of the critically ill adult. *Clin Intensive Care* 1991; 2:217–225 (c)
33. Venkataraman ST, Orr RA: Intrahospital transport of critically ill patients. *Crit Care Clin* 1992; 8:525–531 (c)
34. McCloskey KA, Johnston C: Critical care interhospital transport: Predictability of the need for a pediatrician. *Pediatr Emerg Care* 1990; 6:89–92 (b)
35. Rubenstein JS, Gomez MA, Rybicki L, et al: Can the need for a physician as part of the pediatric transport team be predicted? A prospective study. *Crit Care Med* 1992; 20: 1657–1661 (b)
36. Selevan JS, Fields WW, Chen W, et al: Critical care transport: Outcome evaluation after interfacility transfer and hospitalization. *Ann Emerg Med* 1999; 33:33–43 (b)
37. Warren J, Guntupalli KK: Physiologic monitoring during prehospital and interhospital transport of critically ill patients. *In:* Problems in Critical Care. Kirby RR, Taylor RW, Fromm RE (Eds). Philadelphia, PA, Lippincott, 1990, pp 459–469 (c)
38. Critical Care Air Ambulance Service. *In:* Resources for Optimal Care of the Injured Patient. Chicago, IL, American College of Surgeons, 1990 (d)
39. Interhospital Transport of Patients. *In:* Resources for Optimal Care of the Injured Patient. Chicago, IL, American College of Surgeons, 1990 (d)
40. American College of Emergency Physicians. Principles of appropriate patient transfer. *Ann Emerg Med* 1990; 19:337–338 (d)
41. Commission on Accreditation of Medical Transport Systems (CAMTS). Accreditation Standards. Fourth Edition. CAMTS, 1999 (d)
42. American Association of Critical Care Nurses: AACN Competence Statements for Differentiating Nursing Practice in Critical Care. Newport Beach, CA, AACN, 1989, pp 2–7 (d)
43. Alspach, JG: Designing a competency-based orientation for critical care nurses. *Heart Lung* 1984; 13:655–662 (c)
44. Meiklejohn BH, Smith G, Elling AE, et al: Arterial oxygen desaturation during postoperative transportation: The influence of operation site. *Anaesthesia* 1987; 42: 1313–1315 (c)
45. Task Force on Guidelines Society of Critical Care Medicine: Guidelines for categorization for services for the critically ill patient. *Crit Care Med* 1991; 19:279–285 (d)
46. Henderson A, Coyne T, Wall D, et al: A survey of interhospital transfer of head-injured patients with inadequately treated life-threatening extracranial injuries. *Aust N Z J Surg* 1992; 62:759–762 (b)
47. Lambert SM, Willett K: Transfer of multiply-injured patients for neurosurgical opinion: A study of the adequacy of assessment and resuscitation. *Injury* 1993; 24:333–336 (c)
48. Frew SA: Patient Transfers. How to Comply With the Law. Dallas, TX, American College of Emergency Physicians, 1990 (d)
49. Dunn JD: Legal aspects of transfers. *In:* Problems in Critical Care. Critical Care Transport. Fromm RE (Ed). Philadelphia, PA, Lippincott, 1990 (d)
50. Public Law 99-272, U. S. Government Printing Office, 42 U. S. Code Service, 135 dd. Washington, DC, Lawyer Cooperative Publishing Company, 1986 (d)
51. Boyd CR, Corse KM, Campbell RC: Emergency intrahospital transport of the major trauma patient: Air versus ground. *J Trauma* 1989; 29:789–793 (b)
52. Werman HA, Falcane RA, Shaner S, et al: Helicopter transport of patients to tertiary care centers after cardiac arrest. *Am J Emerg Med* 1999; 17:130–134 (c)
53. Connolly HV, Fetcho S, Hageman JR: Education of personnel involved in the transport program. *Crit Care Clin* 1992; 8:481–490 (c)
54. Burtnyk S: Secondary transportation of critically ill people—Implications for nurses and the need for specialist training. *Intensive Crit Care Nurs* 1992; 8:234–239 (c)
55. Runcie CJ, Reave WG, Reidy J, et al: Blood pressure measurement during transport. *Anaesthesia* 1990; 45:659–665 (b)
56. Tobias JD, Lynch A, Garrett J: Alterations of end-tidal carbon dioxide during the intrahospital transport of children. *Pediatr Emerg Care* 1996; 12:249–251 (b)
57. Beddingfield FC, Garrison MG, Manning JE, et al: Factors associated with prolongation of transport times of emergency pediatric patients requiring transfer to a tertiary care center. *Pediatr Emerg Care* 1996; 12: 416–419 (c)
58. Murray M, Cowen J, DeBlock H, et al: Clinical practice guidelines for sustained neuromuscular blockade in the adult critically ill patient. *Crit Care Med* 2002; 30:142–156 (d)
59. Shapiro BA, Warren J, Egol AB, et al: Practice parameters for intravenous analgesia and sedation for adult patients in the intensive care unit: An executive summary. *Crit Care Med* 1995; 23:1596–1600 (d)
60. Shapiro BA, Warren J, Egol AB, et al: Practice parameters for sustained neuromuscular blockade in the adult critically ill patient: An executive summary. *Crit Care Med* 1995; 23: 1601–1605 (d)