Vermont Helicopter Review Committee Report

At the request of the Vermont Health Authority, a committee was formed to evaluate the appropriateness and effectiveness of the Dartmouth-Hitchcock air transport program known as DHART. This committee was composed of three representatives from Dartmouth-Hitchcock Medical Center, three from Fletcher Allen Health Care and three from Vermont at-large. The committee was made up of three emergency physicians, three emergency/trauma nurses, and three general surgeons. Members included Mary Margaret Ryan, RN (Rutland Regional Medical Center), David Alsobrook, MD (North Country Hospital), Gene Grabowski, MD (Southwestern Vermont Medical Center), Lori Camp, RN (FAHC), Ray Keller, MD (FAHC), Turner Osler, MD (FAHC), Judy Lombardi, RN (DHMC), John Sutton, MD (DHMC), and Norman Yanofsky, MD (DHMC). The charge to the committee was to assess the appropriateness of helicopter transports in Vermont, and to assess the benefit that resulted from helicopter transport.

The Committee met a total of six times from September, 1996 to October, 1997. Patient records from February to November of 1996 were reviewed. All patients from this time interval who were picked up from or transported to Vermont were reviewed. A total of 107 patient charts were reviewed. In some cases there was unanimous agreement on the conclusions of the case review. In many cases there was disagreement and a simple majority vote was used to make a determination.

The Committee broke its task into three components. Appropriateness was taken in two steps. First, the indications for each flight were compared to activation guidelines developed by the Association of Air Medical Services (AAMS), the professional society representing helicopter transport programs throughout the world. In addition an assessment was made as to whether there was a reasonable possibility that the patient could survive their injury or illness. If the group voted no, then the flight was not considered to be appropriate, whether or not it met AAMS criteria.

Secondly the group felt it should take responsibility for creating new guidelines specific for the state of Vermont. This was approached by assessing each flight for potential benefit. If at the time of flight request, it could reasonably be felt that the patient could benefit from more rapid transport, or from advanced life support at the scene of an accident then it was felt to meet that category criteria. By reviewing the results of this analysis, the committee was able to revise the AAMS criteria to be more specific to Vermont. This review did not take into account however, issues relevant to interhospital transport such as length of transport time out of hospital, limitation of resources such as ambulances and critical care personnel, and the skill level which the flight crew brings to the aid of critically ill and injured patients. These are reasons that providers sometimes called the helicopter despite the fact they did not meet the criteria for potential benefit.
Finally, the group attempted to assess the likelihood of actual benefit to the patient provided by the flight. Benefit was defined as life saved or limb saved. Other improvements in morbidity were not assessed. Patients in this category survived their illness or injury and either had lifesaving interventions performed at the scene of an accident, or required lifesaving interventions at the receiving hospital, and the helicopter significantly reduced the time it took to transport them. A consensus process was used to quantify the benefit provided to the patient. The group voted on whether or not it was likely or possible that a flight resulted in a life or limb saved.

**Category One: Flight Appropriateness**

85 out of 107 (79.5%; 90% Confidence Interval(CI) 72% to 84%) met the AAMS guidelines and had a reasonable chance of survival. Patients who were deemed "unlikely to survive" did not meet this criteria even if they met the AAMS guidelines.

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<th>Interhospital</th>
<th>Scene</th>
<th>Total</th>
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<tbody>
<tr>
<td>Meets Criteria</td>
<td>66/82 (80.5%)</td>
<td>19/25 (76%)</td>
<td>85/107 (79.4%)</td>
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Included in the group that failed to meet indications were the following categories of patients:

**Interhospital:**

- Congestive heart failure/respiratory failure/sepsis (5)
- Stable drug overdose (2)
- Hand amputation (2)
- Stable cardiac patient s/p renal transplant/3 hour ground transport (2 trips)
- Severe multisystem trauma in elderly with unlikely survival (1)
- Near drowning/hypothermia (1)
- Cerebral hemorrhage (1)
- Stable congenital heart disease (1)
- Facial fractures and stable c-spine fracture (1)

**Scene:**

- Minor head injuries (4)
- Severe mechanism of injury but no actual serious injury (2)
  - ATV over a 70 foot embankment
  - Car hit by tractor trailer
- Gunshot wound of head with unlikely survival (1)
Category 2: Potential Benefit

To meet this criteria, the patient must have had a critical illness or injury which at the time of the transport request was thought to have need of an emergent life or limbsaving intervention. Potential for deterioration during transport was not considered in this analysis. The purpose of this analysis was to allow refinement of the air transport activation guidelines in order to maximize the number of lifesaving missions and minimize the number of flights which prove to have no benefit.

54 out of 107 (50.5%; 90% CI, 42.5% to 58.5%) met this criteria.

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<th>Interhospital</th>
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<tr>
<td>Meets Criteria</td>
<td>42/82 (51.2%)</td>
<td>12/25  (48%)</td>
<td>54/107 (50.5%)</td>
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There were several categories of patients who failed to meet the criteria for potential benefit. These included gunshot wounds of the head, burns, respiratory failure, non-traumatic intracerebral bleeds, spinal cord injuries, interhospital transport of nonsurgical head injuries and overdose patients not requiring dialysis. (see revised criteria at the end of the report). The following is a listing of these types of patients.

Transports where one hour of time saving would generally make no difference (numbers in parentheses represent the total identified during the review):

- Spontaneous cerebral bleeds (7)
- Stable multiple trauma patient (7)
- Nonsurgical head injuries if CT available at sending institution (6)
- Spine injuries (4)
- Respiratory failure (4)
- Sepsis (2)
- Overdose patients not requiring dialysis (2)
- Burns not involving airway (1)
- Extremity amputations (2)
- Carbon monoxide poisoning with no change in mental status (1)
- Stable myocardial infarction (1)

Patients who have no chance of survival i.e.:

- Gunshot wounds of the head with GCS 4 or less (2)
- Severe cerebral bleeds
- Severe multisystem trauma in the very elderly (1)
**Category 3: Patient benefit**

This category included patients who the committee felt had likely or possibly had their life or limb saved because of the flight. Patients were put into one of three categories: likely to have benefited (patients who would likely not have survived if the helicopter had not been available), possibly benefited (patients who would possibly not have survived if the helicopter had not been available), and no benefit. In order to be placed in one of the first two categories the patient had to have had an emergent life or limbsaving intervention performed, at a significant timesaving over ground transport. If no time was saved, the patient was deemed to have received no benefit from the flight. If the patient died, obviously no benefit to that patient was derived. If the patient's symptoms resolved prior to a planned intervention (cath lab as an example) then no benefit was ascribed to the flight.

Four patients or 3.7% (90% CI, 1.2% to 8.5%) were considered to have likely had their lives saved because of the transport and another 7 patients, or 6.5% (90% CI, 3.0% to 12.0%) were in the possible category. There were no limbsaving interventions among the 107 flights reviewed.

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<th>Interhospital</th>
<th>Scene</th>
<th>Total</th>
<th>CI</th>
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<td>Likely</td>
<td>3/82 (3.7%)</td>
<td>1/25  (4%)</td>
<td>4/107 (3.7%)</td>
<td>1.2-8.5</td>
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<td>Possibly</td>
<td>5 (6.1%)</td>
<td>2 (8%)</td>
<td>7/107 (6.5%)</td>
<td>3.0-12.0</td>
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<td>Total</td>
<td>8 (9.8%)</td>
<td>3 (12.0%)</td>
<td>11/107 (10.3%)</td>
<td>5.7-16.6</td>
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**Time Savings**

The committee also looked at the amount of time saved compared to typical ground transport times. The ground transport times were for the most part estimated from missed flight data. That is, if the helicopter was called and could not transport the patient, how long did it take to get the patient transported by ground. This time interval was defined as the time from the decision to transport, to the time of arrival of the receiving facility for both helicopter and ground transport. Since only DHMC data were available, flights to other destinations were not included in these calculations. The median time savings for interhospital transports was approximately 40 minutes. For scene flights the crew arrived an average of 19 minutes faster than the patient could have been delivered to the closest hospital. For patients who truly required transport to a tertiary care facility, scene transports which resulted in bypass of the local hospital saved an average of two hours. Seven of the 24 patients fell into this category. The following histograms show the distributions of time saved across the patient populations:
Cost

The total cost of transporting the 107 patients was $533,000. The cost per life saved was between $43,000 and $133,000 (4 to 11 patients).

Discussion:

The committee determined that 4 patients (3.7%) likely and 7 more patients (6.5%) possibly would not have survived without the helicopter transport. These results are comparable to studies of non-urban trauma patients which have been published in the medical literature from other parts of the country. These studies showed 2 to 12% improvements in survival. (Gearheart PA, Wuerz R, Localio AR. Cost-effectiveness analysis of helicopter EMS for trauma patients. Ann Emerg Med 1997;30:500-506)

At the same time, it was the feeling of the committee that at the time of the request for the helicopter that it was predictable that 50% of the patients transported could have been safely transported by ground provided adequate critical care ambulance transport services were available. Because 60% of these patients met current AAMS activation guidelines, the committee felt that these guidelines were not adequate for Vermont, and that new guidelines should be developed. Consequently, guidelines were developed by the committee and were based, to the extent possible, on the data which was generated by the review of the 107 patients. These guidelines are listed in the appendix.

In addition, it was found that 52% (13 of 25) of scene flights were made for patients with nonlifethreatening injuries. 77% (10 of 13) of these were situations where the mechanism of injury suggested the potential for a significant injury, the patient required extensive extrication from a vehicle, or the travel time to the closest hospital was long. The committee felt that the helicopter should not be activated for scene transports without close medical supervision from the local hospital. In particular the committee was concerned that the ground crew should not be calling the helicopter to the scene if it is faster to drive to the local hospital. The committee agreed that in scene trauma cases where the patient was so critically injured as to warrant aeromedical transport, the patient should be taken to the closest appropriate medical facility.

While analyzing the reasons for the decisions to transport patients by air who could have gone by ground, it became evident, that there were certain EMS and hospital "system" issues which were resulting in these transports. The main "system" issue for trauma scene calls is the lack of advanced airway management skills among current prehospital providers. For interhospital transports, limitations of ambulance services and adequately trained hospital based critical care personnel has resulted in transportation of patients by helicopter who otherwise could have gone by ground. For most interhospital
ground transports, a nurse from a local hospital is asked to provide all of the necessary critical care monitoring and intervention for one to two hours in the back of an ambulance. This is an important factor in the decision to call the helicopter for seriously ill or injured patients, even for patients whose conditions are less "time critical". In 16.8% of cases air transport was carried out due to lack of critical care ground transport. These issues were particularly important for hospitals in small rural communities who are long distances from tertiary care facilities. In some cases, transporting a patient long distances by ground would leave the local community without adequate EMS coverage for prolonged periods of time.

The committee felt that these issues needed to be addressed regardless of the status of the helicopter, as the helicopter is not available approximately 30% of the time due to weather conditions (24%), maintenance issues (3%), and simultaneous requests (3%), and ground transport is the only option available at these times. This is not to say that an improved ground transport system would replace the appropriate use of the helicopter. An improved ground transport system would reduce the use of helicopter services.

Conclusions:

In summary, the committee finds that four lives were saved and seven more possibly saved by the helicopter transport. At the same time, the committee finds that many patients transported by the helicopter could have been predicted to have received no lifesaving or limb-saving benefit at the time the helicopter was dispatched. Thus we believe that helicopter transports can be substantially reduced without losing the benefits which the DHART program has brought to Vermont. Reduction of unnecessary flights is a realistic goal of redesigned transport guidelines and should be followed as a quality measure of the DHART program. This review has further highlighted the need for improved ground transport in Vermont.

If the DHART program continues to operate in Vermont, the committee agreed unanimously that ongoing review should continue and volunteered to provide that review. In particular it would be essential to monitor the effects of the new activation guidelines developed by the committee, and to provide feedback to hospital and prehospital personnel.
Revised Criteria

These guidelines are not meant to be all inclusive. There are situations where a specific condition not listed in the guidelines would meet the general principles of the guidelines and air transport would be appropriate. Also, the list below is not a mandate that requires air transport for all patients with the conditions that appear on the list. The guidelines are merely a list of conditions for which air transport should be considered.

For interhospital transports

In general, for helicopter transport to be justified, the time saved by using the helicopter should be significant enough to allow a potentially beneficial intervention to take place at the receiving facility. The time savings should take into account the time required to arrange for ground transport including the time to allow an ambulance and crew to arrive at the sending hospital, the time to package the patient, and the time to arrange for an appropriate critical care attendant to be available. In some cases, a patient going by ground may require more extensive stabilization than if going by air because of the increased out of hospital time and the skills of the transporting crew. All of these factors should be taken into account when considering the request for air transport. Helicopter transport has the potential of reducing time to definitive care and time out of hospital, and provides an expert crew during transport. However, depending on the distance to be traveled, the ground transport resource availability, and the condition of the patient, none of these benefits may be relevant.

To the extent possible, the committee attempted to use the results of the review process as the basis for the guidelines. As such, the patients whose lives were saved provide the most compelling indications for air transport. For interhospital transports, these included two aortic aneurysms, and one acute myocardial infarction. The patients whose lives were possibly saved include, two myocardial infarctions, one head trauma, one bleeding duodenal ulcer, and one overdose requiring hemodialysis. The other data source was the group of patients who were found to have conditions which could have potentially benefited from air transport. These are listed below. Finally, other conditions were listed based on the expert opinion of the committee.

The specific criteria are as follows with the number of patients in the review group who fell into that category in parentheses:

Severe head injuries (6 patients in our study)
Potential emergent surgical intervention
   Craniotomy
   Ventriculostomy
Multisystem trauma with potential hemodynamic deterioration (3 patients in our study).
Examples of this would include:
- Unstable vital signs
- Evidence of ongoing severe hemorrhage
- Major liver injury
- Major vascular injury of the abdomen or retroperitoneum

**Chest (4 patients in our study)**
- Potential or suspected major vascular hemorrhage
- Suspected Cardiac injury
- Suspected or potential airway disruption

**Pelvis (2 patients in our study)**
- Fracture with ongoing severe hemorrhage
- Open fracture

**Major extremity injuries (2 patients in our study)**
- Open fracture with significant potential time delay to definitive treatment (arrival at institution providing definitive care within 6 hours)
- Ischemic extremity (arrival at institution providing revascularization within 2 hours)

**Cardiac patients (17 patients in our study)**
- Cardiogenic shock
- AMI unresponsive to thrombolytic agents
- AMI with contraindications to thrombolysis
- Ongoing ischemic symptoms despite maximal medical therapy
- Life threatening refractory arrhythmia
- Rapidly decompensating valvular lesions
- Unstable acute VSD
- Unstable cardiac tamponade
- Suspected aortic dissection
- Need for other emergent interventions not available at referring institution

**Other critical care patients**
- Leaking / ruptured aortic aneurysm (3 patients in our study)
- Acute CVA with potential need for thrombolytic therapy not available at referring facility
- Gastrointestinal hemorrhage not controlled at referring institution (2 patients in our study)
- Severe overdose requiring hemodialysis (1 patient in our study)
- Severe hypothermia requiring cardiac bypass
- Decompression illness or carbon monoxide poisoning with coma or focal neurologic deficit requiring hyperbaric oxygen
- Transfer of time-sensitive transplant organ
- Intracranial hemorrhage requiring emergent surgical intervention (1 patient in our study)
High Risk Obstetrics

In general, mothers requiring transport to a high risk OB unit should be considered for transport by air if the length of time for ground transport places the patient at higher risk of delivery during transport. Patients who are likely to deliver during the time it takes for air transport should deliver at the referring institution. This includes multiparous patients with cervical dilation of 3 cm or more who are in active labor, contractions less than 5 minutes apart, or a history of rapidly progressing labor. For primiparous patients the cervix should not be dilated more than 5 cm.

Specific indications:

Mothers predicted to deliver infants requiring high level neonatal care
Active labor at less than 34 weeks
Abruptio placenta or placenta previa
Third trimester bleeding
Severe heart disease in the mother

Neonatal/Pediatric

Patients requiring lifesaving interventions which are beyond the capabilities of the local institution

Acute airway needs (1 patient in our study)
Systolic BP less than 65 in a child less than 2
Systolic BP less than 70 in a child 2-5
Systolic BP less than 80 in a child 6-12
Acute surgical interventions
   Cardiac
   Neurosurgical
   Intrabdominal
   Trauma
Pediatric/neonatal cardiac emergencies (1 patient in our study)
   Cardiac or respiratory arrest within 24 hours
   Need for emergent septostomy
   Need for maintenance of a patent ductus
Severe hypothermia
Severe hyperthermia
Overdoses with unstable vital signs/coma/need for dialysis
Scene transports:

In general, for scene transport to be efficacious, the helicopter response should take significantly less time then it takes to travel by ground to the closest appropriate facility. If this is not the case, strong consideration should be given to activating the helicopter from the scene, and meeting at the local hospital. This decision should be made in conjunction with local medical control. This is particularly important for head injured and hypotensive patients. Also, patients should always be transported to the closest appropriate facility whether by air or ground. The destination should be determined by local medical control.

(Note: The three scene patients from the study, whose lives were likely or possibly saved by the transport were all head injured. One also had a cervical spine injury.)

The guidelines are as follows:

Head injured patients with one of the following (7 patients in our study):

- GCS less than 12 or deteriorating
- Lateralizing findings
- Penetrating injury or open fracture

Patients with the following chest injuries:

- Possible tension pneumothorax
- Major chest wall injury
- Potential cardiac injury
- Penetrating chest wound

Patients with unstable vital signs including hypotension, tachypnea, severe respiratory failure (2 patients in our study)

- Burn patients with potential airway involvement

- Patients with spine injuries with neurologic involvement (2 patients in our study)

Exceptions (patients who may require transport but do not meet the above indications):

- Long distance transports of critical patients (more than 2 hours by ground)
- Situations where resources at the sending facility are severely limited:
  - Mass casualty situations
  - Lack of availability of ground transport
Lack of availability of critical care personnel to accompany patient
Weather conditions which make ground transport dangerous (e.g. icy roads but clear skies)

Exclusions (These exclusions assume the availability of ground transport and appropriately skilled individuals to accompany the patient):

Transports where one hour of time saving would generally make no difference (numbers in parentheses represent the total identified during the review):

- Spontaneous cerebral bleeds (7 patients in our study)
- Stable multiple trauma patient (7 patients in our study)
- Nonsurgical head injuries (if CT available at sending institution) (6 patients in our study)
- Spine injuries (4 patients in our study)
- Respiratory failure (4 patients in our study)
- Sepsis (2 patients in our study)
- Overdose patients not requiring dialysis (2 patients in our study)
- Burns not involving airway (1 patient in our study)
- Extremity amputations (2 patients in our study)
- Carbon monoxide poisoning with no change in mental status (1 patient in our study)
- Stable myocardial infarction (1 patient in our study)
- Cases where surgery can and should be done at the local hospital
- Terminally ill patients unless they have an acute correctable problem of an emergent nature

Patients who have no chance of survival i.e.:

- Severe cerebral bleeds
- Severe multisystem trauma in the very elderly (1 patient in our study)
- Gunshot wounds of the head with GCS 4 or less (2 patients in our study)
- Patients in full arrest