

MARYLAND'S MED-EVAC HELICOPTER PROGRAM

1970's

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A Med-Evac helicopter program, developed by the Maryland Institute for Emergency Medical Services in 1968 with the Maryland State Police Aviation Division, has been transporting patients to the MIEMS Shock Trauma Center since 1970. The system was developed to reduce the high rural fatality rate. Helicopters pick up victims from the scene of accidents and speed them to special care centers which can manage severe multiple trauma and other medical problems. The helicopters are also used for interhospital transfer of critically ill and injured patients, physician emergencies, transport of premature or ill neonates, transport of medical personnel and supplies. By using the helicopters 90 percent of flight time for police work, the cost of Med-Evac transports has been kept down. The survival rate has improved since the beginning of the program to 82 percent of all transports.

The fatality rate in road traffic accidents is ten times greater in rural areas than in metropolitan areas. This may be accounted for by the higher speeds travelled on country roads, delay in discovery of accidents on little travelled roads, waiting for ambulance transportation, longer distances to be covered, sparcity of physicians and specialty resources and the fact that it is still general practice to transport the victim to the nearest hospital, regardless of its capabilities.

In military situations, helicopters have proven their value for medical evacuation from remote areas to treatment centers. But, although there have been experimental programs, helicopters have not been widely accepted in civilian operations as an arm of the emergency health care delivery system.

A Med-Evac Helicopter system was developed in 1967 by the Maryland Institute for Emergency Medical Services (MIEMS*), in cooperation with the Maryland State Police (MSP) Aviation Division. The system has been transporting patients to the MIEMS Shock Trauma Center since 1970. It has proven to be economical and medically effective. (1)

The Center, established in 1960, had evolved by 1968 into a sophisticated clinical facility capable of providing definitive care to multiply injured patients. But a means was needed to get critically injured traffic accident victims from the state's rural counties to the treatment center in Baltimore.

After some preliminary trials with military helicopter transports, the Center approached the Maryland State Police to obtain helicopters to share between police work and patient transportation. In 1968, a Department of Transportation grant was awarded to develop the program. Bell 206B Jet Rangers with capacity for two litter patients in addition to the pilot and observer/medic were chosen. The helicopters were to be used mostly for

*The MIEMS was established in 1960 as the country's first Shock Trauma Center. In 1968 it moved into its own building, containing an admitting area, operating rooms, critical care recovery unit, intensive care unit, clinical STAT laboratory, and research laboratory. The clinical hub of the state emergency medical services system, the center merged with the system in 1977 to become the Maryland Institute for Emergency Medical Services. System components in addition to the Med-Evac program include the MIEMS Shock Trauma Center, specialty referral centers, areawide trauma centers, a statewide communications system, research, evaluation, and educational programs for physicians, nurses, and EMT/paramedics. The system provides continuity of care from notification of an accident, resuscitation at the scene, transportation, definitive care and rehabilitation.

police work, but Med-Evac transports were to have first priority. A large, all-weather heliport was built adjacent to the Center. The observer/medic completed the standard EMT-A 81-hour course and then took additional training at MIEMS.

The Air Med-Evac system was the first element added to the clinical Shock Trauma Center. Later other specialty referral centers were added to build an integrated, complete emergency medical services system for Maryland. The whole system has grown tremendously since 1970, and is now responsible for planning, developing, coordinating and evaluating all aspects of emergency medicine in Maryland. (2,3)

EMS System Components

A communications system evolved from the need to coordinate helicopter transports. Now, through voice and telemetry communications, SYSCOM, the statewide system communications center, can link, county fire departments, central alarms, ambulances, hospitals, helicopters, consulting physicians and specialty referral centers to any other element anywhere in the state.

The specialty referral centers provide treatment for specific critical problems. The Med-Evac helicopters transport patients from the whole state to these centers in Baltimore.

The original center is the Adult Shock Trauma Center at MIEMS, which provides treatment for patients with:

- severe injuries to two or more body systems
- cardiac and major vessel injuries

- uncontrolled shock from any cause
- multiple injuries with complications such as shock, sepsis, respiratory, cardiac and liver failure, alcohol and drug overdose
- severe facial and eye injuries
- burns
- gas gangrene
- carbon monoxide and other poisoning.

Head and spinal cord injuries are treated in a special Central Nervous System program at MIEMS.

The Johns Hopkins Hospital Pediatric Trauma Center provides services similar to those for adults at MIEMS for children, tailored to meet the specific and different needs of children. The Baltimore City Hospital Regional Burn Center provides the medical personnel, facilities and rehabilitation required by burn victims. A State Intensive Care Neonatal Program at Baltimore City, University of Maryland and Johns Hopkins Hospitals manages critically ill and premature newborns referred from all over the state. The Curtis Hand Center at Union Memorial Hospital has special microsurgical facilities and personnel for the repair and reimplantation of severely injured and severed hands and arms and facilities for rehabilitation of these injuries.

These centers are the top level of care in comprehensive EMS master plan for the state and are the only level of centers to receive helicopter transports. Other levels in the "Echelons of Trauma Care" system include the University Center level at Johns Hopkins Hospital and University of Maryland Hospital in Baltimore, and Areawide Trauma Centers in each of the state's five EMS regions. (Figure 1) Because of the geographical isolation and rural nature of Maryland's Eastern Shore, the Areawide Trauma Center

there, Peninsula General Hospital, will receive helicopter admissions. At each level, strict requirements for facilities, equipment, staffing, clinical procedures and evaluation must be met before the center can be designated as part of the system. (Figure 2)

The foundation of the system continues to be local hospital emergency rooms, which handle 85 percent of the trauma cases. The Areawide Centers are prepared to handle the next, more critical 10 percent. The most critical 5 percent are transported by helicopter to the specialty referral centers.

The Maryland EMS system is voluntary and based on the understanding and participation of citizens, physicians, EMTs, hospitals and communities throughout the state. Public information and education programs for citizens explain how the system and its components relate to them and how to access the system. The medical community is involved through councils in each of five geographical regions and through medical control groups and advisory councils. Physicians are also contacted directly so that the function of the specialty referral centers, the type of patients appropriate for referral, the method of interhospital transfer, and available consultation may be explained.

Med-Evac Operation

The Maryland State Police Med-Evac helicopter fleet has grown to 14: four two-litter Bell Jet Rangers, eight three-litter Hueys, and two eight-litter Sikorskys. Increased state funding within the last year provides for more manpower to be trained and to staff the service around the clock. Four bases, geographically distributed across the state are now staffed 24-hours a day. In the near future, helicopters will be based at four more

locations to assure complete coverage of the state. (Figure 3)

The Med-Evac system is used for six major purposes: 1) direct pickup of patients with life-threatening injuries from the scene of an accident; 2) interhospital transfers for critical multiple trauma victims; 3) transfer of any patient whom a local physician deems an emergency needing care and equipment which are unavailable in his hospital; 4) transport of premature infants from outlying hospitals to the State Intensive Care Neonatal Program hospitals; 5) transport of medical personnel to the scene of the accident or to other hospitals for emergency care or evaluation; 6) transport of medical supplies, blood or blood components, and organs for transplantations.

Direct Pickup

Seventy percent of the Med-Evac transports come directly from the scene of an accident, usually a highway. Maryland's volunteer and paid ambulance and rescue squads cooperate with the State Police Med-Evac program to provide initial triage and facilitate rapid transportation to the appropriate care facility. The direct pickup at the scene of the accident involves the air med-evac helicopter by one of two methods. The helicopter crew, while on patrol, may see an accident or be alerted by monitoring emergency radio bands. In these instances, they would usually be the first paramedical assistance to arrive. Or a civilian or a highway patrolman may call the county central alarm for help, and the alarm dispatches an ambulance with a simultaneous request for helicopter support.

To coordinate the jurisdictional function and responsibilities at the scene of the accident, representatives from state police, local ambulance

services, and physicians responsible for emergency health care delivery developed the following guidelines:

Whoever arrives first at the scene of the accident assesses the injury. If the injury is serious, he calls for both a helicopter and an ambulance. If the ambulance arrives first, the crew immediately administers first aid and resuscitation. If the injury is not life-threatening, the patient will be taken to the local hospital. A more serious injury will be taken by ambulance to an areawide trauma center. If the injury is life-threatening, the ambulance crew will continue resuscitation at the scene until the helicopter arrives to transport the patient to the Adult Shock Trauma Center or other specialty referral center. If the helicopter notifies those at the scene that it cannot reach the scene in a reasonable time or that the mission is not logistically possible, the ambulance crew will proceed immediately with the patient to the areawide trauma center. If the helicopter arrives at the scene first, the crew provides immediate first aid, resuscitation and injury assessment. If the victim does not require transport to a specialty referral center, they sustain the patient until the ambulance arrives for transport to the local hospital.

Mean response time for helicopters from call to pick up is 15 minutes. The helicopter crew spends no time at the scene stabilizing the patient, applying complex splints, G-suits, starting intravenous lines unless the victim is trapped in or under a vehicle. Instead, the medic/observer maintains the airway, administers oxygen, stops external bleeding with compression pads and practices cardiopulmonary resuscitation as needed. He is capable of inserting an esophageal obturator in comatose patients.

From most corners of the state, helicopters can reach the Baltimore centers within the critical "Golden Hour." (Research has shown that if patients reach definite care within one hour of a serious injury their chances for survival are much enhanced.) During this trip, the pilot contacts SYSCOM with the estimated time of arrival and the nature of the patient's injuries.

When the helicopter lands on the Shock Trauma Center heliport it is met by an anesthesiologist and a nurse who rapidly assess the patient during the five-minute ambulance ride to the center.

In the admitting area, a diagnostic operation room, the remainder of the multidisciplinary team is scrubbed and assembled, anticipating the injuries described by the pilot. Rapid, aggressive resuscitation and stabilization follows a predetermined protocol.⁽⁴⁾ If necessary, the patient can be moved to an adjacent operating room for surgery.

Once stabilized, patients are taken to the Critical Care Recovery Unit (CCRU) where they are closely monitored. The average stay in the CCRU is five days, after which the patient is transferred to a step-down unit, the Intensive Care Unit. Average stay is again about five days. From the ICU, the patient may be transferred to the Intermediate Care Unit, a general hospital bed, a rehabilitation facility or home.

Interhospital Transfers

For interhospital transfers, a physician of an outlying hospital telephones SYSCOM at MIEMS to request assistance. A Shock-Trauma physician experienced in endotracheal intubation may be sent to accompany the transfer.

All patients accepted for admission come directly to the Shock Trauma Center emergency receiving area where second triage is performed. They do not pass through the hospital emergency room.

Those admitted are stabilized, diagnosed, and transferred directly to the 12-bed Shock Trauma Recovery Unit, to the operating room, or to the Intensive Care Unit for further assessment, management, and treatment. Those patients not requiring the Center's facilities (4%) are referred to appropriate areas elsewhere in the hospital (e.g., ICU, CCU) or to a general hospital bed.

Physician Emergency

When an emergency arises in the community and patient's survival is compromised because of inadequate facilities or a lack of specialized equipment, any physician may request assistance from the Shock Trauma Center by calling SYSCOM. Such patients automatically qualify for air med-evac transportation unless the Shock Trauma and the referring physician indicate that an ambulance would be the more suitable mode of transportation.

Transport of Medical Personnel

Physicians may be taken to the scene of an accident where victims are trapped or pinned under a vehicle, or if the emergency rescue crews suspect that certain medical procedures are required at the scene. Neurosurgeons, anesthesiologists, and thoracic surgeons have been flown to outlying hospitals to help evaluate and treat patients when the hospital involved did not have the physician staff to prepare the critically injured patient for transport.

Transport of Medical Supplies

Rapid helicopter transportation is of great value to convey unstable and perishable medical supplies, such as blood or blood components, and organs for transplantation, when these are required by other hospitals for both emergency and elective procedures. This especially pertains to distances exceeding 50 miles.

Trends

Each year admissions to MIEMS Shock Trauma Center have increased an average of 7.89 percent. For the last few fiscal years the admissions have been as follows: 1972, 615; 1973, 782; 1974, 872; 1975, 920; and 1976, 1105.

Eighty-two percent of the admissions are delivered by helicopter, 70 percent from the scene of an accident. Admissions are highest in summer months. For example, in June, 1976, there were 130 admissions compared with 73 in January, 1976. Saturday is the busiest day for admissions, with Sunday and Friday next. The largest number of admissions occur within several hours each side of midnight, with the fewest during morning hours. Sixty-five percent of MIEMS patients are 17 to 35 years old; 76 percent are males. Sixty-six percent are admitted as a result of traffic accident, 10 percent because of assault.

In calendar year 1977, there were 1300 Med-Evac helicopter transports, 814 to Adult Shock Trauma Center at MIEMS, 120 to the Pediatric Trauma Center at Johns Hopkins, 180 to Baltimore City Hospital's Neonatal ICU, 77 to the University of Maryland Neonatal ICU, 54 to Johns Hopkins

Neonatal ICU, 49 to the Baltimore Regional Burn Center at City Hospital, 29 to Union Memorial Hospital's Curtis Hand Center, 21 to Washington Burn Center, 9 to Penninsula General Hospital and 35 other Med-Evac transports.

In 1976, of those transported directly from the scene, 9.5 percent were discharged to home within 24 hours. The majority of this group had been intoxicated upon admission, which complicates the already difficult assessment and exclusion of head injury at the scene.

Survival

In 1976, of patients admitted directly from the scene, 6 percent were dead on arrival, either from a rupture of a heart chamber, thoracic aorta or vena cava; severe head injuries; or fracture dislocations of upper cervical vertebrae.

Of those arriving alive, 2.1 percent died in the admitting area from hemorrhage from major vessels or irreversible brain injury. Fifty-six percent underwent immediate, total repairative surgical procedures, during which 2.8 percent died. Uncontrollable hemorrhage accounted for all but three of these deaths.

Ninety-five percent of all patients who arrived alive survived to be admitted to the Critical Care Recovery Unit. Irreversible brain damage caused therapy to be discontinued within 24 hours for 2.1 percent. Of those surviving beyond 24 hours, 6.7 percent died in the unit within seven days, the majority due to brain death, the others due to sepsis. (Table 1)

Comparison of statistics for highway traffic accidents transported by Med-Evac helicopter from the scene to MIEMS from 1972 to 1976 show

improved survival rates. The percent discharged to home within 24 hours was cut in half: 19.2 percent in 1972 to 9.5 percent in 1976, reflecting improved triage at the scene. The number of patients dead on arrival decreased from 8.7 percent to 6.0 percent. The death rate in the admitting area fell from 5.3 percent to 2.1 percent and in the operating room from 6.3 to 2.8 percent. In the Critical Care Recovery Unit, the mortality of those who survived beyond the first 24 hours dropped from 8.0 to 6.7 percent. If the decreased early mortality can be attributed to more successful resuscitative and intraoperative care, more critically ill patients would be carried over to the Critical Care Recovery Unit, making these figures more impressive. Of all patients transported by Med-Evac, the percent surviving rose from 74.5 percent in 1972 to 82.1 percent in 1976, and of those who arrived alive from 81.6 percent to 87.4 percent. (Table 2)

Cost Effectiveness

The Med-Evac system remains cost-effective, because the helicopters are used for Med-Evac missions only ten percent of the total helicopter patrol time. The other 90 percent is used for routine police work: search and rescue for missing persons, aircraft and boats; criminal investigation support including search for escaped prisoners and persons fleeing crime scenes, general area searches for stolen cars and property that may be abandoned in rural, wooded, or isolated areas; surveillance and trailing of vehicles and persons suspected of involvement in criminal activity; aerial photography and area surveys in connection with murder, arson, etc.; route surveys and security; traffic control; security transports; support in disasters

and civil disturbances and highway patrol. Med-Evac missions have first priority, however. By using this sharing system, the cost of each transport has been held down to \$48 which is paid by the state. To keep the cost per transport down, the helicopters confine activities to an area which can be patrolled while maintaining an acceptable time-distance relationship with the specialty referral centers; are maintained on a full 24-hour alert and dispatched simultaneously with surface ambulance; and transport only patients with major life-threatening conditions to avoid competing with surface ambulances. To remain effective, helicopters maintain liaison and communications with state, county, and local police departments, ambulance units and treatment centers to assure maximum utilization and transport only to medical facilities which provide the necessary sophisticated level of treatment.

The Maryland Med-Evac Helicopter Program has thus proven that helicopters can be used successfully and efficiently to bring critically injured civilians to care. It has become an essential element in Maryland's integrated system of EMS care.

TABLE 1

HELICOPTER TRANSPORTS TO MIEMS 1976

ROAD TRAFFIC ACCIDENTS

	From Scene	Indirect
Transported	497	122
Dead on arrival (DOA)	30 (6.0%)	6 (4.9%)
Arrived alive	467	116
Died in admission area (AA)	10 (2.1%)	2 (1.7%)
Died in operating room (OR)	10 (2.8%)	5 (4.3%)
Admitted to critical care recovery unit (CCRU)	444	109
Died in CCRU within 24 hours	10 (2.1%)	6 (5.2%)
Discharged home within 24 hours	47 (9.5%)	5 (4.3%)
Admitted to CCRU longer than 24 hours	387	98
Died in CCRU after 24 hours	26 (6.7%)	11 (11.2%)
Total Survivors	408 (82.1%)	92 (74.4%)

TABLE 2

HELICOPTER TRANSPORTS TO MIEMS 1976

ROAD TRAFFIC ACCIDENTS
Direct from Scene

	1972	1973	1974	1975	1976
Total transported	208	315	324	361	497
Dead on arrival (%)	8.7	5.4	3.7	7.8	6.0
Deaths in admission area (%)	5.3	5.7	3.5	3.3	2.1
Deaths in operating room (%)	6.3	6.0	4.5	1.8	2.8
Total deaths in first 24 hours (%)	12.6	14.8	9.0	6.6	7.1
Discharged home within 24 hours (%)	19.2	13.0	15.1	11.1	9.5
<u>Died in CCRU after 24 hours (%)</u>	<u>8.0</u>	<u>8.9</u>	<u>6.8</u>	<u>8.9</u>	<u>6.7</u>
Survived % all cases transported	74.5	74.6	82.7	79.5	82.1
Survived % those who arrived alive	81.6	78.9	85.9	86.2	87.4

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