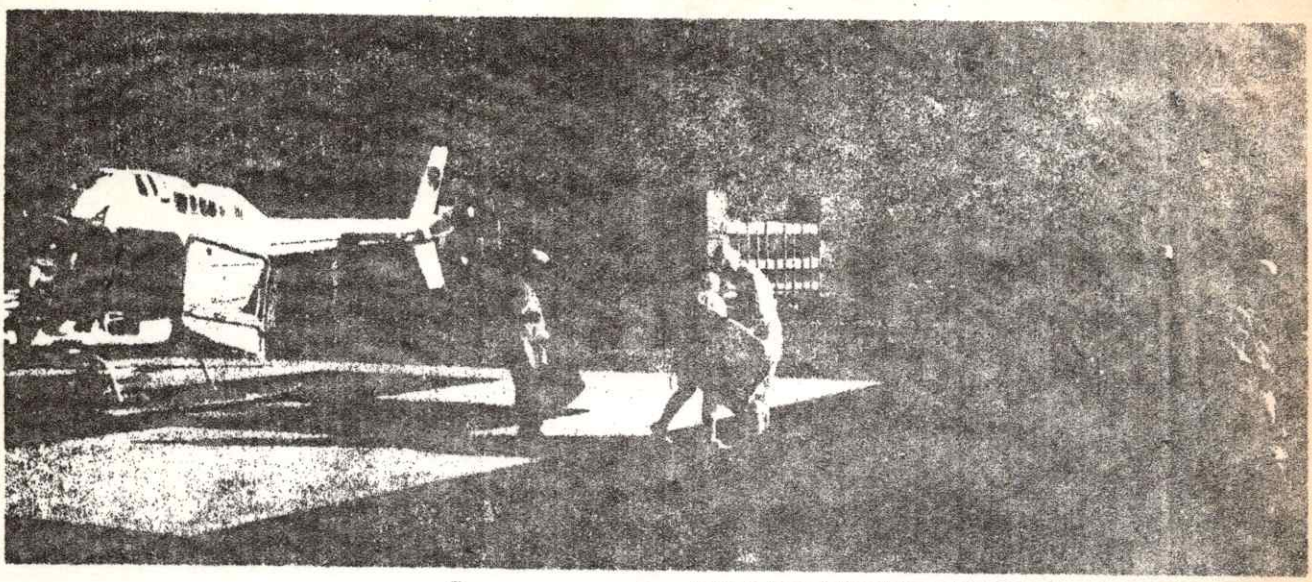

When one of the state's four helicopters arrives with a severely injured person on the rooftop heliport of Maryland's Institute of Emergency Medicine, Baltimore, an expert medical team is instantly ready to give definitive critical care

How Maryland saves lives

Jay Nelson Tuck

A few years ago, a man was critically hurt in an accident at Frederick, Md., suffering a broken back and multiple other injuries. A local hospital, finding that his needs were far beyond its capacities, transferred him to a larger hospital at Hagerstown, but it, too, was not equipped and staffed to save the patient.

As a last-ditch measure, the man was flown by a helicopter of the state police to the University of Maryland's Center for the Study of Trauma (CST) in Baltimore, where he arrived *in extremis*. The CST team went to work; after some days the patient, though unable yet to speak, had recovered enough to write and he scrawled a message on a pad: "Do what you need to do. I want to live."

Though it was a long and arduous process that included two months in a respirator, he did live.

From sadness comes good. The

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recovery of that suffering man is helping today to relieve the suffering and save the lives of other Marylanders, as well as of some people from four other states.

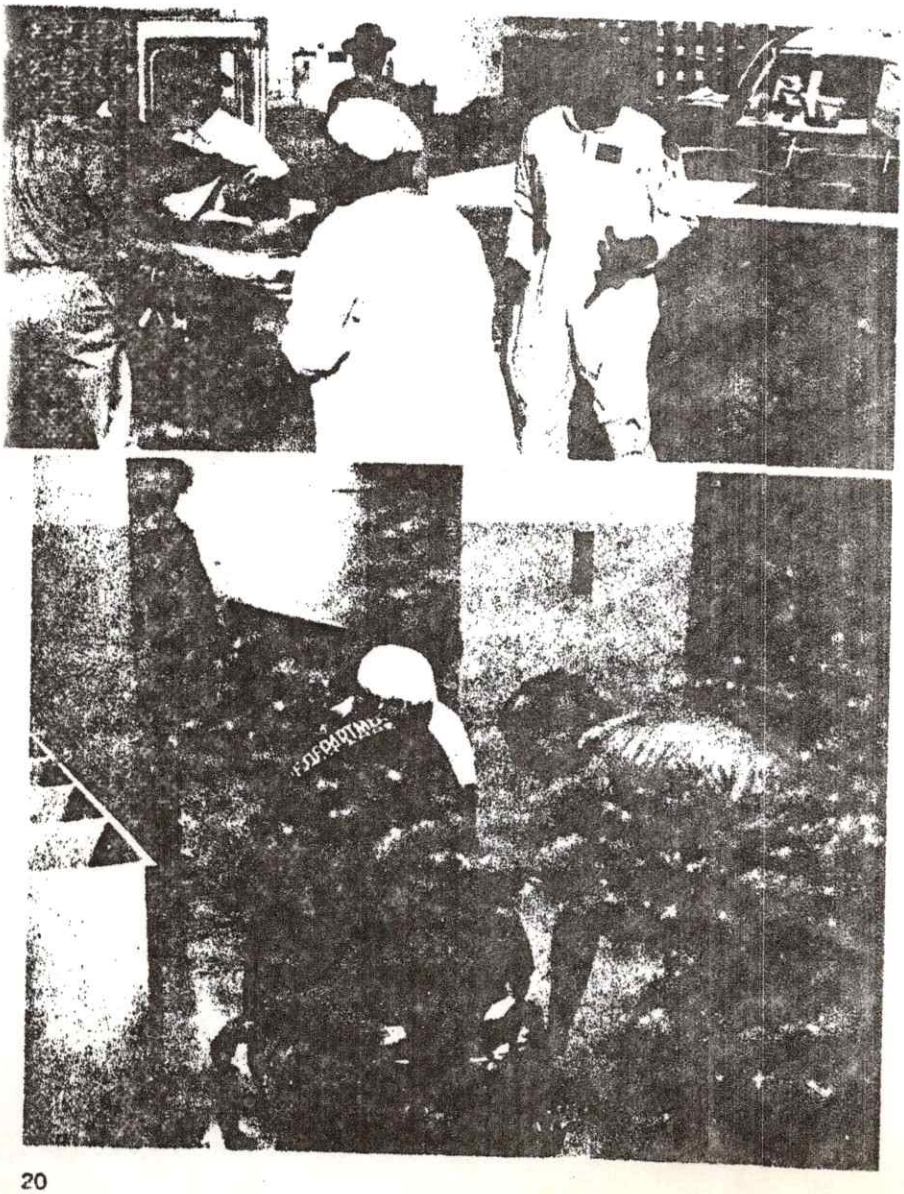
The patient happened to be the chief clerk of the state legislature and, as such, he was well-liked and widely respected at the top levels of the state government. The event brought home to Gov. Marvin Mandel and to the members of the legislature the vital importance of an effective emergency care system.

That event gave new impetus and strong support to what had already been begun at CST — the development of a full system of the best possible emergency medical care. The center was transformed into the Maryland Institute of Emergency Medicine (MIEM), a statewide Division of Emergency Medical Services (DEMS) was established, the helicopter ambulance service of the state police and the communications system were strengthened — all with the object of getting any critically injured person in the state as rapidly as is humanly possible to the best care that today's technology affords.

Heavy emphasis is placed on what R. Adams Cowley, M.D., director of both MIEM and DEMS, calls "the golden hour." That is the first hour after the time a person is injured. Several studies have shown that the earlier definitive treatment can be begun, the greater the chance of saving the patient's life. The helicopter can get him to MIEM rapidly, usually within an hour of an accident anywhere within state borders, but then there must also be ready to go on the instant the medical and hospital team to give him that definitive care.

At the institute, there always is.

Take the crudest measure of results. The survival rate of MIEM patients (the institute's people don't like to reverse the term and talk of mortality rates) hovers above 80 per cent. When it is remembered that every patient who is brought there is in critical condition, suffering from extreme injury



In minutes, patient is transferred from aircraft to ambulance and moved to the institute's unloading dock.

MIEM has arranged for local transport and communication with the Baltimore Fire Department, which operates the city's ambulances.

to at least two bodily systems, and that even patients who could ordinarily be regarded as DOAs (dead on arrival) are counted among the losses, this is an almost unbelievable record. Even patients who have been pronounced dead by a physician at the accident scene are "admitted" and treated until the MIEM teams must finally give up and count them among the statistical losses. A few such "dead" patients have been successfully treated and, disconcerting though they may be to the egos of some local doctors, can maintain, like Mark Twain, that the reports of their deaths have been greatly exaggerated.

But to understand this extraordinary place, and the system of which it is the core, let's go back to the beginning. As is common with such developments, at the heart of it is one man with fire in his belly, in this case, Dr. Cowley.

"A few 'dead' patients have been successfully treated, disconcerting though they may be to the egos of some local doctors."

Dr. Cowley had long been appalled at the inadequacy of most emergency care — the indifference of medical schools to teaching about trauma, the inability of hospitals to provide essential support, the public apathy. Only limited research had been done in the field.

So in 1956, the doctor began to make animal studies seeking to find out what actually happens in trauma, but he soon found it essential to make studies more directly in man and discovered the absolute necessity for multidisciplinary support. The start was made possible by financial support from the Surgeon General of the Army and on Jan. 1, 1961, a special two-bed unit was opened at the University of Maryland Hospital. For the first time anywhere, systematized collection of data on a 24 hour basis on the treatment and care of trauma patients was under way.

The value of the unit quickly became clear and its growth was steady. With the support of the National Institutes of Health and the

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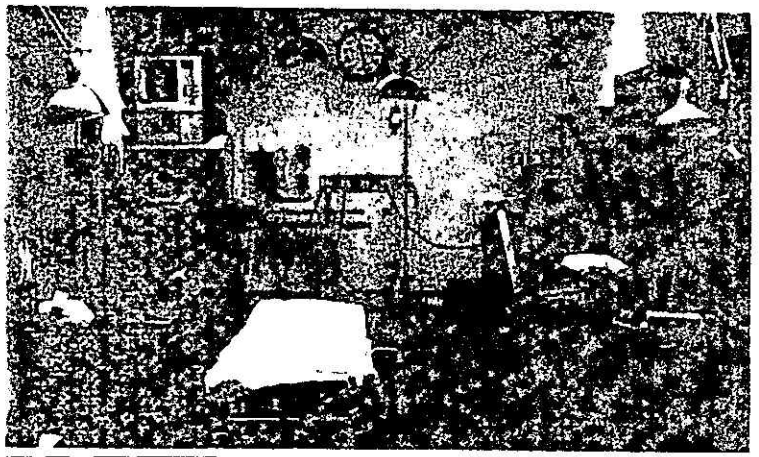
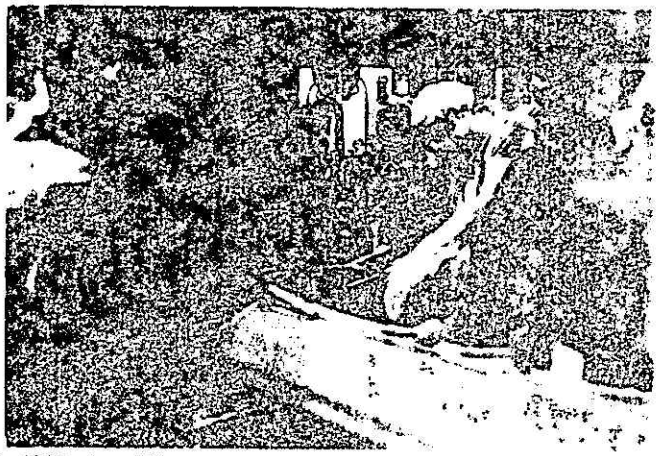
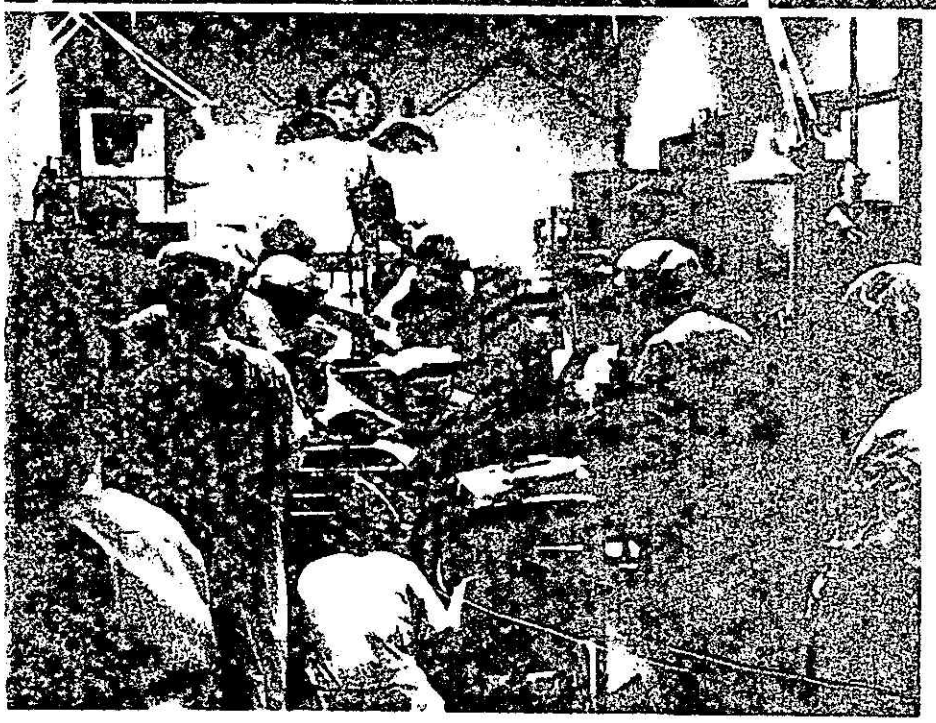






Top left: Surgical work can be done in the admissions area or in two adjoining operating rooms.

Top right: Technicians listen to events occurring in the admissions area or in the ORs and anticipate what assistance may be needed.

Left: Emergency team at work — with everything in its place, there is no fumbling to find something when it is needed.

state government a special CST building, adjoining the main UM Hospital, was built and opened in 1969. Close working arrangements for transportation and communications were made with the Baltimore Fire Department, which operates the ambulances in that city, and with the state police for helicopter service. In 1970 a specially designed all-weather heliport, built on the roof of a parking garage, was opened. And on Feb. 26, 1973, the CST became MIEM.

The building started with 12 beds, but as its volume increased it has overflowed into the general hospital and now has 32 beds, with others to be added. This situation is expected to be remedied in the next couple of years when three more stories will be built.

The vast majority of the more than 200 people who work in the building are nurses, but admissions are basically handled by six-member teams, consisting of four physicians, a physician's assistant, and a nurse. At least one such team is always at the ready in the institute and even in the late night hours a second is on standby and a third on call. Since all MIEM employes live very near the building, the on-call team can be assembled within 20 minutes.

Although any doctor in the state can call upon the institute's services, the vast majority of admissions come from two sources, those who are brought in directly from an accident scene by the helicopters and those referred by other hospitals. Few are brought in directly by Baltimore ambulances; patients picked up within the city are usually taken instead to the regular EDs of other hospitals.

This is because the institute is no ordinary emergency department. There are no lines of patients waiting to be seen for minor ailments nor even patients with serious, but not critical, injuries. Such people are treated at the university hospital's regular ED. To be admitted to MIEM, a patient must have suffered major injury to at least two or more bodily systems, or the equivalent. The institute treats cardiac cases only when they are ancillary to trauma. No person who meets the criteria is ever refused admission. The specially trained state policemen who fly the helicopters are permitted to decide at an accident scene whether or not a patient requires the institute's level of care. In only about 4 per cent of instances do they misjudge the situation and bring a patient who does not require it. The institute would not have that figure any lower; far better to bring in a patient who can be shifted to the regular ED than to let one die because the seriousness of his injuries was not recognized.

The state presently has four helicopters, three of which are on duty at any one time while the fourth is undergoing maintenance or standing back-up. Each is manned by a two-man crew, pilot and observer. The observers have all undergone the full 81 hour training necessary for emergency medical technicians and in addition have received two weeks of special training in the institute, plus a week's refresher course each year. Each plane can carry two litter patients.

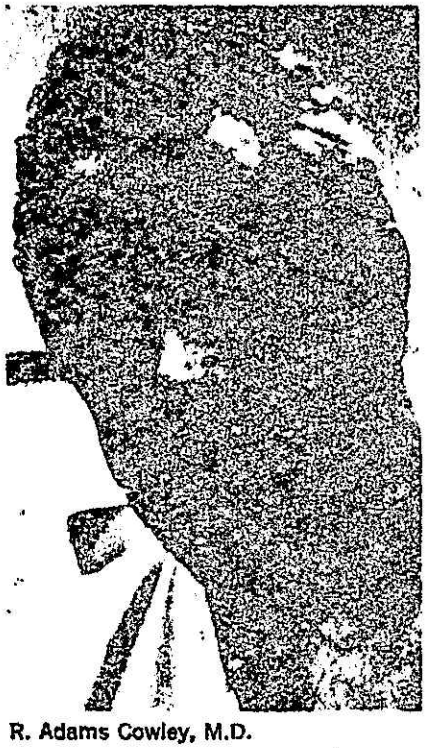
Their main job is routine police work and they spend more than 90 per cent of their time doing just that. But the rule is that a medical emergency, when it occurs, comes before anything. Gov. Mandel must sometimes wince at the application of the rule — five times within the past year he has been bumped off his "own" helicopters for medical emergencies.

Helicopters are expensive and delicate things, requiring highly paid crews and much costly downtime for maintenance. It is only because the Maryland ones are used in the way they are that they can do their medical work, Dr. Cowley says. They would be prohibitively expensive if used only for medical purposes, but with nine-tenths of their total bill being allocated to their other work, the cost of an airborne ambulance ride is about $46.

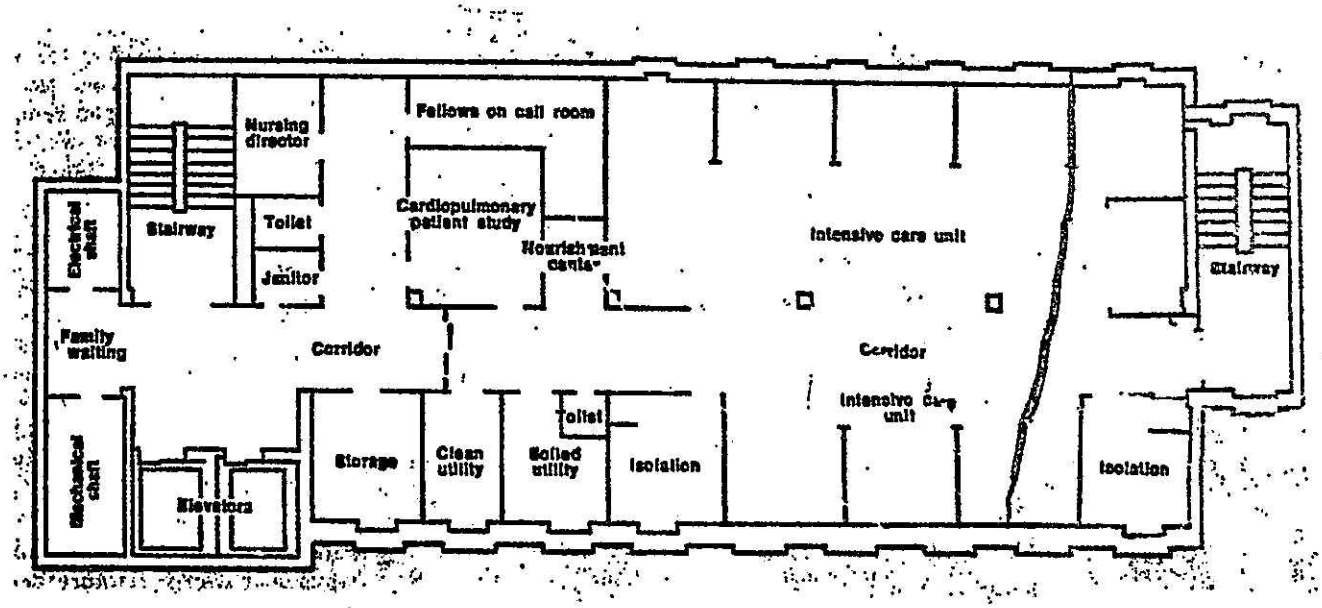
Thus the system is dirt cheap, says Dr. Cowley. Most highway deaths occur in rural areas, where hospitals may be distant and are almost always small and ill-equipped. At the same time, the best hospitals are in metropolitan centers. It costs far less to operate a helicopter system this way than it would to upgrade large numbers of rural and small town hospitals, he argues.

The system is not without its dangers. In the recent past, two "birds" have crashed (one while on a medical mission) and all four crewmen were killed. As a result, flight rules had to be tightened and more maintenance required. In another incident, a deathly sick child was being picked up at a small hospital. The aircraft was barely off the ground when the youngster

"It costs far less to operate a helicopter system than to upgrade large numbers of small rural hospitals."



R. Adams Cowley, M.D.



Shock trauma center at the University of Maryland is an open room 130 by 50 feet, with the treatment area to the right and services and administration at left.

stopped breathing. The medical observer administered mouth-to-mouth respiration while the pilot landed the ship. The child died and was found to have had meningitis. Both crewmen had to be grounded for a period of prophylactic treatment.

The best transportation is worthless unless the medical facilities are available at the destination. There is a yellow phone at MIEM and when it rings, people start to move. A helicopter will be notifying the institute that it is on the way to what appears to be a serious accident, consequences as yet unknown. A few minutes later, word will come again. The medical observer will describe the injuries of his patient or patients and give the ship's estimated time of arrival. (MIEM people are fond of saying, with wry smiles, that their emergency patients arrive by appointment.) When the bird sets down at the MIEM heliport, there are at least two physicians and a nurse waiting.

First aboard the plane is an anesthetist to make sure that an airway is open and the patient can breathe. A surgeon tries to stop any gross bleeding. The patient is rapidly, but smoothly, transferred to a waiting ambulance and, accompanied by a physician and nurse, moved in four minutes to the institute's unloading dock.

In the admissions area, all is waiting. Intravenous bags are hanging at the ready, a portable x-ray machine stands available, trays of instruments for every conceivable type of procedure, each in its proper place, are at hand, and gowned and scrubbed people are waiting. Everything has its precise place and must be there and only there. There can be no fumbling to find something when it is needed and no running off to some other part of the hospital to find something that is not on hand.

Work starts in an instant. Within seconds there are usually four IV lines running into the patient and there may be as many as six. Type O blood is always ready at hand and is started without taking time to match. The institute doctors know this involves risk, but the alternative may be a dead patient.

The institute uses about 80 per cent of all the blood consumed by the 700 bed hospital and nearly half of all that is given in the state.

The institute's own laboratory, open 24 hours a day, is equipped to do about 80 different tests and performs about 500 a day. By pushing a button, the technician can listen to what is going on in the admissions area or the adjoining ORs and anticipate what may be needed. Test results are sent by teleprinter and are usually available within five minutes after blood is drawn.

Internal bleeding in the abdomen is a frequent occurrence in trauma cases and often not detectable externally. Thus abdominal lavage is routinely performed. A tiny incision is made, a liter of sterile solution run into the abdomen and then allowed to run out by gravity. If it comes out pink, laparotomy is performed to find and stop the bleeding.

Much surgical work can be done right in the admissions area, but two full operating rooms stand adjoining and ready. The institute doctors do not believe in piecemeal work if it can be avoided; the definitive surgery is done then and there. Since the patient's wounds are almost always "dirty," the doctors usually do not close them immediately for fear of sewing in infection, but leave them open for a few days for antibiotic treatment, debridement and observation.

From the admissions area, the patient goes to the intensive care unit, which is about as highly automated as it is possible to be.

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For example, since most patients are on some form of assisted breathing, their exhalations are collected and monitored continuously and mechanically. Testing for blood gases and electrolyte balance need not be ordered by the doctor; it is done routinely every six hours. If a patient needs one-to-one nursing care, he gets it without question, but the extreme degree of mechanical monitoring does make possible a great saving in nursepower, Dr. Cowley says.

John W. Ashworth, administrator, meets with purchasing employes to explain special needs of the unit.

A stay in an acute care unit follows the ICU and the patient is then ready to move to the several hospitals. But MIEM does not consider its responsibility either ended at that point or confined to the patient himself, says Dr. Cowley. For one thing, a social worker is available from admission to recovery to help with family problems and take care of all the ancillary difficulties that usually accompany severe trauma. Rehabilitation, so important in trauma, is begun right in the institute on the first feasible day, and, to the degree needed, continues in the general hospital on a short-term basis, in a state facility for a longer haul, and at home.

Nor are the patient's psychiatric needs neglected. A staff psychiatrist helps when the patient's problems are complicated either by alcoholism or drugs, and sometimes his assistance is required by patients' families. A major part of his duties is also to help the staff. Although nurses at the institute must meet rigid original requirements and undergo extensive special training, they are under great emotional pressure, some of which can be relieved by rotating their duties. But the doctor is needed nevertheless. "We never have the pleasure of delivering squealing babies," Dr. Cowley points out. "There is no joy here. We are dealing with death."

Even a cursory look at MIEM will show several basic principles of its method of saving life in trauma. A few of the more important ones:

- Speed. The principle of Dr. Cowley's "golden hour" is vital, both in transportation and in what happens after the patient arrives. This works right down to the physical arrangement of the admissions area: when a doctor calls for a given instrument, the nurse can pick it up almost without looking.
- Teamwork. Every surgical specialty is on the spot at any needed time and this also applies to ancillary assistance. The system is so arranged that anyone who is not actually present, but who may be needed when crisis comes, can instantly drop what he is doing and doubletime it to the institute. And on the spot, anyone does what needs to be done.

MIEM'S Dr. Cowley: "We never have the pleasure of delivering squealing babies. There is no joy here."

- A high index of suspicion. Treatment begins even before diagnosis. It is assumed that a variation of Murphy's law applies: "Anything that could have gone wrong has gone wrong; anything that might go wrong will go wrong, unless we prevent it." There is a reversal of the usual principle of criminal law: The patient is "guilty" of every possible complication until proven "innocent."

A good example of how this assumption works is to be found in so-called "lung shock." A few years ago, mortality from this condition was generally around 90 per cent. In most hospitals, doctors would begin treatment as soon as they observed the condition developing, but it was almost always too late. At MIEM it was assumed that the patient might be going to develop the condition, even though no signs of it could be observed, and he was treated accordingly. Mortality from lung shock is now said to be around 20 per cent generally; at MIEM it has been reduced to around 2 per cent.

Admissions to MIEM follow an unusual pattern. Because between 60 per cent and 65 per cent of patients are victims of automobile accidents (and most are between the ages of 20 and 24), admissions peak on the weekends, but there is also a high rate on Monday and Tuesday when other hospitals which have received weekend accident victims decide they had better refer them to the institute.

MIEM expected 6,700 patient days last year and the actual number turned out to be 6,711, according to Stephen A. Valerio, MIEM's assistant administrator. This year, between 1,000 and 1,200 persons will utilize something more than 9,000 patient days. In the month of September, 97 patients underwent more than 300 procedures in the institute. Their length of stay, before transfer, averages about five and one-half days in the ICU and six or so more in acute care.

MIEM's annual budget is about $5.5 million, and, as might be expected, costs are high, averaging $613 a day in the last fiscal year. (They ran somewhat lower — about $550 — in recent months, but this was largely the result of understaffing caused by a fiscal foul-up: Some state money was not actually made available until October, making it impossible to bring in a full quota of medical staff on July 1.) Actual charges depend upon the type of care. For example,

the expensive hyperbaric chamber cannot be fully utilized, but a staff of technicians must be on call 24 hours a day, so the charge is $200 an hour.

(There are a couple of interesting details about that chamber that would not ordinarily come to mind. For one thing, it is used to oxygenate the blood of Jehovah's Witnesses who refuse transfusions. For another, nurses who work in it are forbidden to wear nylon underwear for fear of what a spark of static electricity could do in that high oxygen concentration.)

Since the university hospital is also a state institution, it, too, admits all comers and about 60 per cent of its patients are indigent. At MIEM, the situation is reversed, says John W. Ashworth, the administrator. About 80 per cent of patients pay their own way, largely through automobile insurance. Dr. Cowley says that about four years ago some insurance companies refused to pay what they thought were exorbitant charges. "We brought their representatives down here and showed them what we do," he says with a dry smile. "We haven't had any trouble since."

Under a complex set of administrative controls, the institute is virtually free-standing from the hospital, yet is heavily dependent upon it for both services and staff support. Since MIEM's needs are so unusual, the situation calls for a good deal of patience and understanding on the part of both. On the administration side, Mr. Ashworth has been inviting the heads of various hospital departments to meetings at which the institute's workings and special needs are explained.

For example, the hospital's purchasing people recently attended a meeting at which a slide show illustrated the work being done. Then the MIEM nurses in charge of each department explained just why they do things the way they do and such points as why when a certain instrument is specified no substitute will do and why stocks must be maintained at a given level. The meeting was followed by a tour of the institute during which, by timely coincidence, an admission occurred, giving the purchasing employes an opportunity to see the system at work first hand.

What of the future? MIEM and DEMS are far from standing still. Three floors are to be added to the institute building and a new rooftop heliport will be built there, eliminating the cumbersome necessity of transferring patients by ground ambulance from the garage rooftop to the admissions area. DEMS is dividing the state into five regions, has plans to upgrade and categorize emergency care in each, and hopes for three more helicopters so that there will be one for each region and two for back-up.

Dr. Cowley also hopes to see the development of more specialized emergency units. At present, Baltimore City Hospitals has a burn unit and Johns Hopkins has a pediatric trauma unit. Appropriate patients are already being taken to those places, instead of to MIEM. And since about 5 per cent of MIEM's patients come from out of state — from Virginia, West Virginia, Delaware, Pennsylvania and the District of Columbia, he hopes to develop a regional system that will ignore state lines. A first meeting looking in that direction has already been held with representatives of those states, HEW and the Appalachian Regional Commission.

And, while the details of MIEM's scientific research lie outside the scope of this report, Dr. Cowley has high hopes there, too. For just one example, Maryland has recently enacted a law that permits immediate post-mortem without waiting for consent of the relatives of the deceased. This, the doctor points out, opens up the opportunity to study fresh cells under the electron microscope and may well expand our knowledge of what exactly happens in the body when we die.

"Dr. Cowley," says Mr. Ashworth, "is always five or 10 years ahead of his time."□