A STATEWIDE COMMUNICATION SYSTEM TO SUPPORT A REGIONAL PROGRAM FOR EMERGENCY HEALTH CARE DELIVERY IN MARYLAND

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Introduction

At the University of Maryland Center for the Study of Trauma, there has been developed a successful statewide air med-evac helicopter system for transportation of critically ill and injured patients to the Center by either direct pickup at the scene of an accident or interhospital transfer. This rapid transportation system is a cooperative effort between two state agencies, the Maryland State Police and the University of Maryland, and would not have been possible without the resources of the already well-developed State Police communication network.

Basically this communication net is connected by a radio-telephone patch system throughout the state between state police patrol cars and regional police barracks feeding into a central receiving and dispatching center located at the Valley Post barrack and thence by direct line to the Center. After three years experience in transporting over 1000 patients,* it has become apparent that other State resources must be pulled together if better health care delivery is to be provided and duplication of systems prevented. Therefore, it is logical to develop a common communication network to connect regions throughout the State so that all medical resources can be used.

The purpose of the communications system is to make possible a significant improvement in the quality and speed of delivery of emergency medical services by providing a means for achieving closer cooperation between existing and future medical resources. These resources include ambulance and rescue vehicles, Maryland State Police helicopters, hospital emergency rooms, intensive and coronary care units, hospital specialty referral facilities, and the fire department central alarm headquarters. A major objective in planning this system has been the provision of new capabilities for emergency health care without inconveniencing or limiting the operation of the present ambulance control system.

At present there are two means of transportation available for patients who because of their life-threatening problem require rapid transportation in special vehicles. The first is the city and county fire department ambulance services which are the envy of most regions throughout the country. These services consist of programs sponsored and controlled by fire departments, both private and volunteer, except in western Maryland where private ambulance companies also assist in emergency health care delivery. The fire department central alarm headquarters is responsible for dispatching fire-fighting equipment and ambulances. Ambulance requests are made by police, physicians, hospitals, or citizens calling the central alarm headquarters in that region. At the accident scene the ambulance crew provides first aid to the best of their ability and then transports the patient to the nearest hospital.

The second means of transportation is the Maryland Air Med-Evac Helicopter System, which has also become a national model, devised to secure appropriate, timely medical care at specialized facilities for the critically ill and injured who would otherwise die. The special advantage of the helicopter is its ability to provide rapid transport over long distances or from areas inaccessible to the ambulance. However, both transportation systems provide outstanding service and each complements the other.

** Two hundred of these patients were infants born with life-threatening problems transported to regional intensive care nurseries at the Baltimore City Hospitals and the University of Maryland Hospital. This innovative program was developed by Dr Herman Reisenberg and Dr Ronald Gutberlet.*

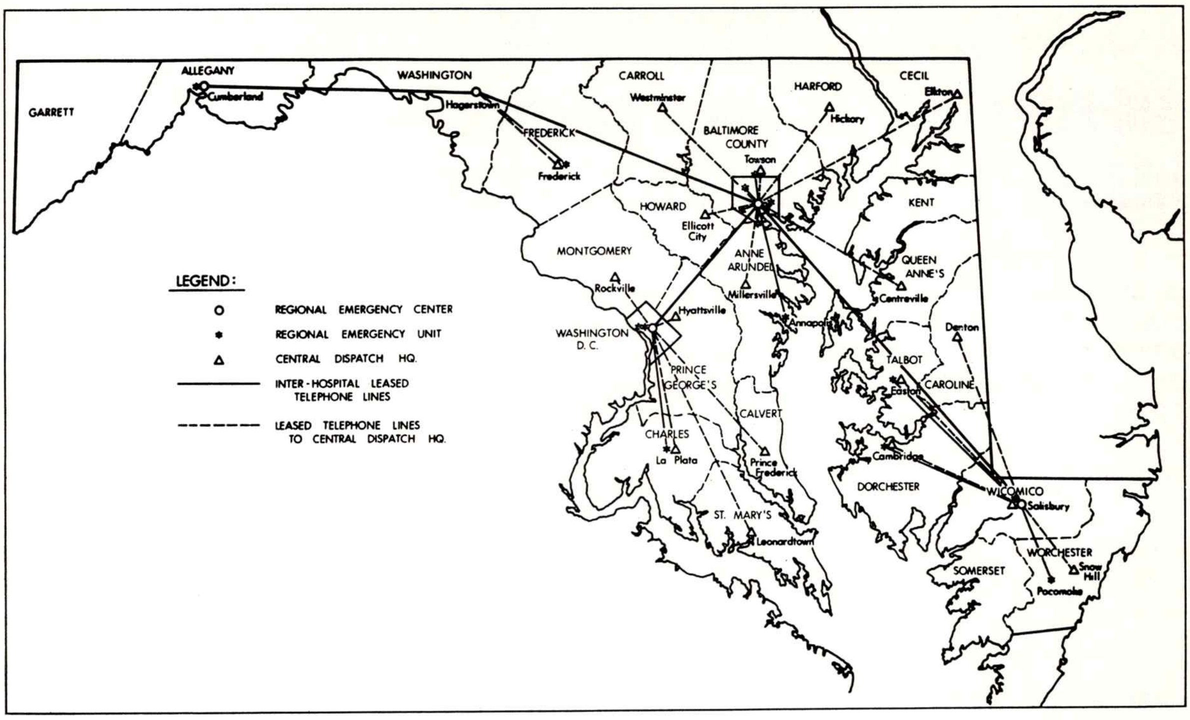

Fig 1:

This map shows how a statewide communication system could be implemented by incorporating five regions:

1) Cumberland—Appalachia region
2) Hagerstown—Frederick region
3) Baltimore Metropolitan region
4) Washington, DC—Montgomery--Prince George's County region
5) Salisbury—Eastern Shore region

A hospital in each area would be selected as Regional Emergency Center on its ability to give multidisciplinary 24-hour-per-day care.

They would be supported by Regional Emergency Units and participating hospitals. Selection of hospitals on this map are only pointed out to give substance (see text). Each of the five centers is connected by private leased lines to the Central Communication Center in Baltimore. Each regional center is connected to its Regional Emergency Unit hospitals and Central Dispatch Headquarters by leased telephone lines. Each regional center communicates with each other and with the ambulance crew at the scene of the accident by radio.

In a statewide communication concept proposed here, Maryland is divided into five regions. A hospital would be chosen in each as a Regional Emergency Center based on its ability to give multidisciplinary care on a 24-hour basis. This hospital would be supported by strategically located hospitals in the region called Regional Emergency Units. Other hospitals supporting the regional concept, to be known as participating hospitals, would provide the remaining necessary medical resources. These hospital categories would be chosen by physicians at the community level in accordance with their ability to provide the appropriate emergency services.*

** Means for evaluation of hospitals at the regional level have already been developed by the excellent effort of the Baltimore Metropolitan Regional Planning Council's Committee on Emergency Medical Services.*

Specialty Referral Facilities now participating in the system include the University of Maryland Center for the Study of Trauma, the Baltimore City Hospitals Burn Unit, and the Johns Hopkins Pediatric Trauma Center. Other Specialty Referral Facilities will be added as they develop. The backbone for such a regional concept is a statewide communication network linking these facilities (Fig 1). Statewide coordination of the system will be accomplished by the CST serving both as a regional center and a statewide communication control center.

Operation of the Emergency Medical System

The proposed emergency medical system operates in the following manner. When an emergency arises, help is summoned in one of several ways: Police may radio from the scene of the accident, a friend or relative may call a telephone operator for assistance, or a passerby may telephone the local county or city fire department central alarm headquarters (Fig 2). Any of these calls results in the dispatch of an ambulance. If the central alarm dispatcher has reason to believe that a life-threatening situation exists, he may request helicopter support at the same time. Upon arrival, the ambulance or helicopter crew provides first aid and examines the victims for symptoms of life-threatening injuries. If none appear, the patient is taken by ambulance to the nearest hospital emergency room. Ninety percent of all ambulance runs will continue to be managed in this way.

If it appears that a life-threatening situation exists, the ambulance attendant requests and obtains transportation instructions and/or medical advice by radio from a Regional Emergency Coordinator located at the nearest Regional Emergency Center. If necessary, the coordinator may also place a physician in contact with the ambulance. If the med-evac helicopter crew arrives at the scene first, they will transport the patient to the appropriate Specialty Referral Facility and notify the central alarm headquarters that the pickup has been made. If the patient is not critically injured, resuscitation and first aid are provided until the ambulance arrives and the patient is removed to the nearest participating hospital.

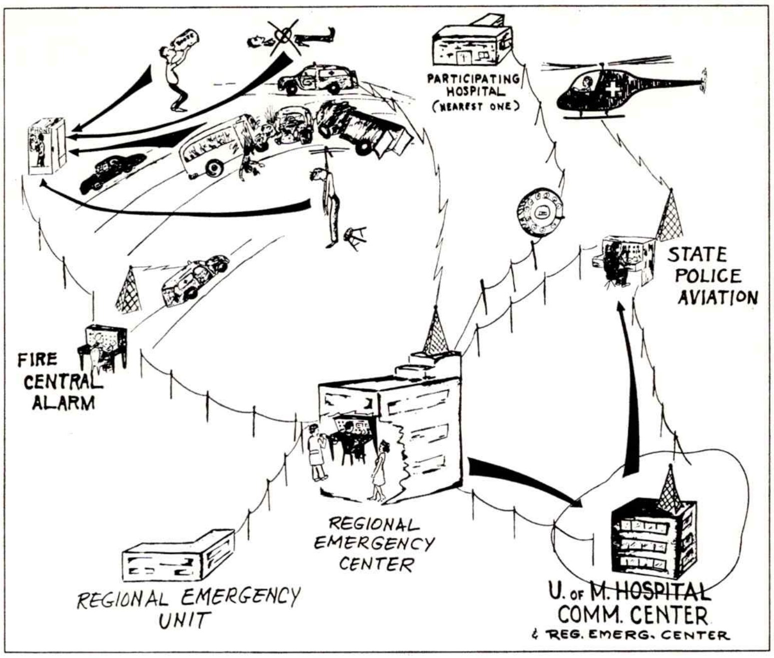

Fig 2:

This drawing considers those life-threatening problems that would be managed by the communication network. Left upper corner shows the accident victim, the heart attack patient, the severe alcoholic, drug addict, psychiatric patient, or neo-natal problem (not shown) entering the system when the observer dials "0" or "911." Following the drawing counterclockwise a central alarm headquarters is shown dispatching the ambulance and calling the Air Med-Evac helicopter, the Regional Emergency Center providing instructions to the ambulance crew at the scene, and reporting data to the University of Maryland Central Communications Center Trauma Registry. This patient would be directed by the Regional Emergency Center to the nearest indicated Regional Emergency Unit, the nearest participating hospital, or to one of the Specialty Referral Facilities in Baltimore. Note that the participating hospital enters the system by dial telephone.

On receiving a call from an ambulance, several courses of action are open to the coordinator:

1) If conditions warrant and resources are available, he may advise transporting the patient to the nearest hospital emergency room.

2) He may advise transporting the patient to another hospital having certain specialized facilities.

3) He may request the dispatch of a Maryland State Police helicopter to evacuate the patient to the appropriate Specialty Referral Facility. In this instance, the ambulance or rescue crew will remain at the scene to give first aid and assist in loading the patient into the helicopter.

4) If there is a suspected cardiac emergency, on-the-scene treatment can be given in accordance with instructions received by radio from a cardiac specialist.

The success of the system in improving the quality of emergency health services depends on the ability of ambulance crews to recognize life-threatening injuries and to request direction from the regional emergency coordinator. This coordinator must know the nature and the availability of the resources servicing the region. These are census of available beds, a list of emergency rooms able to accept the patient at that time, the location and status of the med-evac helicopter serving the region, and the identity and location of specialists on duty. If any of the above resources essential for the care of the patient are not available, the regional coordinator will then request assistance from the Communication Control Center located at the Center for the Study of Trauma.

Following the categorization of hospitals, the management of non-life-threatening injuries may be improved by enabling the ambulance driver to confer by radio directly with the Emergency Room of any nearby large community hospital having around-the-clock capabilities.

Communication System Description

The communication system combines existing facilities for dispatching ambulances, rescue vehicles, and helicopters with new facilities for inter-hospital communications, two-way voice communications between ambulances and regional centers, and EKG telemetry from ambulances to regional centers.

Interhospital communications are provided by leased telephone lines connecting each Regional Emergency Center with the Communication Control Center. Leased lines also connect each Regional Emergency Center to Regional Emergency Units and central alarm headquarters. Other hospitals participating in the system enter by means of conventional dial telephone service. A back-up capability for these telephone lines is provided by the radio system described below.

Two-way voice communication between ambulances and Regional Emergency Centers is provided by transceivers (transmitter-receiver sets) installed in each ambulance, rescue vehicle, and Regional Emergency Center. These radios operate on frequencies allocated by the Federal Communications Commission (FCC) for Special Emergency Radio Service. This equipment supplements the existing ambulance radios presently used for dispatching. In addition, each ambulance is equipped with a light, portable "walkie-talkie" transceiver enabling two-way communication from the patient's side when he is located some distance from the ambulance.

When the need arises for a physician located in a remote region to communicate with the ambulance, a manually operated telephone-to-radio connection can be made at a Regional Emergency Center enabling two-way voice communication between an ambulance and any other point in the State.

A back-up channel for communication between ambulances and physicians is provided by the leased telephone lines between each Regional Emergency Center and the central alarm headquarters. If the ambulance is unable to contact the Regional Emergency Center via the "special emergency" radio, contact can be established through the central alarm headquarters by requesting the ambulance dispatcher to make a telephone-to-radio connection. The ambulance attendants can then talk to the Regional Emergency Center via the dispatching radio.

Communications with other large community hospitals (for major non-life-threatening situations) is provided by adding a channel to the "special emergency" ambulance radio and by installing transceivers at these hospitals. These hospitals have to be licensed separately through channels by the FCC for such operation.

Electrocardiography telemetry permits one-way transmission from the ambulance to the Regional Emergency Center making use of the recently authorized frequency allocations for telemetry in the 460MHz band (Fig 3). Although initially intended only for EKGs, this capability can be expanded later to include telemetry of other biomedical parameters. There are two alternate methods of transmission. If the patient is in the ambulance, the biomedical sensors are connected directly to the vehicle-mounted telemetry transmitter. If, however, it is preferred not to move the patient to the ambulance until initial treatment has been administered, a low-power, hand-portable transmitter can be used at the patient's side. The signal from this transmitter is received in the nearby ambulance and retransmitted at a higher power and different frequency by the vehicle-mounted radio, which now functions as a "repeater" station. When this method of transmission is employed, the previously described hand-portable, two-way radio is carried to the patient and is used for voice coordination of the telemetry transmission and for

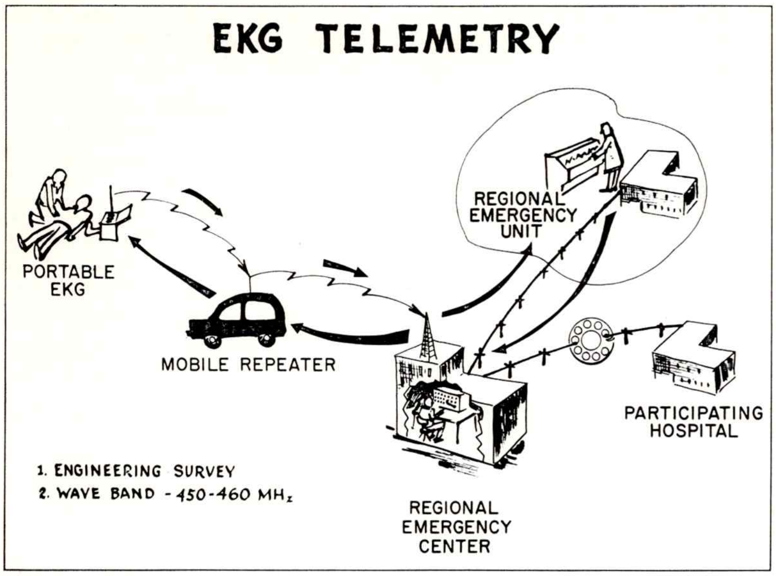

Fig 3:

This drawing is self-explanatory. Portable EKG equipment is carried from ambulance to the patient. EKG telemetry is retransmitted by the ambulance to the Regional Emergency Center. This signal is relayed to that coronary care unit where there is a cardiologist on call at that time of the day. He guides the ambulance technician in performing on-scene therapy and manages the treatment of the patient en route to the nearest appropriate coronary ca.e unit. With this system, a patient in Appalachia with a heart attack could be directed and guided to the nearest coronary care unit by a cardiologist located in Salisbury.

supervision of the patient's emergency treatment. If this low-power radio cannot be heard at the Regional Emergency Center, the transmission can be received instead in the nearby ambulance and a member of the crew can relay messages via the vehicle radio. In either case, voice communication can take place while the telemetry is in progress.

In addition to the equipment described here, recording, monitoring, and display equipment are required at the Regional Emergency Centers. A multiple-channel audio tape recorder provides a permanent record of all voice communication passing through the center. Another audio tape recorder stores EKG signals for retransmission and record-keeping. Display panels are provided indicating regional information such as bed availability, emergency room status, staff availability, helicopter status, and commnications systems status.

System Implementation

The first requirement for implementation of the system is assurance of the participation of existing communication and transportation resources. Thus, the interest and cooperation of each emergency ambulance service in the state is required. It is important to demonstrate to the operators of these systems that the planned additions will enable them to become a vital part of an improved health care delivery system, that will neither usurp nor hinder their normal dispatching operations. Also, in areas where the only emergency service is provided by the private ambulance companies and/or funeral directors, careful coordination must be effected to insure the proposed changes will not adversely affect their effort.

Second, to insure an affective and economical system design, competent engineering consultants must be engaged who are neither hardware manufacturers nor manufacturer's representatives. It will be the job of these consultants to survey each region for radio sites providing adequate coverage of the region for the two-way voice and one-way EKG telemetry systems. They will then prepare a system design defining items such as station locations, antenna heights, antenna types, and transmitter power. License aplications will be prepared to obtain authority for operation of the system with the consultant held responsible for seeing that all FCC requirements pertaining to the licensing are met. The consultants will also prepare detailed technical specifications for the procurement of radio equipment, terminal equipment, status boards, EKG equipment, and telephone service. They will then assist in evaluating contractors and their bids and, finally, will supervise the installation and test of all equipment.

Third, additional orientation and training of ambulance personnel will be necessary. In particular, crews will need training in recognizing and treating life-threatening injuries as well as orientation providing a good understanding of system operation and the new services made available to them. Personnel for ambulances specially equipped for cardiac emergencies will require extensive training in cardiac resuscitation. The training of these crews should be undertaken well in advance of the equipment installation.

Fourth, the Trauma Registry as developed by Boyd will continue to be an integral part of the program and will become of significant importance in evaluating system effectiveness.

In conclusion, the statewide communication system for emergency health care delivery should be undertaken now to assure that all future regional systems will be compatible. Within this framework each regional system can develop at its own pace.

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