EMERGENCY MANAGEMENT AT AN AIRPORT CATASTROPHE

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Prepared by the Maryland Institute for Emergency Medical Services Systems in cooperation with the Maryland Department of Transportation, Transportation Safety Division and the U.S. Department of Transportation, National Highway Traffic Safety Administration.

Printed 1979

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PREFACE

In an effort to highlight the need for consideration of a national plan in the event of a mass casualty incident, the program herein was conceived.

Without question, travel by air is one of the safest forms of transportation, - the major hazards of air travel are encountered during the surface portion of the journey - to and from the airport.

The scenario was chosen because the increased size and passenger load of today's aircraft present the potential for a mass casualty situation that would equal, or even exceed, that of a natural disaster.

During the planning of an exercise there is intense concentration on the existing emergency plans. As a consequence, problems are identified and adjustments and modifications are made prior to the exercise. The necessary organization and interagency cooperation and coordination to conduct an exercise of this magnitude eliminates the element of surprise.

Therefore, "Emergency Management at an Airport Catastrophe" (EMAC) was not presented as a "surprise exercise",--it was planned to present problems and solicit recommendations for mass casualty incidents.

To those who planned this exercise, the field portion was an "anticlimax", and the summation of the inestimable (voluntary) hours of preparation in which most of the learning had taken place. The result--each person and each organization participating achieved a new level of confidence in the ability to perform the assigned emergency management task.

Funding constraints restricted some of the "victim" evacuation plans.

Friday, May 12, 1978 started out as one of those beautiful, warm spring days that is an assurance summer is coming. The controllers in the tower at the Baltimore Washington International Airport looked out over the runways and remarked to themselves that it was a great day for flying.

At 9:30 a.m. Controller Anonymous cleared Flight 13 to Atlanta for takeoff on Runway 28. The jet, carrying 180 passengers and crew, taxied into position on the runway. Receiving final clearance for takeoff, the pilot set the plane in motion, quickly gathering speed.

Suddenly, the pilot saw an aviation fuel truck moving into the jet's path. It would cross before the plane could leave the ground. It was too late to stop.

In the control tower, controllers watched in disbelief as the jet and truck crushed together, then exploded in flame. In an automatic reflex action, one controller reached for the red phone.

In seconds, red phones rang simultaneously in five places.

In the Fire-Rescue Service, the Operations Center, the airport Police Station and the offices of the airport Director and Chief Controller, the ringing of the red phones caused immediate response, as each one implemented his phase of the disaster plan.

In the Fire-Rescue Station, on duty firemen and paramedics were already in motion. Upon seeing smoke from the crash, the firefighter on duty in the control tower picked up his direct line to the Anne Arundel County Fire Department Central Alarm.

The firefighters pulled on fireproof suits as they climbed onto their crash equipment. The huge doors of the Fire-Rescue Station opened and firefighting equipment rolled toward the crash site. Stationing their vehicles upwind of the crash site, firefighters began spraying the blaze with foam. One of the crash trucks sprayed a pathway through the flames for airport paramedics to approach the craft. Also dressed in fireproof suits, the paramedics began moving victims from the high hazard areas beneath and downwind of the aircraft to a pre-determined casualty collection area, 300 feet upwind of the crash site.

Meanwhile, the airport operations manager initiated a call sequence to alert the other medical resources: the airport Medical Director; the EMS system communications center, SYSCOM; and the Baltimore City police to transport a physician/nurse team from the University of Maryland Hospital. SYSCOM alerted potential receiving hospitals and began a bed status list for all facilities.

Within four minutes of the crash, Anne Arundel County ambulances began arriving on the scene. Anne Arundel County paramedics began to assist airport paramedics in removing victims in the high hazard areas to the casualty collection area.

Scenario

The first Maryland State Police Med-Evac helicopter arrived and was staged at a distance away and upwind of the crash site. Additional ambulances arriving on the scene were staged in a line to the casulty collection area. Airport shuttle buses stood by to transport walking wounded and non-injured victims to the Fire-Rescue Station, which acted as a casualty collection facility.

By 10 a.m. the fire was out, and paramedics continued the grim task of separating out the most severely injured victims. Triage tags were attached indicating red for first priority patients, yellow for second priority and green for the slightly injured. The dead, tagged with a gray marker, were left where they lay, to remain until crash investigators could make their verifications.

Baltimore City Police arrived by 10:15 a.m. with the physician/nurse team from the University of Maryland. The team divided itself among the color-flagged casualty collection areas and the Fire-Rescue Station, trying to stabilize patients waiting for transport. The most critically injured were sent by helicopter to trauma specialty centers, others by ambulance to the nearest hospitals.

The overwhelming number of victims were suffering from severe burns. All available critical burn beds in the Baltimore-Washington area were quickly filled. SYSCOM alerted burn centers in Pennsylvania and Virginia to expect admissions.

Military helicopters and additional ambulances from outlying jurisdictions arrived to assist in the transport of the critically and seriously injured.

By 11:30 a.m. all of the victims had been transported to a hospital or the Fire-Rescue Station. The physicians and nurses at the site went to the Fire-Rescue Station to help finish treating the victims there. Airport police secured the crash area as the State Medical Examiner and State Police identification team and National Transportation Safety Board officials moved in to examine the dead.

Smoke still rose from the charred remains of Flight 13 on Runway 28.

EXERCISE OVERVIEW

THE PROGRAM

Introduction

Mass casualty disasters present a myriad of unusual problems for all members of the disaster rescue team. Of all mass casualty disasters, airplane crashes require the rapid mobilization of more aspects of the emergency medical response system. Natural disasters, which occur regularly and usually take a much larger toll in lives and injuries, are for the most part geographically peculiar. Therefore, to study emergency management of a mass casualty disaster, using the air crash scenario is most efficient.

Exercise Overview

"Emergency Management of an Airport Catastrophe," or EMAC, was an exercise geared toward studying the process of managing a mass casualty disaster. Scheduled in conjunction with a national physician conference on disaster emergency medical management (hosted by MIEMSS), the exercise focused on the medical end of disasters, and included tests of the various other aspects and several new applications.

Co-sponsored by the Maryland Institute for Emergency Medical Services Systems (MIEMSS), the Maryland State Aviation Administration's Baltimore Washington International Airport and a number of other agencies (see acknowledgements section), the exercise was also a testing ground for new concepts in the delivery of emergency medical services. The use of a new satellite "briefcase" transceiver, which has the capability for video transmission to remote sites, was tested for applicability in long-distance physician consultation. A computer simulation of the exercise was also formulated to study the potential of computer disaster exercises.

Participating service agencies utilized the exercise to walk through their own disaster plans. Federal Aviation and EMS experts were invited to observe and critique the exercise, as were attendees of the accompanying two-day physician course.

Planning

The actual exercise comprised a relatively small portion of the overall project, most of the "work" having been accomplished during the planning phase. As a learning and information-gathering project, much of the exercise's value for the participating agencies lay in the communication and other cooperative processes involved in planning the exercise.

Regular planning sessions began six months prior to the exercise. A program steering group, comprised of representatives from MIEMSS, the State Aviation Administration, Baltimore Washington International Airport (Operations, Fire-

Rescue Service and the Medical Director) and the Maryland Department of Transportation (Transportation Safety Division), coordinated the overall planning and direction of the EMAC exercise. As functions and task areas were defined, representatives from various agencies were added to the planning group. Agencies participating included the Maryland State and Baltimore City Police Departments, the Federal Aviation Administration, the Anne Arundel County Fire Department, representatives of the commercial airlines, the Air National Guard, the U.S. Army at Ft. Meade, the Airway Limousine Services, Butler Aviation, and the Maryland Fire Rescue Institute (University of Maryland).

Task groups were broken down into the following committees: Program Steering; Air Traffic Control; Public Information and Publicity; Hospitals; Transportation; Communications; Airlines; Police and Traffic Control; Mortuary; Medical Supplies; Medical/Triage; Aviation (helicopters); Victims/Volunteers; Casualty Simulation/Moulage; Fire-Rescue/Ambulances; and Logistics.

Planning meetings were held bi-weekly until three months before the exercise, then weekly. The exercise scope and format changed as planning went on in order to accommodate the overall goals and the objectives of each agency.

A dress rehearsal using simulated casualties was held one week prior to the EMAC exercise for all participating agencies (the airport held a number of "dry runs" weekly prior to the final exercise). A dry run of the satellite portion of the exercise (described in detail) was held two days prior to the exercise.

UNIQUE ASPECTS OF THE EXERCISE

Computer Simulation

A computer simulation of the EMAC was developed to investigate the relationship of survival rate to the utilization of resources--medical supplies, personnel, and vehicles. The outcome of any particular victim would be dependent both on receiving resuscitative treatment at the scene and on receiving definitive care en route and at a medical center. The improvement or deterioration of a patient's condition was to be measured by the simulation which was to note whether and when such treatments are provided. Since some patients may benefit from preferential treatment more than others, the overall pattern of delivery of care was to be reflected in the final mortality rate. Results of the computer simulation were to be compared with those of the Friday EMAC exercise and would provide a quantitative measure of the effectiveness of the exercise.

Satellite Program

MIEMSS and the National Aeronautics and Space Administration's Goddard Space Flight Center conducted a special test of NASA's new "briefcase" satellite transceiver as part of the EMAC exercise. The "briefcase" transceiver is a land satellite station which fits into a briefcase.

MIEMSS and NASA had previously conducted tests of the transceiver to investigate its applicability to emergency medical services. Possible applications discovered included disasters in remote or inaccessible areas. In such a situation, the "briefcase" transceiver could be air-dropped into the disaster area and establish instantaneous communication via satellite. Since the transceiver operates on a UHF frequency, further applications include video transmissions. Should no physician be available in the disaster area, pictures of victim injuries could be transmitted to a physician at a remote site, establishing a long-distance physician consultation.

For the EMAC exercise, it was the remote medical consultation aspect which both NASA and MIEMSS wished to test. For the exercise, physician observer teams were made available at four locations: Chicago's O'Hare Airport; Boston-Logan International Airport; Brooke Army Medical Center in San Antonio; and the Veterans Administration Hospital in Albuquerque, New Mexico.

Two separate satellite exercises were conducted, with the ATS-6 and CTS satellites.

The ATS-6 Satellite

A portable, briefcase-sized transceiver was used with the ATS-6 satellite communications system to transmit and receive a slow-scan black and white television picture, audio or telemetry. To explore the potential of this technology, communications were established with the medical participants at Chicago's O'Hare Airport and Boston-Logan International Airport. Slow-video scans of each of five victims were transmitted along with vital signs. Evaluating physicians in Chicago and Boston attempted to assess the injuries and made recommendations for medical management.

The CTS Satellite

Full-motion color and black and white video were transmitted via the CTS Satellite to Brooke Army Medical Center in San Antonio, Texas and the Veterans Administration Hospital in Albuquerque, New Mexico. Two groups of physicians at each facility observed video of the same five patients. A group at each location observed and evaluated the color transmission as well as the black and white. These physicians also attempted to assess the victims' injuries and make recommendations to the paramedics at the scene.

Physicians at all four locations, as well as those at the exercise, recorded assessment of the five patients as well as the technology and discussed their findings and potential future applications via satellites after the exercise was completed. (See Appendix B and C)

CRITIQUE

Following the exercise, a panel of medical and aviation observers provided a brief critique of the exercise. The panel consisted of the following:

R Adams Cowley, M.D., Director, MIEMSS

Ernest A. Austin, M.D., Chief, Surgery/Traumatology, MIEMSS

Overview

Frank Barranco, M.D., Chief Fire Surgeon, Baltimore County

David R. Boyd, M.D., Director, EMS, DHEW

James P. Brown, Ph.D., NASA, Goddard Space Flight Center

B. Kenneth Gray, M.D.,President, ACEP

Henry R. Herbert, M.D., Medical Director, BWIA

Oliver C. Hood, M.D., Chief, Aeromedical Services, FAA

Matthew McCormick, Human Factors Branch, National Transporation Safety Board

Andrew C. Munster, M.D., Director, Baltimore City Hospital Burn Unit

Basil A. Pruitt, Jr., M.D., Col. U.S. Army Medical Corps, San Antonio, Texas

Captain Roger Simonds, Emergency Care Chief, Anne Arundel County Fire Department

Chief R.E. Sagan, BWI Airport Fire-Rescue Service

John D. Stafford, M.D., Director, EMS Programs, MIEMSS

General comments were made on various aspects of the exercise (for detailed comments see Appendix D).

Medical aspects for the exercise which were critiqued included medical authority, triage process, triage tags, and patient flow.

Medical Authority

Most observers expressed concern over the need for one, appropriately trained physician triage officer. It was agreed that this person should be trained in trauma (and burns) as well as field triage techniques. It was suggested that the best person for this role would be the medical director of the regional trauma center, who should be helicoptered to the scene for the triage process, then return to the trauma center. This physician should remain in contact with the EMS communications system and the hospitals while at the scene, and be available for consultation with other hospitals after returning to the trauma center.

It was also suggested that a field-trained burn specialist and additional multi-trauma specialists be available to expedite secondary triage and field stabilization of the worst injured. It was felt that ER doctors should remain at their hospitals to manage incoming patients.

Concern was expressed over the amount of time necessary to assemble and transport the physician team to the disaster scene. By the time the team arrives, many triage and transportation decisions for transport have necessarily already been made.

Triage Process

It was agreed that good triage makes the difference between life or death for many disaster victims. One observer felt that all victims of a plane crash should be admitted to the hospital for 24 hours observation to watch for reaction problems such as depression or disorientation.

Specific recommendations included the suggestion that one physician be placed in charge at each triage station in the casualty collection area, to coordinate initial and update triage and minimize unnecessary retriage.

Poor communication between physicians at the scene and at the casualty support facility (Fire-Rescue Station) was cited as a problem.

As regarded specific treatment at the scene, one physician observer indicated the need for greater utilization of backboards and spinal cord injury techniques in accidents of this sort.

Triage Tags

One medical observer commented that use of the tags in this exercise indicated a need for further training. Designation of age on the triage tag was a suggested additional feature, which would aid physicians in setting priorities. Tags blowing off and around in the wind was cited as a technical problem.

Patient Flow

Observers commented that all patients should flow in one direction, rather than in three as was done for this exercise (to the triage/ambulance area, to the helicopters, to the Fire-Rescue Station). For purposes of a true disaster it was felt that the Fire-Rescue Station should only be used for uninjured and walking wounded.

Satellite Exercise Comments

Observers comments regarding effectiveness of the satellite exercise follow:

The mean difference between assessments made by on-site and remote personnel was only three percent, which is similar to the variability between assessments made by two observers on scene five minutes apart. Observers also felt that there were no errors or disagreements on management of the victims.

RECOMMENDATIONS

General

Recommendations from the observer panel dealt largely with the need for well-thought out and coordinated disaster plans.

Since full-scale disaster drills are so expensive and funding limited, it was recommended that tests of mass casualty plans be coordinated with all involved agencies. The observers felt that tests should be mandatory and the necessary funding for them made available. Another observer felt that while periodic full-scale tests should be held, frequent tests could be made with a Command Post and computer simulation to build real-time relationships.

The medical management of mass casualty disasters was cited as an area needing extensive study and planning. Such planning should be done as part of the development of the entire regional EMS system plan, taking into consideration the geographical, organizational and political characteristics of the region.

The need for a specific emergency medical services plan for handling mass casualty, natural disasters and emergencies was considered a top priority. It was suggested that the EMS system was not the overall regional health disaster organization, but that it should interface with other organizations to provide planned emergency medical care. Also, the EMS disaster plan should be fully integrated with the local, state and regional disaster plans.

Recommendations for a National Plan

Proposal

Recommendations for consideration of a national plan for the management of burn and multiple trauma casualties at a mass casualty incident.

Background

"The entry of the jumbo, or wide-bodied, jet into commercial air transport operations has posed potential emergencies of a magnitude requiring comprehensive planning that will link effectively the airport facilities with coordinated support from the resources of the surrounding communities.

Besides carrying far more passengers that the conventional jets, the wide-bodied aircrafts are expected to have a higher percentage of survivors of crashes. In view of the possible increased number of injuries, the question of alternative medical assistance is of utmost importance, and should be considered." (1)

"The real lesson of Tenerife is that there is no national plan or international plan to deal with the aftermath of such a disaster--and we need one." (2)

"... a recent informal AMA survey of the nation's ten largest commercial air terminals suggests that the vast majority of the U.S. airports have not done sufficient planning for such mass medical emergencies." (3)

"... one could even consider evacuation by air if the regional hospitals are swamped (this point is of particular interest to burned persons, who must be sent to specially equipped centers). (4)

"When the emergency department facility is less that 60 miles from the specialty burn center, the patient should be transported by ambulance. Fixed wing air transport using a commercial airline is accomplished when the distance between the burn center and the emergency department is greater than 60 miles. The ground or air transport vehicle should be equipped as a mobile advanced life support unit with specifically trained staff." (5)

"The first 60 minutes (the "Golden Hour") following an accident often determine whether a patient will live or die. On-site resuscitation, triage, communication and transportation with care enroute must be available to complement definitive care at the trauma center." (6)

Discussion

The exercise, "Emergency Management at an Airport Catastrophe", held by the Maryland Institute for Emergency Medical Services Systems in conjunction with the Baltimore Washington International Airport on May 12 and 13, 1978, illustrated the need for a national plan to transport victims of a mass casualty incident to specialty referral centers for definitive care.

The scenario of "Emergency Management at an Airport Catastrophe" (EMAC) was developed so that the victim injuries would require evacuation to definitive care outside the Metropolitan Baltimore Area.

As an example, the eighty (80) burn victims exceeded the capabilities of the Baltimore Burn Centers, and the following beds were available in adjacent states:

- Medical College of Virginia (Burn Center) Richmond, VA	12 beds
- Norfolk Medical Hospital (Burn Center), Norfolk, VA	3 beds
- Philadelphia Crozer Burn Center, Philadelphia, PA	15 beds
- University of Virginia (Burn Center), Charlottesville, VA	3 beds
- Washington Hospital Burn Center, Washington, DC	4 beds
TOTAL	37 beds

Overview

The above beds available in adjacent states, coupled with the Baltimore Burn Center facilities and local hospitals would have been adequate for these burn victims. The problem then became one of transportation availability to transport these patients to the definitive care centers.

Conclusion

At the present time there has been identified a need for the development of a national plan to cope with a mass casualty incident presenting a need for immediate evacuation of victims to definitive specialty care centers.

Recommendations

The National Health Resources Advisory Committee should establish a Task Force to develop a National Plan for mass casualty incidents.

The NHRAC Task Force should include one of each of the following :

- National Transportation Safety Board
- Federal Aviation Administration
- Emergency Medical Services, DHEW
- Aeromedical Evacuation Wing, U.S. Air Force
- Federal Preparedness Agency, General Services Administration
- A Traumatologist
- A Burn Specialist
- Representatives of the Fire-Rescue Services

The Task Force will identify and describe:

- The resources available for transportation of mass casualty victims to definitive care centers.
- The communications necessary to mobilize the resources necessary.
- The authority and authentication procedures.

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ARTICLES

PREPARATION AND ORGANIZATION OF AN EMERGENCY MEDICAL PREPAREDNESS EXERCISE

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ABSTRACT

The detailed steps of organization and procedures necessary for the execution of an Emergency Medical Preparedness Exercise (EMPE) are presented. The facets of preparation, planning, coordination and control are discussed, along with the necessary approach to evaluation and critique.

The steps necessary for execution of an Emergency Medical Preparedness Exercise (EMPE) involve detailed planning and coordination. The idea for an EMPE usually is conceived by one progressive individual and implementation becomes the task of many. The period required from conception to delivery in most instances is ten to twelve months. An active, effective everyday Emergency Medical Services capability is the viable solution for medical response to mass casualty situations. The day-to-day emergencies, such as the highway accident and other trauma victims, the cardiac patients, the severely burned, the neonatal emergencies, etc,--all contribute to the medical resources that are available for muster. The phases and steps required for implementation are detailed as follows:

DEVELOPMENT PHASE

This is the initial phase of the EMPE and necessitates:

- Research into possible, or probable precedence for an EMPE and preparation of a realistic "Scenario."
- Defining the objectives of the exercise. What is to be tested? What is to be accomplished?
- Identifying the participants in accordance with the medical resources available.
- Soliciting and gaining support for the exercise from the influential and motivated groups in the area.

The development phase is usually implemented by establishing liaison through personal contact with the interested individuals. The task is not as simple as it appears, and caution must be taken to carefully identify the positive thinkers and definitely avoid the negative thinkers. Progress beyond this phase is not recommended until a positive foundation has been developed to mold an EMPE.

PLANNING PHASE

Once a firm "base for support" is evident, then the formation of a steering committee is crucial, --the individuals chosen must be motivated and industrious. The groups to be represented are:

- Ambulance Associations
- Explorer Scouts
- Fire/Rescue Associations
- Health Department
- Hospitals
- Hospital Associations
- Law Enforcement Agencies
- Local Civil Defense
- Mayor's Office or County Executive's Office
- Medical Society
- Medical Examiner
- Physicians (who have shown interest in past exercises)
- Public Safety Agencies (local and state)
- Red Cross
- United States Military Services Representatives

A letter is sent to each of the agencies, or groups, inviting them to the first steering committee meeting; the letter being tactfully structured to request the individuals desired.

The steering committee meeting must be planned in advance, so agreement for the objectives may be presented and modified to satisfy the interests of all the participating agencies. Once agreement is reached on objectives, then the responsibilities of each committee are enumerated, a chairperson appointed and task assignments made.

The committees, with task assignments and responsibilities, needed for an EMPE are:

CHIEF MEDICAL OFFICER/FIELD MEDICAL OPERATIONS

Task assignments and responsibilities:

- Plan and implement field medical operations.
- Organize triage methods and concepts at the mass casualty site.
- Organize a method for moving patients from the field to the clearing station.
- Establish and coordinate with medical advisory committee.
- Coordinate with medical groups and hospitals.
- Prepare list of anticipated injuries (distribution of casualties).

CASUALTY SIMULATION/MOULAGE

Task assignments and responsibilities:

- Provide area for moulage of victims on morning of the exercise.
- Acquire materials necessary for moulage.
- Organize teams for moulage.
- Issue instructions to victims to be moulaged concerning clothing.
- Prepare lists of injuries for moulage.
- Brief "victims" on demeanor during exercise.

MORTUARY

Task assignments and responsibilities:

- Advise proper authority requesting use and participation of the Identification Team for identification of the "dead".
- Advise State Medical Examiner, and request participation.
- Provide mortuary area at the incident scene.
- Provide refrigeration units for storage of the dead as required.

- Provide "stakes" and necessary maps for location of the dead prior to removal of "dead victims" from the scene.
- Distribute instructions to field medical and triage teams concerning the handling of the "dead victims" in order to avoid loss of items that will assist in identification.

EVALUATION AND CRITIQUE

Task assignments and responsibilities:

- Recruit, organize and instruct evaluation teams.
- Organize teams to evaluate each component.
- Design and distribute evaluation forms.
- Assign evaluation teams to specific locations.
- Coordinate evaluation plans with hospital administrators.
- Conduct formal critique of exercise.

VICTIM VOLUNTEERS

Task assignments and responsibilities:

- Recruit "victims" for the Emergency Medical Preparedness Exercise.
- Prepare instruction sheets for "victim" volunteers.
- Acquire food and refreshments for victim volunteers.
- Coordinate transportation both to and from the incident site.
- Organize accountability and control for each volunteer participating.
- Volunteers may be solicited from:
    - Churches
    - Military bases
    - Hospitals
    - Eagle scouts

RED CROSS

Task assignments and responsibilities:

- Disaster Nurse on call (Prepositioned).
- Providing liaison for blood/plasma.

HOSPITAL

Task assignments and responsibilities:

- Solicit participation of area hospitals.
- Establish liaison with participating hospitals and emergency rooms.
- Coordinate provisions for field Emergency Medical Teams at the incident site.
- Conduct meetings with area hospital administrators to provide information on progress of exercise planning.
- Furnish guidelines to hospitals for establishing holding and refreshments area for "victims" transported to each hospital.
- Provide for critique of hospital participation.

COMMUNICATIONS

Task assignments and responsibilities:

- Provide the communications necessary for conduct of the exercise.
- Establish communications with EMS communications systems.
  - Ambulance to ambulance
  - Ambulance to helicopter
  - Ambulance to hospital
  - Helicopter to hospital
  - Hospital to hospital
- Make provisions for command post vehicle communications.
- Utilize amateur groups such as REACT, CB'ers, etc.

- Provide for informal supervisory communications network at the incident site.

POLICE/SITE TRAFFIC CONTROL

Task assignments and responsibilities:

- Organize and provide necessary personnel for traffic control at the incident scene, parking areas, marshalling points, etc.
- Organize and provide personnel for crowd control at the incident scene.
- Provide escort for emergency vehicles as appropriate.
- Designate parking areas for:
  - Observers
  - Victims
  - Other visitors
- Design and distribute parking stickers and traffic control maps which designate detours and rerouting.
- Provide barricades as needed.
- Coordinate "police mutual aid" agreements as required.

MEDICAL SUPPLIES

Task assignments and responsibilities:

- Determine medical supplies required for exercise.
- Procure medical supplies.
- Prepare medical supply units (kits).
- Distribute medical supply kits to participating ambulance companies.
- Coordinate support of relief agencies, such as the American Red Cross.

AVIATION

Task assignments and responsibilities:

- Organize plans for helicopter operations.

- Coordination with FAA to avoid interference with air space.

- Distribute dispatch of aircraft to definitive care centers.

- Implement a plan for:

  - Utilization of Medevac aircraft
  - Loading of "victims" onto aircraft
  - Delivery of medical supplies as required

- Brief all exercise participants on the functions of medevac aircraft.

FIRE-RESCUE/AMBULANCE

Task assignments and responsibilities:

- Organize and provide EMT-A and firefighters at the incident site.

- Coordinate fire suppression and rescue activities.

- Provide emergency lighting.

- Examine and implement "mutual aid agreements" as appropriate.

- Solicit ambulance participation (local and non-local).

- Coordinate ambulance dispatch and control.

- Provide EMT-A's for triage teams at scene.

- Supply triage tags and instructions.

- Recruit volunteers to assist as litter bearers at the scene.

PUBLIC INFORMATION AND PUBLICITY

Task assignments and responsibilities:

- Prepare guidelines for press releases.

- Manage electronic and printed media representatives.

- Prepare handouts (information packets) including maps, charts of the site, etc.

- Send out invitations to observers and spectators.

- Provide area for the press.

- Make available refreshments for the attendees.
- Video-tape filming of exercise for future documentary.

LOGISTICS

Task assignments and responsibilities:

- Provide shelter, as appropriate.
- Provide Spot-A-Pots.
- Provide observer bleachers.
- Coordinate logistical requirements of other committees.

TRANSPORTATION

Task assignments and responsibilities:

- Provide bus transportation for observers, registrants and "victims".
- Provide transportation for VIPs and special guests.
- Provide transportation for return of "victims" transported to hospitals.
- Coordinate provisions for a transportation/communications network.

PROGRAM STEERING

Task assignments and responsibilities:

- Prepare scenario and "game plan".
- Provide a system and guidance to all committees participating.
- Prepare and issue operational order which provides for command control.
- Issue policy directives as appropriate.

In closing the first steering committee meeting, schedule the second meeting four (4) weeks later. The "minutes" of the meeting should be prepared and distributed within one week.

At the second steering committee meeting initiative and progress are determined, since they reflect early accomplishments and generate enthusiasm for the exercise. Progress reports are given by each sub-committee chairman, and information is exchanged. The EMPE coordinator acts as chairman of the steering committtee, summarizes the meeting with the overall progress to date, tasks to be completed, and offers personal guidance to the sub-committee chairpersons. At the close of this meeting a third steering committee meeting is scheduled six (6) weeks later. The "minutes" of the second meeting should be prepared and sent out within two weeks.

At this point, definitive action by the EMPE coordinator is required:

> Individual contact with each of the sub-committees is initiated and guidance, assistance and encouragement is given. This facilitates completion of the task assignments.

During this period:

- The "Scenario" is finalized.

  The "Scenario" sets the scene of the exercise and describes the events leading to the mass casualty situation. The "Scenario" should not become belabored with technical details.

- The "Game-Plan" is prepared.

  The "Game Plan" chronologically details the sequence of events and becomes most useful in assessment of tasks to be accomplished.

The third steering committee meeting assesses accomplishments to date and inventories the tasks that have not been completed. The "Scenario" and the "Game-Plan" are discussed and each sub-committee chairperson is requested to submit their corrections for the "Game-Plan". Each sub-committee is also asked to prepare the operational plan for their group. Preparation of the sub-committee operational plan serves the following purpose:

- Assists in the organization of the sub-committee and increases the awareness of tasks to be accomplished.

- Provides a rough draft for the EMPE operational plan.

A fourth and final steering committee meeting should be scheduled three weeks prior to the exercise, affording the time to react in the event major obstacles are encountered. The agenda for this meeting includes a progress report from each sub-committee with emphasis on tasks that have not been completed.

The finalized "Game Plan" is distributed and includes the "Task Coordinator" for each event.

The EMPE operational plan is also distributed and fully discussed, the "COMMUNICATIONS" and "COMMAND" paragraphs are deserving of special attention. Command authority must be explicit since this is the area of the exercise that usually breaks down and creates problems. This steering committee is summarized as an inventory of the tasks that remain outstanding.

OPERATIONAL PHASE

Proper and complete development, coordination and planning lead into the operational phase. This phase is the summation of all past efforts and therefore reflects the detailed planning and the capabilities of the exercise that interplay.

Although the operational phase is the most interesting, usually this is truly anticlimatic to the planner. The "Game Plan" and "Operational Plan" control the actions and all parts of the puzzle fall into place.

CRITIQUE PHASE

Upon completion of the EMPE operational phase, information on the evaluation must be assembled and assessed to determine:

What was learned?

How can we improve?

The critique meeting must be held as soon after the EMPE as is feasible. The meeting must be free and open, so that a complete interchange of ideas may take place.

First the Chief EMPE Evaluator will present his views and impressions as assembled through information received from the field evaluator teams. Then each sub-committee chairman reports on the lessons learned and the recommended improvements.

The meeting is summarized listing what was learned and the improvements recommended.

Copies of the "Minutes" of this meeting are distributed to all that have attended previous meetings as well as the participating hospitals.

AFTER-ACTION PHASE

Follow-up on the recommendations for improvement is made so that revisions may be made in existing Emergency Medical Preparedness Plans.

DISCUSSION

The development and implementation of an Emergency Medical Preparedness Exercise is a task of planning and coordination; it involves a great number of individuals in many different activities.

An EMPE is of value to the community and the participating agencies because it:

Acts as a "learning experience"

Prepares the available medical resources to properly respond to mass casualty situations.

Further trains medical and paramedical personnel in mass casualty control, triage and evacuation skills.

Identifies strengths and weaknesses in existing plans.

Affords a stage for field testing new concepts and methods.

Offers a mechanism to evaluate local medical and hospital emergency preparedness plans.

Promotes better coordination and cooperation among agencies.

Permits evaluation of decision making and the capabilities of equipment and medical resources.

Tests lines of authority and communications.

Inspires confidence of the participating agencies, in that they are capable of successfully responding to a mass casualty stituation.

FEASIBILITY STUDY OF SATELLITE . TECHNOLOGY UTILIZED IN "BURN PATIENT" ASSESSMENT OVER LONG DISTANCES

A.L. Trohanis and B.J. Sopp

Maryland Institute for Emergency Medical Services Systems

The goal of the feasibility study was to determine the technical/operational asibility of providing remote assessment/diagnostic assistance via communications satellite technology for victims requiring medical assistance in emergency situations. The emphasis of this demonstration will be (1) initial assessment/diagnosis of the burn patient; and (2) development of first-stage medical treatment recommendations.

This study will compare the accuracy of assessments/diagnosis done through (a) two portable/transportable satellite-based telecommunications systems; (B & W slow scan via the ATS-6 satellite; and full motion color via the CTS satellite;

(b) two-way audio communication; and (c) physical-presence physician consultations. The satellite-based systems that were emphasized during the study were currently available experimental communication satellites.

The four treatment groups included:

Group A - 1 physician on-site assessment at BWI Airport assessing patients.

Group B - 2 physicians at Brooke Army Medical Center, San Antonio, Texas, assessing patients via CTS Satellite in one-way full motion color/two-way audio.

Group C - 1 physician at Chicago O'Hare Airport assessing patients via ATS-6 Satellite in one-way B & W slow-scan video plus two-way audio.

Group D - 1 physician at Baltimore, Maryland assessing patients via two-way audio only.

Nine patients were pre-selected with predetermined injuries which were "certified" by one burn specialist physician on-site at Baltimore Washington International Airport. The nine patients were randomly rotated through all four stations. The stations were manned by one Maryland CRT, or Cardiac Rescue Technician (200 hours plust 84 hours U.S. DOT Emergency Medical Technical training). The CRT transmitted patient related information and vital signs, as described in the primary and secondary survey required in the U.S. DOT Emergency Medical Technician training module. This included:

1. Check for adequate breathing
2. Check for a pulse

3. Check for severely bleeding injuries
4. Check the scalp for lacerations and contusions
5. Check the skull for depressions
6. Check ears and nose for fluid and blood
7. Check the neck for fractures
8. Check the chest for movement or fractures
9. Check the pelvic area for fractures
10. Check the abdomen for spasms and tenderness
11. Check the extremities for fractures
12. Check for paralysis of extremities
13. Check the buttocks for fractures or wounds

The study patients were numbered with a tag such as 1-S, on. The physicians doing remote assessments and the physicians on-site at BWI were utilizing a "Patient Assessment" form; documenting patient data, location of injuries, his estimate of total percentage of 2nd and 3rd degree burns, other injuries such as fractures, etc., and recommended treatment at the scene.

The preliminary evaluation of the data collected from the experiment implied that there was little difference in the effectiveness of the three telecommunication modes when used for remote patient assessment and diagnosis. Thus, we concluded that there is insufficient evidence to indicate that one telecommunication system is superior to another system.

One factor contributing to the fact that the data was inconclusive may be the highly skilled paramedics with extensive experience in patient assessment who were involved at the scene, and their familiarization in the use of a VHF two-way radio communication system (physician to paramedic) which is currently utilized within the State of Maryland. Other factors that affected this conclusion were that a small sample group was used and the patients were moulaged and not actual disaster victims.

Some limitations of both satellite communication systems were identified. These included the portability of the equipment and the technical staff required to operate the said equipment. In regards to the ATS-6 communication system, specifically, B & W slow-scan, the single transmit channel available created a communication problem between the physician in Chicago and the paramedic in Baltimore; it required approximately 60 seconds to transmit a still frame picture of the patient. Consequently, this method did not permit the paramedic and physician to communicate by voice during the visual transmission. In a true emergency situation, this time period is very critical. In addition, the physician evaluating the patients via ATS-6 felt that color would be essential in assisting his evaluation of the burn patients.

Conversely, the CTS satellite system eliminated these disadvantages by providing the physician in San Antonio and the paramedic in Baltimore with two full channels. Specifically, one full motion color video channel, and one two-way audio channel, allowing constant audio and visual communication through the patient assessment process. The paramedic said, "It felt as if the physician was right over my shoulder." Likewise, physicians in San Antonio were impressed by the color and the visual quality.

The VHF two-way portable radio communication system definitely had its advantages over the satellite systems, i.e., the ease of set up, time needed to adjust and its portability. Both the physician and paramedic were familiar with this system.

Although it was concluded that there is insufficient evidence to indicate that one telecommunication system is superior to another system, all participants felt that the utilization of these telecommunication systems could be of value for assistance at a large disaster in medical assessment and triaging of burn and trauma patients.

BURN INJURIES FOR SATELLITE ASSESSMENT

PATIENT #1 - S

Injury Description:

Extensive burns on hands, face and legs. Clothes partially burned away. Third degree burns over 90% of the body.

90% burns | Survival 0% | BP - 80/50 | Pulse - 130
Resp. - 10

PATIENT #2 - S

Injury Description:

Burns on chest, back, arms. Second and third degree burns over 50% of the body.

50% burns | Survival 29% | BP - 110/60 | Pulse - 120
Resp. - 22

PATIENT #3 - S

Injury Description:

Small burned area on face and neck only. Singed nasal hairs, hair partially burned. Second degree burn.

6% burns | Survival 0-97% | BP - 140/80 | Pulse - 120
Resp. - 32

PATIENT #4 - S

Injury Description:

Burned on both legs. Second and third degree burns covering 30% of the body surface. Also fracture of the femur.

30% burns | Survival 56% | BP - 90/60 | Pulse - 120
Resp. - 22

PATIENT #5 - S

Injury Description:

Isolated burn of the right arm up to the shoulder and down to the wrist. Third Degree burn. Only 7% of the body surface.

7% burns Survival 97% BP - 120/82 Pulse - 118
Resp. - 18

PATIENT #6 - S

Injury Description:

Extensive evisceration of abdominal organs. Second degree burns on right leg.

9% burns Survival 95% BP - 110/80 Pulse - 120
Resp. - 18

PATIENT #7 - S

Injury Description:

Small 3rd degree (deep) burn on forehead. Sole of left shoe burned, with 3rd degree burn on heel of left foot.

4% burns Survival 97% BP - 90/Palp Pulse - 160
Resp. - 8

PATIENT #8 - S

Injury Description:

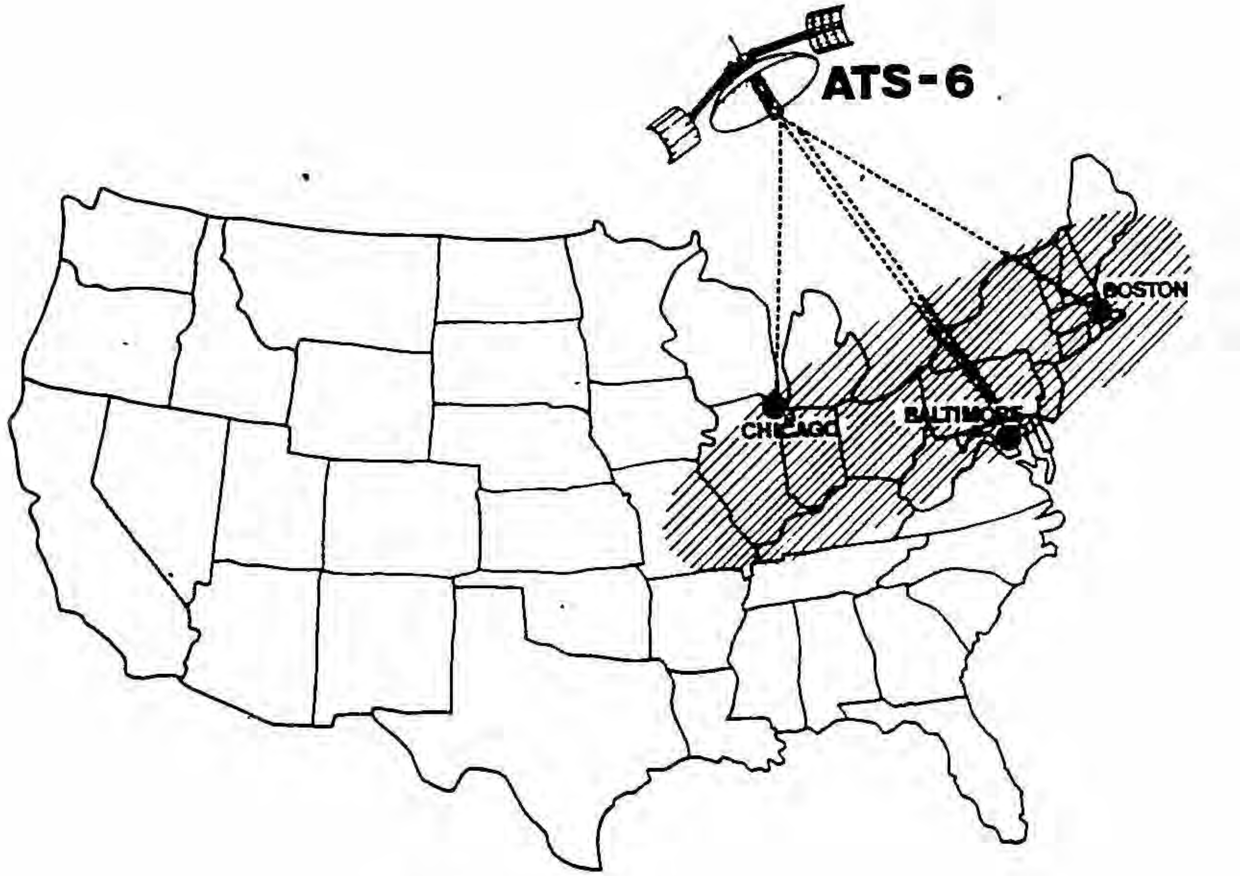
Second and Third degree burns on both hands and forearms. Impailed objects in face.

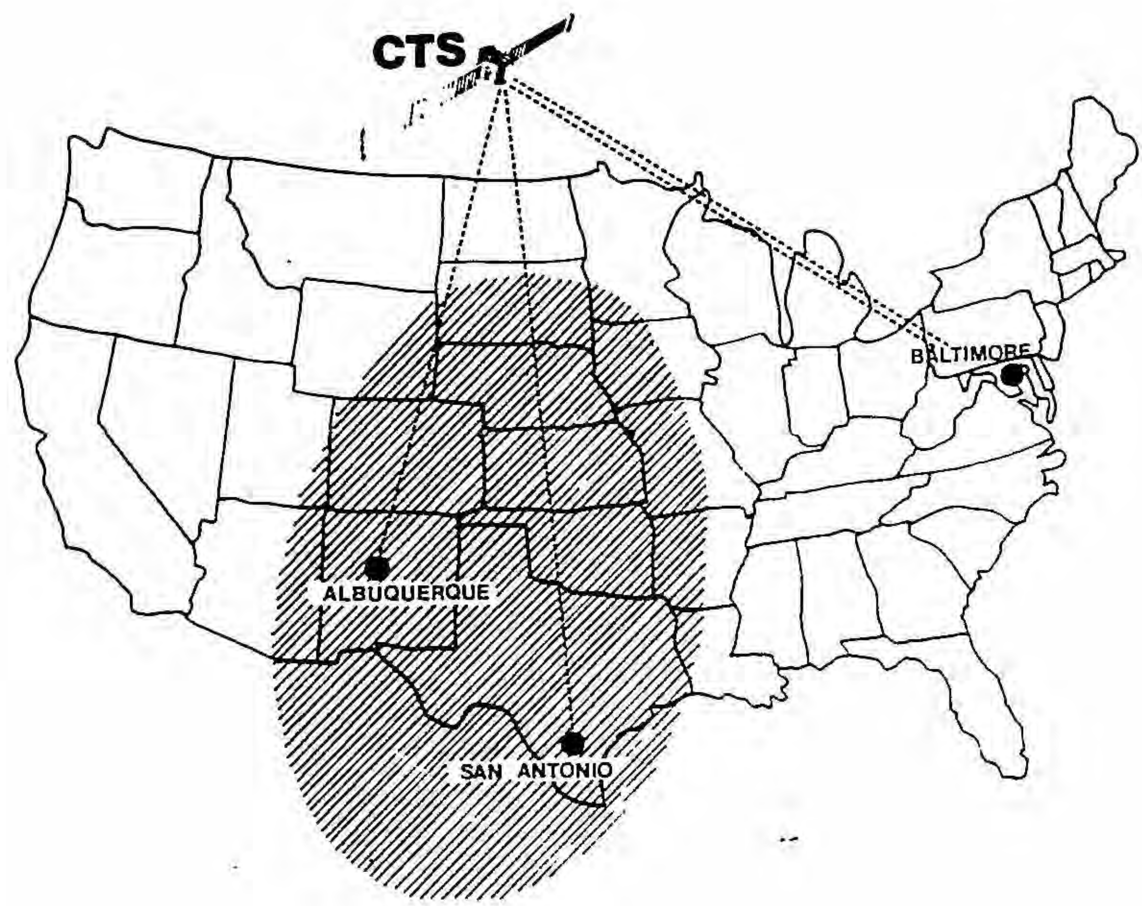
10% burns Survival 95% BP - 108/76 Pulse - 100
Resp. - 20

NOTES:

Above patients should be moulaged with clothes on. Clothes may be partially cut away. Victims dressed with clothes partially burned away and clothes appearing "sooty".

A series of questions were prepared for the evaluating physicians.


ATS-6
BOSTON
CHICAGO
BALTIMORE


CTS
BALTIMORE
ALBUQUERQUE
SAN ANTONIO

COMPUTER SIMULATION OF DECISION MAKING ON THE SCENE OF A MASS CASUALTY INCIDENT

D.E. Lamb, A.V. Milholland, R Adams Cowley, F.E. Sylvanus and A.J. Gretes

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Decision made by medical personnel at the scene of a major Mass Casualty Incident (MCI) may significantly affect the survival rate of MCI victims. These decisions involve the allocation of resources such as medical personnel, supplies and evacuation vehicles to victims at the scene of the MCI as well as the choice of hospital to which each victim is evacuated. Since these resources may be in short supply, victims must wait varying lengths of time to receive needed resources, and these delays can adversely affect the victim's probability of survival.

The objective of decision makers at the scene of a MCI is to allocate resources among the victims in an attempt to maximize the number of survivors. A computer simulation study has been undertaken to explore how this can be accomplished and to determine how much improvement in survival rates might be achieved through better resource allocation decisions. The example chosen for the simulation is that used in a recent emergency medical preparedness exercise involving the collision of an aircraft and a fuel truck with approximately 200 victims grouped into 29 different injury categories. The changing medical condition of each victim as influenced by decisions resulting in the allocation or withholding of resources is included in the simulation.

Results are presented comparing simulation of different evacuation strategies and resource availability scenarios.

INTRODUCTION

Decision making may be more or less difficult depending upon the number of factors which should be considered, the cost of a mistake, and the extent to which objective data and guidelines are available to assist in the decision-making process. Consider a case where:

1. A large number of decisions must be made.
2. Much of the information on which one would like to base these decisions is missing.
3. The decisions must be made quickly.
4. A number of human lives depend on the results of these decisions.

What we have here is the job description of the chief medical officer on the scene of a major MCI. He must decide how to allocate medical supplies and medical personnel to victims at the scene of the MCI. He must decide the order in which victims are to be evacuated, the mode of transportation to be used for each victim and the destination to which each victim is to be sent, i.e. to a nearby hospital or to a more distant specialty care center. He must make these decisions in a highly emotionally charged atmosphere.

What guidelines should be used in making these decisions? How can people be trained to do the most effective job in making these decisions? Clearly, this is an area in which controlled experiments are impossible. The kind of experiment we would like to perform is one in which we could turn back the clock and repeat a MCI such as the Tenerife disaster over and over again, each time using a different basis for deciding how to allocate resources to the victims and each time measuring the overall effect of these decisions in terms of the number of survivors.

As an alternative to the impossible, at the Maryland Institute for Emergency Medical Services Systems, we have been using computers to simulate a major MCI and to study the impact of decision-making at the scene of the MCI on the number of survivors. To do this we need both a broad conceptual model applicable to any MCI scenario and a detailed model specific to one MCI.

The broad conceptual model of an EMS system is shown in Figure 1. The EMS system can be viewed as having three different categories of inputs. Accident victims comprise the first category of inputs to the system. These victims have a variety of attributes, the most important being the nature and severity of their injuries. Other attributes include age and physical condition prior to the injury. The second category consists of the various resources which the victims may require including medical supplies and personnel dispatched to the scene of the accident, and vehicles to evacuate victims from the accident scene to appropriate hospitals. The third category of inputs to the EMS system consists of information in the form of resource allocation decisions. Given the set of victims and the available resources, decisions must be made to establish how the resources are to be allocated to the victims. If an ample supply of all resources is available, the resource allocation problem becomes trivial. However, if sufficient resources are not available, the number of survivors may be significantly influenced by the resource allocation decisions. Outputs from the EMS system consist of victims classified either as survivors or as deaths. The overall objective of the resource allocation decisions is to maximize the number of survivors.

We can translate this broad model into a specific one by specifying:

1. The number of victims and the nature of each victim's injury,
2. The number of units of each resource (personnel, medical supplies and evacuation vehicles) available initially at the accident scene and the rate at which new resources arrive on the scene,
3. The transit time from the accident scene to each hospital for each type of evacuation vehicle.

To illustrate the application for computer simulation methodology to the resource allocation decision-making process, we chose as a specific model the emergency medical preparedness exercise that was held on May 12-13, 1978 at the Baltimore Washington International Airport, "Emergency Management of an Airport Catastrophe," (EMAC). As summarized in Figure 2, the exercise was built around a simulated accident consisting of the collision of a large passenger aircraft and a fuel truck. There were approximately 200 accident victims, each of whom was assigned to one of 20 different injury categories. Details of the injury categories are provided in an accompanying report. Each victim was supplied with a victim vital sign card which listed vital signs as a function of time conditional upon the type of treatment provided to the victim and the time delay in providing the treatment. In addition to vital signs, the cards listed the probability of survival as a function of time and conditional upon the treatment received by the victim. The victim vital sign card also included a brief written description of the nature of the victim's injuries. The victim vital sign cards are described in more detail in an accompanying report. Finally, just prior to the beginning of the exercise, each victim was processed by a moulage team to provide a realistic visual representation of the injuries defined by the various injury categories.

As summarized in Figure 3, the information available for decision-making at the scene of the accident consisted of an injury description for each victim together with a list of the number of units or each resource currently available.

Now consider a single victim moving through the system. The victim has pre-assigned survival probabilities conditional on the resources which he receives at the time at which they are received. As an example, prior to the exercise one victim was give an injury description which is summarized in Figure 4. The survival probabilities listed in Figure 4 are defined as the probability of survival to the end on the indicated time period conditional upon the victim being alive at the beginning of that time period. Different survival probabilities are indicated for each victim at each time period. These survival probabilities reflect the resources which previously have been allocated to the victim. For example, the survival probabilities for many victims reflect whether or not the victim received an IV during the first hour following the injury. The survival probabilities also reflect the time delay before the victim receives definitive care in a hospital. The survival probability for victims who are alive upon admission to a hospital represents the probability of surviving beyond the time of discharge from the hospital. To determine whether or not each victim survives to the end of a time period, a pseudo-random number is generated in the range 0 to 1. If the pseudo-random number is less than the indicated survival probability, the victim is considered to have survived to the end of the time period.

MODEL OVERVIEW

An overview of the various steps in the EMS system through which MCI victims pass is shown in Figure 5. The first step consists of fire suppression followed by extrication of trapped victims. It is assumed that the rate of extrication follows a Poisson distribution, the mean value of which is a user-defined parameter.

A triage assessment is next undertaken based on the injury description and vital signs. Priorities are assigned to victims for transport to the clearing station. Triage team members represent a required resource, the sources of which are CRTs, doctors and nurses. Transport of victims to the clearing station requires two additional resources: litters and litter bearers. Litter bearers are comprised of firemen, CPRs and EMTAs. A specified number of units of these resources is available at the initial time of the accident. Additional units are assumed to arrive on the scene in accord with a Poisson interarrival time distribution, the mean value of which is a time dependent function. The Poisson distribution is typically employed in stochastic simulations of this type because it nearly always provides a good approximation to the distribution of interarrival times obtained by direct measurements of the time interval between the successive arrival on the scene of entities such as ambulances. The Poisson distribution is defined in terms of only one parameter, namely the mean value of the distribution. In a realistic scenario, the mean value of the interarrival time distribution for any resource may change as a function of time. Such changes are incorporated into the model in the form of a separate time dependent function for each resource. An example of the time dependent interarrival time function for the arrival of ambulances is shown in Figure 6.

After arriving at the clearing station, resuscitation and stabilization procedures are administered to the victims. This requires availability of both human resources and medical supply resources which are allocated to victims according to assigned victim priorities. Three different procedures are available in this simulation for assignment of victim's priorities.

1. Priority according to tag color (3 levels). Within a given tag color, victims are assigned priority on a FIFO basis ("First In, First Out") = "First Come, First Served," i.e. the highest priority within a tag color group is assigned to the first victim to arrive).

2. Priority according to arrival time at clearing station on a FIFO basis.

3. Priority according to the difference between the probability of surviving to the next time period with and without treatment. Time periods are defined to be:

   a. 0 to 1 hour after accident,
   b. 1 to 2 hours after accident,
   c. 2 to 4 hours after accident,
   d. 4 to 6 hours after accident.

The next step in the passage of victims through the EMS system is evacuation to a definitive care hospital. This requires decisions by the triage officer as follows:

1. Specification of the priority for evacuation of each victim,

2. Specification of the destination of each victim,

3. Specification of the mode of transportation, i.e. ambulance or helicopter for each victim.

Resources in the form of each type of transportation vehicle are assumed to arrive in accord with a Poisson interarrival distribution with a mean value established by a time dependent function.

SIMULATION CAPABILITIES AND RESULTS

The capabilities of the computer simulation and the results of a series of simulation runs are discussed in this section. The simulation program was implemented in the GASP IV (General Application Simulation Program) simulation language. Since GASP IV is a relatively low level simulation language, it facilitates the implementation of a greater range of capabilities than are possible with other simulation languages. These capabilities include:

1. Evaluation and monitoring of victim status at variable time intervals,
2. Control over the maximum number of units of each resource which arrives on the accident scene during the simulation,
3. Several methods of determining the priority of each victim with respect to clearing, local treatment and evacuation to full treatment facilities,
4. Inclusion of "weather/transportation factors" which alter ambulance transit times and the mean value of the interarrival distributions of all resources. Also included is an independent capability of grounding helicopters,
5. An ability to trace the path of each victim throughout the simulation,
6. Monitoring the arrival and usage of each resource during the simulation,
7. Providing a report at the conclusion of each simulation run including complete statistics on each victim,
8. Inclusion of parameters which Control fire suppression time and victim extrication time,
9. Control of the seed employed by the pseudo-random number generator during each simulation run.

A set of standard parameter values to be used in the simulation were established as a result of a number of consultations with MIEMSS personnel.

The first part of the simulation study involved determination of the number of runs which must be made to obtain reliable estimates of survival rates. In these runs, the pseudo-random number seed was varied while keeping a set of standard parameter values constant. The standard parameter values used in this initial set of runs is listed as follows:

1. Maximum number of IV's = 200,
2. Weather/transportation factors = clear day, normal traffic conditions,
3. Priority for transport to clearing area = FIFO

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1. Maximum number of IV's = 200,

2. Weather/transportation factors = clear day, normal traffic conditions,

3. Priority for transport to clearing area = FIFO

4. Priority for treatment at the scene = FIFO,

5. Priority for evacuation = FIFO.

The term FIFO refers to a first in, first out type of queue. The average fatality rate for these first simulation runs using the standard parameter values was 72.3 out of a total of 160 victims.

At the completion of each run, the standard deviation of the running average of all runs completed up to that point was computed. The maximum number of runs in a give run set was determined by comparing the standard deviation. Additional runs were made until the computed standard deviation became less than the user-specified standard deviation.

Several sets of simulation runs were made in an attempt to optimize queuing priority methods. The results of these runs are summarized in Table I. Run Set 4 showed the lowest fatality rate and employed a queuing arrangement involving sequencing by tag assignment for transport to the clearing station and administration of treatment. The queuing procedure used for evacuation of victims to hospitals in Run Set 4 consisted of sequencing victims in order of the difference between their survival probability conditional upon their receiving full treatment at a hospital during the current time period and their survival probability conditional upon not receiving such treatment in the current time period. Run Set 4 was used as a standard of comparison with subsequent runs.

Based upon the queuing methods used in Run Sets 1-4, it could be expected that Run Set 3 would yield the lowest average number of fatalities. The fact that Run Sets 3 and 4 yield similar results is a consequence of very little queuing for transport to the clearing area due to an ample supply of litter bearers and relatively few victims receiving treatment during the first hour due to limited availability of medical personnel.

Three sets of runs were used to evaluate the effect of a shortage of IV units on the fatality rate. The results of these runs are summarized in Table 2. Finally, runs were made in which the weather/transportation factors were altered to reflect several sets of weather and traffic conditions. The weather/transportation factors are simulation parameters which can be varied to reflect less than optimal weather and transportation situations.

The weather/transportation factor, K, is defined to be the percent increase in an ambulance transit time due to adverse weather or traffic conditions,

i.e. actual transit time =

(normal transit time) x (1. + 0.01 K).

Thus when K = 0, actual time =

normal transit time,

and when K = 100, actual transit time =

twice normal transit time.

Adverse weather conditions are assumed to affect not only ambulance transit time but also the mean value of the interarrival distribution for the following resources: firemen, CPRs, EMTAs, CRTs, nurses, doctors, litters, I.V.s, and ambulances. Each of these resources has a weighting factor, Wi, which is user specified. The mean value of the interarrival distribution for the i-th resource if given by:

actual interarrival time =

(normal interarrival time) x (1. + 0.01 K Wi).

To further explain the role of the weighting factor, consider a comparison of the combined effect of the weather/transportation factor and the weighting factor on the interarrival times for nurses and firefighters. At a given time, T, during the simulation, the normal interarrival time for nurses, Nn, can be extracted from the time dependent interarrival time distribution which is defined for nurses. Similarly, the normal interarrival time can be extracted for firemen:

Nn = normal interarrival time for nurses = f (T)

Nf = normal interarrival time for firemen = f (T).

The actual interarrival times of arriving resources are affected by weather or transportation conditions. However, the influence that these conditions have may vary from one resource to the next. This variation is represented by a user assigned weighting factor assigned to each resource. For example, the influence of traffic conditions on the interarrival times of nurses may vary significantly from the influence of these conditions on the interarrival of firefighters. The weighting factor is used to reflect these differences.

For the case of a simulation involving heavy traffic conditions, a user might assign a weather/transportation factor (K) of 50 to cause a 50% increase in ambulance transit times. Since transportation of nurses to the scene closely parallels that of the ambulances, a weighting factor of 1.0 might be assigned for nurses (Nn). A normal interarrival time of 20 minutes for nurses (Nn) with a weighting factor of 1.0 would result in an actual interarrival time of 30 minutes (An). This implies that at time, T, nurses arrive on the scene at an average rate of once every 30 minutes. Firefighters, on the other hand, may travel a different route and encounter less congested traffic conditions. A weighting factor of 0.5 might be assigned for firefighters (Wf) to reflect this difference. The lower weighting factor of 0.5 for firefighters has the effect of diminishing the influence of the weather/transportation factor on the interarrival times of firefighters as compared to nurses. A normal interarrival time of 20 minutes for firefighters (Wf) would result in an actual interarrival time of 25 minutes (Af). The calculation of interarrival times for nurses and firefighters are illustrated below:

For nurses:

$$An = Nn \times (1. + 0.01 \times K \times Wn)$$

$$30 = 20 \times (1. + 0.01 \times 50 \times 1.0)$$

For firefighters:

$$Af = Nf \times (1. + 0.01 \times K \times Wf)$$

$$25 = 20 \times (1. + 0.01 \times 50 \times 0.5)$$

The normal interarrival times for nurses and firefighters used in this example are for illustrative purposes only and do not reflect values actually used in the simulation.

Additionally, there is a user designated factor, H, which is used to specify the flight status of helicopters:

H = 0, helicopters grounded,

H 0, helicopters not grounded.

Examples of runs with different weather/transportation factor settings reflecting typical situations and the corresponding results are shown in Table 3.

CONCLUSIONS

We believe that through further computer simulation studies of mass casualty incidents, guidelines can be established for resource allocation decisions at the scene of the incident. Further, we hope to generalize the simulation program so that through interactive use of a computer terminal, a user can:

1. Define a Mass Casualty Incident in terms of:
   a. number of victims,
   b. nature of victim injuries,
   c. resources available initially at the scene and rate at which additional resources can be brought to the scene,
   d. transit time to hospitals
2. Carry out an interactive simulation of the EMS system in which the user makes resource allocation decisions as the simulation proceeds.
3. Obtain as output the number of survivors
4. Repeat the simulation as often as desired thereby providing a capability of view ing simulation as a game in which the score is represented by the victim survival rate.

Not only is such a capability useful in training EMS personnel to make better resource allocation decisions but it can also be used in the planning of Emergency Medical Preparedness Exercises where it is desirable to have a reasonable match between the need for resources and their availability. Finally, these simulations can be used to determine the sensitivity of survival rates to changes in the number of units of each resource available and the time delay in delivery of these resources to the mass casualty scene. This is precisely the information needed to decide which components of the EMS system should be strengthened. The effect of IV availability and the effect of weather/transportation factors on survival rates as summarized in Tables 2 and 3 indicate the importance which decisions involving the stockpiling of medical supplies and the acquisition of evacuation vehicles can have on survival rates. The utility of computer simulation for mass casualty incidents is summarized in Figure 7.

In conclusion we believe that computer simulation of Emergency Medical Preparedness Exercises may provide cost effective means of improving the effectiveness of existing EMS systems.

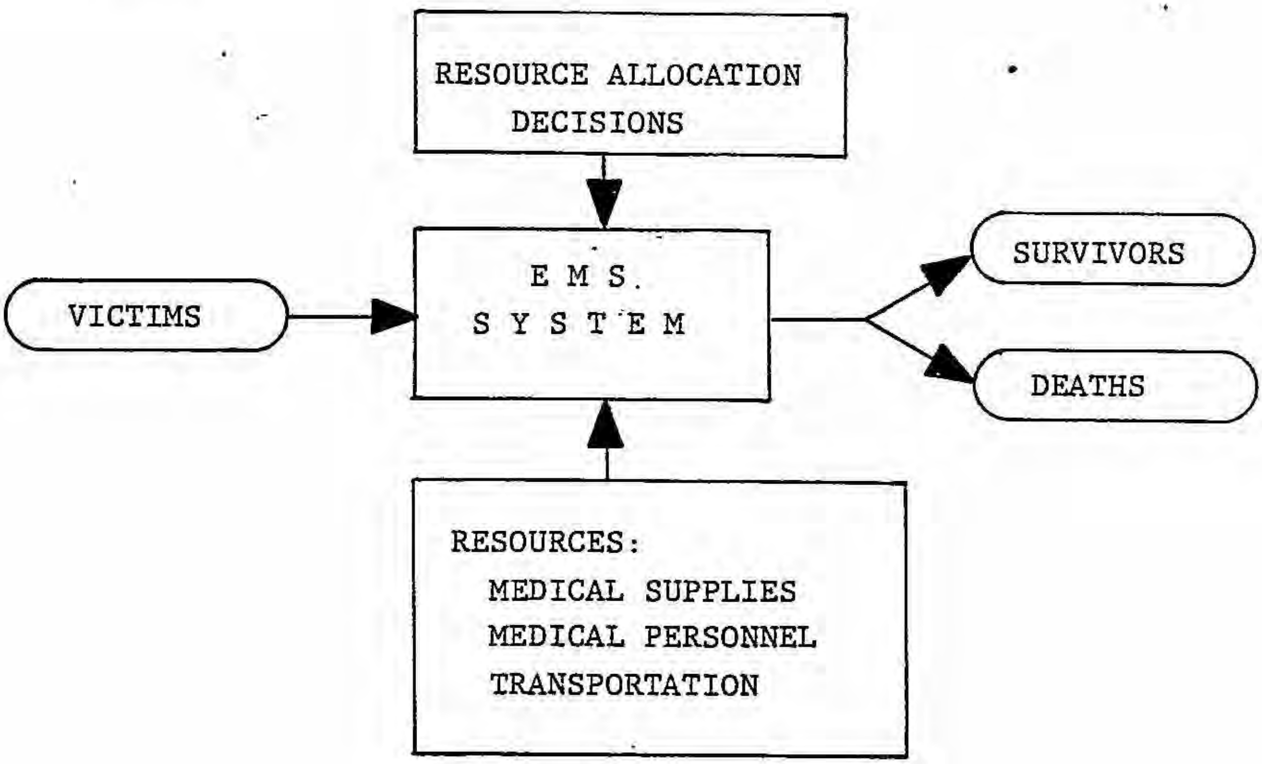

Figure 1

Medical Preparedness Exercise

1. Collision of air craft and fuel truck.
2. Victim count = 200.
3. Victim survival dependent on:
    a. Injury description,
    b. Type of resources provided,
    c. Time delay in providing resources.

Figure 2

Information for Decision Making

1. Injury description for each victim:
   a. Visual,
   b. Written,
   c. Vital signs,
   d. Survival probabilities.
2. Resources currently available:
   a. Medical supplies,
   b. Medical personnel,
   c. Evacuation vehicles.

Figure 3

VICTIM NO. 21

INJURY DESCRIPTION:

Abdominal wall contusion on left
Fracture lower ribs on left (small pneumo)
Closed fractures both lower legs (tibia & fibula)

NOT TREATED AT SCENE DURING FIRST HOUR

TIME (HR)	BLOOD PRESS	PULSE RATE	RESP RATE	PROB. ULTIMATE SURVIVAL GIVEN HOSP. ADMISSION CURR. TIME PERIOD	PROB. SURVIVAL TO END OF CURR. TIME PERIOD GIVEN NO HOSP. ADMISSION
0	150/100	150	30	0.85	0.70
1	130/160	160	36	0.70	0.65
2	110/60	180	36	0.75	0.30
4	70/0	180	36	0.60	
6				0.60	

TREATED AT SCENE DURING FIRST HOUR

TIME (HR)	BLOOD PRESS	PULSE RATE	RESP RATE	PROB. ULTIMATE SURVIVAL GIVEN HOSP. ADMISSION CURR. TIME PERIOD	PROB. SURVIVAL TO END OF CURR. TIME PERIOD GIVEN NO HOSP. ADMISSION
0	150/100	150	30	0.85	0.80
1	150/180	150	36	0.75	0.75
2	130/60	160	36	0.75	0.60
4	110/50	180	36	0.70	
6				0.70	

Tag Color Red
Medical Support Reqd:

Litters 1
IV Kits 1
IV Fluids 1
Splints 2

Figure 4

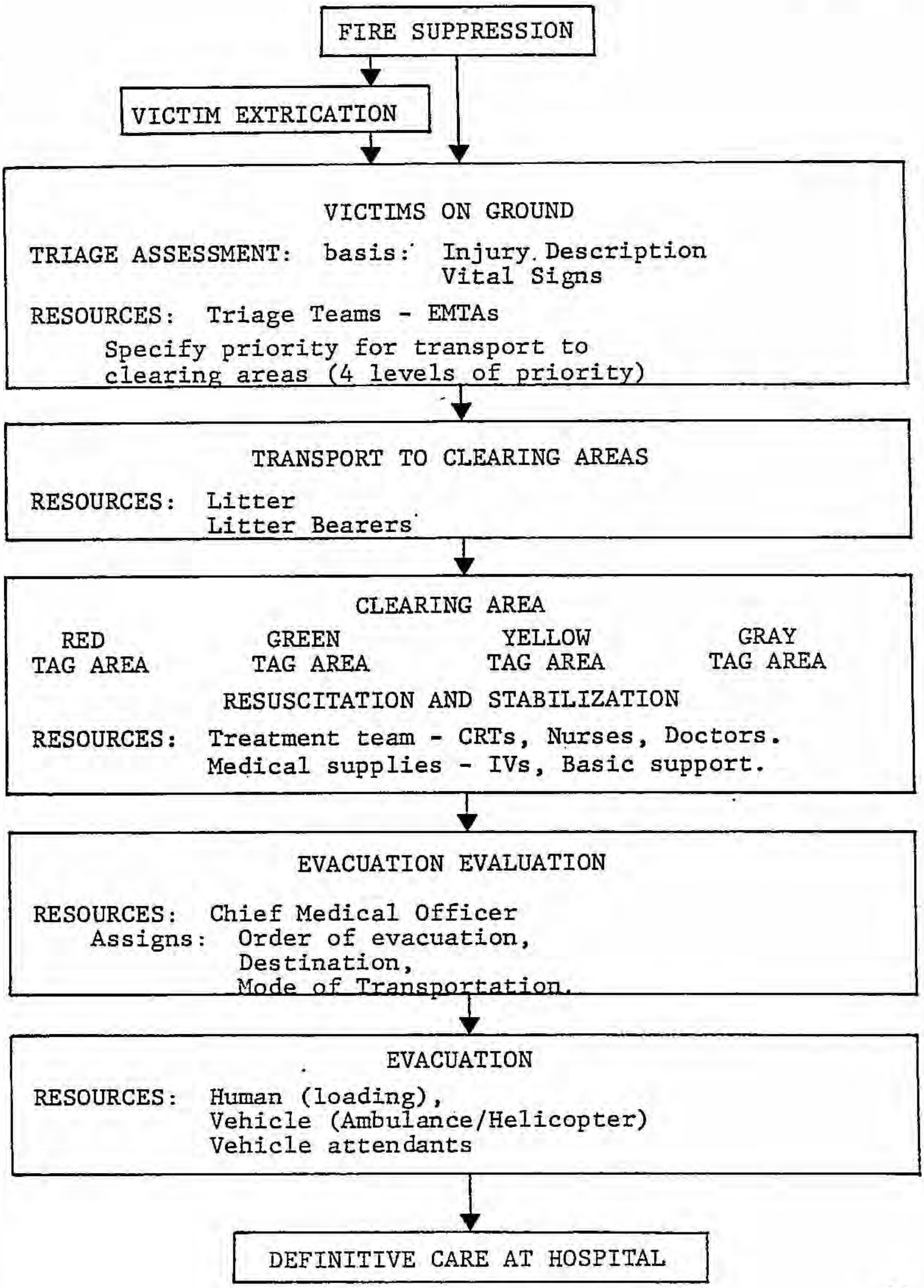
FIRE SUPPRESSION
VICTIM EXTRICATION
VICTIMS ON GROUND
TRIAGE ASSESSMENT: basis: Injury Description
Vital Signs
RESOURCES: Triage Teams - EMTAs
Specify priority for transport to clearing areas (4 levels of priority)
TRANSPORT TO CLEARING AREAS
RESOURCES: Litter
Litter Bearers
CLEARING AREA
RED TAG AREA
GREEN TAG AREA
YELLOW TAG AREA
GRAY TAG AREA
RESUSCITATION AND STABILIZATION
RESOURCES: Treatment team - CRTs, Nurses, Doctors.
Medical supplies - IVs, Basic support.
EVACUATION EVALUATION
RESOURCES: Chief Medical Officer
Assigns: Order of evacuation,
Destination,
Mode of Transportation.
EVACUATION
RESOURCES: Human (loading),
Vehicle (Ambulance/Helicopter)
Vehicle attendants
DEFINITIVE CARE AT HOSPITAL

Figure 5

Mean Interarrival Function

for Ambulances

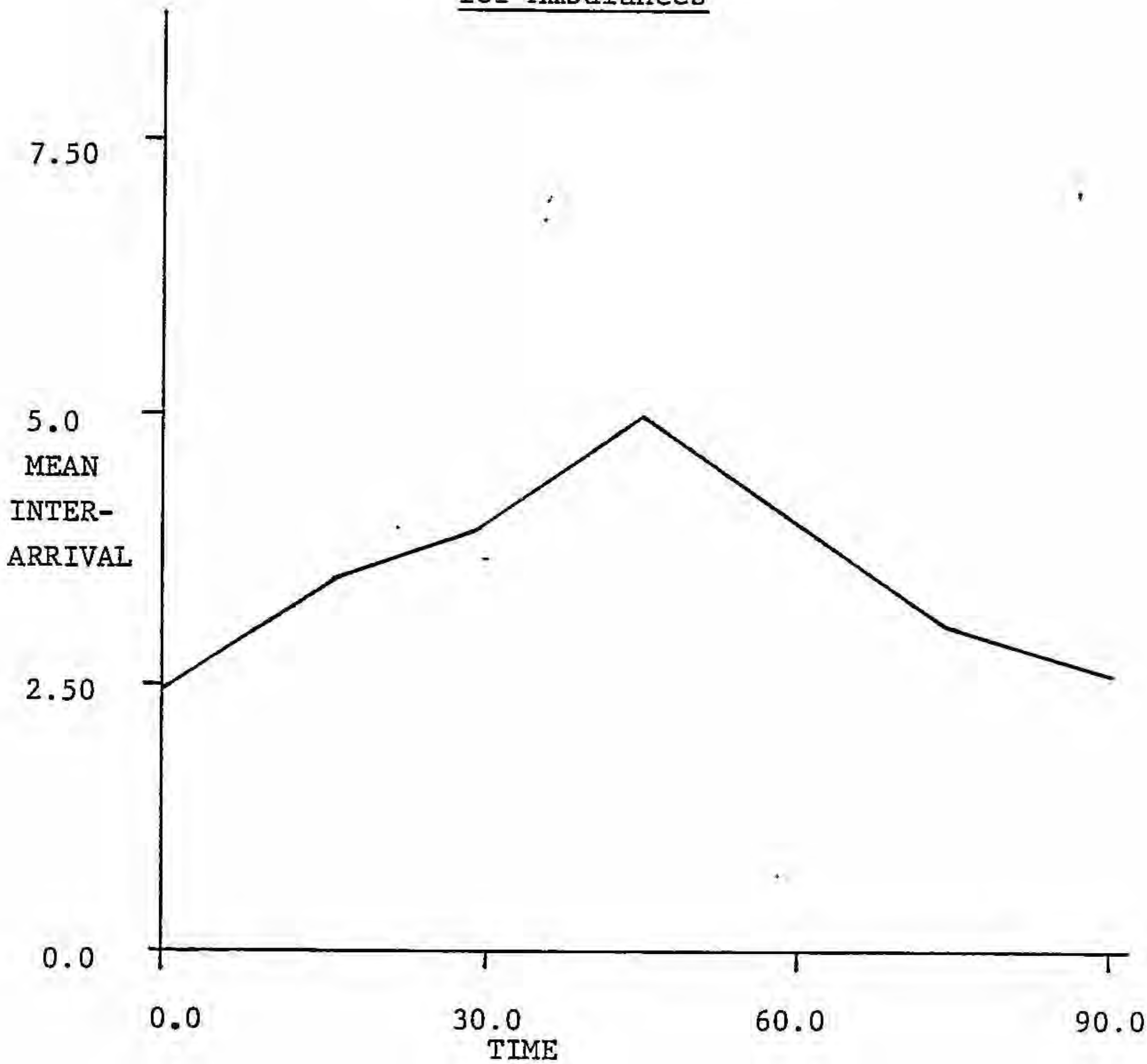

Figure 6

Utility of Computer Simulations

1. Rules
2. Training
3. Planning of Exercises
4. Improving Emergency Medical Preparedness

Figure 7

Table 1

Effect of Priority Queing Method on Survival Rates

	Queueing Method for:			
Run Set No.	Clearing	Treatment	Evacuation	Avg. Fatalities
1	FIFO	FIFO	FIFO	72.3
2	Tag	Tag	Tag	71.0
3	Prob	Prob	Prob	70.8
4	Tag	Tag	Prob	69.0

Key: FIFO - First In, First Out
Tag - According to triage tag color
Prob - Comparison of survival probability if treated with probability of survival with no treatment

Table 2

Effect of I.V. Availability on Survival Rates

Run Set No.	No. of I.V.'s	Avg. Fatalities
4	200	69.0
5	44	72.25
6	30	73.0
7	0	74.4

Table 3

Effect of Weather/Transportation Factors on Survival Rates

Run Set No.	Description	Factors K	Factors H	Avg. Fatalities
4	Normal conditions	0	1	69.0
8	High winds	0	0	73.8
9	Rush hour traffic	50	1	78.2
10	Recent heavy snows	100	1	81.6
11	Dense fog	200	0	93.4

APPENDIX

COMPUTER SIMULATION ASPECTS

VICTIM INJURIES
VICTIM TIME PROFILE
VICTIM VITAL SIGNS CARDS

VICTIM VITAL SIGNS CARDS FOR EMERGENCY MEDICAL PREPAREDNESS EXERCISE

Victim vital signs cards were provided for the exercise in order in increase realism by allowing the victims to change as time from the moment of injury increased. These cards allowed physiologic deterioration to be reflected in changes in blood pressure, pulse and respiration. They even allow death to occur in some victims. Associated with each set of vital signs, at each time period, were also two probabilities. The first probability reflected the chances of this particular victim to survive the next time period. The second probability was an estimate of this victim's chances if he were able to obtain optimal care at a definitive care center. The intent of these probabilities was to mimic some of the information usually obtained by a physician in his assessment of a real victim, but which was lacking by necessity when he tried to assess a mock victim.

The vital cards were supplied in packets of three. The top card was a cover card which indicated various time after the accident occurred. At the beginning of the exercise, the time period 0 displayed the vital signs of the victim at time. When a time equal to 1 hour after the accident occurred, the victim was instructed to remove that portion of the card corresponding to one hour and thus displayed the vital signs for the next period, which were written on the second or underlying card. Similarly, at time equal to 2 hours and 4 hours, the victim would remove that portion of the first card with that time designation and reveal the vital signs and probabilities underneath.

Provision was also made to account for a case in which the victim received certain treatment deemed appropriate for a victim with this injury. If he did receive the appropriate treatment within the first hour, the victim was instructed to remove the second card in the packet, which contained vital signs corresponding to the Not Treated case. Thereafter, the vital signs that would be revealed by removing portions of the first card would be vital signs recorded on the third card. These vital signs on the third card, of course, are vital signs for the patient treated in the first hour.

On the back of the third card, which is never removed whether the patient is treated or not treated, there is also space for recording the injuries of the victim. In a case in which the object of the exercise was not to test how well paramedics and physicians could interpret moulage make-up, this information might be taken as primary medical information, together with probabilities and vital signs upon which to base decisions for allocating resources and making priorities among victims for treatment and evacuation. Other information spaces on the back of the third card provide the capacity for the victim to record whether he received certain types of interventions, to record the color of the triage tag that was assigned to him, and also to record how many times he was examined. The idea of this last recording was to determine whether or not certain victims were examined many times, perhaps because of their geographical location during the exercise, while other victims might be ignored.

An example of the Victim Vital Signs Card and Victim Instructions is provided at the end of this section.

VICTIM PROFILES FOR THE EXERCISE

More than 20 kinds of victims, all of them trauma cases, were developed for this exercise. For each one, estimates were provided starting at time equal to 0 and for each hour thereafter until 6 hours had passed, for their vital signs both with treatment and without treatment. In addition, at each time period the probability was estimated for this survival to the next time period, under each condition of treated or not treated. There was also a second probability of ultimate survival, given that he obtained definitive care in an appropriate hospital setting beginning immediately at the time in question.

We'd like to say again that these probabilities were stated for the purpose of adding some dimension of reality to victims who otherwise could be characterized only according to the make-up job performed. Second, and quite importantly, the probability of survival to the next time period for a large group of patients forms the basis for letting us assign certain victims to die according to the large group statistics. What this means is that even though the mortality rate for a 50% burn might be, say, 40%, an individual victim can only live or die according to the large group statistics of, this case 40%.

This is actually done by using what is called a Monte Carlo technique. This is the name of a procedure in which one obtains a random number from a computer or a hand calculator, the number occurring between 0 and 1. If this random number that is obtained happens to be less than the probability of survival, the victim is classified as surviving. If the number is greater than the probability of survival, that is to say, it lies in the range between the probability of survival and the value 1, then the victim is classified as dying.

A list of the victims who were created for this exercise is provided in this section together with an example of Disaster Victim Profile which was the basis for the Victim Vital Signs Card. Examples of the probabilities under the conditions of treatment or no treatment are provided for two injuries, and the entire set is available upon request.

VICTIM CARDS FOR GENERAL USE

Although the victim cards were designed to provide a space for incorporating the probabilities of survival mentioned above, these probabilities do not have to be included in order to have such cards play a valuable role in conducting an exercise. If they are used to provide sequential vital signs under conditions of treatment or no treatment, they do add significantly to the realism of any exercise. Having patients dying at various times during the exercise is also a strong point in favor of some cards like this.

Other cards could be designed for smaller scale exercises in which the time periods were different, perhaps every 15 minutes or ½ hour. The principles of course, remain the same.

OTHER USES FOR PROBABILITIES

It has been demonstrated that the manner in which probabilities of survival can be used to have certain victims die as the exercise proceeds. At the end of the day, the number of victims lost in the field could be compared with the number expected to be lost according to some accepted or desired treatment standard and decision protocol for assigning priorities of evacuation. Similarly, for patients who did reach the hospital alive, the probability of ultimate survival could be used to determine whether that victim did in fact ultimately survive or succumb to his injuries. Fatalities at the hospital could be added to fatalities at the scene to give an overall estimate of the number of victims lost and saved. These cards were, in fact, part of a larger program to begin developing a quantitative evaluation methodology for conducting disaster exercises by using statistics and computer simulation.

LIST OF SIMULATED INJURIES FOR EMERGENCY MEDICAL PREPAREDNESS EXERCISE

2- - - Age 20, mild contusion, small scalp laceration, minor facial and neck lacerations

3- - - Age 37, penetrating chest wound, contusion, multiple lacerations of shoulder and arms

3- - - Age 20, 15% burns, fracture of femur and humerus, chest injury (chest injury with thoracic contusion and small amount hemoptysis)

Appendix

3- - - Age 24, large scalp laceration and bleeding, comatose

4- - - Age 37, bilateral open leg fractures, severe chest and back pain

2- - - Age 49, 10% burns and bilateral fracture of ankle, concussion

1- - - Age 24, hematoma left temple, laceration left ear, unconscious

1- - - Age 24, contusion left forehead, laceration lip, unconscious

2- - - Age 32, burns 15% extremities and penetrating abdominal wound in left flank

3- - - Multiple bilateral rib fractures and thoracic contusions, (possible bilateral hemo-pneumothorax)

2- - - Age 30, nose injury with epistaxsis, thoracic contusions, surgical emphysema, pneumothorax with no change in trachea.

4- - - Fractured ribs and major liver damage, right side bruising over the lower right chest and upper abdomen

6- - - Tender distended abdomen, burn over lower right chest

4- - - Fracture lower left leg (Open)

3- - - Burn face (3rd degree), fracture left arm, abdominal distension

3- - - Dyspnea, pale, complaining of chest pain and difficulty breathing, 4 fractured ribs on left with thorax contusions (possible L pneumothorax)

3- - - Obvious multiple fractures of ribs, (tension pneumothorax - bilateral)

3- - - Large facial laceration, broken right wrist

5- - - Unconscious, large right open penetrating head wound

2- - - Paraplegic, backpain, distended abdomen, pale (?ruptured spleen)

3- - - Contusion of abdominal wall on left, fracture of lower ribs on left (small pneumothorax) closed fractures of both lower legs (tibia and fibula)

*4- - - Semiconscious, minor facial lacerations, closed fracture of right humerus, tender abdomen

3- - - Distended abdomen, open fracture right thigh (femur), awake but disoriented

3- - - Multiple fractures of right thorax (flail chest), perineal hematomas (pelvic fracture of both pubic rami), contusions of head, unconscious

5- - - Lacerations of both hands and forearms

3- - - Both hands superficially and painfully burned

38- - - Burns 50% total body surface

38- - - Burns 20% total body surface

4- - - Burns 90% total body surface

*Victim #65 (see Victim Vital Signs Card) was from this group

VICTIM
VITAL SIGNS

Victim Number 65

4th HOUR

2nd HOUR

1st HOUR

NOT TREATED

Victim Number 65

B/P	P	R	PS
B/P 4 hours DEAD			
B/P 2 hours 90/50	180	28	.60 ps→t .30
B/P 1 hour 100/70	180	24	.70 PS→t .30
B/P 0 hours 140/90	150	20	.x(.90) ps→t .y(.70)
↑ Blood Pressure	↑ Pulse	↑ Respiration	↑ Probability of Survival

For each time, there are two "Probability of Survival" figures.

The top number indicates probability of survival given that the victim immediately begins to receive optimal care at a definitive care center (e.g. Burn Center, Shock Trauma Center, etc.).

The number printed beneath PS→ t (when t is the next time interval) indicates the victim's chances of surviving to the next time interval under the condition stated at the top of the card, NOT TREATED or TREATED.

TREATED

Victim Number 65

B/P 4 hours	P	R	PS
90/50	180	28	.70
B/P 2 hours	**P**	**R**	**PS**
110/70	160	24	.75 PS→t .75
B/P 1 hour	**P**	**R**	**PS**
130/80	150	20	.85 PS→t .75
B/P 0 hours	**P**	**R**	**PS**
140/90	150	20	.90 PS→t .85

INSTRUCTIONS

VICTIM # 65

INJURY -- Fractured humerus; tender abdomen

PAIN --

NUMBNESS --

NOTES:

Semi - conscious

VICTIM RECORD

COLOR OF TRIAGE TAG - RED GREEN YELLOW GRAY

EXAMINED - 1 2 3 4 5 6 TIMES

TREATMENT : INTRAVENOUS FLUIDS BANDAGES SPLINT

Disaster Victim Time Profile

Description of injuries: Semiconscious; Facial lacerations (minor)
fracture right humerus (closed); tender abdomen

time t = 0 hours

vital signs (t=0)
HR = 150 BP = 140/90 R = 20
Prob (Survival 1 full RX) = 90%
Prob (Survival to t=1hr 1 treatment at scene in 1st hr) = 85
Prob (Survival to t=1hr 1 no treatment) = 70%

t = 1 hour

vital signs (t=1, treated at scene in 1st hr)
HR = 150 BP = 130/80 R = 20
vital signs (t=1, no treatment)
HR = 130 BP = 100/70 R = 24

For those who are alive:

Prob (Survival 1 treated in 1st hr, no other, full Rx now) = 85%
Prob (Survival 1 no treatment, full Rx now) = 70%
Prob (Survive to t=2hr 1 treated in 1st hr, no other) = 75%
Prob (Survive to t=2hr 1 no treatment) = 50%

t = 2 hours

vital signs (t=2, treated at scene in 1st hour, no other)
HR = 160 BP = 110/70 R = 24
vital signs (t=2, no treatment)
HR = 180 BP = 90/50 R = 28

For those who are alive:

Prob (Survival 1 treated in 1st hr, no other, full Rx) = 75%
Prob (Survival 1 no treatment, full Rx now) = 60%
Prob (Survive to t=4hr 1 treated in 1st hr, no other) = 70%
Prob (Survive to t=4hr 1 no treatment) = 30%

t = 4 hours

vital signs (t=4, treated at scene in 1st hour, no other)
HR = 180 BP = 90/50 R = 28
vital signs (t=4, no treatment)
HR = 180 BP = 50/0 R = 30

For those who are alive:

Prob (Survival 1 treated in 1st hour, full Rx now) = 70%
Prob (Survival 1 no treatment at scene, full Rx now) = 50%
Prob (Survival 1 treated in 1st hour, full Rx at t=6hr) = 50%
Prob (Survival 1 treated at scene, full Rx at t=6hr) = 30%

Disaster Victim Time Profile

VICTIM #65

DESCRIPTION

Minor facial lacerations; closed fracture right humerus (right upper arm); abdomen tender; semi-conscious

NOT TREATED

TIME	BP	P	R	PS	P(S= nxt T)	Ran Num	Result
0	140/90	150	20	.90	.70	.746 .098	X
1	100/70	180	24	.70	.50	.868 .330	L
2	90/50	180	28	.60	.30	.168 .438	L
4	50/0	180	30	.50		.713	D
6	/			.30		.933	

TIME	BP	P	R	PS	P(S= nxt T)	Ran Num	Result
0	140/90	150	20	.90	.85	.182	X
1	130/80	150	20	.85	.75	.699	L
2	110/70	160	24	.75	.70	.554	L
4	90/50	180	28	.70		.033	L
6	/			.50		.213	

TAG Color R

Medical Support:

1	Litters	1
2	IV Kits	1
3	IV Fluids	1
4	B Support	1
5	Splints	1
6	Other	

VICTIM VITAL SIGNS CARDS

Provisions have been made to simulate the physiological status of victims throughout the exercise. Apart from the obvious interpretation of injuries via the moulage of volunteer victims, each victim has been provided with a vital signs card.

Based on physician estimates, these cards are designed to reflect blood pressure, pulse, respiration, and probability of survival as both a function of time and whether or not the victim has received appropriate treatment for his particular injury.

The vital signs cards come in packets of three cards which have been stapled together. An identifying number for the individual victim has been printed at the top of each card.

1. The top card of a packet simply indicates the various time demarcations utilized. It has been perforated so that at the end of each time interval, a section of this card may be removed in order to display the victim's vital signs for the next time interval.

2. The second card in a packet reveals the victim's vital signs for the various time periods assuming that he has NOT been treated during the first hour of the exercise. Under this condition, as each section of the top card is removed, a new set of vital signs will be displayed for the victim indicative of his physiological degeneration. This card has been perforated at the tip.

3. If the victim receives treatment within one hour of sustaining injury, the NOT TREATED card is torn from the packet, revealing the TREATED card, which displays his vital signs under this contingency.

The reverse side of the TREATED card contains instructions to the victim, and provides space for him to record which triage tag he was assigned, the number of times he was examined during the exercise, and what treatments he received.

VICTIM INSTRUCTIONS

You will be given a set of VICTIM VITAL SIGN CARDS. There should be three cards stapled together.

1. The top card has 1st, 2nd, and 4th Hour printed on it. During the exercise each interval will be announced, at which time you are to tear off the card for that hour.

2. NOT TREATED: This card displays different sets of vital signs (blood pressure, pulse, respiration) and your probability of survival for each time interval during the exercise. This card is perforated at the top. If you are receiving I.V. fluids during the first hour of the exercise, tear this card off when the 1-hour signal is given. If you are not treated, leave this card intact for the remainder of the exercise.

3. TREATED: This card gives your vital signs if you are treated. It is not perforated, and will be displayed if you remove the NOT TREATED card. Do not remove this card from the packet under any conditions. On the back of the TREATED card you will find a description of your injuries, as well as a place at the bottom of the card, labeled VICTIM RECORD.

4. VICTIM RECORD: Use the pencil provided to mark in the information required by this section. Circle the color of the triage tag pinned to you by the EMT's or Paramedics. If a second tag is pinned to you, X the color of that tag. Each time you are examined, circle the number indicating the total number of times you have been examined. If you are examined more than six time, write in the number of times you have been examined. Circle the types of treatment you receive.

You will be taken from the scene of the accident either to the temporary field hospital or to a helicopter/ambulance discharge point. When you get to the discharge point, turn in both your triage tag and your VICTIM VITAL SIGNS cards to a member of the medical evaluation team.

APPENDIX

NOTABLE COMMENTS

Medical Panel Discussion
"Emergency Management at an Airport Catastrophe"
10:30 AM, Saturday, May 13, 1978
The Friendship International Hotel
Baltimore/Washington International Airport

On the following pages are extracted (paraphrased) the notable comments of participants. To preserve a sense of continuity, free interpretations were made. Therefore, these comments are not to be considered direct quotes of the individuals.

Andrew C. Munster, M.D.
Director, Baltimore City Hospitals Burn Unit
Baltimore, Maryland

- The mean difference between the onsite personal assessment of the nine (9) burn victims at the scene and the assessment via CTS satellite was 3%. This is outstanding because two observers assessing the same patient five minutes apart would probably make that much variability.

Basil A. Pruitt, Jr., M.D.
Colonel, U.S. Army Medical Corps,
U.S. Army Surgical Research Center
San Antonio, Texas

- There appeared to be no management errors made in reviewing the nine (9) burn victims (via CTS Satellite). There was agreement with the management of all these victims.

John D. Stafford, M.D.
Director, EMS Systems Programs,
Maryland Institute for Emergency Medical Services Systems
Baltimore, Maryland

- Triage tagging offers a system for grading the patient. The degree of accuracy is dependent on the circumstances. The EMT-As under day-to-day accident encounters do an excellent job. The few incorrect assessments that come into the MIEMSS attests to this. The wind blowing presents a technical problem that will be resolved when tags are reordered.

Henry R. Herbert, Jr., M.D.
Medical Director, Baltimore Washington International Airport, Maryland

- The fire station was a holding area for uninjured and the walking wounded for observation and release to the airlines who are responsible for their passengers.

- An airport's priority is directed towards a multiplicity of issues in the total comprehensive medical program. Not only is response to a disaster important, but prevention of disasters is also important. There are a variety of issues as well as a variety of priorities,--and all these have an impact on the funding available.

Frank Barranco, M.D.
Orthopaedic Surgeon, Chief Fire Surgeon
Baltimore County, Maryland

- From time to time there is a need for a complete disaster exercise. However, a command post exercise with computer simulation could serve to test plans and build real time relationships.

- Patient flow on a disaster scene should all be in one direction.

Oliver C. Hood, M.D.
Chief, Aeromedical Services Division, Federal Aviation Administration
Washington, D.C.

- The FAA states that a written airport emergency plan must exist. There are no mandatory requirements for testing the plan. Testing is expensive and funding limited. Airport emergency plans are best linked with the communities emergency procedures and requirements.

- An important question that continues to arise is how do you get a victim that is alive, but injured (burned or battered) to the proper place for treatment when he is still alive?

- The first few minutes determines the outcome for severely injured patients.

- An authority system is necessary,--this tells who's in charge!

Mr. Matthew McCormick
Human Factors Branch, National Transportation Safety Board
Washington, D.C.

- If there is an accident we make recommendations to the other agencies to enact legislation.

- The initiative for disaster response begins at the grass roots level.

- The ATS-6 (briefcase) could certainly be used to establish immediate communications when a crash occurs in a remote, inaccessible area.

B. Kenneth Gray, M.D.
Director, American College of Emergency Physicians

- In my opinion, any person involved in a plane crash should be admitted to a hospital for at least 24 hours for observation. Reaction problems such as depression, disorientation, etc., occur in disaster situations that must receive attention.

- The disaster drills increase the awareness to hospital and other health care resources in the community.
- Disaster drills at airports should be mandatory and funding support should be available.

Ernest A. Austin, M.D.
Director of Surgery and Traumatology Programs,
Maryland Institute for Emergency Medical Services Systems
Baltimore, Maryland

- The tagging in the field indicated a need for further training in initial tagging and triage.
- An age designation of the victim should appear on the triage tag. This assists in establishing the priorities.
- There was a small problem with the interpretation of the moulages, therefore moulages have limited value in the assessment when a mock drill is conducted.
- In accidents of this kind, many head and vertebral injuries would result. Such injuries must be properly managed using back boards and other appropriate equipment.
- A physician who is well versed in the management of burn victims and multiple trauma victims should be at the scene during the second triage so that a quick assessment may be made.
- To avoid confusion one physician should be in charge at a particular station.
- There was certainly a lack of communication between the physicians triaging in the field and the fire station holding area.
- Some victims have a reasonable chance of survival if they can be moved out to a definitive care unit within approximately thirty (30) minutes.
- Physician supervision of the people in the field is the key to the entire operation.

Appendix

Captain Roger Simonds
Emergency Care Coordinator, EMS,
Anne Arundel County Fire Department, Maryland

- At the Maryland grass roots we follow and quote Dr. R Adams Cowley's "Golden Hour" for definitive treatment.

- Initial assessment, stabilization and transportation to the most appropriate facility,--this is the direction and keystone on which we focus our program within Anne Arundel County.

- In a mass casualty situation as the one simulated at BWI Airport yesterday (Friday, May 12, 1978). Initial triage and hands-on care is rendered. There is immediate assessment of the resources available, such as definitive care hospital beds, transportation by land or by air. Prior notification of hospitals through the Maryland EMS Communications System gives the hospitals and definitive care centers an opportunity to react and prepare for the victims they will be receiving.

- The movement of physicians into the situation scene is a problem. So often there is a time lag while awaiting physician direction at the scene. In Maryland, direction is at least available through EMS communications. So often by the time the physician arrives, the majority of the primary decisions for transportation have been made and the victims are "on the road".

- The first thing done from the scene yesterday was to contact "MIEMSS" Emergency Medical Resource Center and Systems Communications Center through the Emergency Medical Services Communication System. These centers in turn notified the hospitals and specialty referral centers and also determined bed availability and advised the command post at the scene. This made possible appropriate dispatch of victims to definitive care.

James P. Brown, Ph.D.
Goddard Space Flight Center
Greenbelt, Maryland

- The ATS-6 (briefcase) unit was certainly a success at this exercise. Both the ATS-6 and the CTS offer an opportunity for future development of a concept. The technology available today is remarkable and can become a valuable component in mass casualty incidents.

David R. Boyd, M.D.
Director, Emergency Medical Services,
Department of Health, Education and Welfare
Hyattsville, Maryland

- The physician triage officer should be a member of the field team. It isn't easy to find physicians readily available to go out into the field. Physicians have demands on their time.

- The physician directing the regional trauma center and/or the regional burn center is the man with the experience needed in the field. He can be picked up and transported by helicopter, be effective in the field, then return to his definitive care facility to assist. This physician should be continuously available for response.

- Physician supervision in the field is the key to the whole operation. However, the KEY is who is that physician? He must have a knowledge base from experience or training,--and above all, he must be available.

- On scene, the physician doing the field triage must relate to the EMS Communications System and the hospital world for complete linkage.

- The question of medical management at mass casualty incidents needs further consideration. There are many factors that influence the development of EMS Systems such as geographical conditions, organizational requirements, the operational environment, public health and safety, and above all, definition of who is in charge.

- The Emergency Medical Services system must have a plan to assure that the system will be capable of providing emergency medical services in the system's service area during mass casualties, natural disasters, or national emergencies.

- The EMS system is not the regional health disaster organization. It is the emergency medical program that will work with other agencies during a disaster to provide emergency medical care. The EMS system must have links to the local, regional and state disaster plans.

R Adams Cowley, M.D.
Director, Maryland Institute for Emergency Medical Services Systems
University of Maryland
Baltimore, Maryland

- A rigid posture existed in this country just ten years ago. The idea was doctors all the way through the entire spectrum of emergency care. This didn't work because doctors were not always available at all times. Then came the utilization of EMT-As and paramedics and all other paramedical personnel.

This concept worked and these individuals carried out their tasks exquisitely well. They are able to make cardiac diagnoses and can treat. However, emergency care is a team effort,--and physicians should be the captains of the team. The physician team captain might be a physician at a resource hospital providing information over the EMS communications system, or it might initially be the doctor at the MIEMSS trauma center coordinating through SYSCOM.

- Dr. Ernest Austin's argument is valid. The whole process is going to be improved by utilizing a physician as the team captain out at the mass casualty scene.

- At a mass casualty scene a very complex medical problem exists. The initial tagging by paramedical personnel is usually excellent. However, the physician (team captain) is able to offer judgement in terms of skills and experience,-technology and timing, such as how much blood is needed, etc., as well as resources and facilities available.

- Today, the EMT-As and the paramedics have excellent training and certainly are able to initially handle a scene until a competent physician arrives to act as a team leader, or even a team supporter, especially for the medical judgements that must be made. Nationally, this concept deserves further development, since the presence of a competent traumatologist at the scene explicitly establishes medical command control.

<u>Concluding Comments of R Adams Cowley, M.D.</u>

"I simply want to thank all the people that were involved in this program, both up front and behind the scenes,--this includes the federal, state and local governments, and also to the school children that were the "victims" on the runways.

Untold extra hours of work made this all possible and I am so grateful to everyone. Once all the information gleaned is put together, it is anticipated that an audio-video documentary will be available to you to borrow and use; a small pamphlet of the essentials of the discussions will be compiled, and additional information on the computer simulation will be developed.

Based on the experience gained from "Emergency Management at an Airport Catastrophe" recommendations for a national plan will be forwarded to appropriate Federal agencies and committees.

Again, I want to thank each of you very much for your cooperation and participation, and for being here today."

ACKNOWLEDGEMENTS

ACKNOWLEDGEMENTS

The Maryland Institute for Emergency Medical Services Systems expresses appreciation to the Maryland Department of Transportation, the State Aviation Administration, the Transportation Safety Division and the personnel of the Baltimore Washington International Airport for their assistance and support of this program.

The organizations and agencies are listed as participants within this text. The individuals within these organizations are extended the deepest thanks for their contributions.

PARTICIPANTS OF

"EMERGENCY MANAGEMENT AT AN AIRPORT CATASTROPHE"

American Airlines
American College of Emergency Physicians
American Trauma Society
Anne Arundel County Alarmers Association
Anne Arundel County Fire Department
Anne Arundel County Police Department
Anne Arundel General Hospital

Baltimore City Fire Department
Baltimore City Hospitals
Baltimore City Police Department
Baltimore City Police Department, Helicopter Unit
Baltimore County Civil Defense
Baltimore County Health Department
Baltimore Regional Burn Center, Baltimore City Hospitals
Baltimore Washington International Airport
Bon Secours Hospital
Box 414 Association

Calvert Memorial Hospital
Carroll County General Hospital, Inc.
Church Hospital Corporation
Communications Satellite Laboratories (COMSAT)

Delta Airlines
Doctors Hospital of Prince George's County
Dorchester General Hospital, Inc.

Acknowledgements

Eastern Airlines

Fallston General Hospital
Federal Aviation Administration
Franklin Square Hospital, Inc.
Frederick Memorial Hospital
Frostburg Community Hospital

Garrett County Memorial Hospital
Goddard Space Flight Center, NASA
Good Samaritan Hospital
Greater Laurel Beltsville Hospital

Harford Memorial Hospital
Holy Cross Hospital of Silver Springs
The Johns Hopkins Hospital
Howard County Fire Department
Howard County General Hospital

Kent and Queen Anne's Hospital
Kimbrough Army Hospital, Fort George G. Meade, Maryland

Eugene Leland Memorial Hospital
Logan International Airport, Boston, Massachusetts
Luthern Hospital of Maryland

Maryland Center for Public Broadcasting, Office of Telecommunications
Maryland Department of Transportation
Maryland Fire and Rescue Institute
Maryland General Hospital
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Maryland State Police
Maryland State Police, Airport Security
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Mercy Hospital
Montgomery County Fire Department
Montgomery General Hospital

National Aeronatics and Space Administration
National Airlines
National Transportation Safety Board
North Arundel Hospital

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Sacred Heart Hospital
Saint Agnes Hospital
Saint Joseph's Hospital
Saint Mary's Hospital
Sinai Hospital of Baltimore
South Baltimore General Hospital
Southern Maryland Hospital Center
State Aviation Administration
Suburban Hospital Association

Union Hospital of Cecil County
Union Memorial Hospital
United States Army, Fort George G. Meade, Maryland
United States Army Institute of Surgical Research, Brooke Army Medical Center, San Antonio, Texas
United State Army Materiel Systems Analysis Agency
United States Army, 85th Medical Battalion
United States Army, 247th Medical Detachment, Helicopter Ambulance, Fort George G. Meade, Maryland
United States Army, 440th Medical Detachment, Ground Ambulance, Fort George G. Meade, Maryland
United States Department of Health, Education and Welfare, Division of Emergency Medical Services
United States Public Health Service Hospital
University of Maryland Hospital

Veterans Administration Hospitals Learning Resources Services

Washington Adventist Hospital
Washington County Hospital

Acknowledgements

PARTICIPATING HOSPITALS - ADJACENT STATES

Norfolk Medical Hospital Burn Center, Norfolk, Virginia

Medical College of Virginia Burn Center, Richmond, Virginia

The University of Virginia Burn Center, Charlottesville, Virginia

Philadelphia Crozer Burn Center, Philadelphia, Pennsylvania

St. Agnes Medical Center Burn Unit, South Philadelphia, Pennsylvania

Washington Hospital Burn Center, Washington, D,C,

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