NCHSR

RESEARCH MANAGEMENT SERIES

Emergency Medical Services Systems Research Projects, 1977

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Health Resources Administration

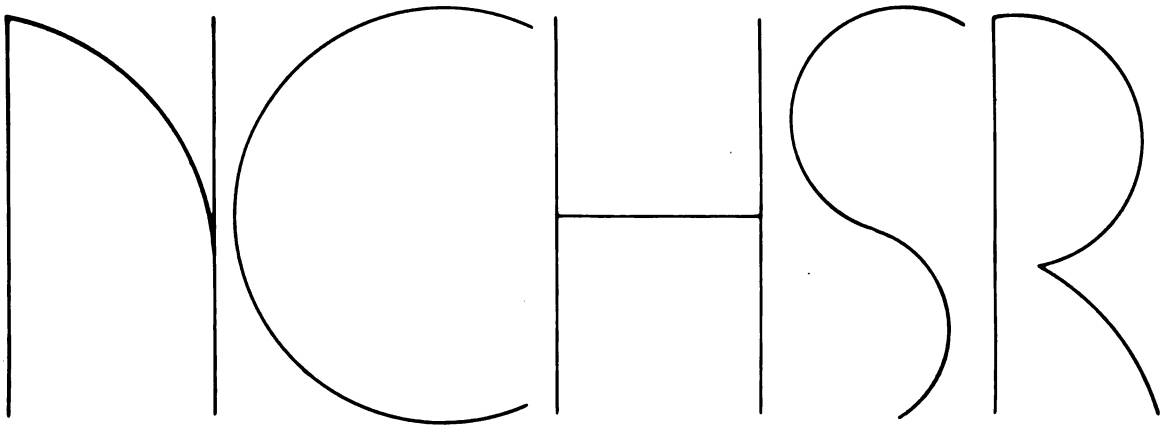
NATIONAL CENTER FOR HEALTH SERVICES RESEARCH

RESEARCH MANAGEMENT SERIES

The Research Management Series describes programmatic rather than technical aspects of the NCHSR research effort. Information is presented on the NCHSR goals, research objectives, and priorities; in addition, this series contains administrative information on funding, lists of grants and contracts, and special programs. Publications in this series are intended to bring basic information on the NCHSR and its programs to research planners, administrators, and others who are involved with the allocation of research resources.

ABSTRACT

Summaries of research projects supported by the National Center for Health Services Research (NCHSR) during 1977, under authority of Section 1205 of the Emergency Medical Services Systems Act.



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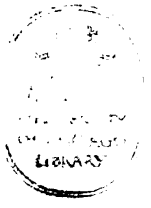

FOREWORD

The National Center for Health Services Research is responsible for administering a program of applied research directed specifically at improving the effectiveness and efficiency of more than 200 regional Emergency Medical Services (EMS) systems which are being established under Title XII of the Public Health Service Act. Vigorous efforts at the Federal, State, and local levels are bringing about significant changes in the ways in which emergency care is delivered, and these new policies are matters of considerable public interest.

The research community is being asked to test the assumptions on which EMS policies are based, describe new options and their probable consequences, and determine ways to measure the effects of existing and alternative policies. Moreover, the results of EMS research are required to be useful and timely, and must include specific recommendations for improving system performance.

EMS systems are being established in a climate of increasing concern about the costs of health care, and the research program has had some success in stimulating new ideas about systems which are designed to be affordable as well as effective. As EMS system planners and managers gain greater appreciation of the value of information obtained through well-designed research projects, we are increasing our efforts to provide them with the results of these studies intelligibly and promptly.

Gerald Rosenthal, Ph.D.
Director

September 1977

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Overview of Emergency Medical Services Systems Research Program

Introduction

Section 1205 of the Emergency Medical Services (EMS) Systems Act of 1973 (Public Law 93-154) and of the EMS Amendments of 1976 (Public Law 94-573) authorize a program of research in "emergency techniques, methods, devices, and delivery." Reports of these studies must "contain recommendations and a plan of action for applying the results of the research .... to improve the delivery of emergency medical services." The National Center for Health Services Research (NCHSR), an agency of the Health Resources Administration, is the DHEW organization responsible for administering this applied research effort, and considers EMS research one of its most important programs.

Scope and Purpose

The EMS Systems Act and Amendments encourage the development of regional systems intended to provide effective emergency services to everyone who needs such care, and therefore the EMS research program focuses primarily on ways to determine how effectively and efficiently each EMS system as a whole is meeting these objectives, how well the elements which comprise the system are functioning individually and collectively, and which changes in the system are likely to produce the greatest improvement.

This focus distinguishes the EMS research program from a number of parallel and complementary activities. For example, the Division of Emergency Medical Services, Health Services Administration, promotes the establishment of EMS systems, provides technical assistance to them, and monitors their compliance with the provisions of the laws and regulations. This agency and its constituents are an important group of users of research results, therefore, but they do not themselves conduct formally-designed detailed investigations. The National Institutes of Health carries out both clinical and biomedical research on many of the illnesses and injuries for which EMS systems provide initial care. Investigations into the causes and treatment of myocardial infarction (National Heart, Lung, and Blood Institute), trauma and burns (National Institute of General Medical Sciences), and central nervous system injuries (National Institute of Neurological and Communicative Disorders and Stroke), for example, produce essential information for improved emergency medical care. Biomedical and clinical research programs are designed to increase the fund of medical knowledge, however, and are not directly concerned with the significant problems surrounding the organization, financing, management, or evaluation of the systems which provide emergency services. Legislation which established the National Center for Health Services Research (NCHSR), Sections 304 and 305 of the Public Health Service Act, authorizes research, evaluation, and demonstration projects concerning the accessibility, acceptability, planning, organization, distribution, technology, utilization, quality,

and financing of health services and systems generally. A number of investigations of the relationships and conflicts between EMS systems and other health care delivery programs are being supported under NCHSR's general activities, but studies which focus on the direct effects of those service activities which are specified in EMS legislation constitute the categorical EMS research program and are described in this document.

In summary, the EMS research program established under Section 1205 consists of investigations designed to describe, explain, and predict the performance of EMS systems and their components, and to prescribe necessary improvements. The product of this research is valid and useful information needed by planners, policymakers and other health programs. The Division of EMS needs these findings to carry out its responsibilities for technical assistance, project monitoring, and disseminating information. When the efficacy of diagnostic and therapeutic devices and procedures has been established through biomedical and clinical investigations, the EMS research program examines their effectiveness and their costs in existing service systems. The research program also identifies issues surrounding the organization, management, and financing of EMS systems which may impinge on other health care concerns (e.g., cost-containment, assessment of quality of care, malpractice), so that these problems can be pursued by NCHSR.

Approach

The information produced through the EMS research program must be both believable and useful, and therefore it is essential that:

(1) The research projects are designed and conducted according to accepted scientific principles, with proper attention to reliability, validity, and generalizability. The results of these investigations are intended to replace the existing fund of anecdotes and expert opinion; they are used to recommend the allocation of large quantities of public resources, and therefore both the research results and the data and methods on which the results are based must be verifiable and open to public and scientific scrutiny.

(2) The findings include plausible reasons for believing that improvements in system performance will result from the changes recommended. It is difficult to determine causal relationships in studies of this sort, but hypotheses can be formulated and tested and theoretical frameworks can be employed to relate the results to other investigations.

(3) Whenever possible, the studies are conducted, or the results tested, in operating service systems so that unexpected obstacles and unanticipated consequences can be identified and realistic solutions proposed.

(4) The results are disseminated promptly and widely, to administrators and planners as well as to other investigators.

Objectives

Better evaluation methods and measures are essential if we are to determine the extent and quality of emergency care being provided at present, and to recommend methods to improve system performance. At this stage in the development of a national network of EMS systems, the objectives of the EMS research program are to:

(1) Develop reliable and valid measures of system input, process, and output which can be used to evaluate and compare system and subsystem performance.

(2) Test these measures in operating EMS systems, to insure that their use is feasible, acceptable, and economical, and that they are sensitive and specific enough to reflect important differences in system organization and administration.

(3) Use these measures to evaluate and compare different EMS systems and components, identify and describe those factors associated with greater effectiveness or lower costs, and develop plausible reasons or testable hypotheses concerning the differences discovered.

(4) Recommend and justify changes in EMS policies, or in system configuration, administration or financing, which will improve the responsiveness and quality and decrease the costs of providing emergency care.

Immediate Research Concerns

The program concentrates on evaluative research, including analyses of the performance of systems and their components, and on the development and testing of pertinent measures. The primary purpose of all EMS systems is to provide appropriate care in life-threatening medical emergencies, and therefore it might seem that research efforts could be limited to direct comparisons of the effectiveness of different systems or different components. Without better measures of system inputs, processes, outputs, and boundaries, however, attempts to judge one system against another produce ambiguous and misleading results:

- Input measures must consider not only system resources (such as ambulances or burn centers) but also descriptors of the number and the status of patients who are cared for. Emergency victims are characterized less by the kind of medical problem than by its urgency, and therefore it is essential that a reliable index of severity be developed so that differences in the case-mix of different systems can be considered.

- The management of critical medical emergencies requires not only that diagnosis and treatment be correct, but that care be given promptly and often in a prescribed sequence. Detailed descriptions of proper treatment plans, often arranged as treatment protocols or algorithms, are being designed and tested. Measures of the process of care can be estimated in terms of compliance with these algorithms, and both the speed and the quality of care given to different patients, in the same and in differnt EMS systems, can then be evaluated.

- The effectiveness of emergency services in terms of clinical outcomes cannot be estimated accurately at this time, since the likelihood of survival and full recovery following critical emergencies often depends on the quality of in-hospital and convalescent care. The medical emergency stage of a life-threatening illness or injury could arbitrarily be considered to have ended when definitive treatment begins and speed of response is no longer an overriding concern. Measures of the patient's condition at one or several points during the hospital course and at discharge can be used as intermediate or proximate outcomes when they can be shown to be adequate predictors of the end-results of care.

- Different EMS systems view the boundaries of their responsibilities differently, in terms both of the authorities shared with other agencies and of the clientele to be served. Most of the patients managed by EMS systems are not in immediate danger of death or serious disability; there is considerable disagreement concerning proper standards to evaluate the performance of EMS systems as "convenience clinics," and systematic procedures for obtaining consensus are needed, to insure that public expectations as well as professional opinions converge in these standards.

Difficulties

The continuation and expansion of this EMS research effort faces a number of obstacles, among which the following are noteworthy:

(1) There are very few experienced investigators available to design studies of acceptable scientific merit, and fewer yet who have access to appropriate sources of data and adequate settings for field testing. In addition, EMS research solicits applied studies which can lead directly to changes in policies or in organization; many investigators tend to be cautious and conservative, and worry that their efforts may be applied to policy decisions prematurely.

(2) Emergency medical care is a dramatic, fast-moving field, and attracts action-oriented, "can-do" people who are impatient with the researcher's need for accurate data and detailed records. Many of the most critical decisions in the management of an emergency patient must be made quickly and must be based on incomplete information. Decisions such as these are difficult to defend objectively, and therefore are particularly troublesome subjects for conventional retrospective quality assessment methods.

(3) National concerns about the rising costs of health care are important to researchers, but have not yet attracted the interest of most EMS system planners and managers, who are providing a service which society clearly values highly. Administrators rank increases in system efficiency and productivity far below accessibility and quality of care as EMS program objectives, and new devices are welcomed enthusiastically, whatever the costs.

(4) It is often difficult to identify all of those who are directly responsible for each of the steps in providing emergency medical services. EMS systems are not widely accepted and financed as public services, and many of the resources used by these systems are not under the direct control of a designated manager. Clinical care for individual patients is provided by a variety of professional and paraprofessional personnel, following different procedures and responding to different pressures and authorities. The emergency phase of an illness or injury blends almost imperceptibly into the definitive and restorative phases, responsibilities for prescribing and administering treatment change subtly, and clinical imperatives shift from the maintenance of life to the lessing of disability. An investigator finds it exceedingly difficult to discern the operating rules of the system and to gain access to all necessary data, and must be especially meticulous in obtaining and evaluating information acquired from different sources.

(5) EMS systems respond to any type of medical emergency at any time. Life-threatening events are relatively uncommon occurrences in a community, and therefore investigators must screen large amounts of data to find items of interest. Information-gathering systems designed to meet management specifications are seldom adequate to meet an investigator's needs for accurate and complete data, but EMS personnel are understandably reluctant to collect additional information to be used primarily for research. It is difficult for a researcher to defend the value of a sophisticated information system which will be of no immedidate direct benefit to the service provider, but without good data an investigator cannot be certain that his findings are reliable and his recommendations useful in other systems or other emergency conditions.

Summary

During recent years, planning for emergency services has been based on models of ideal systems, under the assumption that components which later were shown to be ineffective, duplicative, or non-productive could then be eliminated. In the face of growing concerns about the increasing costs of health care, EMS system planners will soon be faced with the need to choose between alternative uses of EMS funds and personnel. They will also be required to defend the

allocation of resources for emergency care rather than for other necessary health and social programs; EMS system imperatives will be scrutinized, criticised, and revised. EMS research is intended to produce evidence which can help policymakers at national and local levels make these difficult and unpopular choices. Summaries of the investigations in progress are being distributed widely to stimulate further research in this extremely important and challenging field, to solicit the help of system managers in providing new research settings, and to describe the purposes and the value of these studies to policymakers. Principal investigators will be glad to provide further details about their projects to anyone interested, or inquiries can be directed to:

National Center for Health Services Research
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3700 East-West Highway
Hyattsville, Maryland 20782

TITLE: Analysis and Therapy of Life-Threatening Emergencies

GRANT NUMBER: 5 R18 HS 01833

GRANTEE INSTITUTION: Professional Staff Association of Los Angeles County Harbor General Hospital

PRINCIPAL INVESTIGATOR:

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FUNDING LEVEL: $ 91,091 FY 77
$100,085 FY 76

TOTAL PROJECT PERIOD: 6/30/76-6/29/78

SIGNIFICANCE:

The first purpose of this study is to develop criteria for adequate resuscitation of patients suffering life-threatening medical catastrophes arising outside, as well as within, the hospital. The criteria are based on clinical and physiological data that are available at the bedside for decision-making. Second, the project is developing a protocol describing the steps required for optimum resuscitation and subsequent care of the emergency victim. Finally, a measure of the severity of illness will be created for use in emergency conditions. This index of the severity of illness must be relevant to an important outcome measure, such as survival from an acute life-threatening problem, the rationale being that if the monitored value of a physiologic variable can be related to mortality or survival, it can be used to evaluate both the outcome and the process. That is, the capacity of the severity index to predict outcome will be tested by prospective studies. If successful, it will be used to monitor the adequacy of the process of medical care in the emergency situation. The index must be suitable for use at the bedside during acute illness and emergency conditions to aid in clinical decision-making at times of crisis. The project attempts to develop criteria for, and ultimately design, a protocol or patient care algorithm for acute life-threatening problems, beginning at the Emergency Department but ultimately extending to both prehospital resuscitation by paramedics and in-hospital catastrophes. If successful, these protocols will replace the present fragmented and sometimes haphazard approach to resuscitation and critical care with one which proceeds systematically, according to priorities determined by mortality-morbidity statistics and by a physiologic index of severity based upon measurements derived from monitoring cardiorespiratory function.

In essence, the program is directed toward more expeditious and more effective resuscitation guided by presently available monitoring methods and knowledge

of the relative effectiveness of alternative types of therapeutic approaches as well as specific therapy. This information will be of practical importance to Emergency Departments and ICUs where most of the acute crises are or should be cared for.

It is judged that at least half of the estimated 700,000 annual deaths from acute emergencies could be prevented. This investigation explicitly addresses this issue, the reduction in mortality and morbidity of acute life-threatening emergencies which can arise through improving the medical care process.

The second valuable product of the project will be a severity index derived from monitored cardiorespiratory variables which are weighted according to the capacity of each variable to predict survival or death. This product will be applicable in any Intensive Care Unit or Emergency Department where complete cardiorespiratory measurements can be obtained.

The system for physiologic evaluation can also be used to assess the relative effectiveness of alternative treatment methods, and establish their value for individuals or groups of patients.

PROJECT DESCRIPTION:

Briefly, the study aims: (a) to develop criteria for resuscitation of patients entering the Emergency Department; (b) to develop a decision logic for the steps in resuscitation; (c) to test this treatment protocol prospectively; and (d) to extend the protocol to include care given in the Intensive Care Unit as well as the Emergency Department.

The research setting is an 800-bed County Hospital which is run by a full-time medical school faculty and a large resident staff.

The study design involves one clinical service that uses the algorithm and two services that serve as controls. There is no cross-over of residents between these services. Patients are allocated to each service on a daily basis; i.e., from 0800 on one day to 0759 on the next day, all surgical emergencies are seen by the Green service, the following day they are seen by the Yellow service, and the third day by the Orange service, and so on in this sequence.

Initially, resuscitation is monitored by simple means, but the number and type of physiologic monitoring measures increases rapidly in accordance with specific criteria determined by process and outcome measures.

Process Measures

An algorithm was developed from data obtained by physiologic monitoring using an intracardiac catheter to measure pressures and blood volume. Using the last available data set, this algorithm was able to perdict outcome in 94% of a series of 113 critically ill patients. The algorithm is now being tested prospectively and will be used as a measure of the severity of illness; that is, the probability of death is considered an index of the severity of the critical illness.

PROGRESS:

1. A one-page algorithm for initial resuscitation (first 30 min.) was revised and is now being tested prospectively as described above.

2. A predictive index was designed and is now being tested as described above.

3. A therapeutic index based on the predictor is being developed.

4. Records of all emergency patients entering the ED in the past three months have been reviewed, and form a baseline for subsequent evaluations.

PUBLICATIONS:

W. C. Shoemaker, C. Pierchala, P. Chang, D. State: Prediction of outcome and severity of illness by analysis of the frequency distributions of cardiorespiratory variables. Crit. Care Med. 5:82, 1977.

W. C. Shoemaker, F. S. Montgomery, D. H. Elwyn, H. Levin, A. I. Rosen: Early prediction of death and survival by prospective analysis of cardiorespiratory variables in postoperative shock patients. In: Current Topics in Critical Care Medicine, Vol. 2, p. 44-59. Basel, S. Karger, 1977.

P. Chang, M. H. Weil, L.D. Portigal, W. C. Shoemaker: Prognostic indices and predictors for patients in circulatory shock. In Press.

M. M. Shabot, W. C. Shoemaker, D. State: An advanced data acquisition system for hemodynamics and O_2 transport variables at the bedside of critically ill patients. In Preparation.

W. C. Shoemaker, P. Chang, R. Bland, L. Czer, M. M. Shabot, D. State: Cardiorespiratory monitoring in postoperative patients: I. Prediction of outcome and severity of illness. In Preparation.

W. C. Shoemaker, P. Chang, R. Bland, L. Czer, M. M. Shabot: Cardiorespiratory monitoring in postoperative patients: II. Quantitative indices as guides to therapy. In Preparation.

W. C. Shoemaker: Cardiorespiratory patterns in various types of shock and their therapeutic implications. International Shock Symposium, University of Arhus, Denmark, May 10-12, 1977. In Press.

TITLE: Assessing Emergency Systems Quality: Method Development

GRANT NUMBER: 1 R18 HS 02467

GRANTEE INSTITUTION: Regents of the University of California, Los Angeles

PRINCIPAL INVESTIGATOR:

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FUNDING LEVEL: $154,473 FY 77
$124,145 FY 76

TOTAL PROJECT PERIOD: 6/30/76-
6/29/78

SIGNIFICANCE:

Increased expenditures in Emergency Department medicine are the result of several related developments: the proliferation of Emergency Department training programs, the increase in the numbers and technical capability of Emergency Department personnel, and the increasing numbers of patients turning to Emergency Departments for care. In light of the magnitude of these developments, it is important to justify the expenditures. Moreover, given our current political and social climate, which is calling both for accountability of physicians and for cost control, with no sacrifice in quality, it is not surprising that the quality of the care provided in these facilities has been questioned.

Yet, the Emergency Department has generally been neglected in any attempts to assess the quality of care being provided due to the large volume of patients that seek medical care there, the differences in emergent and non-urgent patients, difficulty in follow-up, and the concept that the Emergency Department should serve only to stabilize patients rather than to render definitive medical care. While it is essential to assess the quality of care provided in these settings, there are very few data about the validity and reliability of various techniques of quality assessment applied in this type of health care unit.

This study is designed to develop and test Criteria Mapping, a technique based on branching logic for evaluating the process of patient care through chart audit. The investigators are comparing Criteria Mapping to the most commonly employed method for evaluating process, the criteria list, to see which method better measures the care, according to the external standard of health outcome.

In the criteria list method, a standard list of things to be done to or for all patients with a specific diagnosis is set up. These lists are usually either so general as to provide little indication of the actual quality of patient care rendered, or so detailed and extensive that they require the physician to perform many tests and other clinical procedures not warranted for every patient. Thus the physician may do just those appropriate procedures

for that patient, and yet have a low score for not complying with the whole list. For example, a 28-year-old-patient with chest pain due to a cold requires a different workup and treatment from a 63-year-old patient with stabbing chest pain and a prior history of a heart attack. The same list cannot be applied to the care of both patients.

Criteria Mapping, in contrast, organizes criteria for good care according to the specific patient characteristics that should prompt specific medical action on the patient's behalf. This organization of the criteria allows for evaluation of the specific care received by any patient with a given disease or chief complaint. Evaluation of care by Criteria Mapping, therefore, is expected to reflect the most important elements of patient care in an emergency setting: i.e., the quality of the decisions and actions taken under significant time constraints.

The results of this study are expected to demonstrate that Criteria Mapping provides an accurate evaluation technique for Emergency Department settings. Specifically, a Criteria Map for patients with chest pain/cardiac disease will be thoroughly evaluated and available for use by the end of this project.

In general, quality of care assessment techniques can be used to provide information on two different levels of generality. 1) Within a given emergency facility, this information may be used to identify problems in quality of patient care rendered, and to initiate corrective action to improve such process. On this level, the technique is especially useful in any Emergency Department, be it a university hospital with residency training programs or a community hospital. Assuming appropriate corrective action, the ultimate benefit of improved care accrues to the future patient. 2) Comparative evaluation may be undertaken. The results of quality assessments may be assigned value for policy decision-making in terms of resource allocation or certification.

PROJECT DESCRIPTION:

This research focuses on developing feasible, valid measures for assessing the quality of care rendered to acutely ill patients, with primary attention to comparing two different methodologic approaches to this objective in the Emergency Departments of two hospitals, UCLA, a university teaching hospital staffed by house officers, and Santa Monica Hospital, staffed by full time private physicians.

As explained earlier, two different evaluation techniques are being studied: Criteria Mapping and the criteria list method. Both techniques require specification of the "process" of care -- a series of statements, called criteria, specifying what should be done for patients. (The techniques, however, differ markedly in the manner in which criteria are organized.) Compliance with a criteria set is determined by examining the medical records of patients, resulting in a score for the care the patient received.

A meaningful comparison of scores allowed by each evaluation technique is possible only by correlation with an external standard. In this project, the external standard is the "outcome" or result of the care: whether the patient improved, died, had to return to the hospital, etc. Thus, if the criteria map scores the process as "good," the outcome of the patient should also be "good."

The study is currently focused on patients who come to the emergency room with the chief complaint of "chest pain." Outcomes have been selected for two subgroups of patients, depending upon whether the patients were admitted to the hospital or discharged, following the emergency room visit.

This simple outline of the study omits much of the research plan. For instance, obviously the outcome depends on many other factors than the process of medical care (i.e., patient's attitude, the natural course of the disease, etc.). Careful attention has been paid to selecting outcomes which can be influenced by good medical care; patient characteristics such as age and prior medical condition are stratifying variables to be entered in analysis of the data. Moreover, medical records must be checked for selective bias against either evaluation method, and for reliability of recorded process against actual process. Reliability testing of medical record abstractors is another necessary precaution.

PROGRESS:

An extensive criteria map and comparable criteria lists have been developed to evaluate the diagnosis and management of patients who present to an emergency room with chest pain. Each criteria set -- map and lists -- has been approved by a panel of local physicians including practicing cardiologists, family physicians, and university-hospital-based cardiologists.

Outcomes of discharged patients are being assessed by means of interview, questionnaire and EKG in the patients' home, between 48 and 120 hours after their visit to the Emergency Department. These devices are intended to measure outcomes such as missed diagnoses of serious disease symptom relief, and satisfaction with emergency room care. The home interview and satisfaction questionnaire are available in both English and Spanish.

Outcomes on admitted patients are collected by data abstract from the patient's medical record. These outcomes include necessary vs. unnecessary admission, accuracy of the diagnosis, and mortality in certain subgroups of patients.

Data collection on these variables is now beginning, following pilot testing of all data collection instruments.

DISSEMINATION:

A preliminary study, completed before the onset of this grant, has been accepted for publication in the journal, Medical Care. Unlike the current study, it does not compare results to the list method nor does it include hospitalized patients.

TITLE: Assessment of Quality of Emergency Care

GRANT NUMBER: 5 R18 HS 01958

GRANTEE INSTITUTION: University of Miami

PRINCIPAL INVESTIGATOR:

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FUNDING LEVEL: None FY 77
$191,022 FY 76
$186,508 FY 75

TOTAL PROJECT PERIOD: 6/30/75-6/29/77

SIGNIFICANCE:

Due to increasing public interest and recent legislation, the development and institution of methods for assessment and assurance of quality of health care have become priorities for the medical profession. Unfortunately, in spite of the obvious need, there is still little available in the way of widely applicable and acceptable operational systems for measurement and assurance of quality of emergency medical care. The Emergency Care Project is attempting to develop such a system for evaluating the quality of medical care delivered to burn and vehicular injury patients in three regions of Florida. A particularly desirable feature of this project lies in the fact that it takes severity of the patient's injury into account and therefore may result in a method to compare quality of care delivered to different populations.

PROJECT DESCRIPTION:

The objective of this project is to develop a feasible, reliable, valid and acceptable system for assessing the quality of care rendered to patients with traumatic emergencies. This project involves testing the reliability and validity of an instrument for assessment of care that was developed in a previous project, supported by the Florida Regional Medical Program. Quality of care assessments are based on a sample of the data collected on all burn and vehicular injury patients coming to the emergency rooms and admitted to one of four hospitals (representing the four categories of EMS facilities in three Florida cities (Orlando, Jacksonville, and Miami).

An additional hospital in the Orlando region has been added due to a reorganization of one major hospital, which created a satellite institution to care for a portion of its patients. The data collectors are nurse clinicians. Data collected on all burn patients and on admitted vehicular injury patients include: a) demographic; age, sex, and race, b) diagnostic; details on onset,

transport, prior treatment and clinical findings, c) management; procedures and medications. In addition all diagnoses, procedures, and complications are coded and entered on a clinical coding sheet and an abstract of the medical record is prepared by the nurse clinician for each admitted patient which summarizes the patient's hospital course.

The reliability of data collectors is tested by having data collectors in each city completely recode and reabstract samples of their own cases at 6 month intervals (test-retest) and of each other's cases (interrater). Simple counts of registry and coding discrepancies are computed for both test-retest data and interrater data. In addition, six physician evaluators compare two abstracts from the same patient and assess the degree of clinical disparity along several parameters on a 5 point scale. As an additional reliability check for burn patients only, the data collector and the physician independently estimate the percent body surface area (BSA) and percent full thickness burn on the same patient at the same time.

The Quality of Care Index is based upon assessments by trained physician raters concerning expected and observed outcomes of patients in the study hospitals. Raters use abstracts of process and outcome data recorded by nurse clinicians. Abstracts provide data from the first 24 hours post admission for rating expected outcomes, and the rating of actual (observed) outcomes is based upon the entire course of hospitalization. The expected and observed ratings are compared for each patient and from them a new score is computed as the index of quality of care for that patient. This numerical difference between observed and expected outcome ratings reflects the magnitude of the difference between number and severity of observed and expected complications. Hence, the higher numbers reflect increasingly poorer results than expected. These results are independent of severity of illness, which has already been taken into account by the physician rater in the form of a prognostic judgement based upon clinical abstract.

Reliability of the raters is being assessed in two ways: 1) a test-retest comparison where the rater assesses the same patient at a later time on both expected and observed outcomes and 2) an interrater comparison where raters' evaluations of each patient on each item and on the index score are compared. The validity of the quality of care index will be tested against a separate global assessment of each patient made by the physician rater.

PROGRESS:

1) By December 1976, 3301 burn patients (380 admissions) and 1292 admitted vehicular injury patients were registered.

2) A system for coding and storage of all registry data on magnetic tape has been developed, revised and is in full use.

3) A special manual of instructions for physician raters has been prepared and all raters have been trained. There are 7 raters.

4) All planned reliability and validity checks for data collectors and raters are ongoing.

DISSEMINATION OF RESEARCH RESULTS

Presentations related to this project are as follows:

B.S. Linn, J. Smith, and J. Langson. Vehicular Injuries in the Elderly. Presented at 28th Annual Scientific Meeting of the Gerontological Society, October 26-30, 1975, Louisville, Kentucky.

B.S. Linn, J. Smith, S. Nickell, and S. Stephenson. Using a Trauma Registry of Evaluation of Quality of Care. Presented at 103rd APHA Annual Meeting, November 16-20, 1975, Chicago, Illinois.

J. Smith, J. Civetta, J. L. Lester et al. A Simple Coding System for Traumatic Injuries. Presented at 104th APHA Annual Meeting, October 17-21, 1976, Miami Beach, Florida.

TITLE: Clinical Algorithms for EMT Performance Assessment

GRANT NUMBER: 1 R18 HS 02418

GRANTEE INSTITUTION: Trustees of the University of Pennsylvania

PRINCIPAL INVESTIGATOR:

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FUNDING LEVEL: $227,857 FY 77
$249,088 FY 76

TOTAL PROJECT PERIOD: 6/30/76-12/31/78

SIGNIFICANCE:

The overall objective of the proposed research is to provide a mechanism for upgrading the performance of emergency medical technicians (EMT's) and, thereby, to improve pre-hospital care for victims of emergency accidents and illnesses. It has been shown that proper intervention in the first few minutes following an accident or illness can be the difference between life and death or disability for the patient. In the case of heart attacks, a patient must be resuscitated within 4-6 minutes of a cardiac arrest. For a victim of an automobile accident, improper handling can result in permanent and total paralysis. The training and performance of EMT's is therefore crucial to the well-being of the general public, since anyone at any time can become an accident victim.

To accomplish the above objective, this study is developing and implementing clinical algorithms to be used by EMT's when monitoring and treating patients. Clinical algorithms are decision-trees with branching logic based on standard treatment procedures.

The results of this research have implications for several levels of personnel. For policymakers, the results will enable them to: a) make better and more meaningful assessments of the quality of care delivered by EMT's; b) determine system effectiveness in terms of dollars and efforts via analysis of training and refesher training programs; and, c) pinpoint strengths and weaknesses in the emergency medical services delivery system. For instructors and for EMT's, the project will permit more appropriate and structured training. For the general public, the project will result in improved pre-hospital care.

PROJECT DESCRIPTION:

The project is designed to develop clinical algorithms to serve as a teaching tool and guide to Emergency Medical Technician (EMT) field performance. The evaluation mechanism, clinical algorithms, will be developed by a phased

process. A cardiac algorithm set will serve as a model for initial development, testing, and validation; subsequently other emergency clinical algorithms will be developed, tested and validated based on the process set out in Phase I. The cardiac algorithm validation process involves a "panel of experts" approach; the set was developed by an interdisciplinary group locally, with structured review and input by national consultants. Following development, the cardiac algorithm set is to be pilot tested prior to large scale implementation. Data validity procedures and quality checks have been developed and will be pilot tested.

To date, the algorithm set has been completed and reviewed. The pilot test has begun; its functions are: 1) to collect baseline data for experimental design purposes; and 2) to test the developed data collection and validation tools and integrate necessary changes. EMT-Paramedics are currently being trained with the cardiac algorithm set and data collection and validation will follow. Data recorded on the instruments and forms will then be analyzed to yield a compliance score.

As previously mentioned, Phase II will follow the research design developed during Phase I and will test clinical algorithms for other emergency conditions such as trauma or drug overdose. During the final phase, analyses will be conducted to identify relationships between selected background and experiential characteristics of EMT's and their performance. Resulting algorithm compliance data will be used in the development of structured refresher training. Alternative refresher training approaches will be tested by analyzing changes in EMT performance over time, to identify the approach which yields the greatest impact on performance.

PROGRESS:

Since the project was funded on July 1, 1976, the following tasks have been completed:

1) Development of Sample Algorithm

   Cardiac algorithms designed to address eight arrhythmias have been developed by local staff and reviewed by a panel of national consultants.

2) Development of Data Validity Procedures

   Several methods were developed to assess field performance; the forms are described under Task #3 below.

3) Development of Cardiac Algorithm Forms

   In developing the cardiac algorithm set, several data collection instruments were developed: a treatment checklist form completed sequentially by EMT's; standard run report form completed by EMT's; and sequential treatment procedures as reported by EMT's completed by physicians at the base hospital.

4) Pilot Test and Collection of Baseline Data

A two-month pilot test with four Mobile Intensive Care Units (MICU's) to collect baseline data was completed.

5) Development of Compliance Measurement Model

Several discussions with personnel at the National Board of Medical Examiners and other consultants provided plans for quantifying cases toward the development of a compliance model.

6) Assessment and Revision of Algorithm

The algorithm set was revised based upon two national surveys.

In addition to the above tasks, a literature review of the management of cardiac emergencies was completed and annotated abstracts developed.

Two major EMS system changes have occured as a result of this project: 1) EMT's are now required to call into a base hospital to communicate with physicians regarding cases involving defibrillation or the administration of drugs; and 2) a proposal has been made by the Fire Department to upgrade all fire rescue units (EMT-I) to the MICU (EMT-II) level through extensive training and refresher training courses.

DISSEMINATION OF RESEARCH RESULTS:

L. Cole, J. Sims, S. Otterbein, R. Staroscik, and J. Morganroth. "Clinical Algorithms: An Improved Technique for EMT Performance Assessment," to be presented at the American Public Health Association 105th Annual Meeting 1977.

L. Cole, J. Sims, R. Staroscik, J. Morganroth and G. Cayten. "Pre-hospital Coronary Care: The Illusion of Consensus," to be presented at the University Association for Emergency Medical Services Annual Meeting, May 1977.

L. Cole, "The Use of Algorithms in Evaluation of EMS Training and Manpower," presented at National EMS Evaluation Symposium, New Orleans, January 1977.

Cited in Emergency Care News, "Advanced/Basic Care Among $4 Million Research Targets," November-December 1(12):1, 1976.

TITLE: Complications in Prehospital Cardiac Resuscitation

GRANT NUMBER: 1 R01 HS 02567

GRANTEE INSTITUTION: Johns Hopkins University

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FUNDING LEVEL: $199,591 FY 77

TOTAL PROJECT PERIOD: 9/01/77-8/31/80

SIGNIFICANCE:

Perhaps the most effective procedure which should be carried out by emergency medical service workers is cardiopulmonary resuscitation (CPR). Victims of heart attacks or other emergency conditions which produce cardiac arrest can often be saved if heart and respiratory function can be maintained at a level sufficient to forestall death until definitive treatment can be instituted. In CPR, the rescuer combines forcible compression of the chest to stimulate heart action with mouth-to-mouth administration of oxygen. There is no question that many persons owe their lives to this procedure, as it is presently performed. It is likely, however, that there are ways of improving the procedure, or improving the methods by which rescuers are trained, so that even more lives would be saved. Clinical experts have frequently observed that the procedure itself often produces injuries; damage to ribs or internal organs is often noted. This study will attempt to shed light upon the "complications" of CPR. Such complications fall into two categories: some are considered preventable but others are not only unavoidable but necessary, since they provide evidence that the CPR was administered with sufficient vigor to accomplish its purpose.

PROJECT DESCRIPTION:

Working through the office of the Medical Examiner and hospital emergency services in Miami, the research team will identify out-of-hospital victims of illness or accident who have received CPR, including both survivors and deaths. A careful and systematic postmortem examination will be performed to identify damage to bodily organs or tissues in non-survivors; patients who are resuscitated successfully will be followed throughout their subsequent hospitalization. Rescuers will be contacted to determine such characteristics as their size and weight, level of training, experience, and technical skills

in performing CPR. An attempt will be made to relate the nature of any complication detected to survival or nonsurvival and to characteristics of the incident, the victim, rescuer, and the techniques employed in treatment. Correlations, for example, between body characteristics of the rescuer or the victim and complications of a certain type (such as rib fractures) may point to improved methods of carrying out the procedure. Although the conclusions that can be drawn will be limited, a particular type of injury which is found frequently in the nonsurvivors but not in survivors--or the reverse--will provide important suggestive evidence pointing to ways to improve the effectiveness of CPR, and reduce its negative consequences.

PROGRESS:

The project has developed its administrative structure and has begun recruitment and other organizational activities on site. Data collection is expected to begin in early Fall, 1977.

DISSEMINATION OF RESEARCH RESULTS:

In addition to presentations at professional and scientific meetings and journal articles, a seminar is planned one month prior to the end of the project. Representatives of national agencies with CPR training responsibilities will be invited, as well as researchers in relevant clinical areas, to review study findings and recommendations for changes in policy and practice.

TITLE: Computer Based Consultation in the Care of the Critically Ill Patient

GRANT NUMBER: 5 R18 HS 01195

GRANTEE INSTITUTION: Research Foundation of the State University of New York

PRINCIPAL INVESTIGATOR:

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FUNDING LEVEL: None FY 77
None FY 76
$163,486 FY 75
$131,000 FY 74

TOTAL PROJECT PERIOD: 6/30/72-6/30/77

SIGNIFICANCE:

The practice of modern medicine is becoming increasingly dependent upon the interpretation of the vast quantity of data that is now available to the physician. In order to successfully utilize these data the information must be presented to the physician in a timely manner and a concise and orderly format. The physician must then be able to relate this information to the patient's major problem as well as to other disease processes. Nowhere is this problem more acute than in the treatment of critically ill patients. In these patients, not only is the nature of the problem often especially complex, involving exceptionally massive problems of data interpretation, but the consequence of inadequate management may be death. The application of modern data processing techniques is an obvious approach to providing aid to the physician in the treatment of these patients.

To meet these needs a computer programming system known as the Clinical Assessment Research and Education (CARE) system has been developed by this research team under a grant supported by the National Center for Health Services Research. It is designed to be used in critical care areas, such as intensive care units, by physicians, nurses, and paramedical personnel. Primarily, the CARE system is a consultative aid not only for surgical patients, who often present the most complicated metabolic considerations and difficult recovery courses, but also for many acute medical problems. The system also relates these important problems to the most recent literature as a "living textbook", and permits the physician to gain information from, and communicate with, other members of the health care team. It has been implemented through a nationwide time-shared computer service so as to allow wide-spread and easy access to this type of patient care assistance.

The CARE system offers a means of ensuring that the physician faced with a life-threatening surgical or medical problem need not rely only upon individual memory and knowledge in order to bring to that patient the best that the current state-of-the-art of medicine has to offer.

PROJECT DESCRIPTION:

The CARE system was designed to operate in a time sharing mode to permit use of the system in many critical care areas without inordinate cost. The time sharing facility used has a nationwide network of communications servicing the majority of major cities. In order to meet the demands of medical users the computer system is operational 7 days a week for an average of 18 to 20 hours per day.

The advantages of a time sharing system to the hospital users are many. No large capital equipment expenditures are required. The CARE system requires only a visual display terminal, a hard copy printer and a telephone or acoustic coupler. Once the terminal is installed it takes only a few minutes to validate a new user. There is no minimum charge for service; the user pays only for the time actually on the system. It should be emphasized that, due to the design of the CARE system, little or no technical knowledge of computers is required by the users. The CARE system is a consultative aid that is readily available at almost any geographical location in the continental United States, regardless of whether the user is in a small 150 bed community hospital or a large metropolitan medical center.

The expanded CARE system is comprised of over 150 individual inter-related programs arranged into a logical overlay structure. This overlay allows only those programs necessary for the immediate task to be held in the core memory of the machine at any one time, thereby reducing machine overhead. The programs are divided into 4 basic groups:

1) system control - these are all the programs internal to the CARE system that provide the proper data manipulation, program manipulation and system maintenance.

2) input - these programs control the input of data to the system. The input is divided into 22 categories, each category representing specific related information.

3) Computation and output - these two groups are linked together since the output routines are dependent upon the computational routines. Whenever an output is required the associated computational routines are involved to insure that the output represents the latest data entered, such as corrections or updated laboratory findings.

When a patient has been discharged the total record for his stay is permanently stored on magnetic tape. A complex system of "keys" restricts access to the system in order to protect patient privacy.

When the responsible physician recognizes that the management of a particular patient will be difficult, he may choose to seek consultative aid through the CARE system. The system now offers therapeutic guidelines for 28 major problem areas. The first step for the physician in obtaining these guidelines is to enter an initial assessment for the patient. The physician is then interrogated by the system for basic descriptors of the patient: name, hospital number, age, sex, race, weight, height, etc. The major problem that is manifested by the critically ill or injured patient is then identified by the physician. Depending on the problem selected, the computer next queries the physician for more details. For instance, if the major problem is trauma, questions eliciting the exact nature of the injury are asked.

If the major problem happens to be one of the three general categories of postoperative stress, a series of questions is asked to elucidate the exact nature of the surgical procedure. Information is also requested defining the patient's physiological status. Vital signs at admission (blood pressure, heart rate, respirations), mentation, nature and location of pain, ECG findings, sepsis, expected and present hematocrit, etc., are examples of some of the information elicited. Questions are asked concerning the presence of other concurrent disease processes, cardiac and non-cardiac, that may influence fluid and electrolyte requirements for the patient in the immediate postoperative or post-injury period. The physician is asked to enter the amount of acute losses, either measured or estimated, as well as the amount of replacement given since the onset of the acute episode. Any laboratory data that is available at the time of ICU admission also may be entered.

The purpose of this detailed initial assessment is twofold. First, it forces the physicians to consider in all aspects the interrelated processes that can make difficult the management of the high risk or other acutely ill patient. Secondly, this information is used not only in preparing a detailed patient history but also in computing reasonable estimates of fluid and electrolyte requirements, a major problem in managing high risk and seriously ill patients due to their impaired cardiorespiratory function.

PROGRESS:

In the two years of effort devoted to implementation of the computer based Clinical Assessment, Research, and Education System (CARE) in the care of the critically ill patient the following objectives have been achieved:

1) The basic CARE system has been fully implemented on a national time shared commercial service and is now available for use by physicians, nurses, and paramedical personnel on a dial-up basis.

    a.) Use of the system requires only a data phone or

regular phone plus digital acoustic coupler, a CRT digital terminal for data entry and retrieval, and an impact or thermal printer for hardcopy records when desired. No extensive computer hardware and no computer knowledge is required by the user.

b.) The current estimated user costs are between $250 and $290 per month rental for equipment (depending on the type of printer), phone charges to the nearest McAuto WATS line, and between $15 and $30 per day per patient managed using the CARE system. This latter variability is dependent on the extent of the system capability used for a given critically ill patient's care.

2) The CARE system presently includes advice for cardiovascular studies, metabolic balance including fluid intake and output, initial assessment modules, including the burn module, and daily fluid and electrolyte management recommendations.

3) The phase of medical debugging, checking the medical logic and recommendations against real life situations, is completed. However, it is expected that ongoing tailoring and revision of the medical information, logic, and recommendations will be necessary as long as the system is used for patient care, since new advances are being made in knowledge and therapy and certain unique problem interactions will always occur.

4) A drug information-drug caution module has been created as part of the CARE system and presently contains 50 detailed one page cautions. A total of 60 such cautions on major intensive care drugs will be available and kept updated.

5) Preliminary statistical information has been gathered concerning nursing personnel attitudes to computer implementation (prior to implementation). The ability to alter the pre-implementation attitudes of nursing personnel as a result of comprehensive ICU topic inservice has been evaluated as a base line for later statistics after nursing computer use is established. These have been used in redesigning the user format for the PDP 11/45 conversion.

DISSEMINATION OF RESEARCH RESULTS:

1. Computer based CARE of the aged or high risk patient: Automated assistance in fluid management, metabolic balance, cardiopulmonary regulation. Siegel, J.H., and Fichthorn, J.D. In: Book - "Surgery of the Aged and High Risk Surgical Patient; Medical Surgical and Anesthetic Mangement" by - Siegel, J. H. and Chodoff, P. Grune and Stratton.

2. Computer based consultation in the care of the critically ill. Siegel, J.H., Fichthorn, J.D., Monteferrante, J., Moody, E., Box, N., and Nolan, C. Presented at American College of Surgeons meeting, Miami Beach, Florida, October 21-24, 1974.

3. Computer based consultation of the critically ill patient. Fichthorn, J.D., Monteferrante, J., Siegel, J.H., Cairns, D., Loggia, T., and Glickstein, E. Presented at the "Association for the advancement of medical instrumentation" meeting, Boston, Massachusetts, March 19, 1975.
Abstract published in Medical Instrumentation (AAMI), Vol. 9: No.1, pp. 66, Jan. - Feb., 1975.

4. Computer based consultation in CARE of the critically ill patient. Siegel, J.H., Fichthorn, J., Monteferrante, J., Moody, E., Bos, N., Nolan, C., and Ardrey, R.: Surgery, 1976

TITLE: A Computerized Evaluation Model for EMS Performance

GRANT NUMBER: 1 R18 HS 02902

GRANTEE INSTITUTION: University of Pittsburgh

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FUNDING LEVEL: $255,000 FY 77

TOTAL PROJECT PERIOD: 9/01/77-8/31/79

SIGNIFICANCE:

This project represents a natural extension of the work in Emergency Medical Systems research that has been carried out at the University of Pittsburgh during the last six years. At the project's outset, it became clear that emergency medicine was relegated to a minor role within most hospitals, that ambulance providers were just beginning to recognize a need for more than first aid training and that the public had no concept of what the capabilities of the emergency medical system really were. In consonance with the state of the system, data, if they were collected at all, were inadequate; even where relatively good records were maintained, data were virtually unretrievable.

In response to the lack of available data and recognizing the rapid change that was taking place in emergency care, this research team's strategy was to develop meaningful data resources which would be useful for research and also effective for management purposes. At the same time, research activities were oriented toward system elements which were less data-intensive or for which data could be specifically and economically obtained. Major efforts have been completed in categorization, the ambulatory care-emergency care interface, community dynamics studies, demand estimation, vehicle requirement and location, evaluation of the effectiveness of upgrading the system for coronary care patients and, the work upon which the current project is based, computerized evaluation of prehospital emergency care performance.

This latter study and some of the investigators' other recent activities have been possible because of the rich data resources which are now available and will continue to be developed as part of their excellent relationship

with the Emergency Medical Services Institute, the agency covering the 12 counties of southwestern Pennsylvania which is supported under Section 1203 of the EMSS Act. The ambulance data system now processes over 80,000 trips per year and is still expanding. The Emergency Department data system which has been supported by the Commonwealth of Pennsylvania is being installed in six Western Pennsylvania hospitals -- two city, two suburban and two rural. With these data systems available, it will be possible to respond to the critical need for developing evaluation mechanisms for each component of the emergency care system - prehospital, emergency department and inpatient.

The objective of this proposal is to develop a computerized methodology for evaluating emergency medical care performance. This specifically includes the updating of existing models for evaluating Emergency Medical Technician performance and also testing the usefulness of acceptance sampling as a mechanism for monitoring this performance. In addition, the study will be structured for future extension of this methodology into the Emergency Department, part of the EMS system with much larger volumes than individual ambulance providers and for which no good mechanism exists for evaluating the care that takes place.

Western Pennsylvania has an especially good setting for EMS research of this nature since it is a microcosm of the entire United States. The center of the region is the City of Pittsburgh with all of the characteristics of a large metropolitan center. Substantial portions of the population live in suburban areas and at least half of the counties in this project are predominantly rural. As a result, performance evaluation will be developed in each of these settings and tested to determine the extent of transferability.

In southwestern Pennsylvania, a combination of funds from the Highway Safety and EMSS Acts in addition to State support has resulted in the development of an EMS system after over ten years of planning and politics. Since 1972, over 4,200 individuals have been trained at the EMT I level (81 hour course) and over 540 at the EMT II level (120 hour course). A methodology for the categorization of different hospital clinical capabilities has been developed by the Health Operations Research Group of the University of Pittsburgh and is being implemented by the Emergency Medical Services Institute, the local EMS planning agency, and by the Emergency Medical Services Operations Center, part of the University Health Center of Pittsburgh responsible for medical command, consultation, education and evaluation throughout the 12 county region.

However, the evaluation of both prehospital and emergency department care throughout the country has been extremely limited, particularly when such evaluations must be placed within a regional context. An attempt to have EMSS Act grantees provide for their own independent evaluations last year

proved unsatisfactory. As a result, independent evaluations were replaced this year by a requirement to complete an Evaluation Workbook for EMS (developed by Arthur Young and Company under a contract from the Division of Emergency Medical Services, DHEW). A recent National EMS Evaluation Symposium (New Orleans, January, 1977) provided clear evidence of the lack of satisfactory, nationally acceptable methods of evaluation. While there were many good ideas relative to conducting evaluations of EMS systems presented at the New Orleans symposium, in almost every case the evaluators were severely handicapped by the lack of a solid data base.

Prehospital care evaluations, where they have existed, have typically been in the form of case reviews by the ambulance company's medical director. While case reviews are important, the time required, the lack of explicit review criteria, and the absence of a uniform method of transmitting the results of these reviews to those responsible for providing emergency medical services, makes such reviews inadequate for evaluating regional EMS systems and initiating necessary changes in areawide training programs. To do this, the strengths and weaknesses of each provider must be assessed and their deficiencies and needs determined relative to their capabilities and their role in the regional EMS system.

Such an evaluation is a massive undertaking. In southwestern Pennsylvania, there are over 400 providers of ambulance services. However, the development of a computerized method of evaluation in combination with a uniform data system compatible with protocols for ambulance personnel performance permits a reduction in the number of cases that must be reviewed by a physician with a minimal decrease in the effectiveness and a possible increase in the comprehensiveness of the review. Moreover, by developing sampling techniques which statistically reflect the performance of the region, evaluations can be accomplished as a relatively inexpensive by-product of uniform data systems.

The purpose of a computerized emergency medical services evaluation and review methodology is to identify inadequacies in the emergency care delivery system. It is oriented towards systems assessment and management. This methodology will enable medical directors to identify cases reflecting poor quality care and aid planners in the specification of training programs and the upgrading of equipment and other resources within the region.

PROJECT DESCRIPTION:

The key to computerized regional evaluation is an accurate, detailed, protocol-compatible data system. Such a data system exists in southwestern Pennsylvania for ambulance providers. A second system is under development for Emergency Departments and will be compatible with the ambulance data system. From these systems it will be possible to develop protocols for identifying inadequate care and to use the protocols to isolate the reasons for such inadequacies. For example, protocols are being developed to prescribe the actions which

should be taken by Emergency Medical Technicians in the field. A detailed record of EMT response is currently reported in the standardized ambulance trip report. Matching protocols to records will yield indices for severity, risk and quality. Tabulations of quality scores relative to severity and risk will provide an evaluation of EMT performance during the time period reviewed.

On a regional basis, when care of inadequate quality is observed for a particular diagnostic/complaint type, the particular deficiencies can be alleviated through changes in the training and recertification process. The number of cases which must be reviewed to identify inadequacies is considerably less than the total number of cases available through the data system. As a result, acceptance sampling plans will be developed which will provide sufficient regional information to direct the allocation of training and equipment resources.

In addition, the acceptance plans will also be used to monitor individual providers in concert with local medical directors. Specific cases will be identified as inadequate with the care ranked according to the quality score. These cases will then be reviewed by the ambulance provider's medical director with the objective of isolating the weaknesses. These sampling plans will be modelled after those used in the military with varying percentages of review required, based upon the level of the quality score.

Given this conceptualization as a rational method of evaluating and monitoring EMT performance, it is the purpose of this project to test the effectiveness of computerized review relative to peer review of cases by physicians. Appropriate care typically has been determined by a consensus of qualified practitioners. Therefore, peer review becomes the standard against which any computerized methodology must be tested. If the new technique is at least as effective as physician review in identifying inadequacies, then an evaluation mechanism will have been developed which is several orders of magnitude (250 cases per minute compared to three per hour) less time consuming and more comprehensive.

The peer review approach will be pursued by the American College of Emergency Physicians under a subcontract. While there is justification for judging a case by either local or national standards, there are two important reasons for utilizing the national group. First, an adequate number of E.R. physicians qualified to serve on a review panel is often not readily available within a single locality. Second, the ACEP physicians doing the review will not have to compromise their objectivity since they will not be involved personally with any of the cases, institutions or professionals.

Although one goal of this project is to determine an acceptance sampling program for monitoring EMT performance, it is clearly possible to conduct 100 percent review of the prehospital phase of emergency care if a suitable

data base exists. However, 100 percent review is questionable in light of cost constraints and the marginal value of the additional information that could be obtained. An appropriate sample could provide the important evaluation information needed quite accurately. If a computerized data base did not exist, keypunching and reviewing every ambulance trip would be costly and time consuming notwithstanding its feasibility. Thus the sampling methodology will enable the methodology to be transferred to regions without computerized records systems.

The review mechanisms being perfected and tested during this project are essentially process measures. Protocols or criteria are matched to the tasks performed to estimate both compliance and the success of a particular intervention. Although the literature clearly delineates between process and outcome measures, in reality process and outcome are difficult to define in a continuous system.

In evaluating the performance of Emergency Medical Technicians, many process measures are possible. For example, did the EMT recognize the patient's condition properly? Were standard procedures followed? Were the treatments given appropriate? Were they successfully performed? This patient intervention sequence can at some point in time be specified as an outcome measure. That is, was the patient brought to the emergency room alive? Was the patient in a stable state? Was there any improvement in the patient's condition from the time of EMT intervention until the arrival in the Emergency Department?

While it may be argued that the effect of EMT intervention cannot be known until the outcome of the entire emergency care process is completed, a midprocess measure, such as whether the patient arrived at the emergency department in an improved state, has considerable merit in measuring EMT performance. EMT's perform their tasks as prescribed by some form of standing orders (protocols) or through radio communication with a physician. The EMT performance measure reflects compliance relative to carrying out these directions. If the prescribed intervention is in error, then it remains for medical researchers to identify a more appropriate intervention.

In summary, the overall objective of this project is to develop a computerized methodology for evaluating prehospital care of emergency patients. The project specifically covers improving the design, validating and testing the effectiveness of the investigators' prehospital performance evaluation methodology. In particular the following achievements are expected during the two year undertaking.

1. To appraise and modify existing EMT protocols. This will involve modifying existing protocols and developing some additional protocol material in order to form a set of computer compatible protocols matching the southwestern Pennsylvania uniform ambulance data system.

2. To derive weights for severity, risk and quality indices and to make the prehospital care model operational. This will include a reassessment of weights using a panel of emergency physicians. Then the model will be applied in order to select cases for validating the model.

3. To validate the effectiveness of the computerized model in correctly assessing the quality of performance of ambulance providers. This involves a selection of cases to be reviewed by an expert panel and a comparison of quality scores with peer review assessment.

4. To design and apply quality control methodology to selecting cases for evaluating prehospital performance. Acceptance sampling plans will be designed and tested.

5. To develop a procedure for isolating specific deficiencies in EMT performance and incorporate this information into a feedback program for training purposes. The Emergency Medical Services Institute and individual providers' medical directors will receive feedback on provider performance so that deficiencies may be alleviated through changes in regional and local training programs.

6. To test the effectiveness of the computerized performance evaluation. Measurements of the quality index for particular ranges of severity and risk of intervention will be made periodically. Comparisons will be made between different time periods to test the effectiveness of the evaluation program.

7. To assess the cost of implementing and operating the prehospital performance evaluation systems.

PROGRESS:

While this is a newly funded project, as noted previously, it builds upon extensive work carried out by this group over the past several years. The team has completed preliminary community organization work which includes gaining assurances of collaboration from organizations having the data necessary to the conduct of this study.

DISSEMINATION OF RESEARCH RESULTS:

Some selected relevant papers resulting from previous invesitgations supported by NCHSR follow.

M. J. Gunter, A Comparative Study of Community Planning for Emergency Medical Services: The Impact of Social and Political Factors on Program Implementation, Health Operations Research Group, University of Pittsburgh, Pittsburgh, Pennsylvania, July, 1975.

L. Shuman, H. Wolfe and J. Sepulveda, Estimating Demand for Emergency Transportation, October, 1975, Health Operations Research Group, University of Pittsburgh, Pittsburgh, Pa.

Health Operations Research Group, Ambulance Record Coding Manual, University of Pittsburgh, Pittsburgh, Pa., June, 1975.

J. A. Nachlas, Regional Planning of Critical Emergency Medical Care, Doctoral Dissertation, University of Pittsburgh, Pittsburgh, Pa., April, 1976.

O.R. Salguero, A Categorization Approach to the Regional Allocation of Emergency Services, Master in Public Health Thesis, University of Pittsburgh, September, 1975

J.A. Sepulveda, An Operations Research Approach to the Planning and Development of an Emergency Transportation System in a Rural Environment, Master in Public Health Thesis, University of Pittsburgh, September, 1974.

J. A. Nachlas, L. J. Shuman, and H. Wolfe, Regional Planning for Cardiac Emergencies, 1976, Joint National Meeting ORSA/TIMS, Philadelphia, Pa., April 1, 1976.

L. J. Shuman, "Emergency Medical Services Information Systems," Regional Data Systems Section, American Medical Records Administrators' National Meeting, Miami Beach, Florida, October 17, 1975.

L. Shuman and H. Wolfe, The Implementation Prospects of Operations Research in Regional Health Planning: A Case of the Integration of an OR Team Into the Emergency Medical System Planning Environment.

J. Sepulveda, L. Shuman, and H. Wolfe, Emergency Room Data Collection: A Comparison of Two Sample Sizes.

J. Duckett, A. Medsger, D. Benson, E. Ricci, L. Shuman, and H. Wolfe, Access Reaction to Emergency Medical Care: Prehospital Behavior and Transportation Choice for Critical Emergency Patients.

J. Nachlas, A Regional Planning Model for Critical Emergency Care.

M. Gunter, and E. Ricci, Hospital Planning for Emergency Medical Services: Organizational Issues and Interrelationships.

J. Sepulveda, An Analysis of the Emergency Case-Mix at a Community Hospital.

M. Hutton, J. Sepulveda, G. Whetsell; The Delivery and Planning of Emergency Care: An Overview of the Literature.

TITLE: Computerized Protocols Applied to Emergency Care

GRANT NUMBER: 1 R18 HS 02463

GRANTEE INSTITUTION: Deseret Foundation for Medical Care

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FUNDING LEVEL: $101,846 FY 77
$131,098 FY 76

TOTAL PROJECT PERIOD: 6/30/76-6/29/78

SIGNIFICANCE:

Optimal management of medical emergencies occurring in the hospital must include methods of early detection. A computer-based system has been developed for hospital-wide monitoring which, according to fixed protocols, gathers physiologic and clinical data on patients and from these data recognizes patterns indicating a threat to life. These patterns identify the patient who may need the more intensive monitoring and special care provided by an Intensive Care Unit, thereby preventing late, "doomsday" approaches to the care of such patients caused by delays in recognizing the gravity of their condition.

Care of the acutely-ill patient places requirements on the practice of medicine which are demanding of both time and intellect. Using protocols to assist in patient care will reduce the delays in responding to the moment-to-moment changes in critically ill hospitalized patients, and will also provide better methods of monitoring and treating such patients from the time they enter the emergency room throughout the course of their hospitalization, and especially while they are in the Intensive Care Unit.

PROJECT DESCRIPTION:

An extensive computerized medical data base has been developed over the past ten years from which medical decisions can be made. This data base includes clinical laboratory results, physiological monitoring information, multiphasic screening information and many other items such as automated spirometry and electrocardiography, patient's drug and allergy information, admitting diagnosis, vital statistics such as height, weight, sex, age, and certain historical information. Most of the data are automatically entered from laboratory, ICU, medical record and surgical locations. Although physicians record much of the data in the patient chart, entry into the computer is done by paramedical professionals.

As each piece of data is entered into the machine, it is processed by a decision-making system called HELP which evaluates the data according to protocols (fixed rules). If an "alert" (life-threatening) condition is recognized the data are stored in a special file for review by nurse clinicians. If the data do not represent an "alert" condition, the case is interpreted and reported routinely. Since the program is still developmental, nurse clinicians follow up "alert" patients by first reviewing the patient data to uncover possible errors in either data collection or the alerting logic. These highly trained nurses then review the patient's chart and visit the patient to verify the "alert" condition. If a true "alert" condition exists, the nurse clinicians immediately inform the physician or nurse, record their subsequent actions, and then assess the benefit to the patient of this early recognition. Rapid follow-up and personal patient evaluation, rather than retrospective chart review, are important features of the program since many times indicators of impending complications and critical situations are not recorded in the patient chart.

In addition to the "alert" system for monitoring hospitalized patients, protocols are being developed and tested to improve the recognition of those patients first entering the ER who should be admitted to the ICU, and to standardize the care given in the ICU.

PROGRESS:

In the nine months that the project has been operational, cooperation has been established with other institutions in the local area in development of acceptable alerting criteria. Nurse clinicians are following-up on an average of 54 alerts per day, representing about 2% of hospitalized patients. Of these alerts, nearly half occur on patients already in the Intensive Care Units. The other 30 are new alerts, for patients located on general hospital wards. With most patients, if one alert appears, another will follow within 24 hours. In about 16% of the cases, alerts signal patients requiring "new" visits. In only about half of the cases being observed during the baseline study period, patients who are signaled as "alerts" are already being treated optimally according to the nurse clinicians' judgement. During the "post" phase, both compliance with the recommended course of care and the clinical outcome will be studied.

The baseline data suggest the following preliminary observations:

1. The frequency with which hospitalized patients enter an "alert" or life-threatening condition is rather small.

2. Only about half of the "alert" patients are already being optimally treated.

3. The chances of survival of about 1% of hospitalized patients might be improved through this system if compliance by physicians and nurses is high. Thus, although the yield is to a relatively small number of patients, the benefit would be very great to each one.

The study will also be of enormous help in improving our ability to distinguish those patients who do and do not require costly ICU care, and may permit a shorter length of stay for some.

DISSEMINATION OF RESEARCH RESULTS:

Preliminary experimental design was described in a paper presented at the Technicon International Congress in December of 1976 in New York City. Several discussions have been made at site visits at other institutions by members of the research staff, primarily by Drs. Gardner and Clemmer.

TITLE: Confirmation Parameters to Assess EMT's Decisions

GRANT NUMBER: 1 R01 HS 02102

GRANTEE INSTITUTION: Trustees of Health and Hospitals of the City of Boston, Inc.

PRINCIPAL INVESTIGATOR:

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FUNDING LEVEL: $114,449 FY 77

TOTAL PROJECT PERIOD: 7/01/77-12/31/79

SIGNIFICANCE:

The objective of this research is to assess the quality of EMTs' (81-hour trained EMTs) prehospital decisions by developing and applying a series of diagnostic and/or physiological measurements obtained in the ER which will aid in judging the quality of specific prehospital diagnostic and/or therapeutic decisions by EMTs. These measurements are called "proximal confirmation parameters."

Four conditions are being studied: peripheral fractures, cardiac arrests, abdominal trauma, and suspected MIs. These conditions were chosen because they illustrate four discrete types of confirmation issues and EMT interventions which presently exist or are planned in the future for each condition.

At this stage of Emergency Medical Services growth, objective criteria for assessing EMT decisionmaking are necessary to supplement the expert, intuitive opinions upon which present EMT guidelines are based. Pressure for rapidly expanding emergency services and EMT training from public, private, and governmental sectors has been counterbalanced by concerns from physician and legislative groups about what the EMT can and should do, how well they do it, and the potential harmful as well as beneficial effects of what they do. Now that the expenditures and time commitment have reached significant proportions, a methodology for answering these questions needs to be developed. This study represents a first step in that direction by establishing a clinically meaningful set of parameters to evaluate specific steps in the EMT decision process.

This study, then, is a methodological one. As such, the sample size, the particular locale, lack of randomness in the sample, and other such concerns are less relevant than usual, because findings will not be focusing on the

generalizability of the sample, but rather on the validity, reliability, internal consistency, and feasibility of the criterion measures in terms of whether they do or do not accurately measure the phenomena they were developed to measure. The sample and the setting are a real-life testing arena through which the methodology is developed and evaluated. The assumption here is that once a methodology is available, other studies on other samples, by the same and by other investigators will repeatedly evaluate it and make changes that seem warranted.

PROJECT DESCRIPTION:

The overall steps in the methodology can be summarized as follows:

1. A description of the distribution of confirmation parameters relating to specific components of the EMTs' decisionmaking.

2. Use of these distributions by a Technical Advisory Group to provide a rational basis for restructuring EMT guidelines for making the specific decisions under study.

3. Introduction of the amended guidelines into the EMT set of standard operating procedures.

4. Institution of a Phase II study to assess the effectiveness of the changes in interventions based on the above methodology.

Although physician diagnoses are not infallible, they have been selected as the basis against which the EMTs will be judged for three reasons. First, these physician diagnoses are the most definitive statement available of a patient's condition. Secondly, these diagnoses are made by the physicians in whose stead the EMTs are acting during the prehospital phase, and there is no reason to expect the EMTs to diagnose or treat patients in a manner beyond the physician's capacity. Thirdly, the diagnoses of the physicians reflect the local acceptable level of care.

The performance of 59 EMTs in the Boston City Hospital Ambulance Department will be assessed in terms of condition recognition and/or correct intervention for groups of patients with four specific conditions. The research is intended to develop a methodology for creating baseline standards for judging the performance of the EMTs by the present duties prescribed for graduates of a conventional 81-hour training program. These standards will then be used as a yardstick against which the performance of noncertified EMTs, groups of EMTs trained in various levels/settings and EMTs with advanced training for patient conditions (e.g., cardiac rescue technicians) can be compared. The proximal confirmation parameters to be developed are as follows:

1. For peripheral fractures, false positive and false negative rates of splinting fractures will be calculated. The ER physician with x-ray will provide the true diagnosis of fracture or no

fracture and the EMTs' recognition of a potential fracture and application of the splint would be compared with the true situation, thus generating false negative and false positive rates for each EMT.

2. The pH of arterial blood as a measure for the effectiveness of CPR. CPR is applied by EMTs in cases of cardiac arrest. The rationale for using arterial pH as a proxy measure of the adequacy of the intervention (CPR) is that, controlling for duration of the arrest, CPR should result in a reduction in acidosis and therefore a more nearly normal blood pH level.

3. For patients with abdominal trauma, the number of units of fluid replaced in the first hour after arrival at the ER. This proxy measure will be correlated with rates of change in blood pressure, pulse rate and Double Product, which is blood pressure times pulse rate. Rates of change per unit time will be measured from the time the patient is first seen by the EMT until the patient is first seen by the ER physician. Two categories of abdominal trauma will be studied - solid organ or vascular, and visceral. It should be noted that currently EMTs are permitted only to bandage abdominal injuries; they do not start IVs en route to the hospital. The outcome being measured at present is essentially an outcome without the benefit of intervention. Baseline data will describe the "Natural History" of abdominal trauma prior to treatment in the ER, and measures continued over time after the ER treatment begins will permit measurement of EMT performance when, in the future, they are permitted to perform IV's.

4. False negative rates for each of ten symptoms associated with heart attacks will be used as proxy outcomes for patients with "suspect" MI. It should be noted that these symptoms represent "diagnostic outcomes" for EMT performance in the sense that specific therapeutic interventions are not being tested.

The study population will be patients with the four conditions identified above, transported by the Department of Health and Hospitals' ambulances during a 2-year period and treated by the 59 EMTs employed by that Department. All EMTs have had the national 81-hour EMT course and passed the national registry exam. A centralized ambulance service has been developed under the Boston City Department of Health and Hospitals (DHH). Presently the City has seven ambulances stationed at key locations in the City with three back-up vehicles at Boston City Hospital. The number of ambulance runs and transports has doubled within the last 4 years and the upward trend is expected to continue. Percentage of emergency calls in the City

of Boston to which the DHH responds is greater than 50 percent and it is projected that by fiscal year 1977-78, DHH will considerably phase out police and private ambulance services. An effective communication system has been established and is located in the Boston Police Department Communications Center. The ambulance communication personnel are physically located in the Radio Dispatch Room in close proximity to the Sixth District Police Dispatchers. The Police Department has been developing a computer assisted dispatch system which is programmed to include use by DHH personnel for dispatching ambulances.

The estimated number of patients in each category to be transported to the ER over the 2-year period is: cardiac symptoms 2,470, cardiac arrests 260, abdominal trauma 312, and suspected peripheral fractures 728 resulting in a total of 3,770 cases.

Data collection will take place by daily retrospective record review on each study patient. Record sources will include the EMT Ambulance Service Report and the Boston City Hospital Admitting Department records. Thus, prehospitalization data on EMT diagnosis and treatment will be obtained and the admitting records will provide sociodemographic data, past medical history, clinical course, length of hospital stay, final diagnosis, and outcomes.

An evaluation of EMT performance on the basis of false negative and false positive rates for the various measures will be performed. The major variable of interest pertaining to the EMT is length of experience. This analysis pertains to peripheral fractures and suspected MIs.

Changes in physiologic states over time - blood pressure, pulse rate and Double Product - will be computed for abdominal trauma patients. For cardiac arrest patients, arterial pH categorized by length of time arrested will be plotted by a least-squares fitted curve.

The research represents the initial development of a practicable methodology for assessing EMT decisionmaking. Such an initial effort is necessarily based on certain assumptions. It requires the study of a limited number of conditions and the use of group measurements in lieu of individual patient outcomes. Furthermore, the practical nature of the methodology presupposes the availability of other groups of EMTs so that the continually increasing sophistication of their clinical intervention training can be compared with the baseline measurements being developed in this study. Ultimately the utility of these confirmation parameters will be assessed in terms of harder outcome measures such as mortality, length of hospital stay, and residual disability.

The use of ER confirmation parameters for EMT decisionmaking differs significantly from the more common use of specified patient outcomes

(i.e., mortality rates) to assess the effectiveness of a pre-determined EMT intervention. In most medical research, interventions are determined by experts and subsequently subjected to trials wherein the differences in outcomes are assumed to be related to the new intervention. This model has four advantages over the traditional one:

1. Proximal confirmation parameters relate to specific steps in the EMT decisionmaking process and are not only based upon outcomes as in the traditional model.

2. Proximal confirmation parameters provide criteria for judging EMT decisions immediately upon arrival in the ER and eliminate the confounding variables inherent in traditional outcomes, i.e., the effects of type of hospital, availability of hospital personnel and equipment on the ultimate outcome of the intervention.

3. Proximal confirmation parameters, by providing information on the specific EMT decisions, can be used to develop improved guidelines for making these decisions. Traditional outcomes only describe the new process interventions as effective or ineffective.

4. Proximal confirmation parameters for cardiac arrest and for abdominal trauma provide physiological data for improving decisionmaking as opposed to providing purely statistical data based on outcomes.

PROGRESS:

The research team has carried out a preliminary ambulance survey from which estimates were made of expected numbers of cardiac arrests and impending MIs to be captured in the study. Collaborative arrangements have been established with the Office of Emergency Medical Services of the Commonwealth of Massachusetts and with the City of Boston Ambulance Service.

DISSEMINATION OF RESEARCH RESULTS:

As the study progresses, presentations at scientific meetings can be expected as well as journal articles. The final report will be made available to the public.

TITLE: A Critical Examination of the Illinois Trauma System

GRANT NUMBER: 1 R01 HS 02118

GRANTEE INSTITUTION: University of Illinois at the Medical Center

PRINCIPAL INVESTIGATOR:

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FUNDING LEVEL: $ 93,602 FY 77
$153,498 FY 76

TOTAL PROJECT PERIOD: 6/30/76-
6/29/78

SIGNIFICANCE:

An important thrust in the development of emergency medical services systems throughout the country has been the establishment of regionalized systems of transportation, communications, and treatment facilities to permit the handling of critically-ill patients in the most effective and efficient manner. Patients suffering severe burns, for example, would be resuscitated to a stable condition locally and then transported to a designated critical-care center, staffed and equipped to provide definitive burn care of a sophisticated nature. A well-publicized model for these systems has been the Illinois Regional Trauma System.

This project evaluates the performance of the Illinois Regional Trauma System by comparing various aspects of the care received by patients treated within the system with that received by equivalent patients treated at hospitals outside the system. The results will be useful in evaluating the extent to which organized systems can improve the quality of care for critically-ill patients, and whether this care is provided efficiently. Findings from this research should be particularly important to rural communities, for if they perform as expected, such systems of regionalized care have the potential of ensuring prompt care of the highest level when it is required, without placing upon each community the economic burden of supporting specialized facilities of the degree of sophistication required to treat the most difficult cases.

DESCRIPTION OF THE PROJECT:

The population for study is all cases of eighteen categories of trauma, graded according to three levels of severity, hospitalized during the year July 1, 1973 through June 30, 1974. That year was the final one during which the Illinois Trauma Registry collected data on all cases of trauma treated in the 50-hospital regionalized trauma system. The validity of the data from that system will first be tested by drawing a 10 percent sample

of cases from the records of the fifty hospitals and comparing them with the registry to identify case omissions and to determine the completeness and accuracy of the registry data; in addition, a 10 percent sample of registry cases will be drawn and compared with the hospital record. A sample of 200 cases in each trauma category from the registry will then be compared with a matched sample of similar cases treated in hospitals not designated as trauma centers by the State Health Department. Outcome data such as survival, length of hospitalization, residual impairment, patient satisfaction, and cost will be obtained from the registry, from hospital records, and from follow-up questionnaires.

PROGRESS:

In the first eighteen months of the project, the two-way validation has progressed through the data collection phase. Preliminary analyses have been conducted to determine differences between expected and actual frequencies of cases reported, in order to target more directly the record-search activities.

Data forms and procedures for the case-control study have been developed, and hospital and registry data collection and organization are nearing completion. All trauma registry data are coded and keypunched, and protocols and computer programs for analysis have been constructed.

DISSEMINATION OF RESEARCH RESULTS:

Manuscripts are in preparation on (a) the construction of a new technique to grade injury severity retrospectively, (b) the use of "tracer" conditions for evaluative studies in emergency medical services, and (c) a description of the methods of the case-control study.

TITLE: Delivery of Emergency Medical Services in Disasters

GRANT NUMBER: 5 R01 HS 01781

GRANTEE INSTITUTION: Ohio State University Research Foundation

PRINCIPAL INVESTIGATOR:

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FUNDING LEVEL: None FY 77
$179,892 FY 76
$187,881 FY 75

TOTAL PROJECT PERIOD: 6/01/75-9/30/77

SIGNIFICANCE:

The Disaster Research Center (DRC) is conducting a systematic and comparative study of the delivery of emergency medical services (EMS) in large-scale and relatively sudden disasters in the United States. The objective of the research is (1) to establish by empirical study the characteristics of the programs to provide EMS in mass emergencies and (2) to ascertain the general conditions or factors which affect attempts to deliver services in such crisis situations with many victims. The findings will have important implications for general EMS training and education and will suggest guidelines for the planning of the organization and delivery of disaster-related EMS.

Even the preliminary analysis and observations indicate that disaster-related EMS planning is inadequate, that planners for these kinds of EMS activities have no systematically-derived body of knowledge upon which to draw, and that EMS responses in disasters are only occasionally effective and seldom efficient. It is also apparent that there are widespread misconceptions among EMS and related personnel about human and organizational actions in disasters, that the current structure and attitudes in the EMS sector make it very difficult to learn from disaster experiences, and that the existence of an EMS system at a time of disasters is often a myth rather than a reality. On the other hand, most of the disaster-related problems in the EMS area appear solvable by selective system redesigning and organizational planning. These solutions would not require major financial expenditures, massive reorganization or the creation of a new technology.

PROJECT DESCRIPTION:

During the past two years, DRC has conducted field studies of twenty-eight mass emergencies in twenty-two communities, spanning fourteen states, the District of Columbia, and the U.S. Virgin Islands. Field research has consisted of three kinds of studies: the baseline or Time One studies used to gain information on EMS disaster planning and normal EMS operations in six disaster-prone

U.S. communities; on-the-spot research of five pre-planned events where the possibility of excessive casualties was anticipated; and studies of Time Two operations, or the EMS response in twenty-three mass casualty events. Included in this last category were both natural disasters (seven events) and technological disasters (sixteen events). Disaster agents included five tornadoes, two floods, eight transportation accidents, one major fire, and seven explosions and toxic leaks. Often, more than one trip was made to a community by DRC personnel, so that knowledge could be gained concerning EMS operations in pre-, trans-, and post-disaster settings.

DRC's focus on gathering comparative data on sudden mass casualty-producing events, together with its use of the interorganizational, open-systems theoretical model, dictated a research strategy that was both distinctive and appropriate. Essentially, three things were required. First, multiple case studies exhibiting a variety of system characteristics were needed. Studies were undertaken in communities as small as 5,000 as well as in several major American cities. Communities at all phases of EMS development, from those with only the most rudimentary capability to those with sophisticated systems, were included in the research. Second, field teams had to be present on the scene as soon as possible after a mass casualty incident. DRC's mode of organization made this task possible. Often, field personnel arrived on-site within a few hours after disaster impact and were, therefore, able to obtain immediate accounts of the activities of EMS organizations. In preplanned events, such as Mardi Gras, teams of researchers were on hand before and during the event. Third, in order to understand system organization and functioning, it was necessary to have contact with key EMS officials and operational personnel in a variety of emergency health care organizations. In-depth, open-ended interviews were conducted with hospital administrators; hospital personnel responsible for disaster planning; physicians, nurses and other medical staff; providers of ambulance and other transportation services; persons involved in normal and disaster EMS communications; providers of emergency first aid; and others responsible for EMS tasks in disasters.

Approximately 515 interviews were conducted in the course of this research, and there were perhaps twice that number of informal contacts with personnel of emergency organizations. Additionally, extensive documentary data (e.g., from emergency department logs, newspapers, and disaster plans) were obtained, and thousands of hours of observation were performed.

Observational data, obtained on-site by DRC field personnel, was invaluable as a source of information about the reliability and validity of data obtained by other means as well as information about the reality as opposed to the ideal of EMS delivery in high-demand situations.

PROGRESS:

Analysis of DRC data suggests the following major conclusions:

1. Few community health-care systems have undertaken realistic overall planning for handling large numbers of casualties.

2. Most EMS planning and operational personnel mistakenly assume that the everyday EMS system can be extended in mass emergencies and that a system which functions adequately during normal times will also do so in disasters.

3. There is a widespread lack of knowledge about the overall EMS system in many communities, even within subunits of the system itself, with only a few officials even recognizing this as a problem. In other words, although many of those who must plan or take part in EMS in diasters are intimately experienced in some part of the system, few have a sufficiently broad view to understand how the functioning of one part of the system relates to all the other parts. Thus it is difficult to arrive at a sound plan for interaction of the whole system when circumstances are extraordinary.

4. Self-interested and at times dysfunctional political considerations enter into all aspects of EMS planning and response, even in disasters.

5. In mass emergencies, accurate on-site assessment of the need for EMS almost never occurs.

6. Meaningful, on-site triage and initiation of treatment is seldom attempted in disasters and mass casualty situations, resulting in several problems, particularly for hospitals.

7. Poor intra- and inter-organizational communications are common in disasters, but this is due less to lack of communication facilities per se than to information overload, confused and distorted messages, and absence of trained communication personnel.

8. Extrication, transportation and distribution of victims of mass emergencies leaves much to be desired, sometimes with unfortunate consequences for the medical care given victims.

9. In some instances, although by no means in the majority of cases, care given to regular hospital patients during the trans-disaster period falls below acceptable standards because so much attention is given to providing EMS to disaster victims.

10. During disasters there is inadequate attention paid to standardized record keeping making post-disaster evaluation of activities almost impossible.

11. Centrally coordinated EMS responses are rare in mass emergencies, particularly in situations where there are large numbers of resources available.

12. While the overall picture of EMS in disasters is not very good, instances of effective and efficient responses in certain disasters indicates that increased communication, interaction, planning and cooperation among EMS sector components can bring about desirable changes which can improve EMS care in actual mass emergencies.

DISSEMINATION OF RESEARCH RESULTS:

The following list outlines current and projected publications of research findings and involvements with EMS organizations.

I. Papers and Presentations

J. A. Golec and P. J. Gurney, "The Problem of Needs Assessment in the Delivery of EMS," a paper presented at the Midwest Sociological Association, Minneapolis, Minnesota, April 1977.

V. A. Taylor and K. J. Tierney, "The Provision of Emergency Health Care at Two Bicentennial Celebrations." Forthcoming 1977.

K. J. Tierney and V. A. Taylor, "EMS Delivery in Disasters: Preliminary Findings," a paper to be presented at the Annual Meeting of the APHA, Washington, D.C, October 30-November 3, 1977.

M. F. Worth and J. L. Stroup, "Some Observations on the Effect of the EMS Law on Disaster Related Delivery Systems," a paper presented at the Midwest Sociological Association, Minneapolis, Minnesota, April 1977.

J. L. Neff, "Responsibility for the Delivery of Emergency Medical Services in a Mass Casualty Situation: The Problem of Overlapping Jurisdictions." Preliminary Paper #35, The Disaster Research Center, Columbus, Ohio.

J. E. Wright, "Interorganizational Systems and Networks in Mass Casualty Situations," a paper presented at the Annual Meeting of the APHA, October, 1976.

J. E. Wright, "Coordinating Emergency Medical Services in Mass Casualty Disaster: The Ideal Versus the Reality." Preliminary Paper #33, The Disaster Research Center, Columbus, Ohio.

J. E. Wright, "Interorganizational Relations as Structure and as Action: The Case for Emergency Medical Services in Disaster." Preliminary Paper #37, The Disaster Research Center, Columbus, Ohio.

S. Reynolds and J. E. Wright, "A Selective Literature Review of Disaster Medical Services."

S. Reynolds, "EMS Planning and Disaster Response." Forthcoming, 1977.

K. J. Tierney and V. A. Taylor, "A Methodology for Evaluating Disaster-Related EMS." Forthcoming, 1977.

P. J. Gurney, "Factors Affecting Distribution of Victims in Mass Casualty Situation." Forthcoming, 1977.

V. A. Taylor and K. J. Tierney, "EMS Configurations and Their Impact on Disaster Response." Forthcoming, 1977.

V. A. Taylor and K. J. Tierney, The Delivery of Emergency Medical Services in Mass Casualty Situations (an edited book to be published sometime in the year following the completion of the research).

S. A. Blanshan, "A Time Model: Hospital Organizational Response to Disaster," Disaster Theory and Research, Sage Publications, 1977.

R. R. Dynes, "Delivery of Emergency Medical Services in Disasters, " a paper presented at the Second International Conference on Emergency Medical Services, Baltimore, Maryland, May 1976.

K. J. Tierney, "Emergency Medical Systems Responding to Disasters:Part I," a presentation at the Micro-Communications Workshop on EMS, Columbus, Ohio, June 1976.

V. A. Taylor, "Emergency Medical Systems Responding to Disasters: Part II," a presentation at the Micro-Communications Workshop on EMS, Columbus, Ohio, June 1976.

S. A. Blanshan, "An Open-System Perspective on Organizational Change: The Effect of Environmental Change on Organization Structure," a paper presented at the North Central Sociological Association, May 6, 1976.

II. A Theoretical Statement

J. E. Wright, "Interorganizational Systems and Networks in Mass Casualty Situations."

III. Involvement with Local EMS Organizations

DRC conducted field research in Washington, D.C. and Philadelphia during the 1976 Bicentennial celebrations. One of the objectives of this research was to determine whether prior EMS planning would reduce the demand for non-emergency hospital care during a period of mass convergence and to what extent. A monograph will be written containing case studies about EMS efforts in these two cities during this period.

A similar but more systematic study was conducted with the cooperation of local EMS personnel in New Orleans during Mardi Gras 1977. Data were gathered on emergency department visits at ten New Orleans hospitals for a five-day period. The data are presently being coded and keypunched. Results will be made available to the local EMS Steering Committee.

TITLE: Development of a Guide for EMS Communications Training

GRANT NUMBER: 5 R01 HS 02146

GRANTEE INSTITUTION: The Ohio State University Research Foundation

PRINCIPAL INVESTIGATOR:

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FUNDING LEVEL: $16,242 FY 77
$60,087 FY 76

TOTAL PROJECT PERIOD: 8/01/76-11/30/77

SIGNIFICANCE:

There is growing emphasis on the development of communication systems to facilitate response to emergency medical calls for medical help. This trend is evidenced by increased allocation of funds for this purpose by public and voluntary agencies at national, state, and local levels. The investigators believe that it is particularly important, at this time, to focus on the role of the recipient of the calls and/or the EMS dispatcher, who stands as the "gatekeeper" of the emergency medical services response system. For the most part, the focus of attention has been on hardware, such as the development of "911" call systems and the use of special receiving and dispatching equipment and telemetric devices. The training of emergency dispatchers has been largely directed toward the machinery involved in their work. Emphasis has been placed largely on how to answer a call, how to locate the scene of the emergency event, and how to dispatch aid. Guidelines for dealing with the public have been rudimentary. Little or no attention has been given to the interchange of information between the caller and the recipient and to the development of programs for training EMS communications personnel to elicit information regarding the nature of the emergency event, to offer appropriate advice, and to interact effectively with people in stressful conditions. The object of the present study is the development of a guide for EMS communications training that will allow each community emergency medical system to examine the calls entering that particular system and to develop training programs for their own personnel. This approach offers the advantages of relevance to the local situation, attention to the specific needs of each community, and the acquisition of experience in training at the local level.

PROJECT DESCRIPTION:

The Columbus, Ohio, Division of Emergency Medical Services records all of the incoming calls for medical assistance on master tapes. Arrangements were

made to record these calls on cassette tapes for the purposes of a study recently completed on the content of emergency messages. Typed transcriptions were made from each of the calls and the cases were followed to determine emergency transport and hospital admission decisions.

Panels of emergency physicians, emergency room nurses, and emergency dispatchers were selected to listen to a sample of 100 calls representing a variety of emergency problems dealt with by the Columbus EMS system. These calls were chosen by the investigators as cases, illustrative of problems encountered in the aforementioned study of emergency messages.

A typewritten transcript of each call was reviewed in order to identify the portion of the interchange between the caller and the recipient that would offer the panelists information to:

(1) Recommend the questions that should be asked of the caller to clarify the nature of the emergency event.

(2) Indicate the advice that should be given to the caller regarding actions that are to be taken while help is on the way.

(3) Specify an appropriate dispatching decision for the given case.

(4) Describe the probable nature of the emergency event and the circumstances surrounding it.

(5) Indicate what actions the emergency medical technicians may have had to take at the site of the emergency event.

(6) Indicate the likelihood that the patient would require transportation to a hospital emergency department.

(7) Indicate the likelihood that the patient would require admission to the hospital inpatient services.

(8) Indicate probable admission diagnoses.

The calls were edited in order to eliminate clues to the answers to the above questions without distorting the meaning of the message. Responses are being collected from each of the three groups of panelists in order to determine the agreement or diversity within groups and between groups.

For each of the calls that is presented, information is available regarding the actual findings of the responding emergency squads, their decisions regarding transport to hospital emergency rooms, the decision of the ER personnel regarding admission to inpatient services, and the admission diagnoses. Using a modified Delphi method, the panelists reconsider their responses and are then presented with the actual follow-up information regarding each of the cases. The panels are then convened in order to arrive at a consensus regarding the best set of responses in each case. Finally, these responses are used to develop a set of algorithms or guidelines for training the emergency communications personnel.

The results of these efforts will be presented to the emergency dispatchers on duty in Columbus, and they will be asked to utilize the guidelines and to offer their critiques. The object is not only to present specific algorithms for EMS communication personnel, but to devise and demonstrate a method that can be used economically and conveniently by all communities that wish to develop training programs of their own.

PROGRESS:

A number of technical problems were encountered in the re-recording of the messages to present only the appropriate information to the panelists, without revealing clues to the answers that are requested of them. These problems have been solved and it is now felt that the method can be readily carried out in any community emergency communication system. Arrangements have been made for recruiting appropriate panelists. This required a complex schedule of individual and group sessions and the guidelines for such scheduling will be included in the project report. Actually, it is apparent to the investigators that it will be possible in the future to carry out this process with much less complexity than was involved in the initial effort. A set of questionnaires and response forms for the panelists are being developed and prepared for field testing.

DISSEMINATION OF RESULTS:

As the study data are acquired, reports will be prepared of the study methods and the range of responses obtained from panelists with regard to illustrative cases. Prior to the preparation of the final report, a number of smaller reports and publications will be submitted on different aspects of the results.

TITLE: Effectiveness of Advanced EMTs Versus Basic EMTs

GRANT NUMBER: 1 R01 HS 02536

GRANTEE INSTITUTION: Trustees of Boston University

PRINCIPAL INVESTIGATOR:

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FUNDING LEVEL: $91,990 FY 77

TOTAL PROJECT PERIOD: 7/01/77-6/30/80

SIGNIFICANCE:

Nearly one million persons per year have myocardial infarctions in the United States and of these three hundred and seventy-five thousand patients die, yielding a 28% case fatality rate for myocardial infarction. Three basic reasons are cited to account for these figures:

1) Two-thirds of patients with myocardial infarction never reach medical assistance.

2) Patients delay in calling for help due to denial of presenting symptoms and/or ignorance.

3) Seven percent (7%) of patients cannot be resuscitated by ambulance crews at their arrival on the scene.

There are further data which suggest that a high proportion of "sudden deaths" from myocardial infarction die not from irreversible cardiogenic shock, but rather from treatable post-myocardial-infarction arrhythmias. Patients who reach coronary care facilities have an improved chance for survival.

The principal objective of the proposed research then, is to evaluate the effect that advanced training of EMTs (Emergency Medical Technicians) has upon the quality of prehospital patient care. The quality of prehospital patient care delivered by advanced EMTs will be compared to the quality of prehospital patient care delivered by basic EMTs in a discrete, semi-rural area--Cape Cod, Massachusetts. The advanced EMTs have been trained in a 300-hour community college course. Basic EMTs are those who have been trained in an 81-hour nationally-sponsored EMT course.

This project will evaluate the impact of Advanced Emergency Medical Technicians on the treatment of victims of Myocardial Infarction (MIs). Since the country is apparently going to make a substantial investment in this area, definitive information on the utility of EMTs will be of considerable value.

Advanced EMTs are thought to be better equipped in terms of their diagnostic skills, their clinical judgment and their range of therapeutic modalities. It is further assumed that the appropriate use of these advanced skills will result in improved patient care, manifested principally as reduction in condition-specific case-fatality rates. This research will examine these two assumptions.

PROJECT DESCRIPTION:

The basic aim of this study is to evaluate the effects on patient outcomes of the performance of additionally-trained EMTs as compared to a similar group of patients cared for by basic EMTs. On Cape Cod, there are 20 fire department ambulance and rescue services. These services are staffed by 239 EMTs (122 full-time) who have completed the national 81-hour course and have passed the national registry exam. There are an additional 108 basic EMTs on Cape Cod who serve in a limited, voluntary capacity with various rescue squads. Twenty of these 239 basic EMTs have completed a 300-hour advanced EMT course at Cape Cod Community College. Their practical training was at the Cape Cod Hospital. The training covered the gamut of advanced life support methods and critical case situations, though the emphasis of the training was on treatment of patients with acute MIs.

Eighty percent of the advanced training offered has been in advanced cardiac care, including electrocardiogram (ECG) monitoring and telemetry, defibrillation, intravenous antiarrythmic therapy and administration of cardiotonic drugs. Since the emphasis has been on advanced cardiac training, the greater portion of this research is focused on cardiac emergencies. The existence already on Cape Cod of two groups of EMTs, advanced and basic, provides the basis for a controlled trial between two populations which can be retrospectively matched.

A comparative experimental design will be employed. Fundamentally, the process and outcomes of EMT care for the group of patients treated by the advanced EMTs versus the basic 81-hour EMTs will be assessed. The process parameters are symptom recognition and appropriateness of treatment; the outcome parameters are proximal survivorship, long term survivorship, and residual disability. The two groups of patients for each comparison will be retrospectively matched for diagnostic category and stratification variables.

There are four secondary aims to this study:

1. The effect of a series of stratification variables will be retrospectively examined to determine their effect on the outcomes achieved by advanced versus basic EMTs. In particular, variables such as age, length of delay, past history and severity which can be reasonably and easily assessed by EMT dispatchers on the phone will be examined.

2. A threshold scoring system of these stratification variables for use by ambulance dispatchers will be developed. Essentially, the ratio of computed probabilities for survivorship between a logistic regression function of these stratification variables for the population cared for by advanced EMTs and a logistic regression function of the variables for the population cared for by basic EMTs will be used.

3. Availability of a second group of advanced EMTs in year two of the study will permit evaluation of the effect of experience superimposed on advanced training in terms of patient outcomes.

4. The effects of the influx of a large population (due to summer visitors) on EMT performance and subsequent outcomes will be examined. From June 15 to September 10, the population of Cape Cod increases by a factor of 3.5 (141,559 to 475,000). One can hypothesize from the fact that the population of Cape Cod triples during the summer that the EMTs' skills would either improve due to the increased experience or worsen due to fatigue brought on by the increased work load. The effect of such an influx of people on the performance of EMTs will be analyzed. In particular, change of response time, change in proportion of correct diagnoses and changes in case fatality rate for myocardial infarction will be examined. Congressional testimony concerning the EMS bill has specifically cited the need for an examination of this problem.

PROGRESS:

A Technical Advisory Group has been assembled and collaborative arrangements established with the training college, the 3 hospitals serving Cape Cod, the region XII Comprehensive Health Planning Agency, as well as the ambulance services for the area.

DISSEMINATION OF RESEARCH RESULTS:

Results of a pilot project concerned with the feasibility of conducting an evaluation in this setting were reported to the Injury Control and Emergency Medical Services Section of the Annual Meeting of the American Public Health Association in November 1976.

TITLE: Effect of Burn Education on Quality of Emergency Care

GRANT NUMBER: 5 R18 HS 01801

GRANTEE INSTITUTION: University of Miami School of Medicine

PRINCIPAL INVESTIGATOR:

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FUNDING LEVEL: $118,211 FY 77
$132,045 FY 76
$123,620 FY 75

TOTAL PROJECT PERIOD: 6/30/75-6/29/78

SIGNIFICANCE:

This project is designed to determine the extent to which an innovative program of continuing education can improve the quality of care delivered to burn patients seen in emergency rooms at community hospitals in the Miami area. The educational program is directed towards all emergency room personnel, including physicians, nurses, and occupational and physical therapists. The project design permits testing whether, and to what extent, education will increase the quality of care delivered to these patients. If reinforcing community hospitals with continuing medical education does significantly enhance their capability to provide acceptable care to burn victims, an enormous amount of time, dollars, and lives can be saved. Arming community hospitals with the skills to care for some burn patients as well as they are treated in teaching institutions could become an acceptable strategy for future resource allocations, and may be preferable to the development of additional specialized burn units if benefits are equivalent and costs are less.

PROJECT DESCRIPTION:

The experiment is designed such that there will be 20 community hospitals involved in the project at the end of the second experimental year. The hospitals were randomly assigned to one of two groups: experimental or control. The experimental hospitals receive an educational package whereas the control group does not. The educational intervention consists of four components: seminar, manual, hotline, and feedback to physicians.

A) SEMINAR: These are three-hour sessions in which current burn treatment information is presented to each experimental hospital. The seminars have been approved for continuing education credit by the American Medical Association as well as the Florida Nursing Association. All emergency room personnel are requested to attend as are any other interested hospital staff.

B) MANUAL: Emergency Room Burn Care is a manual that was specifically developed for this project. The manual provides a format for the seminar and is designed to be easy to understand and to use. The manual includes five algorithms or flow charts that specify proper procedures for treatment of burn patients who arrive at emergency rooms under different conditions. Each algorithm is followed by a Notes Section that describes in detail the clinical rationale for the treatment steps recommended. During the seminar it is emphasized that the manual does not represent the only way to manage a burn victim, but rather a tried, accepted and proven way that does work.

C) HOTLINE: A hotline telephone service to the Burn Unit at Jackson Memorial Hospital is available to these community hospitals on a 24-hour-a-day, every day basis for answers to any questions, large or small, that they have concerning the care of burn victims.

D) FEEDBACK TO PHYSICIANS: This component serves a dual purpose: 1) it is part of the education process in that it continually reinforces the physicians in their clinical behavior and 2) it enables the investigators to analyze the educational impact. In each of the experimental hospitals, every physician who treats a burn patient receives feedback. Feedback consists of a coded checklist that describes compliance or disagreement with the treatment regimen presented at the seminar and in the manual. A request is made that the physicians respond to the feedback by "feeding back on the feedback." This is easily accomplished by returning a self-addressed stamped postcard to the investigators with any reactions the physician might have to the feedback.

Data collection begins immediately after a seminar has been conducted at a given hospital. Two types of data are being collected: process and outcome. The process data is collected by a trained nurse clinician who examines the patient's chart in great detail. Outcome variables are collected by the research social workers who visit the patients approximately two weeks after they have been treated in the emergency room. Patient satisfaction and compliance with any home care advice are some of the types of information collected from patients. Patients who have been admitted to any of the hospitals are visited not only at two weeks but also at three months, to determine their satisfaction with the hospital care and to determine their long-term status.

PROGRESS:

The first data collection year ended in March 1977, and as of February, data on over 2000 patients have been collected, 123 of whom had been admitted to the hospitals. The numbers of patients seen at experimental versus control hospitals were very similar:

	TREATED & RELEASED	ADMITTED	TOTALS
EXPERIMENTAL	984	73	1057
CONTROL	951	50	1001
TOTALS	1935	123	2058

The project will continue through two study years, and it is too early as yet to make comparisons between experimental and control groups. Interrater reliability tests to date between two social workers and also between nurse clinicians show good correlations.

DISSEMINATION OF RESEARCH RESULTS:

Although no publications have yet resulted from this project, it is producing a tremendously valuable source of data about burn victims, resulting in a number of presentations concerning burn prevention, compliance with treatment and patient satisfaction. Abstracts have been submitted for possible presentations at national meetings. Presentations were made at meetings of the American Burn Association in 1976 and 1977 which discussed the design of the project, the educational package and the pitfalls in collecting data about burn victims.

Accepted for presentation at the American Public Health Association Annual Meeting in October/November 1977:

J. Wetter, R. Pollack, and B.S. Linn, Problems in Providing Effective Continuing Education in the Emergency Department.

TITLE: EMS Evaluation: Index of Injury/Illness Severity

GRANT NUMBER: 5 R18 HS 01756

GRANTEE INSTITUTION: Trustees of the University of Pennsylvania

PRINCIPAL INVESTIGATOR:

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FUNDING LEVEL: None FY 77
$147,284 FY 76
$213,635 FY 75

TOTAL PROJECT PERIOD: 6/30/75-9/29/77

SIGNIFICANCE:

Evaluation of emergency medical care is limited by the fairly rudimentary methods of medical care evaluation in general. Emergency medical care evaluation can be considered in terms of structure, process, and outcome measures. Outcome measures of medical care include patient mortality and morbidity. The extent to which mortality and morbidity rates can be affected by EMS system performance is difficult to determine, as demonstrated by the confusion concerning the relative importance of lowered speed limits versus improved emergency care in reducing highway accident death rates. The effective measurement of emergency medical care outcomes requires a way to compare the results of treatment for patients whose risks of death and disability are similar, and therefore requires the development of reliable and valid indices of the severity of injury and illness.

This research project focuses on the development and validation of such an index of injury/illness severity. A good index would be computed for each emergent and urgent patient using weighted combinations of available information about vital signs and symptoms, and would describe patient status at a single point in time. However, a patient's status as measured by the index could also be assessed at several points in time, and thus the index could also serve as a surrogate outcome measure for the pre-hospital and Emergency Department care phases. An index of illness or injury severity should make it possible to compare the results of care provided by different rescue units or different hospital emergency departments over a broad group of patients.

Severity indices can be used to triage patients to the appropriate facility and to alert emergency department staffs to the urgency of care needed; to standardize cohorts of patients for epidemiological and clinical studies; to compare the quality of care rendered by ambulance services and Emergency Departments with one another; and to predict health outcomes of patients.

C. Gene Cayten, M.D.

PROJECT DESCRIPTION:

The goal of this research project is to develop an index from readily-available data which is predictive of patient outcome. The central assumptions underlying the construction of such an index are: the existence of some measure of the severity of the patient's condition; the development of a scale which will measure this severity reliably; the existence of a relationship between measurements of the patient's current status and predisposing factors to the eventual outcome.

A rigorous systematic approach is now being taken towards the development of an index that progresses through six general phases of work. They are as follows:

(1) Determination of which data elements are essential to collect; the establishment of precise definitions for those data elements as well as uniform procedures for their measurement; and testing of the reliability and validity with which the data elements can be assessed.

(2) Testing the availability of the data elements using the proposed methods of collection.

(3) Testing the reliability and validity with which the data elements can be abstracted.

(4) Development and reliability and validity testing of an outcome measure more sensitive to variations in patient severity than the binary live-die measure.

(5) Analysis of the collected data to lead to the development of an index or indices with certain desirable properties (e.g. ease of computation, medical plausibility, accurate prediction).

(6) Validity testing of the index use and comparison with other outcome measures.

The first four phases of work outlined above have been completed. The determination of the data elements was based on the development of scenarios that were reviewed by a panel of physicians; they were asked to list any data element they felt was necessary to predict patient outcome. In addition, four physicians completed literature reviews in the general areas for which indices will be developed: cardiac, trauma, respiratory, unconsciousness. Since these four areas make up 50% of emergency patients, enough data could be collected to develop the indices. The purpose of these reviews was to delineate risk factors in each of these clinical areas and to indicate additional data elements that could be collected by EMT's or in the Emergency Department during the first 30 minutes. At the completion of the panel review and reviews of the literature on cardiac, respiratory, unconsciousness, and trauma risk factors, an initial list of data elements was selected. The existing fire rescue form and hospital Emergency Department records were

reviewed to determine which of the elements were available. The results of this review indicate that the forms requested most of the data elements of interest. This list of data elements will continue to be revised in light of further information.

Following the selection of ten qualitative and quantitative data elements, fire rescue personnel were trained and tested with an RN serving as a standard. Their training continued until they reached a level of competence necessary to insure reliable data. Within the Emergency Department, tests were undertaken to insure that the values obtained were within tolerance ranges. Correlations were then obtained between research assistants in the use of an outcome scale, the results of which suggest the data can be obtained in a reliable and valid manner. The procedures used in the development of the scale were to:

(1) create a scale with a particular set of definitions;

(2) test that scale on a number of patient records;

(3) compare the scores obtained by each research assistant;

(4) discuss with the research assistants the causes for the discrepancies;

(5) revise the definitions to eliminate the discrepancies and;

(6) begin the procedure again with a new group of patient records.

This scale is designed to be used by research assistants with clinical nursing backgrounds who assess each patient in six body functions at several points in time using information available in the hospital records.

DISSEMINATION OF RESEARCH RESULTS:

Publications and Papers

1. L. Cole, M.A., C. G. Cayten, M.D., M.P.H., N. Herrmann, Ph.D., S. Walsh, R.N. "Improving the Accuracy of EMS Clinical Data" APHA Convention, Miami, October 19, 1976.

2. C. G. Cayten, M.D., M.P.H. "Severity Indices and Their Implications for EMS." DHEW Symposium EMS Evaluation, New Orleans, January, 1977.

3. M. Woll, M.S., S. Walsh, R.N., N. Herrmann, Ph.D., L. Cole, M.A., C. G. Cayten, M.D., M.P.H. "Assessing the Validity of EMS Data." To be presented at University Association for EMS.

4. N. Herrmann, Ph.D., C. G. Cayten, M.D., M.P.H., J. Senior, M.D., R. Staroscik, M.D., S. Walsh, R.N., M. Woll, M.S. "Inter-observer and Intra-observer Reliability in the Collection of EMS Data." To be presented at APHA Convention.

TITLE: EMS Research Program Projects

GRANT NUMBER: 5 P01 HS 01907

GRANTEE INSTITUTION: The Johns Hopkins University

PRINCIPAL INVESTIGATOR:

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FUNDING LEVEL: $398,853 FY 77
$524,137 FY 76
$441,617 FY 75

TOTAL PROJECT PERIOD: 6/30/75-6/29/80

SIGNIFICANCE:

The overall objectives of this EMS Research Program are to develop and apply methodologies to describe current modalities of emergency medical care and to assess the impact of interventions aimed at improvement. Project I deals with system-wide interventions (such as regionalization, communications, EMT training, etc.) and is being conducted in the five-county Baltimore region. Project II focuses on health education and other service interventions introduced at the individual emergency-room level and is based in the emergency departments of The Johns Hopkins Hospital and Baltimore City Hospitals, as is Project III, the focus of which is clinical interventions.

At present $185 million have been awarded under the Emergency Medical Services Systems Act of 1973 and 1976 and $25 million by the Robert Wood Johnson Foundation to enable communities to plan and operate EMS systems. A major requirement is that systems categorize their hospital facilities and thereby reduce inappropriate utilization (both under-use and over-use). In addition, the new Health Planning legislation requires Health Systems Agencies to be concerned with the appropriate coordination of regional and specialized health services, including emergency medical care. Nevertheless, there is not presently available a methodology to assess current emergency department utilization, nor one to assess the effectiveness of categorization in modifying utilization. Further, there is insufficient evidence currently that the suggested system-wide interventions change utilization or that such changes are associated with improvements in processes and outcomes of emergency care. Project I is developing and applying such a methodology, to facilitate an assessment of the effectiveness of regional interventions and an evaluation, by process and outcome measures, of the return on the considerable public investment to date.

With regard to Project II, it is clear that emergency room utilization is at a high level nationally and increasing rapidly. As the trend of the past two decades continues, increased ER usage cannot be attributed to concomitant increase in the incidence of clinical emergencies, but rather results from the

emergency department's assuming a primary health care function for patients unwilling or unable to secure health care from alternative ambulatory care sites. Consequently, it is important to attempt to determine what interventions can be introduced in the services provided by Emergency Departments to improve the quality of care in the face of this increase, and to examine ways whereby non-urgent ER usage can be diverted to alternative health care delivery sites. Project II is mounting and evaluating service interventions aimed at these issues. The significance of Project III stems from the fact that despite the resources involved in hospital-based emergency care and the crucial significance of the quality of care provided, very little is actually known about the quality and outcomes of emergency department care. From the perspectives of training and of evaluation, an emergency department is one of the few settings of health care delivery where providers do not routinely see the consequences of their clinical management. Patients appear, are treated, and are discharged with little likelihood that the initial provider will see the patient on follow-up. As a result, one of the most important learning mechanisms is denied the Emergency Department physician and nurse. This has served as a powerful deterrant to developing knowledge systematically concerning the effectiveness of clinical interventions in the emergency department. Project III is specifically addressed at resolving these deficiencies.

PROJECT DESCRIPTION:

Project I is developing, and applying in the Baltimore area, methods to describe the present level of patient utilization of local hospital and ambulance emergency facilities, and is assessing the impact of categorization efforts on these patterns of system wide interventions. A set of resource standards has been developed which specifies the hospital resources needed for the treatment of the emergency conditions listed in the Emergency Medical Services Systems Acts of 1973 and 1976: trauma, acute cardiac, burns, high risk infants, poisonings and behavioral emergencies. These resource standards, as validated by nationwide samples of expert clinicians, are being applied to data describing resources at hospitals treating patients with these conditions, so that each hospital can be categorized on a condition-specific basis as to its resource level and therefore its appropriateness for treating each condition. A categorization model, including the prevalence of each condition and the probability that patients with these conditions will need each resource, has been developed. It is being used to generate various regional configurations of hospital emergency resources in order to assess which categorization scheme best maximizes the resource combinations for each clinical condition. After each hospital has been categorized to allow normative statements as to where emergency patients should be treated, utilization data will then be secured for each diagnostic group from each hospital, identifying where emergency patients are being treated at present. The survey is being repeated at subsequent time periods to evaluate the degree and quality of changes in utilization patterns resulting from regionalizing the resources. Information is also being secured on the use of clinical resources specified as necessary within each hospital by diagnostic group and the outcomes of selected emergency conditions. A secondary task is to assess the appropriateness of emergency ambulance utilization by measuring unmet ambulance need and inappropriate ambulance use. This is being approached by the development of ambulance standards for each of the diagnostic conditions, specifying whether or not

patients with a given condition should receive ambulance care and what resources should be available on the ambulance transporting them. These standards will then be applied to actual ambulance utilization data to describe the level of appropriateness. In addition, ambulance utilization data and reporting systems are being examined to determine feasible, economic and managerially-useful ways of describing and evaluating the nature and quality of ambulance care.

Project II is evaluating the efficacy and effectiveness of service interventions designed to improve patient care in the hospital emergency department and to enable emergency departments to respond more effectively to increased patient demand for nonurgent services. Patient advocacy, health education interventions aimed at reducing household hazards and pediatric injuries, emergency room use by asthmatics, triage by nurses, etc., are all being systematically evaluated. More particularly, there are two major foci: substantive and methodologic. First, the intent is to evaluate the usefulness of service interventions directed at improving the care needed by chronic and nonurgent patients, and to design and conduct a series of prospective field experiments (with random assignment to intervention groups) to assess the effectiveness of health education strategies in reducing nonurgent use of emergency department and of non-physician manpower in improving care. The second aim is to develop, apply and assess methods by which emergency departments may monitor the quality of care given.

Project III is describing and evaluating quantitative measures of system performance, developing outcome-validated standards for treatment of emergency medical conditions, and assessing the impact of clinical interventions introduced under controlled conditions at the emergency departments of The Johns Hopkins Hospital and Baltimore City Hospitals. For a range of diagnostic conditions which include hypertension, minor lacerations, chest pain, asthma, pneumonia, and trauma, the following steps will be undertaken: describe and evaluate the diagnostic and therapeutic procedures currently employed in the emergency departments, identify or develop clinical interventions thought to improve patient outcomes, implement these clinical interventions and test their efficacy by random assignment of patients to experimental and control groups, and evaluate the success of the proposed interventions in improving diagnostic and therapeutic procedures and outcomes of emergency department care.

PROGRESS:

The products of Project I in the first two years of the research program have included:

(1) The development of hospital and ambulance resource standards for each of the six high-risk conditions mentioned in the EMSS Act;

(2) The face validation of the resource standards by nationwide samples of clinical experts;

(3) The development of a categorization model as a tool to assess the trade-offs resulting from alternative regionalizing schemes;

(4) An assessment of the emergency patient information systems within the 23 hospitals of the Baltimore regional EMS system;

(5) The collection of time series mortality rates for each of the six emergency conditions for each of the five jurisdictions within the Baltimore region each year from 1968 to present;

(6) The methodologic assessment of 17 frequently used indices of severity;

(7) The development of a sampling scheme for Emergency Department utilization;

(8) The analysis of 50,000 ambulance run sheets within the Baltimore region to develop quality assessment and monitoring methodologies; and

(9) The development and application of methods to assess the capacity of physicians, nurses and EMTs to correctly identify ten frequent cardiac arrhythmias.

The products of Project II have been:

(1) A study which indicated a high degree of concordance between provider and patient perceptions of appropriate clinical responses and sources of care for hypothetical emergency symptoms;

(2) A study of patients who walk out of Emergency Departments before receiving treatment and the reasons for walking out;

(3) A prospective study which assessed the impact of health education interventions (follow-up by an asthmatic nurse, and patient group discussions) upon compliance behavior by asthmatic patients and on return visits to the Emergency Department;

(4) A study which found that nursing audit had a marked and beneficial impact on the quality of nursing care charted in the Johns Hopkins Emergency Department;

(5) A study showing negligible impact by patient advocates employed in an Emergency Department upon the satisfaction, knowledge and compliance of Emergency Department patients;

(6) An evaluation which failed to demonstrate any impact by a health education strategy upon mothers' knowledge and practice of home safety measures aimed at reducing pediatric household injuries;

(7) A study documenting a substantial impact of a newly opened 24-hour urgent care clinic in reducing inappropriate hospital Emergency Department usage.

The products of Project III have been:

(1) A series of descriptive studies documenting the use of antibiotics, irrigation and suture meterials used in the treatment of patients with uncomplicated minor wounds, which indicated an exceptionally low rate (1 percent) of infection but found that only half of the patients told to return for suture removal actually did so;

(2) A quality assessment study which developed and applied criteria on the quality of care received by asthma patients and indicated acceptable care;

(3) A double-blind evaluation of two treatment protocols for the emergency management of asthma to determine whether a combination of subcutaneous epinephrine and intravenous aminophylin (as opposed to subcutaneous epinephrine alone) would result in a more rapid improvement of acute asthmatic episodes and a reduction in the waiting and treatment time of the asthmatic patient (it did not);

(4) A descriptive study of patients presenting with chest pain to assess the relative effectiveness of diagnostic and therapeutic procedures used and associated outcomes;

(5) A retrospective study of patient screening for hypertension on presentation at the Emergency Department, which described a high proportion of patients with hypertension but a low proportion of patients recognized by providers as such;

(6) A study which indicated that alcoholics presenting at The Johns Hopkins Hospital Emergency Department are likely to receive qualitatively and quantitatively better care than that given to non alcoholics; and

(7) The design and implementation of a surveillance system to monitor Emergency Department utilization and to assess outcome of care received.

DISSEMINATION OF RESEARCH RESULTS:

Publications And Presentations During First Two Years Of Grant Period (July 1975 - June 1977)

1. G. Gibson and D. S. Gann, Health Services Research as an Emergency Department Management Tool, Paper presented at annual meeting of the University Association for Emergency Medical Services, Vancouver, Canada, May 1975. Published under same title: Journal of American College of Emergency Physicians, 5:1 (January, 1976), pp 49-52.

2. G. Gibson, Emergency Medical Services and Pre-paid Group Practice: Challenge or Money Loser?, Proceedings of 25th Group Health Institute, Chicago, June, 1975, 123-139, Group Health Association of America.

3. G. Gibson, Predicting the Unpredictable: Methodologies for Assessing Demand for Emergency Medical Services, Chapter in Monograph: Methods for Determining and Projecting Areawide Demand for Health Services, Bureau of Health Planning and Resource Development, Health Resources Administration, DHEW, June 1975.

4. G. Gibson, Needs Assessment and Program Evaluation of Emergency Medical Services, Presentation at National Training Course for EMS Administrators, Center for the Study of Emergency Health Services, University of Pennsylvania, August, 1975.

5. G. Gibson, Regionalization of Hospital Emergency Services: National Progress and Research Studies, Presentation to DHEW Conference on Hospital Categorization of EMS, Chicago, September, 1975.

6. G. Gibson, Resource Inventories and Performance Standards for EMS Systems, Presentation at National Training Course for EMS Evaluators, Center for the Study of Emergency Health Services, University of Pennsylvania, September, 1975.

7. V. Stafford and G. Gibson, Nursing Care of the Asthmatic Patient in the Emergency Department: The Impact of a Nursing Audit, Paper presented at annual meetings of American College of Emergency Physicians, Las Vegas, Nevada, October, 1975, Journal of Emergency Nursing, July/August, 1976, pp. 22-28.

8. V. Stafford, Nursing Audit in The Johns Hopkins Hospital Emergency Department. Paper presented at annual meetings of the American Public Health Association, Chicago, November, 1975.

9. G. Gibson, EMS Evaluation: Criteria for Standards and Research Design, Keynote Address, Section on Evaluation, First International Conference on Traumatology, Baltimore, Maryland, May, 1976, and Health Services Research, (Summer 1976), 105-111.

10. G. Gibson, EMS Research: Methodology Development or Substantive Applications, Health Services Research, Winter, 1977, in press.

11. G. Gibson, Regionalization and Emergency Medical Services, Chapter in Monograph: Regionalization and Health Care, Editor Eli Ginzburg, U.S. Department of Health, Education and Welfare, 1977, in press.

12. M.D. Fottler, G. Gibson and D. Pinchoff, Physician Acceptance of the Nurse Practitioner Innovation, Working Papers Series No. 76-15, College of Business Administration, University of Iowa, May, 1976.

13. G. Gibson, Emergency Medical Services and Manpower Training Requirements: The Role of Schools of Nursing, Medicine and Allied Health, in Proceedings: Selected Papers from Health Manpower Education Conference 1974-1976, pp. 186-192, American Association of State Colleges and Universities, 1976.

14. G. Gibson, Measures of Emergency Ambulance Effectiveness: Unmet Ambulance Need and Inappropriate Ambulance Use, Journal of American College of Emergency Physicians, in press.

15. G. Gibson, Categorization and Regionalization of Hospital Emergency Facilities, Hospitals:Journal of American Hospital Association, in press.

16. G. Gibson, Emergency Medical Services: Federal Programming or Local Initiatives in The Role of Local Governments in Providing Health Services, Academy of Political Science, 1977 in press.

17. G. Gibson, Evaluative Measures and Data Collection Methodologies for EMS Systems, Presented at DHEW Los Angeles Conference on Evaluation, April 1976, and Public Health Reports, in press.

18. R. G. Jarmon and C.E. Yesalis, III, Provider Performance in the Recognition and Treatment of Telemetered Electrocardiogram Patterns, Journal of American College of Emergency Physicians, December 1976, 971-974.

19. C.E. Yesalis, III, N. Kuehn and G. Gibson, A Survey of Hospital Emergency Medical Information Systems and the Implications for EMS Research and Planning, paper presented at the 1976 meetings of the University Association of Emergency Medical Services, Philadelphia, Pa., May 1976.

20. A.L. Kaszuba, E. MacKenzie, G. Gibson, Emergency Department Surveillance: A Data Base for Patient Care Management Research and Teaching, paper presented at the annual meetings of the American College of Emergency Physicians, New Orleans, La., October, 1976, Journal of American College of Emergency Physicians (in print).

21. N. Fink, E. MacKenzie, G. Gibson, G. Matanoski, W. Greenough and H. Murray, Evolving Emergency Care Standards for Asthmatics, paper presented at the annual meeting of the American College of Emergency Physicians, New Orleans, La., October, 1976. Journal of American College of Emergency Physicians, in print.

22. G. Gibson, Indices of Severity for Emergency Medical Evaluative Studies: Reliability, Validity and Data Requirements, paper presented at annual meetings of American College of Emergency Physicians, October, 1976, New Orleans, La., (Submitted for publication).

23. A. L. Kaszuba, E. MacKenzie, G. Gibson, Emergency Department Utilization and Patient Perception of Symptom Severity, paper presented at the annual meetings, APHA, Miami, Fla., October, 1976 (submitted for publication).

24. E. G. Fine, E. MacKenzie, J. Krischer, A. Kimball, C. Yesalis, G. Gibson, The Development and Validation of Resource Standards for the Vertical Categorization of Hospital Emergency Facilities, paper presented at annual meetings of the American Public Health Association, Miami, Fla., October, 1976.

25. G. Gibson, Evaluation of EMS Regionalization, Paper presented at DHEW's Conference on EMS Evaluation, New Orleans, La., January 1977.

26. R. G. Jarmon, Cardiac Telemetry Exercise Program, Journal of the American College of Emergency Physicians, February, 1977, 50-52.

27. A. L. Kaszuba, G. Matanoski, G. Gibson, Hypertension: An Audit of Emergency Detection and Management, paper presented at the meetings of the University Association for Emergency Medical Services, May, 1977.

28. N. Fink, B. Slosberg, G. Gibson, Emergency Service Treatment of Patients with Chest Pains: A Comparative Analysis, paper presented at meetings of the University Association for Emergency Medical Services, May, 1977.

29. N. Fink, Wm. G. Greenough, G. Gibson, Strategies of Care for Patients not Returning for Suture Removal, paper presented at the meetings of the University Association for Emergency Medical Services, May, 1977.

30. G. Gibson and L. Maiman, Walk-out Patients in the Hospital Emergency Room, paper presented at the meetings of the University Association for Emergency Medical Services, May, 1977.

31. M. White, G. Gibson, Evaluation of the Patient Advocacy Program of the Johns Hopkins Hospital Emergency Department, paper presented at the meetings of the University Association for Emergency Medical Services, May, 1977.

32. R. A. Dershewitz, The Reduction of Childhood Household Injuries: A Demonstration Project, paper presented at the meeting of the Association of Ambulatory Pediatrics in San Francisco, April, 1977.

33. E. Fine, G. Gibson, E. MacKenzie, Clinical Consensus in Specifying Categorization Standards, paper presented for the meetings of the American Public Health Association, Washington, D.C., October, 1977.

34. N. Fink, G. Gibson, Quality Assessment in the Emergency Department, Paper to be presented at the meetings of the American Public Health Association, Washington, D.C., October, 1977.

35. G. Gibson, E. Fine, Is Baker's Injury Severity Scale A Reliable and Valid Index of Severity for Trauma Patients?, paper to be presented at annual meetings of the American Public Health Association, Washington, D.C., October, 1977.

36. G. Gibson, The Emergency Department as a Screening Point for Hospital Specialty Services: Inclusionary vs. Exclusionary Strategies, paper to be presented at the annual meetings of the American Public Health Association, Washington, D.C., October, 1977.

37. M. Widome, G. Matanoski, W.B. Greenough, G. Gibson, Pedacycling: Factors Associated with Severe Injury, paper to be presented at annual meeting of American Public Health Association, Washington, D.C., October, 1977.

Technical Assistance and Consultation

In addition to publications and presentations, an important mechanism for disseminating research results and developed methodologies is technical assistance and consultation given to EMS systems and facilities. Such assistance has included:

- State of Illinois Health Department (Division of EMS): Assistance on data collection and severity measures for evaluative study comparing mortality rates of various trauma centers (1975-1976).

- State of Pennsylvania Health Department (Bureau of Program Evaluation): Advice on data collection and analytic design in comparing the availability and use of hospital and ambulance emergency resources with selected mortality outcomes across Pennsylvania counties (1976).

- Spinal Cord Center - Department of Neurological Surgery, University of Miami School of Medicine and Jackson Memorial Hospitals: Design assistance in comparing the outcomes of patients treated at a Spinal Cord Center with comparable patients treated in non-centers, and evaluating the effectiveness of pre-hospital administration of a steroid/Mannitol therapy to cord-injured patients by ambulance attendants (1977).

- University of Toronto, Department of Community Medicine/Ontario Provincial Government Ministry of Health: Assistance in establishing a data base and evaluative design to assess the impact of establishing a centralized trauma center with helicopter evacuation for the Toronto metropolitan area (1977).

- District of Columbia, Department of Human Resources (Division of EMS); Technical assistance in surveying hospital and ambulance resources in order to designate regional referral centers and in establishing a resource information system for a proposed EMS Control and Dispatch center (1976-1977).

- Washington Hospital Center Emergency Department and Trauma Center, (Washington, D.C.): Advice on reliability testing for clinical measures of severity (1975-1977).

- Kitsap County EMS System, State of Washington: Design of clinical panel case review of the quality of ambulance and hospital emergency department care, and of the evaluation for the Robert Wood Johnson Foundation funded EMS communication intervention (1976).

- San Francisco Health Department (Division of EMS): Technical Assistance in the use of vital statistics in evaluating the impact of the Robert Wood Johnson Foundation funded EMS interventions (1975).

- Medical College of Pennsylvania (Division of Emergency Medicine): Advice on data collection and analytic design for Survey of Residency Programs in Emergency Medicine (1975-1977).

- Nassau and Suffolk Counties Health Departments (Divisions of EMS): Development of evaluative measures and data collection methods to assess the impact of the Robert Wood Johnson Foundation funded EMS interventions (1976).

- Westchester and Surrounding Counties Health Departments (Division of EMS): Development of evaluative measures and data collection methods to assess emergency medical services (1976).

- John Andrews Hospital, Tuskeegee Institute, Alabama: Technical assistance in measuring emergency department non-urgent usage and health status for an evaluative study which is examining whether an outreach primary care program (nurse practitioner, protocols and mobile trailers) reduces the non-urgent use of hospital emergency department and offers equally attractive, timely and economic care to rural Alabamians (1976-1977).

- East Michigan EMS, Inc.: Technical assistance in data collection, design and in making severity adjusted mortality rate comparisons for trauma patients treated at several eastern Michigan Hospitals (1977).

- State of Maryland Health Department(Division of EMS): Coding, data processing and analysis (under contract) of 47,936 ambulance run reports to describe the amount and nature of ambulance utilization in central Maryland.

- Research Committee, American College of Emergency Physicians: Assistance in developing questionnaire to ACEP membership on emergency department management and manpower and EMS system involvement and in evaluating proposed research projects for ACEP funding.

In addition, program staff has offered significant EMS technical assistance and consultation to the National Center for Health Services Research, the National Heart and Lung Institute, the National Academy of Sciences, the Mitre Corporation,

JRB Associates, Arthur Young and Company, the Bureau of Health Resources and Development, the Division of EMS (DHEW), the Orkand Corporation, the Association of University Programs in Health Administration, the Navaho Health Authority, the Emergency Department Nurses Association, the University of Cincinnati School of Medicine Emergency Medicine Residency Program, University of Virginia Emergency Medicine Residency Program, University of Washington study of pre-hospital cardiac care, University of Florida study of EMT performance, State of Iowa Health Department (Division of EMS), The Center for the Study of Emergency Health Services at the University of Pennsylvania, the University of Iowa Health Services Research Center, Health Information Technology Services, Inc., Omaha, Nebraska, the Miami VA Hospital, and the Johns Hopkins Hospital Department of Anesthesiology

TITLE: EMS Severity Index Research

GRANT NUMBER: 1 R18 HS 02621

GRANTEE INSTITUTION: University of Wisconsin

PRINCIPAL INVESTIGATOR:

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FUNDING LEVEL: $177,864 FY 77

TOTAL PROJECT PERIOD: 7/01/77-
6/30/79

SIGNIFICANCE:

With the investment of significant amounts of federal dollars in the emergency medical services area, there is considerable interest in developing measures of the effectiveness of these programs. It is important to have some rational basis for a variety of strategies and approaches to allocating resources for systems. As the Emergency Medical Services Research Program Solicitation, issued in 1976 by the National Center for Health Services Research, stated it:

> "Attempts to measure adequacy of EMS systems must insure that comparable groups of patients are being studied...Separation of patients into categories such as emergent/urgent/and non-urgent is not precise or reliable enough to permit comparisons of different EMS conditions. Accurate methods are needed, therefore, to describe and classify patients with regard to degree of severity of their presenting complaint."

The classification of patients according to types of conditions and their severity is a necessary avenue toward developing some measures of effectiveness for use in evaluation. Some work has begun to show promise for certain well-defined conditions. A way to determine severity scores for patients is clearly necessary at this time for successful evaluation of EMS systems, and that method must be applicable to many conditions, acceptable to providers, and useable in a variety of settings.

PROJECT DESCRIPTION:

Other approaches have attempted to develop severity indexes by collecting large amounts of data, but these have proven to be expensive. This research

avoids expensive data collection efforts by employing procedures which use the judgments of medical experts in determining levels of severity. In the past thirty years, there has been considerable development of techniques which use experts to set priorities and determine the relative importance of factors in complex judgmental processes. These methods have been systematized and have proven to be reliable. In this project, these techniques are applied to the development of severity indices for the first time on any major scale. In experience with these methods in other areas of inquiry, the derived agreement on factors and relative scores has been significantly high. As a result it is anticipated that similar success can be achieved for severity scaling of EMS conditions. The approach will be tested for reliability, sensitivity, usefulness and acceptability to physicians in emergency medical practice.

This study will devise and test two severity index development methods, derive severity indices for two EMS conditions, and demonstrate the utility of the index in classifying patients for evaluating EMS systems. During the period of this grant, indices will be developed, the strategies used in their development will be evaluated, and personal characteristics of the index developers will also be evaluated. The conditions for which severity indices will be developed are cardiac conditions, intracranial/spinal cord injuries, drug overdose/poisoning cases, and abdominal pain.

The actual index development will utilize three panels of five physicians each for each condition. The panels will operate independently of each other. A Delphi procedure will be used to develop a list of factors which would serve as indicators of severity prior to the panel meeting. The panel will assemble in the evening at which time a set of variables will be extracted from the list. A computer program will then be used to generate 30 test cases containing possible ranges of the variables in the set.

Two types of utility models will be employed: 1) a self-explicated model, wherein experts identify factors to consider, estimate the relative importance of the factors, and use utility theory to translate all factors to a common measurement scale, and 2) observer-derived models, wherein experts estimate severity of cases presented and regression analysis is used to model their behavior.

Once the indices are developed they will be tested utilizing a sample of abstracts and medical records. Data are available through the State Health Department which include computerized ambulance trip reports, tied into an ED data system (primarily designed for billing and management purposes) and then linked to inpatient abstracts.

The four criteria that will be used in evaluating the severity index strategies are reliability, utility, sensitivity, and acceptability. Reliability will be tested by comparing models made by different panels

and by the same panel at two different times. Specialists will independently create patient profiles that span the range of severity. Thirty of these profiles will be rated using each of the panel models and the correlation of ratings between the five self-explicated panel models will be compared to the correlation of ratings of the five observer derived models. The test-retest reliability study will use three of the five panels in a second conference 3 months later. Data to be used in development of models will be collected from hospitals representative of different categories. Patient outcome information collected 3 to 5 months after a patient has left the EMS system will be compiled.

Predictability will be studied by convening a panel of physicians to review 120 abstracts and charts of a sample of actual patients within one condition. Data on everything but cost and outcome will be made available to the review panel, who will then rate the severity of the patient at the time of the first contact with the EMS. Severity estimates made by reviewers of the patient record abstracts will be correlated with the severity index scores for the same patients. Utility will be studied by determining whether differences in care between institutional types can be detected when patients are first classified by the severity index into comparable groups. The panel which has been used in studying predictability will be asked to rate the acceptability of care provided to those patients and the ratings will be correlated with institutional type.

Sensitivity will be studied based upon the use of three sets of weights for each factor which has been developed by the panels: "best estimate" and values to be considered high and low extremes. Acceptability will be assessed by two panels for each condition of persons who are influential in the medical community in the state, but who have not previously participated. They will be asked to review the process by which the indices are developed, the index itself and data on its reliability, utility and sensitivity.

Utility of indices in evaluation will be studied through cross-sectional and longitudinal evaluations of process and outcome for the test conditions. The severity indices will be applied to determine if the index identifies significant differences in EMS systems.

The personal characteristics of index developers will also be evaluated. Included are the effects of specialty, institutional setting, and conflict-resolution style.

PROGRESS:

This is a newly funded project. However, the research group has assembled a staff and will hold its first meeting with the panels of physicians in the fall. The research group includes experts in group decision theory

and practice, physicians and statisticians, and has access to physician panelists, experienced in emergency medical care, through the State EMS Medical Advisory Committee.

DISSEMINATION OF RESEARCH RESULTS:

It is anticipated that evaluation of EMS by using this index will be tested within the State of Wisconsin. Should the method prove practical, other conditions, beyond the two employed in this study, will be added to the list of those scaled for severity. There will also be detailed reports and active dissemination strategies attempted with other states on applications of the methods for use within those jurisdictions.

The research is significant locally, regionally, and nationally insofar as it advances the state-of-the-art of severity index development.

The emphasis is on a "transportable" index development methodology as opposed to arriving at indices which can be utilized nationally. The intention is that the methods developed can be used on a national level.

Most methodologies for the development of indices of severity have attempted to closely approximate "truth," as opposed to "consensus." The emphasis on "consensus" will enhance the usefulness and acceptability of the indices for ongoing evaluation locally.

A strength of this project lies in its methodological development. When completed, it will provide a definitive study of the solicitation of judgments from expert groups. Although different severity indices may be developed by individual panels, their predictability and reliability will be quite similar. Once the methodologies have been refined, it will then be possible to construct a state or national index in a very short time utilizing one additional panel. Consequently, the research will provide much insight into the usefulness, reliability, repeatability and validity of the expert panel judgment process.

TITLE: Evaluation of Elements in a Community-Wide EMS System

GRANT NUMBER: 5 R18 HS 01943

GRANTEE INSTITUTION: University of Washington

PRINCIPAL INVESTIGATOR:

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FUNDING LEVEL: $ 92,808 FY 77
$100,007 FY 76
$139,392 FY 75

TOTAL PROJECT PERIOD: 6/30/75-6/29/78

SIGNIFICANCE:

This is a multifaceted study concerning the effectiveness of certain aspects of out-of-hospital emergency care. The study emphasizes the assessment of bystander-initiated cardiopulmonary resuscitation and the evaluation of training programs for this purpose. Because of the obvious need to avoid delays in treating cardiac emergencies, participation of bystanders in the initiation of cardiopulmonary resuscitation is likely to be a critical factor in reducing mortality in patients with cardiac arrest. In addition, this project is seeking answers to basic questions related to the effectiveness of emergency health care; e.g., what is the effect of early care on morbidity and mortality in acute myocardial infarction, and what effect has pre-hospital care had on mortality rates? Finally, the investigators are working to define the requirements for drugs used to correct acid-base balance administered during cardiac arrest. Alkalinizing agents are commonly given during resuscitation; there is reason to believe that currently recommended dosages need revision.

PROJECT DESCRIPTION:

In this three-part project, the investigators are examining the value of training the public in the techniques of cardiopulmonary resuscitation. This problem is being analyzed in terms of effectiveness in improving patient outcome. The investigators are also examining all hospital admissions of patients with acute myocardial infarction to the major hospitals in Seattle during a one-year period. The major purpose of this detailed evaluation is to assess the effect of early intervention for acute myocardial infarction on hospital morbidity as well as mortality.

The third phase of the study concerns the definition of requirements for alkalinizing agents during cardiac arrest and is being carried out by monitoring acid-base balance in patients during the course of resuscitation outside

the hospital. A special blood gas apparatus is transported to the scene of resuscitation, and blood samples are collected for determination of the amount of alkalinizing agents to administer. These data are subsequently related to the clinical conditions at the time. The purpose of this work is ultimately to develop clinically useful guidelines for the use of bicarbonate injections in resuscitating cardiac emergencies.

PROGRESS:

To date, the study has shown that bystander-initiated CPR is associated with an approximate two-fold increase in initial survival and with significantly lower hospital morbidity when treatment for ventricular fibrillation is begun outside the hospital. With the availability of good quality advanced life-support in the field, approximately 40% of patients found in ventricular fibrillation are resuscitated, brought to the hospital and ultimately discharged home when resuscitation is initiated by a bystander. In bystander-initiated CPR, hospital morbidity after resuscitation is improved, probably because of the protection of the central nervous system through promptly administered CPR.

The CPR training evaluation is about half complete. A sample of 150 persons trained six months previously has been tested for competency. Preliminary results show that about 80% of those trained achieve adequate levels of CPR performance. Further testing will be carried out on a group which were trained one year previously. Of these, half will already have been tested at the six-month interval. If the latter show improved performance, it will suggest that the test itself, with the feedback which is given to those tested, has beneficial effects, and could be a practical continuing education method.

The blood gas study will be able to achieve a larger number of observations than previously planned because of installation of the test equipment on a separate, nonmedical vehicle, thus increasing mobility. Data collection should be completed by Fall of 1977.

DISSEMINATION OF RESEARCH RESULTS:

R.G. Thompson, R.E. Haynes, and L.A. Cobb. Hypokalemia in patients resuscitated from out-of-hospital ventricular fibrillation. Annals of Internal Medicine (in press), 1977 abstract. Presented to the American College of Physicians, April 19, 1977.

L.A. Cobb, A.P. Hallstrom, and G. Harris. Determinants of outcome in patients with out-of-hospital ventricular fibrillation. Presented to the Association of University Cardiologists, Phoenix, Arizona, January 21, 1977.

TITLE: Evaluation of EMS by Use of a National Burn Registry

GRANT NUMBER: 1 R18 HS 01906

GRANTEE INSTITUTION: University of Michigan

PRINCIPAL INVESTIGATOR:

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FUNDING LEVEL: $191,642 FY 77
$211,184 FY 76
$206,178 FY 75

TOTAL PROJECT PERIOD: 6/30/75-6/29/78

SIGNIFICANCE:

The primary purpose of this investigation is to evaluate the quality and effectiveness of the care provided in specialized burn care facilities and to develop appropriate standards to improve burn-patient care. A current scientific basis for the attainment of excellence in burn medicine for both emergent and long-term care will be established. This is being achieved through the analysis of the data of the National Burn Information Exchange (NBIE) and through site visits to leading burn care facilities. The methodology developed will be useful for the evaluation of other emergency care procedures. The results of the study will be helpful to burn care physicians and investigators concerned with the use of medical registries for the evaluation and improvement of patient care in other settings, including traumatic emergency settings. Medical registries are important for gathering understanding of the clinical aspects not just of burns, but of a great many serious and complex conditions. They allow the collection of uniform data on large numbers of patients so that effects of many variables, including variations in care, can be examined empirically.

PROJECT DESCRIPTION:

The research plan for this investigation consists of a sequence of inter-related studies which involve comparisons of burn care institutions with respect to mortality and other outcome variables in order to determine the extent to which different results are associated with various procedures for patient management apart from institutional and patient characteristics. These studies are as follows:

1) A Retrospective Institutional Differences Study consisting of a comparison of the results of burn treatment in eleven major facilities on the basis of data submitted to the NBIE and data obtained from the next study;

2) An Institutional Review Study consisting of the design, implementation and analysis of on-site reviews of these same institutions;

3) A Prospective Institutional Differences Study consisting of refinement of the data gathering instruments and procedures, the evaluation of feedback to the institutions in the Retrospective Study, and extension of the study to other burn care facilities.

PROGRESS:

The following goals for the current second year of this investigation are nearing completion:

1) to complete a Retrospective Study of eleven major burn care facilities with data submitted to the National Burn Information Exchange (NBIE) in order (a) to explain institutional differences in survival rates and (b) to develop new baseline curves for patient survival relative to several prognostic variables;

2) to design and implement an Institutional Review Study primarily through site visits in order (a) to evaluate the quality and effectiveness of burn patient care, (b) to develop standards for burn care and, in conjunction with the Retrospective Study, (c) to explain institutional differences in the outcomes of care;

3) to evaluate the current NBIE data gathering instrument and procedures;

4) to provide guidance on the use of other registries for the evaluation and improvement of patient care.

Statistical methodology and computer programs have been developed for the Retrospective Study and preliminary analyses have been obtained. The methodology for on-site evaluation of the organization and delivery of specialized burn care has been developed, all site visits have been completed and analysis of site-visit data is underway. Additional hospital participants have been trained for entry into the project next year. Feedback to directors of institutions who are currently participating was completed during a June meeting. Integration of the data from the Retrospective and Institutional Review studies is underway.

DISSEMINATION OF RESEARCH RESULTS:

Drafts of several technical reports are nearly completed. These reports were reviewed by the directors of the participating institutions in June and final reports will be available shortly thereafter.

The topics of the reports under preparation, the corresponding goals they pertain to and summaries of their content are as follows:

1) Statistical methods for burn studies [See Goals (1a) and (1b)] Methods of analysis for burn patient data are reviewed and illustrated. Univariate data smoothing techniques such as probit analysis are described. The multivariate techniques applied to this study, which take into account many explanatory and prognostic variables, are presented and their contribution to the understanding of burn survival is discussed.

2) Institutional differences among major burn facilities [See Goals (1a) and (2c)] A statistical test for institutional differences in survival experience after adjusting for age, percent total burn (TB), percent full-thickness burn (FTB), sex, year of burn, time from burn to admission and tracheostomy has been developed. The survival rates differ by a statistically significant amount. The estimated differences in mortality after controlling for these variables are large; two-fold differences in survival are estimated between some of the institutions studied.

3) Factors affecting burn survival [See Goals (1b) and (2b)] A model for the survival of a burn patient has been developed based on severity and on demographic and treatment variables, and has been used to assess which variables most crucially affect burn survival. A multiple logistic model for survival probability has been developed based on the set of variables listed under item (2). The most crucial predictors of survival are age, TB, FTB, and time from burn to admission. A simplified predictive model which can be used by the medical practitioner has been formulated.

4) Evaluation of the quality of the NBIE data base (See Goal 3) The data base has been evaluated in terms of completeness, selection bias, and validity. Particular attention has been focused on the percent full thickness burn.

5) Description of characteristics of burn patients and burn care [See Goals (3a) and (3b)] For each institution, a profile of the patients has been prepared giving a comparison of different types of institutions on the basis of the age, sex, race, size of burns and other important variables recorded in the NBIE. Included are profiles prepared by cause of death and types of complications.

6) The utility of data registries (See Goal 4) The utility of voluntary data registries is discussed. Statistical implications of non-random data acquisition and standardization of data reporting have been explored. Generalizations will be made of the results of the investigation of the burn study to other registries.

7) On-site evaluations of burn care facilities [See Goals (2a), (2b), and (2c)] The site visit methodology and findings will be presented and discussed. These results will also be incorporated into the analyses described in reports (2), (3), (4), and (5).

The following publication by project participants reports upon the baseline for this research:

I. Feller, J.D. Flora, and R. Bawol. "Baseline Results of Therapy for Burned Patients." Journal of the American Medical Association 235 (1975), 1943-1947.

TITLE: Evaluation of the Role of Police in the EMS System

GRANT NUMBER: 1 R18 HS 01767

GRANTEE INSTITUTION: Georgia Institute of Technology

PRINCIPAL INVESTIGATOR:

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FUNDING LEVEL: $79,691 FY 76
$87,114 FY 75

TOTAL PROJECT PERIOD: 6/01/75-8/31/77

SIGNIFICANCE:

The purpose of this research is to evaluate the performance of specially-trained police officers serving as rapid-responders in conjunction with an existing Emergency Medical Services (EMS) system. (The response of these police officers for the purpose of administering first aid procedures prior to the arrival of an ambulance is referred to as the medical aid vehicle (MAV) concept.) Examination of the police MAV concept will provide insights concerning the desirability of incorporating police and other public safety agencies into the EMS system, as the EMSS Act specifies.

The significance of this research can be seen in the many areas of the United States which do not have the funds to insure that well-equipped and well-trained emergency resources are always readily available. All of these areas, however, have some form of full-time public safety resources, including county or state police, county sheriff, or other law enforcement personnel. The impact of this research, in terms of the types of conditions most frequently encountered, types of training experiences of greatest benefit, and the general ability and willingness of police officers to perform first aid duties will greatly aid planners in providing broad-based decentralized emergency services as efficiently as possible.

PROJECT DESCRIPTION:

Overall objectives of this research include the following: (1) to analyze an existing police trauma-management training program for the purpose of describing medical skills taught to participants; (2) to describe the tasks, or groups of tasks, from the existing training program which should be performed for specific, individual medical emergencies; (3) to determine the frequency with which police perform specific MAV tasks and other non-medical

tasks in a functional MAV environment; (4) to assess the relationship between police performance on MAV skills and performance of "traditional" duties associated with law enforcement; and (5) to measure attitudes and perceptions of the police officers with regard to the MAV concept.

The research setting is DeKalb County, Georgia, one of the central counties in the Atlanta Metropolitan area. DeKalb County has a total population of 464,000. In over one half of the land area of the county, the population density is only 1.01 persons per square mile, with 4.5 persons per square mile in the urban areas. The DeKalb County Police Department (DKPD) has required all new personnel to undergo first aid training as part of the police academy training program for several years. The present first aid program consists of forty hours of instruction and practice. Satisfactory performance in this course is mandatory. Emergency ambulance service for DeKalb County is primarily provided by the DeKalb County Fire Department, which has a close working relationship with the police department.

The evaluation of the MAV concept is focused upon the performance by the police officer of a set of prescribed first-aid tasks based upon the condition of the patient. Related to the assessment of first aid performance is the performance of non-medical, or "police" tasks required at the scene of the medical emergency. These first-aid and police tasks have been assigned numeric weights developed by modified Nominal Group processes using panels of medical and police experts, respectively. The accuracy of the patient condition determination (or diagnosis) made by the police officer is checked by comparison to ambulance run reports filed by the Fire Department on each case. An overall score is computed for each case based upon weighted task completion by the officer rendering assistance prior to EMS arrival. Cumulative scores are being developed for each officer based upon the total cases encountered by the officer. These scores are being computed with weighted allowances made for conditions at the scene which might influence the officer's performance. Performance monitoring at the scene is conducted by the project staff using a randomized sampling plan of the individual sectors and shifts.

The effect on performance of intervention time (primarily the time available to the officer before EMS arrival), the relationship between first aid task performance and police task performance, and the interrelationships among the behavioral variables and between task performance and behavioral variables are being examined and analyzed as well.

PROGRESS:

Progress to date includes: (1) the analysis of the police first aid training program, (2) an analysis of police operations specifically related to the performance of initial emergency care and documentation of the communication interface between the police department and the fire department which operates

the EMS program, (3) the development of a series of specific first aid tasks to be performed for specific medical conditions based upon the content of the training program, (4) the development of a series of police-related tasks which are commonly performed at the scene of a medical emergency depending upon the setting, (5) the development of weights for both police and first aid tasks based upon the relative importance of the tasks according to certain medical emergencies, (6) the identification of various conditions at the scene of a medical emergency thought to influence the officer's performance (via the Delphi technique), (7) an analysis of actual police-related medical emergencies to determine the frequency of occurrence for various types of emergencies, (8) the design and test of an incident form to be completed by each police officer involved in an emergency medical situation along with a data reporting and monitoring system, and (9) the development, administration and analysis of questionnaires to measure attitudes and perceptions of the police officers.

A computer program to analyze the data collected over a twelve-month period has been developed and is presently operational. One of several preliminary analyses permits comparisons such as response time of the police first responders vs. the EMS system. Of the 4,000 cases captured, 24% of the calls were in the rural section of the study area. Response times in the rural areas averaged 5.85 minutes for the police and 7.94 for the Fire Department dispatched EMS vehicle. In the urban areas, the response times were 4.99 for the police vehicle and 6.96 for the EMS vehicle. Response time is defined as time from dispatch to time of arrival on the scene of the emergency. These preliminary results strongly suggest the potential maximal value of this concept when applied to rural settings where response time and low population density are particularly important considerations in the delivery of emergency medical services. The results of the completed analyses of data from this study will be available in the final report which is due in the Fall of 1977.

DISSEMINATION OF RESEARCH RESULTS:

R. Cochran and J. Myrick, "Effects of Advertising Upon Emergency Aid Seeking Behavior," -To be presented at the Annual Meeting of APHA October 1977 - Washington, D.C.

J. Myrick and R. Cochran, "Attitudes and Perceptions of Police Regarding Delivery of First Aid," -To be presented at the Annual Meeting of APHA, October 1977, Washington, D.C.

J. Pittman and C. Thomason, "Quantification of the Task Performance of a Uniformed Police Patrol Officer: A Group Process Approach," Socio-Economic Planning Sciences (accepted for publication).

Staff Working Papers resulting from this study include:

"The Performance of Police in Medical Emergencies"

"Use of Police First Responders in Medical Emergencies"

"The Development of a First Aid Performance Index for Police Officers: A Group Process Approach"

Additionally, several papers will be developed for publication when the analysis phase of this project is completed.

TITLE: Hospital Emergency Services

GRANT NUMBER: 5 R01 HS 02538

GRANTEE INSTITUTION: Regents of the University of Michigan

PRINCIPAL INVESTIGATOR:

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FUNDING LEVEL: $225,498 FY 77
$123,290 FY 76

TOTAL PROJECT PERIOD: 6/30/76-
8/31/78

SIGNIFICANCE:

This is a large-scale comparative study of hospital emergency services (HES). Its main purpose is to describe the organization and assess the effectiveness of emergency care delivery units/departments. Aspects of effectiveness which are being considered include economic efficiency, the quality of service or clinical efficiency, responsiveness to community expectations, and staff and patient satisfaction. One major objective is to examine the nature and sources of inter-hospital differences in emergency service effectiveness. Another is to specify those organizational factors and conditions which promote successful problem-solving and facilitate effective performance in HES. The underlying question is, "What makes for an efficient and effective emergency service -- how can HES improve their organization and make more efficient use of their resources in order to better serve their patients and improve the quality of care?"

This study is likely to make a significant contribution to understanding and solving the problems of organizing and operating emergency medical services. The project's contributions are expected to go well beyond their immediate value to those emergency services and hospitals participating in the effort. The concerns of the project focus on the single most important question in the field -- the question of the effectiveness of the health services delivery system. Given the difficult problems now permeating the system at all levels (and the burden that these entail for patients, the public health professionals, and government policy makers), this type of research seems not only desirable but essential.

There is a pressing need for high-quality problem-focused research in the areas of emergency and ambulatory care that addresses current major problems, and especially those problems about which available dependable knowledge is grossly limited. Most notably lacking is research going beyond single case studies and tackling the problems of emergency service systems with a rigorous methodology on a scale that is commensurate with their magnitude and complexity. More specifically, problem-focused research which relies on a sound theoretical base and also on comparative designs and scientific sampling holds the greatest promise of contribution, pragmatically as well as scientifically. This project represents this type of research.

The empirical data on the organization, functioning, and effectiveness of the dominant source of emergency care in the country -- the hospital emergency service -- remain at a primitive state. The problems and difficulties now being experienced are appreciated and even lamented, at least from a practical standpoint and in terms of undesirable outcomes. However, they are inadequately understood in terms of their origins and correlates, and even more poorly understood in terms of their interrelationships and likely solution requirements. Especially missing is dependable knowledge about the factors and conditions (many of which potentially could be controlled by the system) which facilitate or hinder the effectiveness of hospital emergency service departments in its major aspects -- the quality of care, economic and social efficiency, patient satisfaction, and responsiveness to community needs. The present project is designed to fill this gap.

Also missing is dependable knowledge about inter-hospital differences in HES effectiveness and their sources, and especially their sources in the nature of HES organization and organization functioning. This project focuses on both organizational variables and effectiveness criteria, relying not only on the most useful assessment techniques available, but also on new and promising approaches. The research has the potential, therefore, of making a significant methodological contribution in addition to producing much needed factual knowledge about the substantive problems of emergency services on which it focuses and making available, for the first time, meaningful norms against which hospitals could compare their own HES situation. Finally, since HES represent a certain type of organization about which current theory has very little to offer, the study has the potential of making an important contribution to the broader field of modern organization theory as well.

The findings will be directly useful to hospitals and their emergency service units, to emergency physicians, nurses, and technicians, and to hospital administrators. In addition, they should be of value to Health Systems Agencies and Professional Standards Review Organizations, to those responsible for training emergency service personnel, to policy makers, and to researchers. The results will be useful to these groups in at least three important ways. First, the study will provide heretofore unavailable factual knowledge and meaningful "norms" against which particular HES situations can be compared and assessed. Such "benchmark" data will be generated for various criteria of HES effectiveness (including economic, social, and clinical efficiency) as well as for important organizational variables (e.g., coordination, resource allocation, adaptation). These data can be useful for identifying and resolving problems within an HES, setting goals and objectives for the HES, and motivating the individuals involved to initiate constructive changes to improve the effectiveness of emergency medical services.

Second, the study is designed to identify the organizational patterns and characteristics which are associated with HES effectiveness. These results can be used by hospital policy makers and professionals to identify and implement those structural, technical, and/or staffing changes which are most likely to improve the effectiveness of emergency service units.

Third, the study will be useful by extending to HES a theoretical formulation of organizational behavior that is more applicable than others which currently are available. Existing models of organization do not adequately explain the behavior of complex systems such as the HES and, therefore, fail to provide a basis for generating innovative structures and processes which could improve emergency services. Our study is designed to generate relevant concepts and theory that can be applied directly to analyzing and resolving the problems that emergency services face.

PROJECT DESCRIPTION:

This study is designed to: (1) describe the resources, structure, and work requirements of HES; (2) ascertain the major strengths and weaknesses, problems and needs, and goal priorities of HES, and examine these in the context of the environment within which different HES's operate; (3) estimate the relative organizational effectiveness of HES (using several techniques, including a matrix of selected patient conditions, to obtain both quantitative and qualitative measures), and analyze inter-hospital differences in effectiveness; (4) identify organization patterns and social-psychological conditions associated with effective HES performance, and test certain hypotheses of practical and theoretical interest in the process; and, based on the preceding, (5) provide each participating hospital with factual knowledge and meaningful "norms" against which to evaluate its own emergency service situation (e.g., compare itself to the average for hospitals of the same type, size, etc.).

The study focuses on a significant segment of the hospital population -- the nonfederal, not-for-profit, short-stay general hospitals in the 100-499-bed range within HEW Region V (Michigan, Ohio, Indiana, Illinois, Wisconsin, and Minnesota) which have Emergency Departments. A total of 436 hospitals which meet these criteria will be represented with a scientific cross-sectional sample -- a ten percent stratified (by hospital location, size, auspices), controlled-selection, probability sample. The sample, now drawn, consists of 44 hospitals whose emergency departments will be studied. Data will be obtained from administrative staff, physicians, nurses, recent patients, and selected individuals in the community, from hospital records, and from supplemental sources. The data will be collected at each site in the fall of this year.

PROGRESS:

The research is progressing satisfactorily and on schedule. One major activity during the first year was the elaboration and refinement of the research plan. In this connection, many important practical, conceptual, and theoretical issues were carefully examined and resolved, and in-depth working papers concerning the principal areas of research interest were prepared. These papers focus on: (1) the coordination of staff efforts within the HES; (2) the allocation of available resources (staff, funds, information); (3) the adaptation of HES to the external environment and relations with the local community; (4) the economic efficiency of the HES; and (5) "clinical efficiency," or the quality of emergency care.

The research framework, which views the HES as a complex work-performing and problem-solving system, now has been perfected sufficiently to permit the development of the necessary data collection instruments (a task now underway). As the work on such issues as, for example, economic and clinical efficiency has progressed, specific procedures for measuring these variables have been identified. The research model being used, with some modifications, can also serve to provide hospital personnel with an understanding of the organizational factors critical to effective performance on the part of emergency services.

Other activities during the first year included reviewing the relevant literature on hospital emergency services, selecting the sample of hospitals to be studied, and gathering preliminary data about the 44 hospitals in the sample.

Work to date has been aided significantly by the inputs of knowledgeable researchers and practitioners in the areas of economic efficiency, organizational processes, and quality of care. Additionally, the investigators attended the recent Emergency Medical Services Conference in Atlanta and have visited HES sites in order to gain a better understanding of the problems faced by practitioners. Finally, they have met with key representatives of the American College of Emergency Physicians, the American Hospital Association, and the American Medical Association. These contacts have proven fruitful in helping to formulate the research in a way that is both scientifically and practically meaningful. They are expected also to be helpful in securing the participation of the hospitals in the sample. In the near future, they will be holding similar discussions with the Emergency Department Nurses Association, the American College of Surgeons, the Catholic Hospital Association, and other relevant groups.

DISSEMINATION OF RESEARCH RESULTS:

Results are not yet available since the study is still in the pre-data-collection phase. As mentioned above, however, the investigators have discussed the project widely with representatives of relevant associations and have consulted with both researchers and practitioners in order to perfect the research plan and procedures. Additionally, they have made arrangements to disseminate information concerning the objectives and methods of the research through journals and newsletters of the American Medical Association and the American College of Emergency Physicians.

After the data are collected and analyzed, a special "feedback" report will be prepared for distribution to the hospitals participating in the study. Each hospital will receive data about its own emergency department as well as data about particular groupings (e.g., urban-rural, small-large) of hospital emergency departments. Research presentations communicating the findings of the study will be made at professional meetings, seminars, and the like, both prior to and after the completion of the project. In addition, theoretical, substantive, and methodological articles will be prepared for publication in scientific and professional journals. The final report of the project will be suitable for publication and wide distribution.

TITLE: Measurement of Emergency Medical Technician Performance

GRANT NUMBER: 1 R01 HS 02702

GRANTEE INSTITUTION: Florida State University

PRINCIPAL INVESTIGATOR:

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FUNDING LEVEL: $164,470 FY 77

TOTAL PROJECT PERIOD: 7/01/77-6/30/79

SIGNIFICANCE:

A key area in which there is an opportunity to improve the capability of EMS systems to reduce mortality and morbidity at an affordable cost is in the training of Emergency Medical Technicians (EMT's) and paramedics who provide prehospital care. Up to this time, however, the best available methods for studying the performance of these vital responders have not been reliable and have been able to consider only whether or not these personnel performed particular tasks in appropriate situations. The measurement methods were totally inadequate to evaluate aspects of the speed, sequence and quality of task performance, essential features of proper initial resuscitation. In this study, trained observers will be placed on emergency vehicles to record the activities of these emergency personnel. The findings will provide definitive information concerning the relationships between existing proficiency and certification tests and actual performance. The study will also determine the best method of monitoring performance in the field, as well as the relative importance of training versus experience in good performance. Selection, training and employment of emergency medical technicians are significant and costly components of EMS systems, and more efficient methods to assign and monitor ambulance personnel will have important consequences for the budgets of communities nationwide. Even more important, the effective performance of the entire Emergency Medical Services system in saving life and reducing disability begins with the appropriate and skillful administration of prehospital care by the workers in the field. Ways to improve the education and testing of these technicians will translate directly into benefits to the victims of sudden and serious illness and injury.

PROJECT DESCRIPTION:

The setting for this project, Jacksonville, Florida, is ideal. Not only is the Emergency Medical Services system in this community widely considered

to be a model for other metropolitan areas, it is also an excellent site for systematic investigation because of its strong, central administrative control, deeply committed to supporting this study. About 28,000 emergency calls are handled each year by a two-tiered system. Initial response to medical emergencies is provided by a fire-department unit staffed by combat firefighters who have had basic EMT training. Because of the number and the location of fire stations staffed by these versatile personnel, average response time for these units is 3 1/2 minutes. Firefighters immediately administer basic life support, including cardiopulmonary resuscitation for heart attack victims, and continue to do so until a paramedic unit arrives at the scene--about 4 minutes later on the average. The paramedic unit then assumes primary responsibility for stabilization of the victim, with the fire unit providing assistance as necessary.

Observers will be guided by carefully-designed protocols; they will also have extensive training both in emergency medical procedures and in methods of systematic observation. They will collect data on about 500 calls, selected according to a sampling frame designed to focus on those incidents which involve serious illness or injury. The source of these observed responses will include urban and suburban Jacksonville, and rural areas in the surrounding eight counties. The data obtained from these careful observations will be correlated with proficiency-test scores and with other characteristics, such as level of training and degree of experience of the personnel. The information will also be compared with data collected through self-reporting methods, so that recommendations about the most accurate and efficient approach to performance evaluation can be provided to EMS system managers.

PROGRESS:

The project has selected staff and is developing its administrative structure and instrumentation. Actual data collection is planned to begin early in 1978.

DISSEMINATION OF RESEARCH RESULTS:

In addition to presentations at scientific and professional meetings and journal articles, an important avenue for dissemination of this project relates to its setting. The prominence and prestige of the Jacksonville Emergency Medical Services system in the eyes of EMS administrators and policymakers, and the serious committment which the local EMS leadership has made to this project, insure that the recommendations for system improvement which will be forthcoming will have direct and immediate impact on other communities.

TITLE: Model for Criterion-Referenced Medical Specialty Test

GRANT NUMBER: 1 R18 HS 02038

GRANTEE INSTITUTION: Michigan State University

PRINCIPAL INVESTIGATOR:

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FUNDING LEVEL: $169,117 FY 77

TOTAL PROJECT PERIOD: 7/01/77-6/30/78

SIGNIFICANCE:

The primary objective of this project is to design a set of procedures to develop, score and interpret certifying examinations for the newly-emerging specialty of Emergency Medicine. The model resulting from the research is expected to be scientifically sound and potentially applicable to specialty certification in other medical areas.

About thirty residency programs have already been instituted in the new field of Emergency Medicine. A specialty certifying examination will be administered by the American Board of Emergency Medicine beginning in 1977-78. The American College of Emergency Physicians, representing about 10,000 physicians nationally, is enthusiastic about developing the best certifying examination possible, and has welcomed the interest and assistance of a recognized medical education research team. The opportunity to use research-based information in developing a specialty exam and evaluating it empirically against physician performance occurs rarely. A performance-validated test will have direct benefits in improving and assuring the quality of emergency medical care, and will also be useful in terms of its future impact upon certification examinations for other medical specialties.

PROJECT DESCRIPTION:

This study will build on new techniques of educational research to devise a better test method for this new medical specialty. The examination to be developed and analyzed will be comprehensive (multi-domain). It will

also be "criterion-referenced"; that is, it will be graded in these several domains against the performance of a group of "exemplars"--Emergency Medicine practitioners who have demonstrated their expertise in the field and whose test performance is therefore judged to be the standard of competency. In order to be certified, the candidate must at least meet this standard in all domains in contrast to a norm-referenced grading system in which candidates' scores overall are ranked against each other, and an arbitarary cutoff is applied (i.e., "grading on a curve").

The research objectives include explorations of ways to select test items and to design scoring procedures for the specialty examination, including tests of reliability and content validity; comparisons of criterion-referenced versus norm-referenced test strategies; tests of the ability of the examination to predict physician performance and competencies; and analyses of the judgmental processes used in certification decisionmaking.

Data for analysis will be obtained from field tests using medical students, residents in approved Emergency Medicine training programs, and practitioners recognized as experts in the field of Emergency Medicine. An Advisory Group of nationally recognized consultants will oversee and document the research and development activities.

Among the thirteen research areas to be examined are such problems as the value of multiple-choice formats versus simulation formats and the value of "tracer diseases" as indicators of clinical competence. Lists of the elements of competent physician performance defined by logic will be compared with performance measures determined empirically. In addition, the research will include an investigation of the predictive validity of the examination in estimating the performance of Emergency Medicine practitioners.

PROGRESS:

This project has begun to examine the performance dimensions of a pilot certifying exam, and is establishing contractual relations with the American College of Emergency Physicians. Methods to collect and organize empiric data are also being developed.

DISSEMINATION OF RESEARCH RESULTS:

The results of this research will be incorporated into a procedural model, with documentation through supporting data. The model will depict the development, scoring and interpretation of certification examinations with a potential for increased predictive validity relating to measures of competence in health care delivery settings.

TITLE: Myocardial Infarction Prediction in Emergency Rooms

GRANT NUMBER: 5 R01 HS 02068

GRANTEE INSTITUTION: Trustees of Health and Hospitals of the City of Boston, Inc.

PRINCIPAL INVESTIGATOR:

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FUNDING LEVEL: $158,870 FY 77
$145,770 FY 76

TOTAL PROJECT PERIOD: 6/29/76-12/31/78

SIGNIFICANCE:

The basic objective of this research is to develop a model for predicting the occurrence of a myocardial infarction (MI) among patients presenting to an emergency room with symptoms consistent with, but not necessarily diagnostic of, an MI. The model aims to improve utilization of limited Coronary Care Unit beds by assuring the admission to the CCU of patients with a reasonable probability of having an MI.

The research also addresses a number of secondary questions, including the following:

a. What are the proportions and determinants of false positive admissions and false negative discharges of MI patients from the emergency room?

b. What are the risk factors, historical, clinical, and electrocardiographic parameters used in making correct and incorrect CCU admitting decisions by the housestaff?

c. What are the effects of social characteristics of the patient and the physician and of variations in staffing patterns in making correct and incorrect admitting decisions by the residents?

d. What is the effect of an information feedback loop, using a logistic regression model as a source for objective prognostic admission criteria, on reducing errors in judgment by the housestaff?

This prognostic model is designed to be operationally practical and applicable for ultimately supplementing physicians' diagnoses in the Emergency Room.

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Although recent studies have questioned the effectiveness of intensive coronary care in influencing outcomes for hospitalized patients, it is still widely believed that CCU's are beneficial. The literature suggests that further analysis should be directed to patients who are most likely to derive the greatest benefit from CCU care. There is no serious disagreement among American physicians about hospitalizing in CCU's all patients with bona fide MI's in order to monitor arrhythmias and intervene early with drugs and/or defibrillation for potentially life-threatening arrhythmias. The practical and critical question pertains to that group of patients admitted to the CCU who do not have infarcts. A reduction in the number of these "false positive" admissions represents one method for reducing the overall costs of this very expensive care unit. Ten years of rapidly rising costs due to proliferation of CCU beds, inflation, and medical manpower limitations have engendered a rethinking of the essential cost/effectiveness ratio of these specialized units. The cost data are well known: CCU beds are at least 25% more expensive than routine hospital beds, CCU per diem costs have risen by more than 100% in the past five years, and serious shortages of nursing staff exist.

Thus the practical and critical focus in the cost/effectiveness question is related to that proportion of patients admitted to the CCU who do not have MIs.

PROJECT DESCRIPTION:

A multiple-discriminant logistic regression model for predicting the occurrence of an MI in the context of patient admissions and discharges from an emergency room is being developed. The model is based on empirical observations of 174 variables available in the emergency room (ER), including patients' risk factors, presenting historical and clinical parameters, initial ECGs, symptomatology, and social and organizational factors. The 174 variables are reduced by cluster analysis into mutually exclusive and clinically logical clusters which will be correlated with the final diagnosis of MI and with false positive admissions, and false negative discharges. From these correlations, equations predicting each of these outcomes will be developed. Lastly, over a period of a year, during alternate months, the predictive results of these equations will be available to the admitting ER physicians on a patient-by-patient basis. The utility of such predictive equations as a supplement to the clinical decision-making process in the ER will be examined as to their effect on increasing appropriate admissions and reducing false-positive admissions and false-negative discharges. This model can easily be extrapolated to admission decisions regarding a large array of other common medical problems seen in emergency rooms.

The study is being conducted at the Boston City Hospital, which is located in Roxbury, Massachusetts and serves an inner-city population.

Any patient who presents to the ER with one or more of the Rotterdam "IMIR" symptoms, and signs an informed consent form, is eligible to participate in the study. This list of IMIR symptoms is derived from the Netherland's IMIR (Imminent MI-Rotterdam) Study, and the symptoms are as follows:

- recent chest pain
- recent unstable angina pectoris
- recent unexplained dyspnea
- recent unexplained palpitations
- recent unexplained upper abdominal pains
- recent unexplained syncope
- recent unexplained tiredness
- recent unexplained irritability
- recent unexplained fear or tenseness
- other reasons

All eligible study patients are identified by the triage personnel in the ER, and then the research assistant interviews the patient, draws bloods for cardiac enzymes, and takes an ECG.

Patients who are admitted to the hospital are followed during hospitalization, at which time ECG's and cardiac enzymes are collected, and a questionnaire given. Patients who are eligible for the study, but who are discharged from the ER, are scheduled for a follow-up appointment within 72 hours, at which time a second interview, ECG, and set of enzymes are obtained. Based on this follow-up information, patients judged by the ER admitting residents to be in need of immediate medical care are admitted forthwith.

Performance of the triage personnel is monitored routinely by a daily review of all ER charts.

PROGRESS:

Data collection was begun prospectively on September 1, 1976. From that date until January 15, 1977, 421 patients presented to the ER with one of the IMIR symptoms. Of these, 161 were discharged and 260 were admitted as inpatients. Follow-up is successfully completed for 92% of the admitted and the discharged patients. Initial analysis of the data indicated that there were many variables capable of discriminating in varying degrees of precision between true positives and false positive patients, suggesting that a series of weights is necessary in such a predictive model.

To be of greatest use, any model employed in an ER must be capable of synthesizing and reducing massive amounts of input data into a small series of predictors which will yield discrete probability statements. To arrive at these predictors, the investigators examined the relative diagnostic value of 174 variables available in the ER in all combinations for all patients with one or more of the IMIR criteria. Fifty-nine of the 174 variables occurred with greater than 20% frequency in the ischemic heart disease and non-ischemic heart disease patients. The 59 variables were reduced by cluster analysis into 22 mutually exclusive and clinically logical clusters. A step-wise discriminant function identified nine of these clusters as adding

significant predictive power to the diagnostic model. The contribution by cluster was:

ECG	(.179)
Past History MI	(.097)
Chest Pain	(.045)
Transportation	(.017)
Demographics	(.010)
Palpitations	(.006)
Day of Week	(.004)
Congestive Heart Failure	(.004)
Symptom frequency	(.004)

In comparing the diagnostic classifications predicted by the resulting model with the accuracy of housestaff physicians' ER diagnoses, it was found that the model was capable of correctly reclassifying 84% of patients into correct diagnostic categories. The physicians classified 81% of the patients correctly. The data suggest that the model, in conjunction with the physician's diagnosis, can diagnose ischemic heart disease correctly in 94% of patients.

In year 2, this model will be applied prospectively, both independently and in conjunction with house officers' diagnoses. During six randomly chosen months, the model's prediction of the probability of an MI will be compared retrospectively to diagnoses reached by ER physicians. During the other six months, the model's prediction of the probability of MI will be calculated and given to the Junior Resident making the diagnosis. The Resident is expected to take into account this probability in reaching an admission/discharge decision, but is free to ignore this additional information. This controlled trial will be essential to transform the model into a practical clinical tool and to delineate its areas of potential effectiveness.

The final model will permit the synthesis and quantification of large amounts of input data which affect admission/discharge decisions of patients with suspected myocardial infarctions. Potentially, this model can delineate the relative contribution of multiple sets of factors in the decision making process, including the inappropriate influence of social factors and staffing patterns. In addition, the model will be able to be utilized in an educational program for housestaff.

In summary, this model has three potential areas of significance. First, the model can be useful in insuring appropriate utilization of CCU beds. At today's CCU inpatient cost, even a small percentage reduction of false positive admissions can result in large savings countrywide. In turn, reduction of false negative discharges might lower the out-of-hospital case fatality rate, in that two-thirds of this latter group of patients have been seen by a physician a short time before their terminal event. Second, the model can be useful as a teaching tool for housestaff, especially in delineating the influence of social/organizational factors on these decisions. Thirdly, the model can be expanded to include many of the other emergent clinical problems seen in medical emergency rooms. Such a model lends itself as an adjunctive predictive tool which can easily be incorporated into the clinical decision making process in that environ.

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DISSEMINATION OF RESEARCH RESULTS

Presentations

M. Pozen, R. D'Agostino, J. Guglielmino, N. Teebagy, L. Bielawski, W. B. Hood, Jr.: Relative Effectiveness of a Multiple Discriminant Model Versus Emergency Room Physicians in Diagnosing Acute Myocardial Ischemia. Paper to be presented to the American Federation for Clinical Research, May 2, 1977, Washington, D.C.

American Statistical Association and the Biometric Society, April 30, 1977- Comparisons of Predictors Made by Logistic Versus Discriminant Models for Diagnosis of Myocardial Ischemia.

American Heart Association, May 20, 1977 - Presentation of Logistic Regression Model for Predicting Acute Ischemic Heart Disease - A Retrospective Analysis Based on 750 Patients.

Publications

Relative Effectiveness of a Multiple Discriminant Model Versus Emergency Room Physicians in Diagnosing Acute Myocardial Ischemia - A paper prepared by Dr. Pozen and Dr. D'Agostino, which will be presented at the National Meeting of the American Federation for Clinical Research and then formalized for publication.

A second article with Dr. D'Agostino as the principal author will focus on the statistical aspects of this analysis and will be submitted to a biomedical/ statistical journal.

An Analysis of the Rose Questionnaire - An Emergency Room Update. This article will focus on some of the fairly significant disparities between our findings concerning the use of the Rose Questionnaire and the original Rose Questionnaire as published in the Bulletin of the World Health Organization (27:645-58, 1962).

Assuming that one or more of the abstracts listed above will be accepted, in a like manner, papers will be presented and submitted for formal publication soon after the meetings in which they are given.

TITLE: Outcome Measure of a Suburban Paramedic Program

GRANT NUMBER: 1 R18 HS 02456

GRANTEE INSTITUTION: King County Health Department

PRINCIPAL INVESTIGATOR:

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FUNDING LEVEL: $89,555 FY 77
$88,592 FY 76

TOTAL PROJECT PERIOD: 6/30/76-3/31/79

SIGNIFICANCE:

A proliferation of emergency medical services has occurred nationally during the past five years. The heightened interest and concern for emergency services has been manifested by the training of thousands of Emergency Medical Technicians (EMT-A's) and paramedics (EMT-P's), the establishment of local Emergency Medical Services Coordinating Councils, and dramatic popularizations in the media.

The professional and public interest in emergency medical services has been accompanied by a need for evaluation of these programs. The Emergency Medical Services Systems Act of 1973 requires evaluation of Federally funded programs. In addition to this mandated requirement, there is a general demand for accountability of the programs.

The goal of most emergency medical systems is straightforward: to reduce mortality and morbidity resulting from medical emergencies. Evaluation should be designed to measure this effect. Most evaluations to date consider the structure and process of the various paramedic programs. There have been few studies evaluating outcome results.

This study is the first nationally to evaluate critically the outcome of paramedic service in a suburban community. The results of this study will define for other suburban communities the benefits of such a program for treating cardiac arrest.

Of national significance is the fact that the study will allow definitive comparisons as to the cost of paramedic services and the effectiveness of such programs, specifically how many lives can be saved at what economic cost. The costs of training and equipping paramedic teams are considerably greater than for EMT units, and it is tremendously important to establish that these additional costs are warranted in terms of improvements in morbidity and mortality. Such cost-effectiveness analysis will have considerable impact on national policy formulation.

On a local level, the King County Council has expressed interest in the study and has stated that the findings will play a significant role in future allocations of resources for paramedic programs. This project demonstrates that outcome studies are feasible and useful for evaluating existing paramedic programs throughout the nation.

PROJECT DESCRIPTION:

The aim of this study is to determine whether the addition of a highly sophisticated and relatively expensive paramedic program in a suburban community can improve the outcome of cardiac emergencies more effectively than the basic fire department EMT program presently available in the study area.

A before and after study design with two control communities is being used. The study will prospectively assess the outcome (death, admission to a hospital, discharge from a hospital, and survival six months after discharge) of cardiac emergencies which occur during 15 months in the study community (population 320,000) presently served by EMTs, a paramedic control community (population 220,000) and a non-paramedic (EMT) control community (population 100,000). The study community will then have paramedic services added and another 15-month prospective assessment of outcome will be made in all three areas.

Data are collected on all sudden cardiac emergencies which occur in the study and control communities and which meet the case definition. A case is defined as a patient who receives cardiopulmonary resuscitation (CPR) following circulatory arrest in a non-trauma situation occurring outside hospitals. A surveillance system has been established with the cooperation of public and private agencies. All participating agencies (fire departments and districts, ambulance companies, hospitals, and police departments) notify the research office of each CPR event within 24 hours of the event. If hospital admission occurs, the hospital is contacted for follow-up information.

In order to assure 100% reporting of all CPR incidents, redundant collection systems are maintained. One system involves review of Medical Incident Report forms sent to the Emergency Medical Services Division of King County by 75% of the fire districts and departments. A second system involves maintenance of hospital emergency room logs. These logs include name, date and emergency agency for patients arriving in the emergency room who have received CPR. In addition to the information requested on a questionnaire, the study obtains information from the King County Medical Examiner's Office. The cause of death as listed on the Death Certificate is also obtained.

On the basis of the questionnaire, hospital record room information, information from the attending physician, autopsy reports and death certificates, cases are classified into etiologic categories: cardiac, respiratory, suicide/overdose, etc. Cardiac incidents are further classified by type of cardiac rhythm.

The final outcome measure is survival at six months following admission to the hospital. To determine the functional status of patients, each patient is interviewed using the Sickness Impact Profile (SIP). This is a 136-question

health status measurement tool designed to determine the physical and the social/emotional health status of the patients. In addition, all patients are asked a small series of questions developed specifically for this study. This latter group of questions includes descriptive information comparing current employment and the ability to care for self with the situation prior to their cardiac arrest. Also, information on hospital admissions during the intervening six months and other pertinent information is collected.

PROGRESS:

The results reported here encompass only nine months of the projected 30-month study period. The vast majority (83%) of the 304 incidents which occurred from April through December of 1976 were cardiac with a relatively small percentage representing respiratory, suicide/overdose, drowning and other. Of the 304 cases, 75% died before hospital admission and 25% were admitted. A total of 14% survived to be discharged from the hospital. In the paramedic area, 37% of the patients were admitted as compared with 18% in those areas served by EMT's alone. The differences are not only statistically significant but large, showing that the paramedic areas have the highest admission and discharge rates, approximately twice as high as the other areas.

Most of the patients (72%) are male. The average age of all patients is 58 years. Admitted patients averaged 56 years of age and discharged patients averaged 53 years.

Some validity is given to the use of response-time as an EMS system performance measure by the finding that if CPR is initiated within less than four minutes after collapse, there is a higher likelihood of admission (45%) and discharge (16%) than if CPR is delayed by four or more minutes. When CPR is delayed by four or more minutes, 34% are admitted and only 6% are discharged. Given that CPR is begun early, however, it may be that the length of time it must be maintained before more definitive steps are taken to stabilize the patient becomes a critical determinant of survival. Paramedics can perform cardiac defibrillation and other procedures which must otherwise await transport to the hospital.

At this point the long-term outcome, survival at six months, is not reported because the study has not proceeded far enough to make meaningful conclusions. Although only preliminary findings on the first nine months of the study are reported, it is apparent that an outcome study utilizing a before-and-after design with control communities is feasible. It is anticipated that the findings at the conclusion of the study will allow definitive statements as to the value of a paramedic program in reducing cardiac mortality in a suburban setting.

DISSEMINATION OF RESEARCH RESULTS:

1. Abstract presented to the National Emergency Medical Services Evaluation Symposium, New Orleans, January 10-11, 1977.

2. Abstract accepted for presentation to the American Public Health Association Annual Meeting, Washington, D.C., October 30- November 3, 1977.

3. Abstract submitted for presentation to the Robert Wood Johnson Clinical Scholars Program Annual Meeting, Lincolnshire, Illinois, October 26-30, 1977.

Several papers are in preparation. Because of its potential national significance, requests for information about the project have been received from numerous emergency medical programs throughout the nation. Many requests for information are received from elected officials, press, and emergency agencies in the Seattle area also.

TITLE: Quality Assurance System (QAS) in a Large Emergency Department

GRANT NUMBER: 1 R01 HS 01905

GRANTEE INSTITUTION: University of Southern California

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FUNDING LEVEL: None FY 77
$102,382 FY 76
$101,600 FY 75

TOTAL PROJECT PERIOD: 6/30/75-6/29/77

SIGNIFICANCE:

The significance of assuring the quality of care provided by the emergency medical services (EMS) system cannot be overstated. The emergency medical team is usually the first to provide care to the patient in life-threatening situations. In the case of acute illness or injury, the patient turns to emergency medical services for care that is not immediately accessible elsewhere. Even in situations of less acute illness or injury, the public utilizes emergency departments to seek primary, non-emergent medical care - particularly when a private physician is unavailable to them (due to reasons of time, money, or knowledge). Thus, the EMS system addresses a wide variety of emergent and non-emergent situations that call for immediate action. Often action must be taken under extreme pressures of limited time, inadequate information about the patient, and incomplete information about the patient's illness. The quality of medical care delivered at this initial contact with the health care delivery system can directly, and often seriously, affect the subsequent course and duration of the patient's illness. The social, psychological, and economic costs of illness and disability can be greatly reduced when the highest possible quality of emergency medical care is assured. The potential of decreasing human suffering and the costs of this suffering to society are well worth the efforts currently being expended.

PROJECT DESCRIPTION:

Quality assurance implies the use of the principles of evaluation to assess the quality of current care and improve future care. Assessing quality in emergency medicine involves selection of the appropriate illness or injury types to be studied, determining the type and source of data to collect, defining criteria against which actual care can be measured, developing methods for scoring and summarizing the results and developing methods for using these results to improve the quality of care through feedback and education. A total

system of quality assurance should include all stages of the EMS system: pre-hospital, emergency department, in-hospital, and, ultimately, outpatient follow-up and rehabilitation. The complexities of such an evaluation system require development of a prototype, or model, that can then be tested, refined, implemented and expanded.

The purpose of this research is to design and test a model for a Quality Assurance System that can be used in emergency departments of large hospitals (25,000 or more patient visits per year). The focus is on the steps in the emergency medical care process and their effects on the patient. The scope is to design: 1) methods for selecting the appropriate illness and injury types for evaluation; 2) criteria for evaluation measures; and, 3) basic data collection tools for evaluation.

The Research Laboratory

The laboratory for this research is the clinical division of the Department of Emergency Medicine, Los Angeles County-University of Southern California Medical Center. With nearly 5,000 patient visits per week, this environment provides an appropriate setting for gaining information on the emergency medical care process and for initial trials of data collection tools.

Selection of Illness/Injury Types

Emergency medicine is a specialty with unique problems of diagnosis and treatment. The presenting symptom complex and medical history of the patient are often unknown or incomplete. Treatment of the patient often requires a rapid response by the emergency medical team in order to stablize and/or support life. At the very least, the emergency medical team must provide temporary comfort, relief or interim care to the patient until more extensive diagnostic testing and definitive treatment can be undertaken. Given this unique circumstance, selection of the illness and injury types for study cannot be based solely on specific diagnoses. The approach has been to develop a working list of Illness/Injury types that includes presenting symptoms as well as diagnoses.

A systematic approach is used to identify the Illness/Injury types to be selected for indepth evaluation. The selection methods should be adaptable to the needs of individual emergency departments, and should consider the complexity of recognizing and treating each clinical problem as well as its frequency in the department. The procedure designed for selecting the study types includes: 1) periodic survey of the patient population and changes in problem characteristics; 2) rating of the Illness/Injury types; 3) analytic review for special problems; and, 4) final selection. Each emergency department may have unique medical factors or practical problems that influence the choice of Illness/Injury types for evaluation. The value of a systematic approach to these choices is to accomodate any such special problems.

Gail V. Anderson, M.D.

Development of Criteria for Evaluation of Care

In order to develop a quality assurance system model, criteria describing appropriate emergency medical care need to be defined. Evaluation implies some degree of judgment and subjectivity. To the extent that the basis of these judgments can be defined explicitly and ordered in advance, evaluation efforts will become more objective. Evaluation criteria are needed to define some minimum level of appropriate emergency medical care. Such criteria need to be specific enough to allow measurement, but flexible enough for individual circumstance and unique department organization. Individualized standards for each case seen in an emergency department would be impractical, but general patterns of treatment for specific categories of illness can be developed.

The criteria for quality emergency medical care can best be defined by professional medical peer consensus. A research peer review committee was formed to develop research "heuristics" (i.e., general patterns of treatment for specific Illness/Injury types). Once such general patterns are defined, the medical steps can be refined into a flow-chart format (algorithm) that identifies the major decision and management points in emergency medical care.

Development of Data Collection Tools

The focus of this model of quality assurance is evaluation of the actual care and treatment process. This requires data on the events that actually occur. Data collection tools have been developed and are being continuously refined. These have included: 1) observation of patient management by trained observers; 2) analysis of patient management records; 3) telephone interviews of patients regarding their conditions; and, 4) a pilot study of patient attitudes toward the care received.

Observation techniques were used as a primary data source, since entries in the medical record cannot be utilized as the sole source of information on treatment events. Medical records usually contain only a portion of information obtained about the patient and the care delivered to the patient. Observation yields additional information regarding what is done, what members of the staff are involved, the order in which items are done, and the time taken to perform these services.

Early observation studies did not yield enough detail regarding the medical history and physical examination, and therefore, observation techniques are being refined. Medical history and physical examination forms are being tested by research personnel as possible additions to the current limited forms used for the medical record. A basic problem of quality assurance is to capture detailed information on the history and physical. The emergency medical team, more often than not, performs procedures and obtains relevant information about the patient, but simply does not have time to record it. This problem will not be easily resolved without providing technical support to the clinical staff in the form of computers, human scribes or other personnel assigned the task of medical documentation.

PROGRESS:

Progress to date on the project can be briefly summarized as follows:

1. Illness/Injury Types. Fifty-six Illness/Injury types have been identified through surveys of patient populations and emergency physician task analysis. A trial physician rating system of these Illness/Injury types has been attempted.

2. Criteria for Quality.

   a. Research Heuristics. Fifty-six preliminary research heuristics which define the basic ingredients of emergency medical care for each Illness/Injury type have been developed and refined by research peer review through case review and analysis procedures.

   b. Research Algorithms. Twelve of the above Illness/Injury types have been developed into research algorithms (flow-charts) which define the major process steps in emergency medical care, the procedures to be performed and the order of performance.

3. Data Collection Tools.

   a. Process Observation. Systematic observation of the treatment process has been developed and refined to acquire more detailed information on the content of the medical history and physical examination. Trained data collectors are currently pilot testing medical history and physical examination forms. The feasibility of using such forms in lieu of the standard method of recording information is being assessed.

   b. Outcome Measures. A singular problem of quality assurance is the need for valid outcome measures appropriate to emergency medicine. Problems of developing valid outcome measures are compounded by difficulties in contacting patients for follow-up and medical care they receive elsewhere. Simple outcome measures that are clinically meaningful and useful to quality assurance are unavailable. Considerable work on this important parameter of quality is still required.

DISSEMINATION OF RESEARCH RESULTS:

Publications

G. V. Anderson, A. Roy, G. L. Looney, and P. M. Donnelly: A Unique Approach to Evaluation of Emergency Care; JACEP, June 1977.

G. L. Looney, G. V. Anderson, A. Roy, R. Scharf, and P. M. Donnelly: Algorithms in Emergency Medicine; Accepted for presentation at the Annual Scientific Assembly of the California Chapter of American College of Emergency Physicians. San Francisco, June 8-12, 1977 (In preparation for publication.)

TITLE: Quantification of Injury and Critical Illness

GRANT NUMBER: 5 R18 HS 02559

GRANTEE INSTITUTION: Washington Hospital Center

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FUNDING LEVEL: $152,500 FY 77
$151,290 FY 76

TOTAL PROJECT PERIOD: 6/30/76-
7/31/78

SIGNIFICANCE:

Injury as a disease comprises a wide spectrum, from the very minor to the instantaneously lethal. Since trauma is the major cause of death up to the age of 37 years and is a major cost factor in delivering emergency health care, the treatment of injury has been scrutinized and certain deficiencies identified. Before objective evaluation of the quality of care being provided to the injured can occur, and before comparisons can be made and improvements identified, some method to describe the extent of injury accurately must be developed.

The question being asked in this research is, can the severity of a patient's injury be described in quantitative terms as a function of various anatomical and pathophysiological states and does this quantity accurately correlate with outcome?

Previous attempts to develop a system for scoring injury severity have relied heavily on arbitrary assignment of scores to specific anatomical injuries or physiological states, without any proven correlation to severity or outcome. Attempts to evaluate system performance or compare different methods to allocate resources which rely on such arbitrary measures are likely to provide misleading information for system planners and policy makers.

PROJECT DESCRIPTION:

This research project builds upon and refines earlier efforts directed towards establishing a numerical index of severity of injury which directly correlates with patient status and outcome. Firmly based on a concept of the pathophysiology of injury, the research project aims at testing and refining three different indices which independently and collectively are predictive of patient status. The indices are Blunt Anatomical Index (BAI), Acute Trauma Index (ATI) and Triage Index (TI). Each index was formulated from patient data customarily obtained to assess and treat trauma victims. Pattern recognition and systems analysis techniques are used to formulate each index on the basis of probability of outcome.

The indices are defined as follows: BAI is the probability of patient survival based upon site of anatomical injury; ATI is a calculated score derived from measures of the biochemical and pathophysiological response to trauma; and TI is the score related to probability of patient status based upon ten physiological parameters which are obtained to assess clinical status in the prehospital phase or immediately on entry to a hospital.

PROGRESS:

During the first year of this research effort, operational definitions for the data elements in the Triage Index were devised, tested, revised and then accepted for implementation. The data collection forms for the ATI and BAI were devised and tested. Subsequent modification lead to combining the two forms. Protocols for identification of the patient study population were developed and explained to all personnel. False exclusions are analyzed by individual, time and shift and special meetings held to correct deficiencies in data collection.

The problems in improving interrater reliability for the data collection personnel prompted several changes from the originally proposed methodology. The lack of adequate opportunity to test raters on patients with abnormal signs in the emergency department required that personnel be tested in the intensive care units. Mechanical testing devices have also been used where appropriate to validate the standard rater and all data collection nurses. Finally, tolerance ranges were established for all data items to reflect acceptable levels of disagreements between the standard and the raters.

The original Acute Trauma Index being tested presented problems in the emergency department because of inconsistent application. As a result a new ATI was developed using variables which are readily available. This new ATI is now in the testing stages. A Surgical Shock Resuscitation Team was formed in February, 1977, to respond to the needs of acute critical patients presenting to the emergency department. Incorporated into the team protocols are the desirable and clinically warranted measurements of the parameters of the original ATI, thus permitting validation of it. Continued modification of the ATI to improve its ease of use and prognostic ability is being pursued.

The project relies heavily upon the accuracy of the data collected by a number of people. A strong emphasis on continued eudcation has helped to minimize the potential impact of these problems.

As of February, 1977, 568 patients had been included in the study population. Testing and validation of the Triage Index on 381 patients showed a 98% correlation with the outcome of death. However, the limited number of deaths (21) indicated that at least 1,000 patients will be required to test the index adequately. Testing of the Blunt Anatomical Index to predict individual outcome and expected deaths for the population under study was carried out on 271 retrospective and prospective patients. The index predicted ten deaths and there were actually seven.

The validity of the new ATI is still being tested. Data are also being collected to validate the original ATI.

As a result of the research, a new coding system for penetrating injuries is being developed and will be submitted for inclusion in the 1978 revised International Classification of Diseases.

DISSEMINATION OF RESEARCH RESULTS:

H. R. Champion, W. J. Sacco, S. Hannan, "Quantification of Human Injury" Emergency Medical Services Bicentennial Symposium, Baltimore, Maryland, May, 1976.

S. Hannan, H. R. Champion, W. J. Sacco, "An Objective Triage Index" ACEP/EDNA Symposium, New Orleans, October, 1976.

H. R. Champion, W. J. Sacco, "Quantification of Injury" Proceedings IEEE, November, 1976.

H. R. Champion, "Evaluation of Critical Care Units, Facilities Evaluation, Transfer Agreements" Emergency Medical Systems Symposium, New Orleans, January, 1977.

H. R. Champion, "Prophylaxis and Prognosis in the Critically Injured" 2nd Annual Symposium, Ontario Regional Trauma Program, Toronto, 1977.

W. J. Sacco, "Evaluation of Injury" Regional Emergency Medical Service Symposium, Baltimore, Maryland, 1977.

TITLE: Rural Volunteer Emergency Medical Coordinators

GRANT NUMBER: 1 R18 HS 02507

GRANTEE INSTITUTION: Georgia Institute of Technology

PRINCIPAL INVESTIGATOR:

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FUNDING LEVEL: $221,364 FY 77

TOTAL PROJECT PERIOD: 9/01/77-2/28/80

SIGNIFICANCE:

There are approximately 54 million persons in this country who are classified as living in rural areas. A rural area is defined, for national census purposes, as any incorporated or unincorporated area having a population of less than 2,500 persons. This study will focus on those areas with under 1,000 in population. Using a conservative estimate derived from census information, one can expect to find 10,910 places across the nation with populations of less than 1,000 persons.

It has been stated that rural residents have emergencies that"...potentially or actually are more serious than those of urban residents." (Waller, 1969) Part of this suggestion is in consideration of farm work, which is one of the most dangerous occupations in the U.S., following only construction and mining with respect to the number of injuries sustained by workers. Additionally, the high proportion of elderly in rural areas contributes to the seriousness of medical emergencies.

Meeting the emergency medical needs of this population is confounded by estimates that rural areas have about one-half the access to medical resources as compared to the rest of the nation. Other factors related to problems of dealing with rural emergencies include:

(1) Lack of physicians, ambulance services, or other medical resources in the immediate area.

(2) Ambulance personnel are often volunteers and are not always readily available.

(3) Distances to advanced medical resources which are often great.

(4) An insufficient number of cases to justify and/or support readily available EMS resources.

(5) The wide separation of residences; awareness of need for medical aid and calls for assistance may be prolonged.

(6) A high proportion of non-residents, many not knowing how to access the medical assistance system.

The problem of response time, a critical factor in reducing morbidity and mortality of patients who are severely ill or injured, is particularly difficult to deal with in rural communities. "Response time," defined as the time between receipt of a call for service and the arrival of appropriate medical resources on the scene of an emergency, does not reflect the total delay experienced by a person in need of medical attention. An important delay factor is the time between recognition of the emergency and the time the appropriate medical resource is contacted. Further, a central dispatch system (911) which helps in identifying the proper resource, obtaining the correct telephone number, and making contact with that resource, usually is not available to rural communities, especially the low-population ones like those in the study group. What's more, many rural communities do not even have access to public safety resources. This is especially true in unincorporated areas with no police or safety resources. In many cases even the nearest sheriff or highway patrolman is many minutes away. Hence, this study seeks to demonstrate and evaluate an innovative approach to improved emergency medical care in rural areas by reducing response time and fostering more timely and effective delivery of that care.

PROJECT DESCRIPTION:

These investigators have designed a demonstration study which will evaluate the usefulness of trained volunteer Emergency Medical Coordinators (EMCs) for medically-isolated rural communities. These EMCs are conceptualized as being highly visible, well-respected and motivated members of rural communities who are trained to be first responders to medical emergencies. The EMC will not only directly provide readily accessible emergency medical care, but will also act as a coordinator, organizer, and informational resource for the EMS needs of the community in which she/he lives.

Two volunteer EMCs (one primary and one alternate) will be selected in each of 50 communities within a 50 mile radius of Atlanta but beyond the suburban/commuter area. Through the cooperation of community leaders and organizations such as the elementary school principal, the mayor, a local minister, a local businessman, civic groups, fraternal groups, PTAs, local churches, town councils, and local industry, both volunteer EMCs and sponsoring organizations will be identified. The next step will be to train the EMCs in advanced first aid and emergency care, emphasizing patient stabilization concepts of airway management control, hemorrhage control, and cardiopulmonary resuscitation.

The training courses will make use of National Red Cross and Georgia Heart Association materials and certified instructors. In addition to the training in first aid, the groups will be trained in the use of the data collection forms to be used in the evaluation of this project. A plan will also be developed to aid the EMCs in identification of emergency medical resources and development of proper communication and coordination procedures. Community communication, cooperation and support will be emphasized.

Aid in attaining that cooperation and support will include advertising through local and regional media, presentation of the program by the EMC to various community groups, and distribution of stick-on telephone decals giving emergency telephone numbers including that of the EMC.

The demonstration will be evaluated by assessing the elements involved in the development and implementation of the program, as well as more elaborate evaluation of EMC acceptance and performance. The latter will include telephone and mail surveys and incident data.

The evaluation is cast in the framework of a stratified, multiple group, single-intervention, quasi-experimental design. Several dependent variables will be used in the analysis including measures of community awareness, community attitudes, and EMC performance, as well as response time. Independent variables will include EMC selection processes, EMC characteristics, community size, whether or not the community is incorporated, and degree of financial commitment on the part of the communities.

In summary, the investigators hope to learn the answers to the following questions.

Will the concept work in reality?

- Does the need exist in the community?
- Will the EMC respond as trained?
- Will the community attempt to call the EMC for help?
- Can the citizen get the EMC on the phone when needed?
- Is the response time for the first responder reduced?
- Is total access time reduced?
- Are there phone stickers on every telephone?

Will the EMC concept work from an organizational standpoint?

- Are EMCs likely to move away from the community?
- Will they refuse to perform?
- Is there community financial support?
- Is the community aware of the resources?
- Is the EMC confident of his/her abilities?

- o What types of EMC characteristics are associated with performance?
- o Which types of community organizations make good sponsors?
- o What are the time and dollar estimates to set up the program in other areas of the country?
- o What are the factors which contribute to the success of the project?

PROGRESS:

Well in advance of the start date of this project, the research team undertook community development efforts in over a half-dozen communities to test community organization techniques and acquire time and dollar estimates for the organizational phase of this project. Their activities included speaking to local groups such as the PTA to explore community acceptance of the experiment; contacting local businesses to explore their willingness to share the cost of first aid kits for the EMCs; establishing rapport with owners of private ambulance companies serving the target communities and explaining the need for data such as ambulance run reports, observations by EMTs of the EMC's performance, and baseline data; and identifying additional training course content needs. Results of this preliminary work show that communities accept the EMC concept readily; and that there are enough EMC candidates who meet the criteria for selection to suggest that a meaningful evaluation can be conducted.

DISSEMINATION OF RESEARCH RESULTS:

Plans include: (1) The development of media packages for communities concerning EMC implementation which will be immediately useable in other parts of the country, (2) several concept articles in the EMS journals, (3) several press releases in the local, regional, and national media, and (4) an EMC newsletter. Additionally there will be presentations at professional and scientific meetings as the project progresses.

TITLE: A Study of the Impact of Mobile Coronary Care Units

GRANT NUMBER: 1 R01 HS 02079

GRANTEE INSTITUTION: The Ohio State University Research Foundation

PRINCIPAL INVESTIGATOR:

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FUNDING LEVEL: $165,715 FY 77
$165,400 FY 76

TOTAL PROJECT PERIOD: 1/01/76-6/30/78

SIGNIFICANCE:

There is an immediate need to develop methods for assessing the effectiveness of mobile coronary care units (MCCU) in reducing morbidity and mortality from acute myocardial infarction (AMI). Such units, staffed by paramedical personnel with advanced training in emergency medical care, are being introduced rapidly throughout the country. While the vehicles and personnel are equipped and trained to deal with many different life-threatening illnesses and injuries, the emphasis has been on the treatment and stabilization of patients with acute cardiovascular emergencies. The expense of this equipment and training is substantial and, in a time of increasing demands upon limited resources, must be examined against the effectiveness of the system.

The object of the present study is the development of a methodology for evaluating and comparing the effectiveness of such programs in different communities. This level of emergency medical service has come to be expected in many communities around the nation and new programs for the training of personnel and the equipping of vehicles for such service are increasing in number. The system in Columbus, Ohio, has certain unique characteristics that lend themselves to this type of evaluation. The MCCU program was started in 1969 with a "heartmobile" that was actually a coronary care unit on wheels. This was staffed by a cardiologist and several emergency medical technicians (EMT's). During the first year of operation, the cardiologist carried out all of the procedures with the assistance of the EMT's. The following year, the cardiologist allowed the EMT's to carry out the procedures under his observation and supervision. It was finally decided that the EMT's were able to make the appropriate decisions and that they had the skills required to read electrocardiograms, administer intravenous fluids and cardiovascular drugs, and carry out defibrillation and intubation. They have since worked independently, supported by a training program developed by the College of Medicine and a set of protocols prepared by an Emergency Medical Services Advisory Council

established by the City of Columbus. This system therefore, has the appropriate elements for serving as a study site for the development of methodology for evaluation and for the acquisition of information that will be useful to many communities through the country.

PROJECT DESCRIPTION:

The collection of data starts with a review of the logs maintained by the Columbus Emergency Medical Communication Center. From these logs, the calls for which the MCCU's (medic units) were dispatched are identified. The reports submitted by the units that were dispatched are located in the files of the Columbus Division of Emergency Medical Services. The reports that indicate possible cardiovascular emergencies are entered into the study sample. At the same time, the initial calls that were made that led to the dispatch of the MCCU's are retrieved from master tapes on which all calls are recorded. Typewritten transcripts are made of these calls and the message content coded on specially prepared forms. The report forms of the MCCU's were also specially prepared for the purpose of the present study and the information from these forms is coded as well.

The MCCU cases are followed using the records of the emergency rooms to which they were transported, in order to determine the medical impression, the decision regarding admission to the hospital, and the admission diagnoses. In each case in which the admission diagnosis indicates possible AMI, the attending physician is contacted and permission is obtained to interview the patient and/or the patient's family. A comprehensive interview form is used to obtain information regarding the patient's prior medical status, the prodromal (or early-onset) period, the acute onset of illness, and the actions taken from the onset through entry into the emergency medical care system.

Control cases are selected from among patients admitted to the same group of hospitals in the City of Columbus. These are patients admitted as possible AMI, who arrive at the ER by means other than the MCCU. As closely as possible, the controls are matched with the cases by age, sex, and race. The control patients and their families are interviewed, utilizing the same interview forms. All of the subsequent data collection is the same for the MCCU cases and the control cases.

Upon discharge from the hospital, a detailed abstract is made of the hospital chart including laboratory data, complications from admission to discharge, discharge status, and discharge diagnoses. The hospital chart abstracts are reviewed by two cardiologists to determine the most appropriate diagnostic classification of each case. The reports of the MCCU's are also reviewed by the cardiologists to determine the appropriateness of the treatments given in the pre-hospital phase, in relation to the established protocols.

Patients who are discharged alive from the hospital are contacted six months after the initial event to determine their functional status compared to their pre-hospital status, the complications of illnesses that may have occurred in the interim, and their requirements for medical care. All of the above information is gathered for both the MCCU cases and the control cases.

In addition, information regarding all hospital discharges for one year was obtained from all of the hospitals in the Columbus Area. From these the diagnoses of cardiovascular disease are singled out in order to construct denominators to which the data obtained in the present study may be related. Information obtained in the "Sudden Death Study," that is being carried out in the Department of Preventive Medicine, is also used to further assess the fraction of the overall problem that is included in the present study.

PROGRESS:

In the initial phase of the study all forms were prepared and field tested for:

transcription of calls
coding of message information
MCCU reports
patient and family interview
hospital chart abstracts
cardiologist's review of hospital chart abstracts and MCCU reports
follow-up data

To date, the sample includes 523 MCCU cases and 526 controls. The data from these forms have been coded and entered on computer tape and an initial set of computer runs have been made for error surveillance and for the testing of a variety of programs for data analyses. It is anticipated that the entire study sample will be completed during the remainder of the present calendar year and that the study will be ready for statistical analysis by 1 January 1978. During the first six months of 1978, the analyses will be run and the final report prepared. At the same time, a cost-effectiveness study of the MCCU system will be carried out by an economist on the staff of the Department of Preventive Medicine. The object is to make all of the information obtained in the study relevant to clinicians, managers of emergency medical systems, EMS research groups, and all others who are concerned with the development of programs for dealing with cardiovascular emergencies.

DISSEMINATION OF RESULTS:

By the Fall of 1977, sufficient data will be available for beginning the preparation of research reports and papers on specific segments of the study. It is anticipated that a number of such reports and publications will be submitted prior to the preparation of the final report. The final report itself will be compiled in a format that will lend itself to publication as a book.

TITLE: Telephone Protocols for Emergency Room Services

GRANT NUMBER: 1 R18 HS 01705

GRANTEE INSTITUTION: Children's Hospital Medical Center

PRINCIPAL INVESTIGATOR:

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FUNDING LEVEL: None FY 77
$132,678 FY 76
$119,517 FY 75

TOTAL PROJECT PERIOD: 6/15/75-12/31/77

SIGNIFICANCE:

This study has addressed a central question: Can paraprofessionals using protocols improve pediatric telephone service in the emergency room? Since most of the pediatric calls received in an emergency room pertain to a few self-limiting non-emergent conditions, it was hypothesized that paraprofessionals could handle many calls if they were aided by explicit guidelines for determining which patients needed medical attention by a consulting physician.

If such a system can deliver safe care, it can be used not only in the emergency room, but also in other ambulatory care settings. The system will doubtless be far less costly since less highly trained personnel will perform functions now requiring M.D.s and R.N.s. The protocols would assure uniformly high quality of care and an auditable record of telephone encounters. The system may also prove more satisfactory to patients since paraprofessionals can take ample time to ask and explain the necessary questions, to go over instructions carefully, and to follow the encounter with a subsequent phone call. Further, it appears that paraprofessionals can be trained to respond to the psychological and social concerns of the caller.

In short, if the paraprofessional-protocol-consultant system works, it can reduce costs, improve quality of care, and enhance patient satisfaction. The magnitude of such benefits may be guaged from the tremendous number of pediatric encounters by telephone--29.2% of all pediatric encounters in 1971.

PROJECT DESCRIPTION:

The study has proceeded in three phases, assessment of demand, development and validation of the system, and a controlled clinical trial.

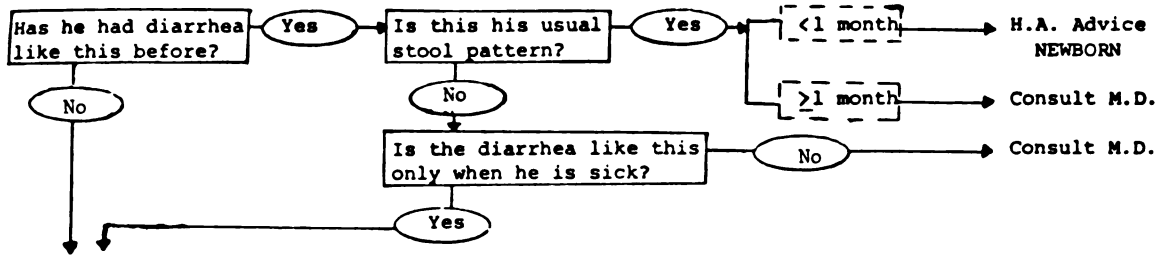
Phase 1: An initial survey was carried out to determine the number and nature of telephone calls to the emergency room, and to examine how telephone requests

for medical advice were being handled. Calls coming into the Children's Hospital Medical Center emergency room were surveyed in August 1975. Calls were also surveyed at Harvard Community Health Plan (a large HMO) and at Dedham Medical Associates (a small private group practice) and again in the emergency room in January 1976 and May 1976.

In the emergency room, such process indices were recorded as: 1) provider's identification of himself to the caller, 2) caller's identification of his relation to the child, 3) length of the wait to speak to a provider, 4) length of the conversation, 5) consultations required, and 6) whether the call was abnormally terminated (hung-up or disconnnected). Three indicators of the presenting problem were recorded: 1) age of the child, 2) chief complaint, and 3) associated symptoms. Two aspects of outcome were also noted: 1) disposition (come in, stay at home) and 2) medications recommended (none, prescription, non-prescription). In the two pediatric practices, the same type of information was collected about the presenting problem and the outcome, but none about process.

Phase 2: Protocol development and validation and training of the health assistants comprised the second phase of the study. At first, the group of project physicians was asked to draft each protocol, but this method was found to be cumbersome. Subsequently one physician drafted the protocols and the rest criticized and changed them.

There were two unanticipated developments in the protocol system: one change in format and one in concept. The protocols were originally to be written in flow-chart format:



The flow-chart protocols were often several pages long and did not permit the health assistants or a consultant to scan the record of a call easily. All protocols were therefore translated into a compact, color-coded format.

The change in concept resulted from field testing in the pediatric practices. Although the logic and wording of the protocols proved applicable to non-emergency services, the dispositions did not. Unlike emergency room providers, providers with a registered population of patients can often risk treating a child at home because they know the parent's competence and the child's overall health. The emergency room protocols' questions were therefore retained, but the dispositions were altered.

Two health assistants were trained in the use of protocols. A training manual for health assistants which documents that procedure, and allows such personnel to learn to use the protocols, will soon be available.

To assure the safety of the protocols, formal assessments were conducted of the outcome, process, and content of the protocol-health assistant-consultant system. To evaluate logic and wording (content), medical staff personnel reviewed the protocols, and 12 medical reviewers listened to taped conversations between parents and the health assistants. To confirm that questions were appropriate to specific complaints and that health assistants were responsive to the callers (process), staff members recorded and audited all calls. In addition, tapes for selected complaints were assessed by the peer reviewers. Three tests were used to show that the protocols were unlikely to leave a child at home if a doctor would have had him seen (outcome). First, the 12 medical reviewers gave their own disposition for each taped call; this was compared to the protocol disposition. Second, a field test was conducted in three sites. In the small private group practice and the HMO, the protocols were used to gather data, but the usual provider made dispositions; the disposition each system made was compared for the same call. In the emergency room, dispositions were made directly; the charts of the callers who came into the emergency room were examined to learn which visits were medically appropriate. As a third test, 141 in-patient medical charts were retrospectively reviewed of patients admitted with chief complaints covered by the protocols. Based on the medical charts a determination was made as to whether or not the protocols would have reached safe dispositions in all cases.

Phase 3: After validation, the protocols were tested in a seven-month controlled clinical trial in the emergency room, the HMO, and a clinic (Comprehensive Child Health Program). Calls for medical advice were allocated to the protocol system or the control system on alternate weeks. (Although calls were not "randomized", the weekly alternation minimized seasonal and longitudinal differences between the protocol and the control calls).

Information was gathered during the calls by health assistants or research staff for each group to permit comparisons of:

a) the process by which the call was handled,
b) the outcome of the call: disposition and advice, and
c) the type of problem: age of the child and the complaint.

One to three days later, all callers were interviewed by telephone to ascertain:

a) the caller's compliance with advice,
b) the caller's satisfaction with the encounter, and
c) the child's subsequent health.

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PROGRESS:

Phase 1: The survey yielded three main findings: a) A few types of complaints accounted for a large proportion of the calls. b) There was surprisingly little variation in type of complaint among the three very different settings. c) Calls pertaining to colds increased during winter in all three sites.

Phase 2: A set of 30 protocols has been developed for each type of setting, together with associated advice for each protocol, advice for 12 common health maintenance questions, and the training manual.

The multi-phased evaluations of process and content verified that the protocols are logical and sufficiently clear that health assistants can use them accurately while responding to the caller's concerns. The evaluations of outcome showed the protocol system to be safe. In each evaluation, we compared the protocol-dictated disposition to a provider's disposition that was taken to be the "true" or appropriate disposition. Patients brought in by protocol but left at home by the provider were thus false-positives. those left at home by protocol but brought in by the provider were false-negatives. The lower the false-negative rate, the safer the system may be considered; the lower the false-positive rate, the more efficient the system. The protocol system was designed conservatively, so as to minimize the false-negative rate even at the expense of a higher false-positive rate. In other words, if an error were to be made, it was considered preferable to err on the side of creating an unnecessary visit, rather than that of increasing the risk that an urgent need for care go unrecognized or be inadequately handled.

Phase 3: Data from the experiment in the pediatric practices are now being analyzed. The follow-up survey at the HMO showed that the parents who dealt with health assistants were as satisfied as those who dealt with conventional providers. The compliance with advice of callers who spoke to health assistants was slightly lower, though not significantly so. The practice has chosen to retain the system, since providers and patients are satisfied with it.

In the emergency room, protocols were somewhat more conservative ("safer") than the house staff. Among children under 2 1/2, the protocol system brought in 6 out of 10 callers while the house staff brought in 4 out of 10. Among other children, the protocol system brought in 6 of 10 and the conventional system brought in 5 out of 10. There was no difference in medication. House staff frequently failed to ask several key questions, just as they had during the survey period. The hospital has expressed a desire to retain the system if finances permit.

DISSEMINATION OF RESULTS:

Abstracts Submitted for Presentation to Professional Societies:

1) Development of Clinical Algorithms for Telephone Services.
2) Telephone Encounters in Pediatric ER Setting.
3) Telephone Services in Pediatric Practice.
4) Pediatric Telephone Encounters: Meeting the Demand.
5) Multi-Phase Evaluation Techniques for Assessing Quality of Care by Paraprofessionals.

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Articles in Preparation:

1) How to Manage the Common Cold by Telephone.
2) Telephone Pediatric Encounters: Meeting the Demand.
3) Applying Evaluation Methodology to Pediatric Telephone Care.
4) A Controlled Clinical Trial of Pediatric Telephone Protocols.

In addition, the training manual, emergency services protocols and pediatric practice protocols with their associated medical advice will soon be available for use.

TITLE: Treatment and Outcomes for Critical Patients

GRANT NUMBER: 5 R01 HS 01923

GRANTEE INSTITUTION: Hospital Educational Foundation of Southern California

PRINCIPAL INVESTIGATOR:

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FUNDING LEVEL: None FY 77
$465,550 FY 76
$406,278 FY 75

TOTAL PROJECT PERIOD: 6/30/75-12/31/77

SIGNIFICANCE:

In the mid-1960's, the inadequacies of existing emergency medical services (EMS) and the possibilities for translating advances in medical knowledge into new forms of EMS began to be publicized widely. The federal government responded to these needs and opportunities with the passage of the Highway Safety Act of 1966. This legislation provided funds for the development of some new tools for the planning and evaluation of EMS systems and for introduction of experimental forms of EMS systems in a few regions of the country. EMS in most of the country, however, continued to lag substantially behind the known state-of-the-art. The Emergency Medical Services Systems Act of 1973 was the next major milestone. It set forth guidelines and requirements for regional EMS systems and provided funding for the planning, establishment, expansion, improvement and operation of such regional EMS systems. It also provided funding for EMS systems research, including planning and evaluation.

A critical problem remained, however. Simply stated, it was that there were gaps in our understanding of those alternative system models which would permit the most effective use of the available funds, whether Federal or other. The reason for the existence of EMS is the reduction of mortality and morbidity among victims of medical emergencies. Therefore, both existing EMS systems and candidate designs for the improvement of EMS need to be evaluated primarily in terms of the effects that they have, or that are predicted, on mortality and morbidity within the target population. The kinds and timings of the treatments that victims of medical emergencies will receive can be varied by choice and manipulation of the various elements of EMS systems. The means for doing this is to vary the treatment subsystem itself, namely the number, location, staffing and operational policies of fixed EMS facilities and of mobile EMS units. In turn, the requirements for the supportive subsystems that provide management, transportation, communications, training and public education for EMS can be derived for any specific configuration of the core treatment subsystem.

The state-of-the-art tools for EMS planning enable one to predict the future demands for EMS under normal operating conditions. For any specific candidate EMS system design, one can also predict: (1) the timing with which it will deliver specific kinds of treatments in response to the projected pattern of demand and, (2) the investment and operational costs. What we cannot do is to predice what effects a candidate EMS system will have on the population it would serve. Although it is usually assumed that for critical patients, the sooner appropriate treatment is given, the better, this assumption is insufficiently precise to serve as a basis for resource allocation decisions.

For a few widely studied kinds of medical emergencies, particularly heart attacks, we probably have nearly enough information to provide rough estimates of the medical outcomes for patients under different modes of delivery of EMS. To make planning decisions about the level of resources to be devoted to EMS and the choice of a specific design for the delivery system, however, it is necessary to be able to make reasonable predictions for all, or at least a significant majority, of critical injuries and illnesses.

The primary objective of this project is to examine empirically the influences of the kinds of, and elapsed times to, medical interventions on mortality, morbidity and disability of critical patients. It is intended to contribute to the body of knowledge and methodology for use in the planning of EMS systems. Properly used, this knowledge should save both lives and money.

PROJECT DESCRIPTION:

Neither conventional descriptors, such as the name of a disease or the nature of an injury, nor existing classification schemes which have been developed for other purposes, provide a suitable means for categorizing patients to study empirically the relationships between the kinds and timings of treatments and patient outcomes. A central element of the project, therefore, has been the development of a classification scheme which is appropriate for this purpose. The new classification recognizes that the final pathway to death of the individual or of a limb or organ is the cessation of cellular metabolism. A medical emergency exists whenever the functioning of the cellular metabolism system is severely compromised. This can happen because of changes within the cellular metabolic system or because of compromises in the functioning of either or both the ventilatory system and blood gas transport system. The latter systems maintain an aerobic environment for, and supply "fuel" to, the cells. A total of thirteen conditions, which are based on pathologic events and the anatomic levels at which they occur, were identified as an exhaustive listing of how the functioning of the three body systems may be impaired. Each of the thirteen conditions is uniquely identified by a set of rules which employs indicators such as history, physical signs, laboratory results, interventions and diagnoses. A patient may have more than one condition. Multiple conditions may compromise one, two, or all three body systems.

Specially trained Registered Nurses, with extensive critical care or emergency department experience, are collecting data from medical records in hospitals

in Los Angeles and Ventura Counties. They are using the new classification scheme to sort patients and precise criteria to evaluate whether or not each patient is critical, i.e., whether or not there is an immediate threat to life, limb or organ.

The data recorded for each patient is tested by computerized editing for internal consistency and completeness. Every four to eight weeks, the reliability and consistency with which the nurses are following the rules for extraction of data from the hospital records are tested. This is done by having each nurse evaluate the same set of pre-selected medical records in the same hospital. The particular cases are selected to present different potential problems. The results are analyzed and form the basis of retraining and clarification of rules and procedures, as needed.

The data, which are collected and edited, are stored in computerized files. Multivariate statistical techniques are used to analyze these data, to test various hypotheses, and to develop parameters for theoretical models.

PROGRESS:

Pilot data collection efforts revealed a series of problems from which it was possible to derive a number of conclusions that, in turn, modified the design of the project:

1. There was great variation in the accessibility and availability of data between hospitals and between different staff members and departments within hospitals.

2. The staff of participating organizations (hospital and emergency mobile units), while supportive of the project, were not able to take the time to learn a new classification system and apply it to recording patient data. This was a function not only of the individual's attitude, but also of the numbers and types of personnel involved (physicians, physician specialists, nurses, hospital technicians, ambulance personnel - Emergency Medical Technicians levels I and II, etc.)

3. The yield of "usable" critical cases was far lower than originally estimated. "Usable" means that sufficient data were available so that the case could be used in the study. "Critical" cases were defined stringently to include only patients at substantial risk to life if not treated. It was originally estimated by emergency physicians that approximately 10% of all emergency department patients were critical. Our results indicate that this 10% consisted of patients whose conditions were "critical" (approximately 1%), "potentially critical", which were those who required prompt treatment in order to prevent them from becoming critical (approximately 2%), and "urgent" or those who needed prompt treatment because of anxiety, pain or suffering even though they were not in potentially life-threatening conditions.

To summarize, there were limitations in the quality of the data, in the actual number of "critical" cases available, and in the extent of help that we could realistically expect from providers. Our conclusions were to:

1. Increase the number of hospitals in which we would collect data from the seven originally projected to 28.

2. Increase the number of nurse data collectors from seven to 13.

3. Orient personnel in participating organizations to the need to record certain items of information more accurately and consistently, such as time of onset of criticality and the interventions employed.

4. Intensify the training of the nurse data collectors.

When full scale data collection began, another set of problems was identified which related to the classification system itself. Early validation studies showed relatively low scores in the consistency and accuracy with which different nurses gathered information about the same case. An analysis of the problems revealed that there were:

1. Ambiguities in the classification scheme itself.

2. Greater differences in clinical knowledge, experience and abilities of the nurses than originally perceived.

3. Multiple sources of information in medical records which were inconsistent.

A series of steps was undertaken to deal with these issues:

1. A revision of the classification scheme.

2. A two-week long retraining of data collectors.

3. Elimination of some of the data collectors.

4. Establishment of priorities of choice if there were more than one source for the same piece of information.

5. Establishment of a rapid response telephone consultation service for nurse data collectors to answer data collection and clinical questions.

6. Continuing validation studies which involved all staff periodically.

7. Changes of hospital assignments so that data collectors worked in pairs and could support each other psychologically as well as use each other as consultants.

We have begun collecting additional data which will allow us to describe the emergency department population more completely. These will include a breakdown of patients into categories of criticality, the total number and distribution of potentially critical patients, and the numbers and descriptions of those patients who: (1) died prior to receiving treatment, (2) received no significant interventions, or (3) died of a terminal episode in the course of a previously diagnosed chronic illness. Numbers and descriptions are being collected on cases which are not adequately enough documented to be useful in this research. Such data will be of considerable value to future EMS research projects.

The prospect of an additional benefit has emerged from the use of the new classification scheme. Medical professionals and paraprofessionals who have been exposed to it as a result of the project have been very positive in their responses. They feel that the framework has the potential of becoming a valuable teaching aid and of providing a unified approach to the initial clinical management of time-critical patients.

To date, we have accumulated data on over 2,000 cases and anticipate a total of 5,000. Preliminary analyses of data are currently underway.

DISSEMINATION OF RESEARCH RESULTS:

Presentations

J. Brill, M.D. "Time to Medical Intervention versus Medical Outcomes for Emergency Patients" Presented at Annual Conference, American College of Emergency Physicians, Las Vegas, Nevada, Oct. 1975.

R. Andrews, Ph.D. "Macro--Modeling Applications" 1976 International Conference on Cybernetics and Society, Institute of Electrical and Electronic Engineers, Washington, D.C. 1976.

J. Brill, M.D. "A Common Theoretical Framework for Emergency Medicine" Presented in two places - North Dakota Medical Association, Bismarck, N.D., April 1977 and American Conference on Critical Care, Vail, Colorado, April 1977.

A working paper describing the conceptual framework of the study and the classification scheme for critical conditions is available and has been disseminated to interested parties throughout the country.

TITLE: Validation of Quality Assessment Measures in EMS

GRANT NUMBER: 1 R01 HS 02149

GRANTEE INSTITUTION: Yale University

PRINCIPAL INVESTIGATOR:

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FUNDING LEVEL: $236,709 FY 77
$230,850 FY 76

TOTAL PROJECT PERIOD: 6/1/76-5/31/78

SIGNIFICANCE:

Assessing the quality of medical care has become an increasingly important issue in recent years. Concern with quality assessment is related to the increasing cost of medical care, rising malpractice insurance rates, programs aimed at certification and recertification of physicians, and a common complaint of the public that they are not getting what they pay for in the area of health care. The literature on quality assessment distinguishes between process and outcome measures of quality. Process measures relate to specific procedures or therapies that the physician administers to a patient. Outcome measures relate to a patient's health status at a specified time after he is treated. A process-based quality assessment system evaluates the physician according to what he does - what questions he asks the patient, what diagnostic tests and procedures he orders, and what treatment he selects. An outcome-based system, in contrast, evaluates the physician according to the results he achieves, that is, how well his patients respond to treatemnt. Most studies in quality assessment have focused on either process or outcome, without attempting to link the two. The present study is developing a quality appraisal system which includes both types of measures. This study recognizes the principle that good outcome depends upon good care (i.e. correct process), but it also recognizes that knowledge of what constitutes "good care" is not always available. A quality assessment system which uses process criteria, therefore, must validate those criteria through appropriate outcome studies.

The purpose of the present study is to develop a quality assurance system for Emergency Medical Services (EMS) which can accurately distinguish between appropriate and inappropriate care, and which is cost-effective in terms of both manpower allocation and dollar cost. Such a system will benefit health care providers and administrators responsible for running an Emergency Medical Service by providing an objective means for measuring quality of care and for improving care through educational feedback of audit results. The system will benefit institutions by reducing waste caused by "over-treatment" and by fulfilling Federal requirements for cost-control and peer review of professional

activities. The system will benefit patients by monitoring the care which they receive to assure appropriate treatment and to avoid unnecessary tests and procedures which patients must pay for out-of-pocket or through insurance premiums. Finally, all parties will benefit from the improved medical records that will result from the data generated by the system. High-quality medical records are essential to resolve questions about the appropriateness of medical practices in specific cases, especially when legal proceedings are involved.

The results of the study will be used to recommend the design of a general EMS quality assurance system. Based on preliminary findings, the following results and recommendations are expected to emerge from the study:

1. The vast majority of patients who use an Emergency Service have relatively simple, straightforward problems which fall into a small number of categories. For example, approximately 80% of the problems seen in the surgical area of the Yale-New Haven Hospital Emergency Service fall into only 10 groups, which include simple lacerations, simple fractures, superficial infections, and so forth.

2. The proper management of each of the above problems can be specified with a series of clinical algorithms or explicit detailed maps, which display the logic of medical decision making.

3. A quality assessment system based on clinical algorithms will be capable of monitoring and improving patient care at a reasonable cost. By computerizing the algorithms, it is possible to audit by machine 100% of the cases falling into the 10 most common categories. Individual physician reviewers would be required only for (a) those cases identified by the machine as "deficient" according to the algorithmic criteria and (b) the 20% of the patient population with complicated or unusual problems not covered by an algorithm. Rather than spend the majority of his time reviewing routine, straightforward cases, the physician reviewer would then concentrate on cases requiring his expertise and clinical judgement.

4. A standard medical record is not adequate to provide the data necessary for an algorithm-based quality assessment system. The record frequently omits data that are essential to evaluate medical care, while including other data which are superfluous for evaluation. The typical handwritten note must, therefore, be replaced with a structured, problem-specific data collection form. This form will contain those items required by the pertinent algorithm and will also include space for additional comments that the physician considers important.

5. Most physicians and other providers will adjust easily to using structured data collection instruments. The forms will contain a series of check boxes, and will require less time to complete than

a handwritten note, since the physician will not have to write the same information time after time. More important, the resulting records will be decidedly superior in terms of thoroughness and legibility.

6. The implementation of a structured data collection instrument provides a frame work for conducting studies to test the relationship between therapies (processes) and patients' responses to those therapies (outcomes). Only a carefully structured data base makes it possible to form groups of patients according to their clinical characteristics, so that outcome evaluations can compare only patients who had similar characteristics at the outset.

PROJECT DESCRIPTION:

The present study is designed to (a) delineate the data requirements of an algorithm-based quality assessment system, (b) demonstrate how to collect the necessary data and (c) demonstrate how to monitor and improve patient care by incorporating the data into an on-going quality assessment system.

To accomplish objective (a), a series of clinical algorithms have been constructed which define the data requirements for a selection of the problems seen most frequently in the surgical area of the Yale-New Haven Hospital Emergency Service. The medical records of all patients seen for these problems have been abstracted onto special data collection forms, and the data have been used to evaluate the care provided using the clinical algorithms as standards. A selection of these patients had a more complete medical record filled out by a trained observer on the research staff who was stationed in the treatment room with the patient. A comparison between the physician's standard medical record and the observer's more complete record will be used to demonstrate that the physician's record is inadequate for evaluation purposes regardless of the adequacy of his clinical performance.

Objective (b) entails substituting a series of structured data collection forms for the standard medical record and entering the resulting data into a computer so that the cases may be monitored by machine according to the algorithms. By comparing the adequacy of the data base before and after introducing the structured check lists, one can observe the improvement in record-keeping due to the change in the data collection instrument. Objective (c) involves using the results of the machine audit to identify deficient or questionable care and to feed back the results to the physician to provide education to change inappropriate medical practices.

The following conceptual model will be used to evaluate the adequacy of a given data source for quality assessment. Each node in a clinical algorithm contains either a decision-making criterion or an instruction to perform a specific task. A decision node branches into two alternative paths, and the correct path depends upon whether or not the decision criterion is satisfied. Determining the correct path through the entire algorithm involves the successive application of a series of decision criteria.

Knowledge of the variables upon which decisions are based is necessary to determine the correct path to be followed. Unless these variables are known, the evaluator cannot determine the correct path, and consequently cannot know which treatments are indicated, or determine whether the treatments actually given were appropriate.

An "adequate" data set for evaluation purposes must, therefore, include at least all the variables contained in a series of decision nodes along a specific path through the algorithm. Knowledge of these data enables one to identify which treatments are appropriate for a particular patient. Assuming that one also knows which treatments the physician has or has not administered, one can then evaluate his performance by comparing it with the recommendations of the algorithm. Any system which considers only what the physician does (i.e. performance data) cannot succeed, because it is essential first to determine whether a patient requires a given treatment (i.e. decision data) in order to know that what the physician did was appropriate.

A node is termed "determinant" if the variables required by the node can be determined from available data. Using this terminology, an ideal data source is one which generates, for each patient, a path of nodes all of which are determinant. For the purpose of making comparisons, the "adequacy" of a data source may be defined as a percentage consisting of the number of determinant nodes divided by the total number of nodes encountered. The following section will explain how these concepts have been used to analyze the data that have been collected to date.

PROGRESS:

Clinical algorithms for the management of lacerations and burns have been developed by a panel of plastic and reconstructive surgeons on the Yale Medical School faculty in collaboration with the Project Director. The laceration algorithm will be used in the discussion below to illustrate the method for evaluating the adequacy of a data source for quality assurance.

Formal data collection began on September 15, 1976, after a series of data collection instrument pilot tests. A total of 10,394 patients have been treated in the surgical area of the Emergency Service since that date, and their medical records have been abstracted onto a basic checklist containing data on patient demographics, diagnoses, chief complaints, severity index, and resource consumption. The population of 10,394 included 3,187 laceration, 218 burn, and 360 infection cases. These selected cases have also been abstracted onto more detailed "clinical" checklists, containing data on history, physical findings, treatment, and disposition. When these patients returned to the Emergency Service follow-up clinic, a follow-up checklist was completed by the examining physician. Observers stationed in the treatment rooms have completed their own clinical checklists for 678 patients (574 lacerations, 39 burns, 65 infections) or 18% of the patients treated in the Emergency Service for these problems.

All data are computerized by means of an on-line data entry system. This system has been operational since November 29, 1976, and approximately 40% of the data collected to date (4,331 patients) have been entered. This 40% sample of cases includes 189 laceration cases for which an observer was present. These 189 cases have been used to derive preliminary results concerning the adequacy of the medical record. Each case was traced through the laceration algorithm and each time a node was encountered a record was made indicating whether or not the node was "determinant" based on the physician's data (taken from the medical record abstract). Whenever an indeterminant decision node was encountered, the observer's data were consulted in order to decide which way to branch at that point in the algorithm.

A series of computer programs was written to perform the above analysis, and the following results were obtained:

2229 determinant nodes
609 indeterminant nodes
2838 total nodes encountered
(N= 189)

Based on these results, an overall coefficient of "adequacy" of 2229/2838= 79% can be assigned to these medical records. Analogous percentages will be computed after the structured checklist has been substituted for the standard medical record, thereby providing an objective means for comparing the adequacy of the two data sources.

These preliminary results indicate that the physician neglects to record approximately one-fifth of the data needed to evaluate the care which he provides. The significance of this finding from the perspective of evaluation can be appreciated by realizing that a single indeterminant decision node would preclude the analysis of a case in the absence of the observer's "backup" data. All but seven of the 189 cases had at least one such node. These results suggest that an EMS quality appraisal system cannot be based on the medical record in its current form, assuming that these results for laceration patients also hold true for other patient groups.

In addition to investigating the adequacy of an Emergency Service medical record, establishing an alternative structured data collection system, and implementing an automated medical care audit mechanism, the study includes a method for periodically revising audit criteria. As additional outcome data are generated by the study, associations between process and outcome will be examined so that a set of audit criteria may be developed which contains only elements shown to have an impact on outcome. Elements which represent provider tradition, habit, or preference, but which have no demonstrable bearing on outcome, will be excluded from this set of audit criteria.

DISSEMINATION OF RESEARCH RESULTS:

W. H. Frazier, "Algorithms, Protocols, and Quality Assessment," National EMS Evaluation Symposium, New Orleans, La., January 11-13, 1977.

D. A. Brand, "Assessing the Quality of Burn Care," The Initial Management of the Burned Patient (Symposium), New Haven, Ct., March 4, 1977.

W. H. Frazier, "Quality Assessment in the Emergency Care of Hand Injuries," Emergency Care of Hand Injuries (Symposium), New Haven, Ct., May 27, 1977.

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Publications in Emergency Medical Services
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Emergency Health System Planning: An Annotated Bibliography	William F. Hamilton and J. William Thomas	8/73		PB 239 170	69
Analysis of Emergency Medical Services in Health Maintenance Organizations	Marian A. Solomon and Terry Batt	9/30/75	HRA 106-74-193	PB 253 762	634
Development of an Emergency Room Medical Team:					
Volume I. Quality Efficiency Monitoring System	Gail V. Anderson	1/30/75	HSM 110-71-119	PB 253 705	125
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Emergency System Simulator:					
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Impact Evaluation of Emergency Medical Service Projects: Final Report	"				
Volume I. Methodological Studies on Patient Outcome and Cost Analysis: and Executive Summary	Geomet, Inc.	7/15/75	HRA 106-74-01	PB 247 436	219

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Volume II. Methodological Studies on Patient Outcome and Cost Analysis - Appendices	Geomet, Inc.	7/15/75	HRA 106-74-01	PB 247 437	168
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3. Tracing Patient Paths in Emergency Medical Service Systems	John J. O'Neill (Mitre Corporation)	11/75	HRA 106-74-182	PB 252 278	41
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The following National Center for Health Services Research publications are of interest to the health community. Copies are available on request to NCHSR, Office of Scientific and Technical Information, 3700 East-West Highway, Room 7-44, Hyattsville, Maryland 20782 (tel.: 301/436-8970). Mail requests will be facilitated by enclosure of a self-adhesive mailing label.

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(HRA)	76-3144	Evaluation of a Medical Information System in a Community Hospital (PB 264 353)
(HRA)	76-3145	Computer-Stored Ambulatory Record (COSTAR) (PB 268 342)
(HRA)	77-3160	Program Analysis of Physician Extender Algorithm Projects (PB 264 610)
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(HRA)	77-3187	Criterion Measures of Nursing Care Quality (in preparation)

Research Summaries

The Research Summary Series provides rapid access to significant results of NCHSR-supported research projects. The series presents executive summaries prepared by the investigators at the completion of the project. Specific findings are highlighted in a more concise form than in the final report. The Research Summary Series is intended for health services administrators, planners, and other research users who require recent findings relevant to immediate problems in health services.

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(HRA)	77-3176	Quality of Medical Care Assessment Using Outcome Measures (in preparation)
(HRA)	77-3178	Algorithms to Train, Support, and Evaluate Paramedics (in preparation)
(HRA)	77-3192	An Approach to the Assessment of Long-Term Care (in preparation)

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The Research Management Series describes programmatic rather than technical aspects of the NCHSR research effort. Information is presented on the NCHSR goals, research objectives, and priorities; in addition, this series contains lists of grants and contracts, and administrative information on funding. Publications in this series are intended to bring basic information on NCHSR and its programs to research planners, administrators, and others who are involved with the allocation of research resources.

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(HRA)	77-3167	Emergency Medical Services Systems Research Projects (Active as of June 30, 1976) (PB 264 407, available NTIS only)
(HRA)	77-3179	Research on the Priority Issues of the National Center for Health Services Research, Grants and Contracts Active on June 30, 1976
(HRA)	77-3183	Recent Studies in Health Services Research, Vol. II (CY 1976) (in preparation)

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(HRA)	77-3138	Women and Their Health: Research Implications for a New Era (PB 264 359, available NTIS only)

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(HRA)	76-3150	Intermountain Medical Malpractice (PB 268 344, available NTIS only)
(HRA)	77-3154	Advances in Health Survey Research Methods
(HRA)	77-3181	NCHSR Research Conference Report on Consumer Self-Care in Health (in preparation)
(HRA)	77-3186	International Conference on Drug and Pharmaceutical Services Reimbursement (in preparation)

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