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THE COSTS ASSOCIATED WITH DIFFERENT LEVELS
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IN RURAL MICHIGAN

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THE COSTS ASSOCIATED WITH DIFFERENT LEVELS AND ARRANGEMENTS OF AMBULANCE OPERATIONS IN RURAL MICHIGAN

By

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ABSTRACT

THE COSTS ASSOCIATED WITH DIFFERENT LEVELS AND ARRANGEMENTS OF AMBULANCE OPERATIONS IN RURAL MICHIGAN

By

Robert E. Navin, Jr.

Based upon an in-depth analysis of six ambulance operations, this study has:

1. Improved the methodology for analyzing the costs of rural ambulance operations. Relevant parameters were defined, and ambulance operations were conceptually differentiated based on both institutional and personnel arrangements.

2. Presented market information on the price of different types and levels of service and the costs that a service might incur if it changed institutional arrangements, levels of service, or degree of volunteerism.

3. Developed a set of analytic guidelines which:

   a. Identify and define relevant cost variables that should be evaluated.

   b. Recommend methods of depreciation of capital equipment.

   c. Provide an easy to use format from which individual ambulance operations can compute their own costs.

Based on empirical and budgeted data, this study also includes findings as to the ranges of costs that can be anticipated for different institutional and personnel arrangements as well as different levels of service.

To my parents

Their support has guided me through the educational process so that I might constructively utilize those skills which I have acquired.

ACKNOWLEDGMENTS

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The author would like to express special thanks to Wayne McKenna, Assistant Chief of the EMS Division, and to Neal Andrews, Chief of the Planning Section. Neal Andrews was invaluable in directing this study to meet the current planning needs of the State of Michigan. Special thanks are also deserved by the other staff members of the EMS Division, including Joe Hall, John Hubinger, Larry Sheridan, and Yvonne Haviland for their invaluable insight and assistance.

This study would not have been possible without the assistance of the rural ambulance operations themselves. They volunteered much of their time assisting in the completion of the questionnaires.

The supervision of this study was handled by Dr. Robert D. Stevens, Professor of Agricultural Economics, Michigan State University. It was he who initially got the writer interested in the problems of rural EMS. To him much appreciation is owed for his invaluable assistance in formulating the methodology and editing this study, and for his guidance throughout my Masters program.

Appreciation is also extended to Dr. Allan Schmid for his constructive criticism and for perceiving the similarities in rural communities of providing EMS, fire, and police services; and to Cindy Cordes for her general support and typing of the first three drafts of this study.

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PART I. INTRODUCTION

A. Background to the Study

1. Statement of Need

> At the present time one of the most important unaddressed needs in EMS (Emergency Medical Service) in the State of Michigan is the need to be able to say . . . more satisfactorily what it would cost to do more and what effect it would have. Only then can the people of Michigan determine realistically what they wish their government to do or what they are willing to do for themselves, what they are willing to pay, and whether it is worth it. (The Michigan Plan for EMS, p. 58)

It is in light of this need that this study is being conducted.

2. Objective of this Study

The objective of this project was to furnish EMS decision-makers at the state, regional, and local levels with information which would help them to better estimate the costs of providing different levels of service to rural areas under different types of institutional and personnel arrangements.

3. Current Situation Nationwide

Across the nation each year, there are more than 115,000 accidental deaths, and an additional 600,000 victims of coronary heart disease. The cost of accidental deaths alone, in terms of lost wages, medical expenses, property damage, etc., exceeds $29.5 billion (Accident Facts, 1972).

This figure would be even higher if it included the effects of traumatic neurosis which often result from disabling injuries.

There are distributional factors which shape the location of accidents and illness. A study conducted by Waller, Curren and Noyes (p. 66) showed that rural counties had four times more traffic fatalities per thousand population than did urban counties (greater than 500,000 population). They concluded that the consequences to accident victims in rural areas are more severe than in urban areas, even though the nature of the injuries themselves in rural areas is initially no more severe. They determined that 62% of rural fatalities could have been prevented by "immediate and adequate" prehospital care. Three explanations were offered for why this care did not exist in rural settings:

a) Slow discovery of the accident.

b) Transportation to a medical facility took longer due to both relatively greater distances and to difficulty in obtaining a vehicle.

c) Poorer quality of prehospital care (Waller, Curren, Noyes, p. 66).

Omitted from this list of explanations of the higher rates of fatalities in rural areas is consideration of the costs of establishing and operating an EMS. These costs are higher on a per capita basis in rural areas. In general, rural areas have a higher proportion of old people (Iden, p. 1), lower per capita income, lower population densities, and thus lower tax bases from which to fund EMS. The combined effects of higher fatality rates and these financial difficulties make the provision of adequate EMS in many rural areas very difficult.

The benefits of rural EMS accrue not just for those people living in rural areas but urban residents as well. In the Waller study, 32% of the rural traffic deaths occurred to urban residents who were either vacationing or passing through (Waller, Curren, Noyes, p. 67). Thus, anyone may be affected by the quality of EMS in rural areas. Therefore, adequate EMS is not a problem just for the residents of these rural areas. It must be tackled on a state or even a federal level. In this context, the EMS problem might be viewed as a need to change jurisdictional boundaries precipitated by a change in EMS clientele and a desire to meet a new set of demands.

4. State Initiatives with Emergency Medical Care

During the past 15 years, both state and federal legislation have reflected increasing concern over the adequacy of EMS. Three EMS statutes, Acts 288, 290, and 330, which took effect April 1, 1977, give Michigan "the most comprehensive statutory framework for the development and administration of an EMS system to be found anywhere in the country." (Grant Proposal . . . p. 14)

Public Act 288 provides for the administrative and planning framework which will integrate all EMS activities at local, regional, and statewide levels. The Act provides for coordinated efforts in the area of facilities, communications, public education, disaster planning, standardized record-keeping, and review of grant proposals.

Public Act 290

a) Sets consistent standards for EMS personnel.

b) Authorizes the Department of Public Health to approve all training and continuing education programs.

c) Authorizes MDPH to certify instructors and EMS communications personnel.

d) Authorizes MDPH to distinguish between and license all ambulance attendants, basic Emergency Medical Technicians, and advanced EMT's.

Public Act 330 replaces P.A. 248 of 1968 in setting standards for all types of ambulances. This act differentiates by function the equipment that must be carried by the ambulance. These standards follow those set by the Department of Transportation. This Act also provides for the licensing of ambulance operations.

The development of these Acts reflected the higher expectations of Michigan citizens regarding the quality and availability of emergency medical assistance. The Acts also reflected the groundwork established by the federal government which showed the importance of having a comprehensive and integrated system, where properly trained personnel, specified equipment, and properly designed vehicles can save lives and reduce the number of permanent injuries. The Michigan legislature decided that the best way to develop a statewide EMS system would be to mandate it via statutes. The statutes incorporate the Department of Transportation's standards for vehicles, equipment, and training of personnel.

5. EMS in Michigan Today

Since the passage of this legislation, state initiative in continuing to improve EMS in Michigan has not waned. The Michigan Department of Public Health completed in 1977-78 a series of public hearings throughout the state to establish the specific rules for the 1976 legislation. The hearings have revealed an overwhelming satisfaction with the legislation.

But general satisfaction cannot hide the large task ahead for all EMS personnel.

The Division of EMS for the State of Michigan estimated that for Michigan, better equipment and training of EMS personnel could reduce deaths from accidents by 20 percent and deaths from myocardial infarction by 10 percent. These 1975 rates could translate into a savings of 800 from accidents and 2,830 lives from myocardial infarction per year (The Michigan Plan for EMS . . . p. 44-45).

Better equipment and training of EMS personnel are only two possible ways of improving emergency care. It has been recommended that rural EMS needs to be reorganized. Local chauvinism must be replaced by cooperation, consolidation, and mutual assistance pacts among rural communities if the costs of operating an equitable and effective EMS are to be minimized (Waller, Curran, Noyes, p. 67). This recommendation faces the obstacles of requiring a change in both the structure and the conduct-performance of the EMS. These terms are defined on the next page.

This study will attempt to examine the costs of these various solutions--better equipment, better training, and different institutional arrangements of rural ambulance operations.

B. Review of the Literature on the Costs of Rural Ambulance Operations

1. Framework of Analysis

By way of introduction to the literature on the costs of ambulance operations in rural areas, a structure-conduct-performance chart is presented on the following page. It identifies the major components that must be analyzed in order to compare various ways of organizing and delivering emergency medical service. The structural components define the problem facing rural EMS. The conduct components identify the response to these problems. And the performance components attempt to evaluate the response to the problems. Some highlights of research into the structure, conduct, and performance of EMS are presented in the Addendum to this section.

This paper focuses on the costs of various programs (or conducts) from the point of view of the ambulance operations and their personnel, given different structures that could be legislatively mandated. The literature reviewed in this section also has this same focus.

All of the costing methodologies found in the literature are neither purely "financial" nor purely "economic" (Gittinger, p. 1-30). None of the studies examined make explicit whether or not the prices of capital items were subsidized. Nor do these studies consider the costs to society as a whole, which would exclude taxes and interest payments on loans since these are just transfer payments.

The studies also do not attempt to quantify the societal costs associated with the loss of productivity of a man due to a disabling injury, nor the opportunity cost of people attending training classes. Usually the opportunity cost of labor is theoretically defined as the

Table 1

ECONOMIC FRAMEWORK FOR ANALYSIS OF RURAL AMBULANCE OPERATIONS

STRUCTURE	CONDUCT	PERFORMANCE
Demand = f(...	Personnel Employed	Physical Measures
A. Emergency Treatment and Transfer	1. Levels of Education	
Need: 1. Severity of Accidents/Illness	2. Levels of Training	1. Response Times
a. Demographic--total population, population density, age, income race, employment, health, sex		a. Notification
b. Environmental--climate, industry		b. Arrival
c. Temporal--vacation, population, days, hours	Communication	c. Disposition
d. Geographic--distances from medical care		2. Medical Outcomes
e. Vehicular--vehicle miles per year on roadways		
2. Substitutes (e.g., police, fire, personal vehicle)	Transportation (Vehicles)	3. Queuing
3. Tastes, Preferences, Public Education		
4. Legislatively & Informally Mandated Minimal Acceptable Parameters of Care	Sophistication & Comprehensiveness of Equipment	
		Social and Psychological Measures
B. Non-Emergency Transfers		1. Subjective Assessment by Clients; Percent Satisfied.
Supply = f(...	Coordination & Administration	Medical Measures
1. Community Resources		1. Assessment by Physicians
a. Alternative Institutional Arrangements	Value of Resources Used	2. Change in Rate of Disability
b. Alternative Personnel Arrangements		3. Change in Rate and Location of Mortality
c. ...		
		Economic Measures
2. Competing Uses of Resources		1. Economies of Scale
		2. Joint Products
3. Complementary Uses of Resources (Joint Production)--Coordination & Cooperation		3. Productivity
		a. Cost per unit of service
4. State of Technology		b. Etc.

value attached to its most valuable alternative use. For ambulance attendants, this alternative use could be work, leisure, or even sleep. The value attached to working on the ambulance is thus a function of individual tastes and preferences, and the relative amounts of work,

leisure, and sleep. It is important to understand these terms since they are often used imprecisely in the literature.

In order to compare and contrast the cost studies in the literature, a summary of the best studies of rural EMS was developed (Table 2). The figures in many cases are aggregations of those presented in the literature. This was done for the sake of clarity in the presentation, as well as to highlight certain aspects of the most relevant studies.

The figures for each study are <u>not</u> directly comparable due to:

1. Different cost methodologies.
2. Different physical units, both type and amount.
3. Different terminology.
4. Different levels of aggregation.
5. Prices
6. Omission of certain "hidden" or "shared" costs.
7. Different numbers and types of ambulance services sampled.

These seven categories will be discussed in the remainder of this section.

2. Different Cost Methodologies

In the literature, different cost methodologies are used to value labor, depreciation of capital equipment, and the interest on capital investment. Vehicle depreciation ranges from 3-10 years, and is usually calculated as a function of expected annual mileage. Only the studies by Briese (1974) and Hsu (1973) include calculations of salvage values. The former uses $\frac{\text{value of new vehicle}}{\text{4 years}}$ = salvage value, and the latter

Table 2

COMPARISON OF RURAL COST STUDIES

Name or Author of Study / Cost Components	AMSAA (1977)	ODEKSEN (1974)	BRIESE (1974)	HSU (1974)
I. Number of Vehicles	2	1	2	2
II. Number of Runs/Year	1000	338	730 (estimate)	500
III. Total Cost of EMS/Year	$160,382.	----	Vol. full service $21,597 - $120,663	$35,406
IV. Cost per Run	$160.38	----	$29 (vol.) - $165 (gov't.)	$70.81
V. Service Area	15 mi. round trip	71 mi. round trip	45 mi. round trip	26 mi. round trip
VI. Cost per Capita	O	O	O	O
VII. Fixed Costs				
A. Primary Vehicle, Cost/Year	4 yr. depreciation $4500	3 yr. depreciation $3228	5 yr. depreciation $4425	7 yr. depreciation $731
B. Second Vehicle, Cost/Year	$1000	----		O
C. Major Equipment, Cost/Year	included above	included above	$3000	X
D. Communications Equipment, Cost/Year	10 yr. depreciation $2300	10 yr. depreciation $800	10 yr. depreciation $675	$100
E. Garage & Office, Cost/Year	$4080	$300	$5100 - $6600	$960
F. Insurance Cost/Year	auto & property $750	auto & malpractice $1000	$2000 - $4000	$534
G. Professional Fees/Year	$600		$1000 - $1500	
H. Interest (loans & opportunity cost)	O	8% opportunity cost $1440	O	7% opportunity cost $467
I. Salaried Personnel Costs/Year	12,000 + 13%		Vols - $9000 + 18%	
1. Managers	$13,560	8 full time $45,760	0 - $73,100	$9600
2. Dispatchers	4.2 x $2.25 x 40 x 52 + 13% fringe $24,679.20		Vols. - 8.6 x 8500 + 12% $0 - $73,100	2 x $7200 = $14,400
3. Attendants/Drivers			Commercial-Vols, $600 - $200	X
J. Initial Training Cost	O	O	$150 - $200	X
K. In-Service Training Cost	O	O	$3500(½) + 10% or 12% $0 - $3920	$3 x 1000 hours $3000.
III. Variable Costs				
A. Clerical	$2.25 x 40 hrs. x 52 + 13% fringe = $3159.08			
B. Attendants/Drivers				
C. Vehicle Costs	$2063	$1636	$.15 - .17/mi $4927 - $8146	$1683
1. Total Mileage/Year	15,000 miles	24,000 miles	32,860 miles	26 x 500 = 13,000
D. Supplies & Equipment	$1288	$749	$1912 - $2162	
Miscellaneous				2% of full costs = $696

Table 2 (cont.)

COMPARISON OF RURAL COST STUDIES

Name or Author of Study / Cost Components	NCCEMS (1977)	MANZ (1977)	McMillen et al. (1975)	
I. Number of Vehicles	1	0		
II. Number of Runs/Year	386	38 - 462	372	510
III. Total Cost of EMS/Year	Vol. full service $24,000 - $190,000	$2,844 - $22,236	$26,348	$31,881
IV. Cost per Run	$66 - $820.50	$22.59 - $122.82	$70.83	$62.51
V. Service Area	10,000 population	910 - 8,931 population	12,606 population	12,855 population
VI. Cost per Capita		$.71 - $6.64	$2.09	$2.48
VII. Fixed Costs				
A. Primary Vehicle Cost/Year	X		4 yr. depreciation 25% salvage $3,281	3 yr. depreciation 25% salvage $4,375
B. Second Vehicle, Cost/Year	----		$1,093	$1,458
C. Major Equipment, Cost/Year	X		included above	included above
D. Communications Equipment, Cost/Year	X		included above	included above
E. Garage & Office, Cost/Year	X		$600	$600
F. Insurance Cost/Year	auto X		$1,200	$1,200
G. Professional Fees/Year				
H. Interest (loans & opportunity cost)	O			
I. Salaried Personnel Costs/Year			$8,000 + 15%	$8,000 + 15%
1. Managers	$0 - $82,000			
2. Dispatchers				
3. Attendants/Drivers				
J. Initial Training Cost	O			
K. In-Service Training Cost	O			
VIII. Variable Costs				
A. Clerical				
B. Attendants/Drivers			$7,440	$10,200
C. Vehicle Costs	X		$6.50 per call $2,418	$3,316
1. Total Mileage/ Year				
D. Supplies & Equipment	X		$1,116	$1,533
Mipcellaneous				

uses $\frac{\text{value of the new vehicle}}{\text{estimate years life}}$ = salvage value. The majority of the studies depreciate major equipment over ten years with no salvage value. Only two studies consider the interest or opportunity cost of capital investments (Hsu, 1974; Doeksen, 1975). The opportunity cost of capital is the value the capital could earn if it were invested in its best alternative use. Both the Hsu and Doeksen studies include only the capital invested in vehicles and major equipment, valuing it at 7 percent and 8 percent per year respectively.

Labor should be valued at its opportunity cost, but this opportunity cost appears to be at least in part a function of the laborer's self perception. Three methods for imputing the value of volunteer labor are discussed by Manz (1977, p. 89-96). These methods are:

a) Replacement cost of volunteers with full-time paid personnel based upon the minimum number (5.7) of professional squadmen required to staff an ambulance.

b) Replacement cost based upon an equivalency ratio of three volunteers to one professional squadman.

c) Cost to the community to compensate the volunteers for their time in making emergency runs.

The total cost of labor for an ambulance operation is a function of the pay scales, fringe benefits, and the staffing (shift) patterns. Pay scales range from \$0 - \$9,000 and fringe benefits range from 10 - 25 percent. To fully staff an ambulance service with two attendants who work 40 hours per week, 52 weeks per year, the EMS would need 8.6 attendants. This required number is used in calculating the opportunity cost of personnel. This number of attendants required varies according to the shift pattern (Briese, 1974, p. 35).

Personnel costs, both fixed and variable, exhibit the greatest cost differential among services with similar demand. The Briese (1974) cost analysis illustrates this very well. This analysis compares institutional arrangements that differ primarily because of volunteer or shared labor whose costs are less than fully paid staff. The Hsu (1973) study, although it does not state it, shows that even though a rural EMS has volunteers, its costs per run may be higher than those of a non-rural EMS that does not employ volunteers. This apparent dichotomy is explained by the average round trip distance which is greater in rural areas than in more urban areas.

How initial training costs were calculated by Briese is not explained. The LACCCEMS (1975) study spreads the cost of training over the average years that an attendant will work with the EMS (the longer the service, the less the cost of initial training per year).

3. Different Physical Units

The usage of different physical units in the cost studies renders direct comparisons among the studies invalid. The studies differ in terms of the number of vehicles per ambulance operation, runs per year, total population in the service area, average mileage per round trip, total miles per year, types and amounts of equipment and supplies, etc. Since ambulance operations have different demand patterns and different levels of service, any comparisons among the studies must specify both the monetery units and the physical descriptive amounts for each component that comprises the Conduct of the EMS. The summarized table in this paper contains this failure. If direct comparisons were to be made from this chart, they would be of dubious quality unless the specific physical units, which are listed elsewhere, were used to adjust them.

The literature is not yet consistent in its recommendations as to what constitutes the appropriate type and amount of equipment per ambulance operation. In terms of number of vehicles, for example, studies suggest that one vehicle will be sufficient when annual calls are less than:

a) 275 (Schuman, 1977, p. 740), estimate based on work of G. Esposito, 1974.

b) 1,460 (NCC/EMS, 1977, p. 4), estimate based on "typical" New England model.

c) 600 (Sargent, 1974, p. 11), estimate based on eight case studies.

The Addendum of this paper also mentions the controversy in the literature over the relationship between total population in the service area and the number of calls.

Even the type of vehicle used is not standard in rural areas, nor is one vehicle categorically recommended over another. The modular unit with its chassis-change feature has cost and space advantages. But in areas of light usage, automobile-type chassis last longer (Jelenko, 1976, p. 86)(Cross, 1973, p. 8).

4. Different Terminology

There is also a problem of inconsistent terminology in the literature on costing EMS. In economic theory, costs are usually differentiated on the basis of being either fixed or variable. Fixed costs are also referred to as "capital expenditures" (Doeksen, 1975), as "operational" costs (Geomet, 1975). Variable costs are also referred to as

"ongoing operational costs" (Geomet, 1975), as "operating expenses" (Doeksen, 1975), and as "operational costs (variable elements)" in Briese (1974). A third distinct category is added called "initial capital outlay" (Sargent, 1974) or "capital costs" (Briese, 1974). This category specifically isolates the initial capital expenditure which was made to acquire the vehicles and equipment. This is a useful category for identifying potential cash flow problems at the inception of the project.

5. Different Levels of Aggregation

Cost studies differ in the level of aggregation with which they present the cost data. Highly aggregated figures do not lend themselves readily to verification through comparison with other studies. Sadler (1977) presents cost per run figures of $21.73 (volunteer with 477 runs per year), $33.45 (commercial with 3,440 runs per year) and $46.72 (municipal with 959 runs per year). They sampled 46 EMSs of which only some were rural. The Manz, Hitzhusen (1977) study analyzes the determinants of cost from a sample of 26 volunteer organizations. They calculated an average cost per run of $45.82 for 198.5 average runs per year, with an average total population of 4,300. The LACCC/EMS (1975) study of urban Los Angeles County determined vehicle costs to be 25¢ per mile, based upon unspecified empirical data. The Rural EMS (1974) study gave ranges of costs per major cost categories. Based upon an unspecified sample, they determined that average total cost per run was $120 - $160. Jelenko (1975, p. 88-89) gave cost estimates for just the vehicles and supplies and major equipment.

6. Prices That Are Not in Real Terms

The cost studies cited data from 1973 through 1977, and the cost figures are in actual prices. For a valid comparison, these figures would have to be expressed in prices that adjust for the rate of inflation.

7. Omission of Shared or Hidden Costs

"Shared" or "hidden" costs are those that may not be included in the ambulance operation's cash flow budget. Unless each ambulance operation handles these costs in the same way, the comparison of their cost data will not be valid. The Touche Ross and Company study expounds on this point. A single cost procedure must be defined for handling such things as shared facilities, personnel (e.g., with a fire operation) and administrative overhead (Touche Ross, p. 5.1-5.19).

The Geomet (1975, p. 3-3, 3-4, A-1-4) study offers the following indicators, listed in order of preference, for determining that portion of a joint cost that should be attributed to the EMS.

a) If separate billing exists, use it as the basis for recording the costs.

b) $\frac{\text{Number of EMS calls}}{\text{Total calls}}$

c) $\frac{\text{Number of hours spent handling EMS calls}}{\text{Total hours spent on all calls}}$

d) $\frac{\text{Population served in total EMS area}}{\text{Total population served}}$

e) $\frac{\text{Geographic area for EMS (square miles)}}{\text{Total geographic area served}}$

Geomet also recommends using the rental value of similar space in the community when valuing garage and office space that might have been

subsidized by the local government. Twenty-five and thirty percent respectively should be included on this rental cost to value utilities and maintenance.

Note that in Table 2, the process of aggregation makes it difficult to tell if "hidden costs" are included or overlooked. There are, however, some blatant omissions that have been marked with a circle.

8. Different Numbers and Types of Ambulance Services Sampled

The cost studies of rural EMS in the literature also differ in terms of the number and thoroughness of the samples and case studies which comprise the individual studies. These differences should be noted at least, even though it is difficult to criticize these survey methodologies used in the cost studies based on their effects on the validity of the results presented.

9. Additional Comments

In addition to the seven categories of problems in comparing the studies, there are some problems in the studies themselves. The most complete description in the literature of how to go about determining the costs of EMS is provided by Geomet (1975). This "Cost Finding and Reporting System" was built off of the 1968 study by Dunlop Associates entitled The Economics of Highway EMS. The major strengths of the Geomet manual, in addition to those already mentioned, are its discussion of data sources, data collection problems, and the components that must be considered when costing EMS. The major shortcoming of this manual is that it is not well suited for rural areas. The procedures and charts are highly disaggregated. The benefits derived from such a complex

cost-finding procedure are limited by the scarce administration and other resources which are found in rural areas.

The Doeksen (1975) study examined eight rural Oklahoma counties and designed a manual to be used to estimate costs of EMS. This manual is oversimplified and incomplete. In the AMSAA (1977) study which was based on two years of research throughout Illinois, the calculation for the number of runs per year appears high in comparison to the population base. In the Briese (1974) study which was based on an unspecified but limited survey, the number of calls per year is not stated, nor is the population in the service area. Both the Briese and the Sadler (1977) studies include useful layman's guides to economic jargon. The Sadler study also includes a useful typology of ambulance operations based first on financial source, and then on method of paying the staff.

The Hsu (1974) study, based on 16 case studies in Wyoming, defines and sets out the formulas for such costs as depreciation and interest. The Hsu study attempts to compare the costs of various institutional arrangements and concludes that "services staffed with volunteer personnel had the lowest expenses and those with paid, full-time personnel had the highest." This is a true statement, but it is deceptive. These "lowest expenses" are in fact the lowest <u>total</u> expenses. Volunteer-staffed operations actually had the <u>highest</u> cost per call. Volunteer operations had the lowest total expenses primarily because the number of runs was not fixed for each type of service, and the volunteer operation had the lowest number of calls per year.

The Manz (1977) study uses regression analysis in an attempt to identify variables that explain the variance in the per unit costs of ambulance services. Two recommendations of ways to reduce the per unit

cost of rural ambulance operations were given. First, rural ambulance operations should consolidate so that more people would use existing fixed services. Second, the use of volunteer assistance in operating an ambulance service should be promoted. The study done by McMillen, et al., (1975) also geared its analysis to showing that economies of scale can be achieved through consolidation of rural ambulance operations.

A document entitled Medical Transportation Report (1977) is worth noting because it is both unique and potentially helpful to EMS planners and administrators. The document presents a relatively simple methodology for estimating projected increases in the cost of operating ambulance services.

In conclusion, this paper has placed the literature on the costing of emergency medical services in rural areas within the overall Structure-Conduct-Performance framework. The seven major difficulties that are encountered in comparing the figures in these studies are specified. Various methodologies for costing are discussed, and criticisms of the various studies are presented. No one study includes all of the cost variables, nor goes about the calculations in the same way. Perhaps this is understandable given the data problems described in Sadler (1977, p. 106).

10. Addendum

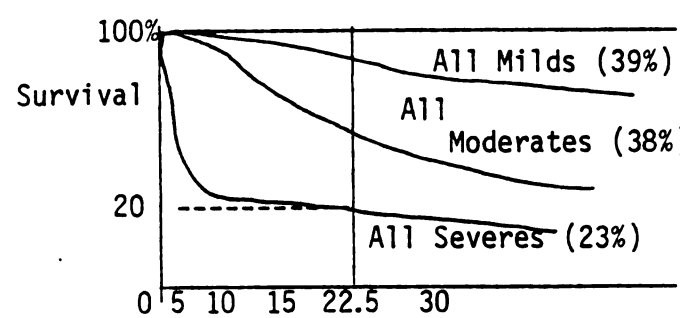
It is beyond the scope of this paper to discuss the evaluations that have been done of either the Structure or the Performance of EMS, but the following results are worth noting:

a. In 1977, an HEW-sponsored study by Chicago State University used a correlation analysis and found that none of the 23 independent variables (including level of personnel, number of DOT vehicles, number of radios, etc.) are significantly associated with changes in the total case fatality rate. Victims in the age group 50+, however, do exhibit the greatest benefits (in lives saved) from the ambulance operation. It is hypothesized that older people are less resilient to trauma, and therefore more sensitive to the speed of delivery and quality of medical care (Roth, 1977, p. 118, 122-123, 138).

b. In 1975, the Los Angeles Countywide Coordinating Council on EMS conducted a study in which victims were classified as mildly, moderately, or severely critical. The graph depicts the percentage rate of survival of these three groups related to the elapsed time to first intervention. The bulk of lives lost in the severely critical group occurred within the first ten minutes. Given that it took an average 17.5 minutes from occurrence of the accident/illness to notification of the ambulance

Table 3

Elapsed Time to First Intervention and Survival Rates



(total number in sample was 69,300)

operation, the speed of the EMS response will have little impact on the severely critical group which represents 75% of the total deaths in the first 22.5 minutes.

The conclusion, then, is that although improved response time will result in saved lives, the marginal cost will be very high. The authors suggest that "there appears to be a potentially greater yield from public education efforts directed at reducing delay times and by educating people regarding life threatening conditions and what to do about them until help arrives." (LACCCEMS, 1975)

c. Although there are numerous factors affecting demand, total population in the service area is usually thought to be the most significant. The literature, however, is not consistent in its estimates of annual demand (number of calls) per 10,000 population:

365 calls	(Schuman, 1977, p. 740)
365 calls	(NCC/EMS, 1977)
1000 calls	(AMSAA, 1977)
150 calls	(Sargent, 1974)
290 calls	(Doeksen, 1975)

Since 365 calls per year per 10,000 population is the standard rule of thumb used in the literature, some explanation is needed for the AMSAA and the Sargent figures.

C. Methodology of the Study Including Sampling Procedure

1. The Research Design

This Research Design (Appendix I-A) supplements the original contract by identifying specific objectives, general methodological steps, and the necessary data gathering techniques. Included also in the Research Design was a "Framework for Data Collection . . ." which identified the category of information needed, the specific data required, and the potential sources of that data.

2. The Sampling Procedure

The objective of the sampling procedure was to identify five or six "typical" rural EMS at either the Minimum or Basic levels of service for detailed study which had accessible, high quality records. Hence, the variables that had to be carefully examined in the sampling process included:

a. Type of institutional arrangements.

b. Level of EMS service.

c. Size of EMS operation.

d. Population density of service area.

e. Accessibility of high quality records.

A summary of the sampling procedure is presented in Table 4 on the following page. The steps involved in the sampling procedure are described in detail in Appendix I-B.

For the sake of clarity and accuracy, the following definitions have been formulated and will be used throughout this paper:

Table 4

SUMMARY OF SAMPLING PROCEDURE

Number of Ambulance Operations	
412	Total number of Ambulance Operations in Michigan
319	Total number of Ambulance Operations in Michigan that are based in cities of population less than 25,000.
77	Total number of Ambulance Operations in Michigan that are based in cities of population less than 25,000 and: a) Potentially have good data. b) Potentially willing to cooperate with study. c) Are not located in the Upper Peninsula. d) Are of the four most common institutional arrangements (Public Non-Fire, Fire, Private, Independent Volunteer).
38	Number of Ambulance Operations that meet the above criteria and have just two vehicles.
33	Includes only those operations that were thought to be at the Minimum or Basic levels.
13	Initial site visits of ambulance operations. Chosen on basis of: a) Aforementioned criteria. b) Potential for meeting criteria of the sample which consisted of one ambulance operation from each of the following categories: 1) Fire--minimum level 2) Fire--basic level 3) Independent Volunteer--minimum level 4) Independent Volunteer--basic level 5) Public--basic level 6) Private--basic level
6	Final Sample. Consists of ambulance operations which fill the aforementioned categories of the sample, plus have: a) Reasonably good data. b) Willingness to cooperate with study. c) Population density below 120.

Personnel Arrangement:

Refers to the staffing pattern and remuneration mechanisms of the ambulance operation. It consists of a number of variables including the number of workers, their function, their levels of training, their pay scales, and their method of reimbursement. These variables specify the personnel arrangement as to where it lies along the continuum from unremunerated volunteers, to partially remunerated volunteers, through fully paid personnel.

Institutional Arrangement:

Refers to the method of decision-making and responsibility bearing.*

Volunteer:

Noun; Someone whose primary source of financial support is not derived from work with an ambulance operation. The level of remuneration can range from zero to a wage or compensation such as $5 per person per ambulance run.

Volunteer:

Adjective, used only to modify "Personnel Arrangement."

Paid:

Adjective, to modify "Personnel Arrangement." A continuum exists from fully volunteer through fully paid personnel arrangements. This study recognizes this continuum, but did not have a data base sufficient to make operational such a continuum.

Independent:

Adjective, used only to modify "Institutional Arrangement."

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*Neal Andrews, Chief of Planning, EMS, Department of Public Health, April 15, 1978.

Independent Institutional Arrangement:

An arrangement in which major decisions affecting the quality and quantity of service (such as hiring practices, authorization of major purchases, incentives for the personnel) are made by a committee of individuals who represent their own personal interests, and not those of private or governmental organizations.

Public Institutional Arrangement:

An arrangement in which major decisions are made by a formal governmental body, such as the Township Committee, the City Board of Directors, or the County Commissioners.

Private Institutional Arrangement:

An arrangement in which major decisions are made by the private owners of the ambulance operation.

Type of Operation:

Whereas the aforementioned arrangements described the decision-making mechanism, the 'Type of Operation' is a sub-heading of these arrangements which described the administrative unit of daily activities.

This sub-heading categorizes an institutional arrangement as being either "single" or "joint" function. A single function operation is an institutional arrangement whose daily administration handles only EMS activities. A joint function operation is an institutional arrangement whose daily administration handles not only EMS activities, but other activities as well. Such joint activities are typically either fire or funeral home or police work.

For Profit or Not-for-Profit Operations:

These two mutually exclusive concepts describe the motivation behind the decision-makers in an institutional arrangement. Either one may be associated with Public, Independent, or Private institutional arrangements.

PART II. EMPIRICAL STUDY OF SIX AMBULANCE OPERATIONS, THEIR INSTITUTIONAL ARRANGEMENTS AND THEIR COSTS

A. Description of Alternative Institutional Arrangements of Ambulance Operations as Represented in the Six Case Studies

The section on sampling procedure has already discussed the criteria used in choosing the six EMS for intensive study from 412 ambulance operations in Michigan. Table 4 concisely summarizes some of the data on these six operations. A detailed empirical description will be discussed in this section. The next section will entail a much more critical comparison of the institutional arrangements and potential development strategies for rural ambulance services.

1. Public (County) Ambulance Operation A*

The Public Ambulance Operation is an institutional arrangement in which major decisions (e.g., purchase of a new vehicle or a change in the fee structure for calls) are made by a formal governmental body. Case Study A is a county-wide, Separate operation, administered by a County Ambulance Board and run on a day-to-day basis by a salaried manager. All recommendations, however, go to the County Board of Commissioners for approval.

As is true with the other ambulance operations in this study, Operation A has two emergency vehicles. But, unlike the other studies,

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*Note that the names of the actual ambulance services have been replaced by the letters A through F in order to protect the confidentiality of these ambulance operations that most graciously assisted with this study.

Operation A does not use one as a back-up vehicle for the other. Rather, it has one based in Town A and one based at a hospital in Town B.

a. History

This present arrangement has been functioning since 1974. Previous to that, funeral homes handled emergency medical runs. In 1974, however, the funeral homes backed out of the ambulance business due to minimum wage and other laws which were on the horizon that would increase their costs beyond a level that would permit them to make a profit.

Fire Departments in this county generally shied away from taking on the ambulance duties. The administrators of the one county hospital also felt that the ambulance service would be too much trouble. So the County Board of Commissioners were left with the mandate from townships and towns to set up and administer an emergency medical service for the Northern Michigan county's 8,600 people.

b. Personnel Arrangement

The County Commissioners agreed to support a group of enthusiastic volunteers in Town A that wanted to keep an ambulance service located in their community. The Commissioners enticed the one hospital in the county, located in the county's most populated town, to garage and man a second vehicle by offering to build the ambulance garage adjoining the hospital. The hospital accepted this offer which also included:

1) Reimbursement of all emergency vehicle operating expenses.
2) Reimbursement on an hourly basis of hospital personnel who are called away from their jobs to handle ambulance runs. The rate

of reimbursement was set at approximately double the hourly wage of the personnel with the idea that this rate would cover the ambulance attendants' wages, benefit packages, and the remainder would go to defray the hospital's expense of having to pay people to cover the duties of those off on emergency runs.

3) A $1,000/year flat fee for the hospital was agreed upon to cover items of overhead such as utilities, building maintenance, communications and laundry for both ambulances in the county.

The county reimburses Town A for all vehicular and garaging expenses plus a base rate of $36 per run. Nine dollars of this per run figure is kept by the Town A Ambulance Association for miscellaneous expenses and social events. The remaining $27 per run is divided up amongst the attendants on each run. There is also an agreement whereby the county reimburses for overtime on exceptionally long runs.

Separate reimbursement records are kept by the two ambulance headquarters. Town A hires someone at $15 per month to keep the records; the hospital at Town B handles ambulance records along with their other records. Each site submits their records to the County Clerk. The County Clerk reimburses the two ambulance headquarters and also handles the sometimes difficult task of getting the clients of the ambulance to pay their bills.

c. Communications System

Notification that the services of an emergency vehicle are needed is received by the County Sheriff's Office. The Sheriff's Office will determine which ambulance vehicle is best able to

rapidly respond to the call. If the hospital in Town B is preferred, the Sheriff will signal the hospital's central dispatch via a tone encoder. The hospital will in turn signal the appropriate ambulance attendants through their internal communications network.

If the ambulance in Town A is preferred, the Sheriff will use the encoder to signal the ten tone decoders that are kept by the attendants at Town A. In either Town A or Town B, when the attendants get to the emergency vehicles, they communication with the Sheriff's Office on the vehicle's radio in order to get the location and nature of the call.

Upon reaching the accident victim, the attendants will radio the Sheriff's Office if additional assistance should be dispatched, and then switch to the hospital frequency to notify the hospital of the nature of the accident/illness and the approximate time of arrival. Occasionally consultation will also take place on the radio concerning procedures or triage. Eighty-five percent of the runs for both ambulances go to the hospital in Town B. Two other hospitals handle the remainder of runs.

Beginning last year, non-emergency transfer runs have been referred to another ambulance company outside the county because the ambulance personnel in particular did not like having to interrupt their daily schedules for a non-emergency transfer which often tied them and the vehicles up for much more than the average one hour round trip run.

2. Independent Volunteer Ambulance Operation B

There were two ambulance operations in this study classified as Independent Institutional arrangements which also had Separate operations.

The second one, referred to as Operation C, will be discussed next. The reader is referred back to page 22 where the definition of "Independent Volunteer" is given.

The Board of Directors of Ambulance Operation B fills its positions on an annual basis by having elections among the membership. Memberships cost $10 per year per adult and entitle the holder to voting privileges during the annual elections and substantial savings in case they need an ambulance. The positions of president, treasurer, and staffing manager usually change hands every few years. Day-to-day decisions, administrative decision, are also made by the Board's elected officers.

This ambulance operation has run so successfully the past few years that they have had to pay Federal income tax on the excess of revenues over expenditures which has been between $2,000 and $4,000 for each of the past few years.

a. History

In 1969, the local funeral home discontinued emergency medical runs for reasons similar to those described for Ambulance Operation A. Townspeople perceived a need for continuing an EMS system, so a group volunteered to organize amongst themselves under the guidance of the funeral home director. The local fire station continued to be relied upon for the use of its rescue truck when the need arose.

b. Personnel Arrangement

Located above the garage where the emergency vehicles are housed is a very comfortably furnished lounge/office where the

drivers and attendants on duty stand ready to respond to an emergency call. With beds, sofas, color TV, coffee pot, desk, card table, and soft drink machine, Operation B's headquarters has a club-like atmosphere so that people seem to gather there when they want to get out of the house. Officially, the staffing manager arranged for four six-hour shifts of two people. Often there are more than just two people congregating there.

Attendants and drivers are not reimbursed for their donated time and thus they are referred to as having a high level of volunteerism. Nor are the people who handle the time-consuming tasks of billing clients and arranging the staffing so as to cover people who are sick, on vacation, or just out of town on business. The fact that no personnel are reimbursed for their ambulance work eliminates completely the most costly aspect of a service that requires people to be available 24 hours a day, 7 days a week.

c. Communications System

Ambulance Operation B receives direct notification of an emergency accident/illness by phone from the person reporting the incident. The emergency telephone number is listed in area phone books and the telephone operators in the area are also familiar with it.

When an emergency call comes in, the crew on duty leaves the office garage immediately. Since the ambulance is in the center of town, the volunteers will hear the ambulance leave, and will telephone the non-emergency ambulance number to see if someone remains there to answer the phone. If no one is there, the volunteer will go over and cover until the ambulance crew on duty returns. In the

interim between when a crew leaves and people come in to back up, there is a tape that is connected to the emergency phone. When a call comes in, the tape gives the listener the telephone numbers of neighboring ambulance operations with whom the service has mutual aid agreements. Rare is the occasion when this sort of mutual aid is needed, but when it is, a recorded message is certainly more comforting to a caller than receiving no response at all. The advantages and drawbacks of Operations B's dispatch will be discussed in both the following Section and in Part III, Section A, which discusses moving to the Basic level of service.

Operation B runs 20 percent of its calls to the small local hospital, and the remaining runs go to two hospitals in a nearby large city. Non-emergency transfers are handled by Operation B. but they try to schedule them at times that are convenient for the volunteers.

3. Independent Volunteer Ambulance Operation C

Ambulance Operation C has the same institutional arrangement as Operation B. Its Board of Directors consists of eight members--two from each of the townships in the service area. They meet once a month, both to make major decisions and to handle administrative matters. This Board is also elected by Operation C's members who are paid an annual fee.

a. History

In 1967, the funeral home director dropped the ambulance business. Volunteers in the largest town in the area decided to fill in until the four townships themselves took over. The volunteers are still waiting.

b. Personnel Arrangement

Although Operations B and C have the same institutional arrangement, they do not have the same personnel arrangement. Both ambulance operations have comfortable and comparably equipped garage and lounge/offices. Both have attendants on duty in the office/lounge 24 hours a day, 7 days a week, with possibly a few exceptions for Operation C. Both have managers, treasurers, and staff schedulers who are not paid. But Ambulance Operation C does pay the drivers, attendants, and dispatchers $5 per run, which accounts for the difference of about $4,000 in total annual costs between these two Independent Volunteer Ambulance Operations.

c. Communications

Operation C has an emergency telephone which provides direct contact between the ambulance attendants and those who are seeking emergency medical assistance. This same phone can also be answered at a nursing home in town which has a switchboard that is manned around the clock. This is helpful during the few hours a week when no one is at the ambulance lounge. If a call comes in at such a time, attendants are notified by an encoded tone which is picked up on the four portable and two desk-top tone receivers which attendants have.

Occasionally the emergency phone is answered simultaneously at both the nursing home and at the ambulance garage. This has been helpful in the past where the directions to the scene of the accident/illness have been confusing. The receptionist at the nursing home can sometimes assist in deciphering the harried message.

Eighty-seven percent of Operation C's runs go to four hospitals, while the remaining runs are scattered amongst nine other hospitals. The vehicles are equipped with HERN radios which aid in preparing the hospital of destination. Non-emergency transfer runs are handled as they can fit into the schedules of volunteers.

4. Fire-Ambulance Operation D

Ambulance Operation D is a Public institutional arranagement and an example of an operation with joint administrative duties. It is one of two Fire-Ambulance Operations in this study, the other being Operation E. These two operations cover only one township each.

Major decisions are made by a governmental body--in this case Township Commissioners, but day-to-day activities are handled by the Fire/Ambulance Board. Staffing patterns, in-service training, and bookkeeping are all handled simultaneously. The Township Clerk reimburses all expenses out of township funds. Fire-Ambulance Operations are able to achieve economies of scale (Baumol, p. 517) by sending the second emergency medical vehicle, as a precautionary measure, to as many fires as there are personnel to drive it there. This function is discussed further in the next chapter.

a. History

Since 1951, Ambulance Operation D has been functioning as it is presently constituted. It is thus one of the oldest Fire-Ambulance Operations in Michigan.

b. Communications System

When someone within Operation D's service area requests emergency medical assistance, he or she will dial a local telephone

number listed in the phone book under Operation D's name. The call is in fact answered, however, by the County Sheriff's Office which is miles from Ambulance Operation D. The Sheriff's switchboard operator will see that Operation D's phone line is ringing, and will respond to the call using Operation D's name.

Having recorded the pertinent information regarding the call, the switchboard operator will use the tone encoder to notify Operation D's personnel that their assistance is urgently needed. The tone associated with Operation D will be picked up on the tone decoders of Operation D's 22 personnel. Usually 12 of these 22 hear the signal and respond to the call by driving down to the Fire-Ambulance garage. Fortunately, the town is small enough and the streets designed so that the 12 responders do not create their own traffic accident requiring medical assistance. Note that ambulance attendants are not at the garage on a 24 hour basis.

It was estimated by Operation D's Fire Chief that the emergency vehicle is en route within three minutes on an average. The first one arriving at the garage will use the vehicle's radio to get directions and particulars from the Sheriff's Office. The emergency vehicle usually rolls with two attendants and a driver on board. Upon arrival at the scene of the accident/illness, the ambulance crew will radio back to its Fire-Ambulance garage for additional assistance, if needed, from the attendants who have stayed at the garage.

A HERN radio in the primary vehicle is used to notify the hospital of destination. The Fire Chief of Ambulance Operation D complained, however, that many times the hospitals do not have their radios turned on. Fifty percent of the calls go to one

hospital, with the remainder going to three others.

c. Personnel Arrangement

The Fire Chief, the Township Clerk who pays the bills, and a janitor all receive a yearly salary. The ambulances' budgeted share of these salaries was estimated at $845 for 1977.

For each ambulance run, the Township pays the Fire-Ambulance Operation $45. Half of this sum is put into a general fund for social events, such as parties, beer after in-service training sessions, and donations to Little League. The other half goes into a special account to reimburse personnel. For each volunteer attendant a tally is kept of the times that individual shows up at the Fire-Ambulance garage in response to a call. The amount of money in the special account is divided annually by the total number of people who responded to the calls. This yields a dollar (cents) per attendant/call figure. This figure was $1.90 last year. Multiplying this figure against the total number of responses for each individual will yield the annual reimbursement per person. The equation is summaried below:

$$\frac{\$45 \div 2 \times \text{Total annual runs}}{\text{Total number of respondees to calls during the year}} \times \text{Total Annual responses per person} = \text{\$ reimbursed per person per year}$$

Note that although the financial incentive to respond to a call is minimal, at least everyone who responds does get some recognition.

Non-emergency transfers are avoided by Ambulance Operation D. With no charge being made to clients of the ambulance, and volunteer attendants being reimbursed only a token sum, non-emergency transfers are only an added burden to the attendants and an expense to the Township as a whole.

5. Fire-Ambulance Operation E

Operation E is the second of the two Fire-Ambulance Operations in this study. The Fire Board handles day-to-day administrative matters and makes recommendations to the Township Board of Commissions concerning major decisions. The Township Clerk pays all the bills and handles the task of trying to collect on the bills sent to clients of the emergency vehicle. Residents of the Township are charged a $25 flat fee, while non-residents are charged a $50 flat fee.

a. History

The Fire-Ambulance Operation has been operating as it is presently constituted since 1960. Previous to that, emergency transport was not institutionalized for the Township. People would either have depended upon a neighboring funeral home, or they would have transported themselves.

b. Communications System

Fire-Ambulance Operation E is set up in the exact manner as Operation D. The County Sheriff answers the emergency telephone call, relays the message via first tone encoder and they by radio to Operation E's personnel who each have tone receivers. The county charges the Fire-Ambulance Operation $1,200 per year for this service. All who hear the tone signal will drive to the ambulance garage, with the first three or four people there taking the vehicle out on the call. The vehicles have HERN radios with which the attendants are able to communicate with their six receiving hospitals. Three of these hospitals, however, receive 77 percent of the runs.

c. Personnel Arrangement

Seven different people receive salaries in conjunction with the Fire-Ambulance Operation. Their tasks include managing, recruitment and training, vehicle maintenance, supply purchasing, record-keeping and bill collection and payment. The estimated ambulance share of this expense is $465 per year.

For each call, between eight and nine people during the day and ten to twelve people at night respond. All those who respond are paid $3 each, regardless of whether they go out on the vehicle. The rate of pay is $6 per person after midnight, and those out on a run that lasts more than one hour receive an additional $1 each. Personnel who participate in in-service training, vehicle maintenance, and general clean-up on Saturdays receive $3 each. These variable personnel expenses amounted to $2,968 in 1977.

Non-emergency transfer runs are not handled. The second emergency vehicle does go to all fires, however, as was the case with Operation D.

6. Private Ambulance Operation F

The Private Ambulance Operation is an institutional arrangement in which major decisions are made by the private owners of the ambulance operation. This operation is an example of a Private, not-for-profit, institutional arrangement. The Private Ambulance Operation F has had to rely on government subsidies in order to cover expenses. This subsidy amounted to $34,563.12 during the year for which data was collected.

The owner of Operation F also manages its daily affairs. The owner does not draw a salary from the ambulance operation, but does use

its working capital for personal loans which are later repaid without interest.

There is an Ambulance Committee composed of representatives of the five townships in which Operation F serves. This Committee reviews Operation F's budget, and decides on the appropriate level of subsidy and how that should be divided amongst the five townships involved.

a. History

Up until 1969, a funeral home in a large nearby city more or less covered Operation F's present service area. When this service terminated, the local fire department tried for 60 days to handle the service, but the results were unsatisfactory to the fire volunteers. The present owner of Operation F then worked out an arrangement with the five townships to provide them with emergency medical coverage.

b. Communications System

Telephone calls for emergency medical assistance come in directly to Private Ambulance Operation F's office/garage where at least two people are on call 24 hours a day, 7 days a week. During the day, someone is always there to man the telephone so that if a second vehicle is needed, the dispatcher can call in back-up personnel. At night, one salaried employee has a radio at home upon which he is called in to answer the phone when the night crew is out on a run.

Operation F uses three hospitals, with 75 percent of the runs going to one of them. The vehicles have radio communications capabilities with this hospital, but on a non-HERN frequency. Both

the ambulance service and the hospital foresee switching to the HERN system within the next few years.

c. Personnel Arrangement

In addition to the owner-manager who was mentioned previously, the Private Ambulance Operation pays a salary to one full-time dispatcher/secretary, one part-time bookkeeper, one full-time attendant, and seven attendants. These seven are paid $2.65 per hour for coverage at the station. Collectively they work about 277 hours per week.

No one is paid on a per run basis. The fee of $50 plus $1 per mile plus an additional charge for runs outside the county goes to defray the cost of the salaries and the hourly wages (which amounted to $53,762.16 in 1976), and other operating expenses.

B. Comparison of the Costs of the Six Ambulance Operations

This section will serve two primary functions. First, the cost factors relevant to an analysis of financial costs will be identified and operationally defined. These definitions will provide the background for and basis of the analytic guideline (included as Part IV, Section B) which will assist local, regional and state decision-makers in doing their own study. Second, this section will provide a guideline for interpretation and evaluation of the data in this study which is summarized in Tables 10 and 11.

Care must be exercised when interpreting this data. Discussion in Section A on sampling procedure defines both how typical and atypical these operations are in rural Michigan. Any generalizations made from the data in this study must bear these statistical factors in mind.

Table 10 and 11 briefly summarize some of the qualitative and quantitative characteristics of the six ambulance operations in this study. The data shows that the Private Ambulance Operation F has the highest total annual cost of $78,653.08 and the Fire-Ambulance Operation D has the lowest at $13,482.71. The costs per run range between $40.98 - $108.04, with the Fire Ambulance Operation E at the high end and the Independent Volunteer Ambulance Operation B at the low end. The costs per capita range between $.93 - $5.29, with the Fire Ambulance Operation D on the high end and Independent Volunteer Ambulance Operation C on the low end. The costs per mile range between $.99 - $5.36, with the Private Operation at the high end and the Independent Volunteer Ambulance Operation at the low end.

Total Financial Cost: Unlike the bookkeeping records that are kept by many rural ambulance operations, the items of cost which make up the "Total Financial Cost" figures in Table 11 include more than just annual cash outlays. These figures include costs for non-cash flow items such as training of personnel, vehicles, equipment, tires, and office furnishings. Such items are often referred to as capital expenditures or start-up costs.

In order to develop a more accurate statement of what it costs to operate an ambulance operation on an annual basis, these start-up costs have been allocated onto an annual basis. Ideally, these annual allocated costs for the capital or start-up items would reflect the decrease in market value of the item from the previous year. But since real market values or user costs are either difficult or impossible to assess, close approximations are sought via depreciation formulas. Depreciation is an accounting algebra for spreading the cost of an item over the lifetime of that item.

There are many different methods for depreciating an item. The method best suited for this study is a Replacement Fund Concept. If the depreciation schedules are an accurate* reflection of reality, the Replacement Fund should have sufficient funds to handle the periodic capital expenditures that are required to replace depleted or obsolete resources. If an ambulance operation actually sets aside the appropriate* sum of money in the Replacement Fund, and this Fund is wisely invested, the compounded interest earned could possibly take care of the difference between the acquisition and replacement costs of these capital items.

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*The operational definitions of these terms are provided in the subsequent pages as each item is discussed.

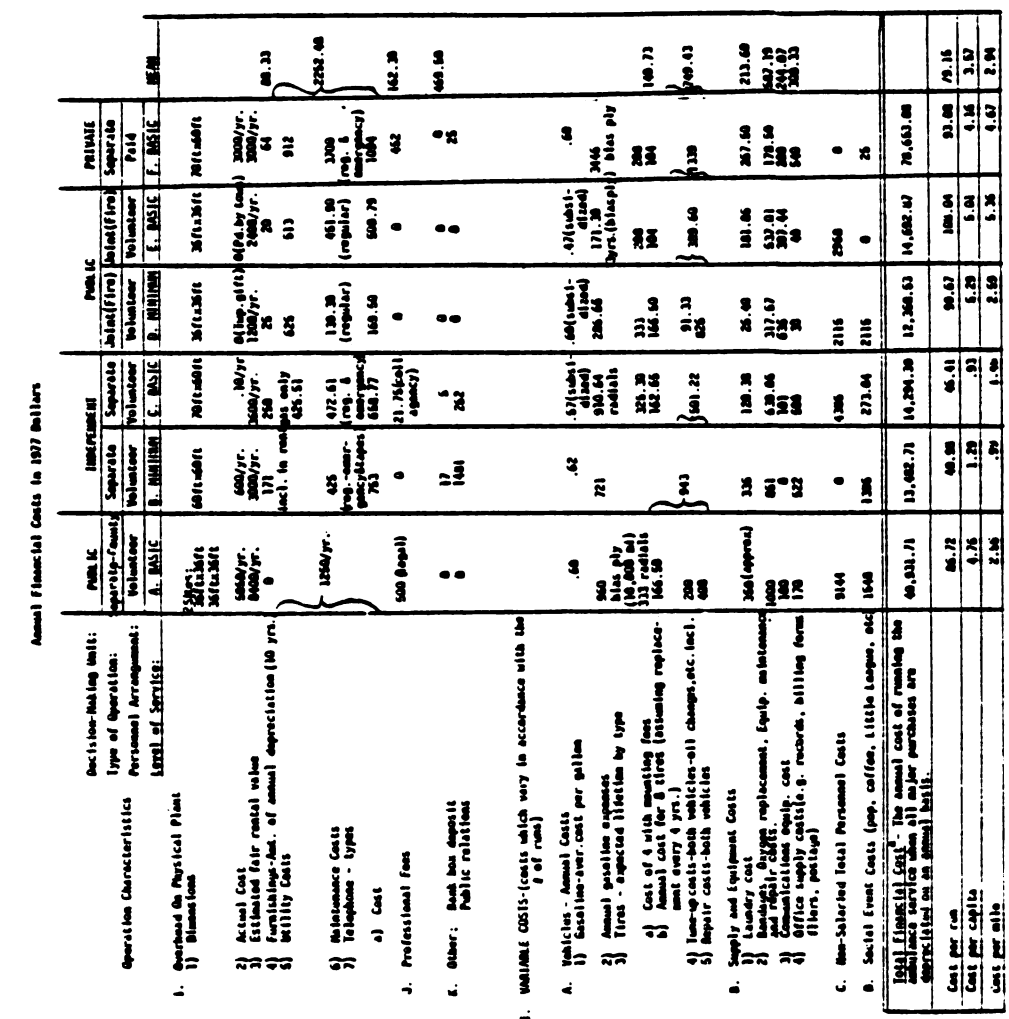
Comparison of Six Ambulance Operations in Rural Michigan During CY 1977

Operation Characteristics	Decision-Making Unit:	PUBLIC	INDEPENDENT		PUBLIC		PRIVATE	
	Type of Operation:	Separate	Separate	Separate	Joint(Fire)	Joint(Fire	Separate	
	Personnel Arrangement:	Volunteer	Volunteer	Volunteer	Volunteer	Volunteer	Paid	
	Level of Service:	A. BASIC	B. MINIMUM	C. BASIC	D. MINIMUM	E. BASIC	F. BASIC	MEAN
I. SERVICE AREA CHARACTERISTICS								
A. Service area square miles		318	102.4	144	36	36	161.7	133
B. Total Population		8593	10449	15420	2338	2934	18923	9776
C. Population Density		27	102	107	65	81.5	117	83.25
D. Total Runs		472	329	308	124	136	845	369
1) Percent Emergency Runs		74	56	58	92	83	26.4	64.9
a) Percent transfers		5	0	0	5	0	17	
b) Percent Vehicular Accident		27	35	16	15	34	71	33
c) Percent other (e.g. home, work)		68	65	84	18	59	9	50.5
2) Percent Non-Emergency Runs		24	42	32	5	0	71	
3) Percent Non-transport Runs		2	2	10	3	17	2.6	
E. Average Response Time 95% of Runs		13	12	12	13	9	7	11
F. Average Notification to Arrival at Hospital Time		30	40	52	40	40	23	
G. Annual Mileage for Both Vehicles		16000	13676	9758	4778	2742	16833	10630
1) For just primary vehicle		9000	11208	6339	3667	2657	11079	
2) For just second vehicle		7000	2468	3419	1111	985	4754	
H. Total Number of Attendants & Drivers		35	52	20	22	26	8	
1) Total number with at least EMT training		35	15	18	0	20	5	
2) Total number who handle bulk of runs		16	25	8	12	15	8	
I. Aver.# & level of training of personnel on run		2 EMT's	2(1 EMT)	2 (1EMT)	3 attendants	3 (1 EMT)	2 (1 EMT)	
J. Type of Communications System		County Sheriff HERN	24 hr. duty, vehicle to hospital	24 hr.duty, HERN	County Sheriff HERN one vehicle	County dis-patch, HERN	24hr. phone, vehicle to Hosp	
K. Age of Primary Vehicle and Types		1974 Van	1974 Van	1972 Van	1971 Carryall	1973 Van	1973 Van	
L. Age of Second Vehicle and Type		1975 Van	1974 Van	1972Carryall	1960 Carryall	1967Carryall	1972 Van	
M. Population and Special Characteristics		Resort area, Pop.growth	Resort area	Farming/ Bedroom Community	Farming/Igt. Industry	Farming/Rt.69	Railroad Tracks	
N. Average Mileage per Run		33	41	31	50	33	20	34.7
O. Population of Town in which Vehicle(s) is Used		900, 1660	2135	2526	900	1280	11020	

Annual Financial Costs in 1977 Dollars

Operation Characteristics	Decision-Making Unit:	PUBLIC	INDEPENDENT		PUBLIC		PRIVATE	
	Type of Operation:	Separate	Separate	Separate	Joint(Fire)	Joint(Fire	Separate	
	Personnel Arrangement:	Volunteer	Volunteer	Volunteer	Volunteer	Volunteer	Paid	MEAN
	Level of Service:	A. BASIC	B. MINIMUM	C. BASIC	D. MINIMUM	E. BASIC	F. BASIC	
II. FIXED COSTS PER YEAR (costs that are not a direct result of frequency of runs)								
A. Primary Vehicle Annual Depreciation		547.21	1227.30	311.11	715.55	497.80	996.25	715.87
B. Second Vehicle Annual Depreciation		1580.20	674.51	622.22	0.00 (Fully depreciated)	336	996.25	701.53
C. Communication Equipment Depreciation(5yr-Toners (10yrs-Other Equip)		1214.50	312.43 (7yr-depre)	582.03	1165	1666.82	410	891.8
D. Other Major Equipment Depreciation		403.30	403.47	493.42	337.50	570.45	404.44	435.43
E. Taxes and Fees on:								
1. Vehicles								
a. Annual motor vehicle registration fee		0 (city exempt)	228	44.10	0 (exempt)	0 (city exempt)	151	
b. Annual Dept. of Public Health licensefee		20	20	20	20	20	20	
2. Personnel Licenses(1.50 yr/person)		39	45	18	6	18	4.50	
3. Property		0	n rental fee	Pd.by Twp.	Pd.by Twp.	Pd.by Twp.	In rental fee	
4. Income taxes - (Federal and State)		0	450	0	0	0	4700.48 (Matching S/S Payroll)	
F. Insurance								
1) Primary Vehicle - coverage		10/30/25 Colli-sion, auto damage	Collision, Property	10/30/25	Comprehensive Collision	10/30/25	10/30/25,Comp Collision, Med Pymts.	
a) Cost		850	595.50	435.21	458	990	307	505.95
2. Second Vehicle - coverage		10/30/25,Colli-sion, auto repair	Collision, Property	10/30/25	Comprehensive Collision	10/30/25	10/30/25,Comp. Collision, Med Pymts.	
b) Cost		850	420.50	435.21	81	245	249	380.12
3. Workman's Compensation		900	605	1115.52	800	747.41	1200	894.66
4. Other-(specify coverage)			Malpractice Base prop-erty	Fire,Hab., base property		Liability, Inland Marine (prop.)		
a) Cost		0	11	130	0	2242.24	0	
G. Salaried Personnel-(specify types)		Manager 10 Attendants 1 Secretary County Clerk			Manager Bookkeeper Janitor	Management Trainers Clerical		
1) Cost		9120	0	0	945	465	53762.16	
2) Cost of physicals		250	0	44	20	90	0	
H. Training Costs								
1) Average yearly cost of training to present proficiency		219	260	336.50	61.22	205.26	105	197.83
2) In-service training-type & costs		3300	25	18.35	180	1014	(part of salary)	

Table 11 (cont.)



The depreciation schedules, described later on in this section, all are based on a straight line method. This was chosen over other methods such as the double declining balance method because it is simpler, yet still serves its function.

The concept of amortization was also examined, but found to be less appropriate than straight line depreciation and the Replacement Fund Concept. The concept of amortization is usually applied to cash payments that are scheduled without regard to physical life or to intangible assets such as patents (Gathmann and Dougall, p. 60-62).

Note, the ambulance services that were studied had not taken out loans to finance their capital expenditures. Therefore, there is no interest charge which they must pay.

Capital items and training costs for an ambulance operation tie-up resources and thus they are a form of investment. A value could be calculated for the opportunity cost of capital by multiplying the investment in capital equipment and training by a shadow price for capital (Gittinger, p. 41-44). It is important to recognize the value of capital. The calculation of this value for each ambulance operation was not undertaken due to the complexity of doing so and the desire not to obfuscate the other costs in this study.

Note that these financial costs are not as high as the economic or total costs which accrue to all individuals and organizations in society. For instance, economic cost accounting would treat as a transfer payment the value of governmental subsidies on the purchase of vehicles, equipment, gasoline, and garage/office space.

Cost per Capita: These figures are derived by dividing the total cost figures by the total population in the corresponding service area.

If total cost is kept low, and the population in the service area is relatively high, then the cost per capita will be relatively low.

These cost per capita figures also should not be interpreted as the actual costs per capita in the corresponding service areas. This study has merely mentioned the financial mechanisms involved, but has not explored the intricacies of alternative revenue-gathering techniques. The actual cost per capita of an ambulance operation is some function of total costs minus the revenues collected from user fees.

Costs per Run: This is another performance indicator that is often used, but used improperly. Economies of scale can result from having more runs per year which will reduce the fixed annual cost component of the cost per run. In general, the operations with more runs per year will have lower costs per run. But the data does not support this generalization for each case study primarily because the runs among the operations are not homogeneous in terms of average miles per run.

Cost per Mile: This is a better performance indicator for ambulance operations than cost per run because it is adjusted for differences in the average miles per run of each operation. Although in general it is reasonable to say that Ambulance Operation B, with a cost per mile of $.99, is better than Operation F with a cost per mile of $4.67, there still remains a problem in comparing the operations because the quality of care among them may differ. The variance in quality of service among the ambulance operations limits the usefulness of all three performance indicators that are used in this study--cost per capita, cost per run, and cost per mile. Just because an ambulance operation has lower costs does not mean it is better than other ambulance operations.

Neither the quality of data in this study concerning these output variables, nor the quality of the methodology permit but the broadest generalizations concerning the effectiveness of service administered by the ambulance operations in this study. For example, the "Average Response Times on 95 Percent of Runs" are data resulting from the opinions of the individual ambulance service managers. These figures should be interpreted in that light. See Appendix II-A for a specific analysis of the figures in Table 10.

Average Notification to Arrival at Hospital Time: This qualitative measure is a function of response time, time at the scene, and time from scene to hospital. The figures in the table give a general feel for quality of care in rural areas, but they are not specific enough to criticize one operation as opposed to another. See Appendix II-B for a specific analysis of these figures in Table 10.

For analytical purposes, items of fixed cost have been separated from items of variable cost. As the size or population of a service area grows, and thus the number of runs per year increases, the average cost per run will decrease.

Vehicle Depreciation: The most significant fixed cost item is vehicle depreciation. It is assumed in this study that an ambulance will be replaced after 15 years use or 75,000 miles, whichever comes first. This is equivalent to saying that a vehicle that gets less than 5,000 miles per year will last 15 years. Those lifespans include the time that the vehicle is used as a back-up to a primary vehicle.

The following formulas are used to determine the annual depreciation of each vehicle: If $\frac{\text{Annual Mileage for both vehicles}}{2}$ is greater than 5,000 miles, use depreciation formula A. If it is less, use

formula B.

A. $$\frac{\text{Initial Cost - Salvage Value}}{75{,}000 \text{ miles} - \frac{\text{Annual Mileage for Both Vehicles}}{2}}$$

B. $$\frac{\text{Initial Cost - Salvage Value}}{15 \text{ years}}$$

Salvage value is calculated as being equal to $\frac{\text{Purchase price of vehicle}}{\text{Life expectancy of vehicle}}$ where the "life expectancy of the vehicle" is equal to $\frac{75{,}000 \text{ miles}}{\text{Average annual mileage both vehicles in operation}}$ with 15 years as the maximum life expectancy on any one emergency vehicle. See Appendix II-C for the calculations behind the figures in Table 11.

Communications Equipment: The variance in annual costs associated with the communications equipment is a function of different institutional arrangements, different qualities of service, and different subsidies. See Appendix II-D for a specific analysis of the figures in Table 11.

Other Major Equipment: The annual depreciated values of "Other Major Equipment" are based on average estimated costs of the supplies and equipment carried on the vehicles. Appendix II-E yields the figure of $3,375.78 for an average complement of equipment and supplies which are carried on the two vehicles to meet DOT specifications. An ambulance usually carries more than the required quantities of supplies, and these figures depict this. Appendix II-F lists extra equipment and their corresponding prices which some of the operations carry. The figures from Appendix II-E and II-F, depreciated over a ten year period, yield the values listed in Table 11.

Better equipment permits potentially better service from an ambulance operation. All of the operations in this study, however, appear to be about equally well-equipped except for extrication equipment.

Taxes and Fees: These are a function of the institutional arrangements and administrative finesse. Government vehicles are exempt from the "annual motor vehicle registration fee." All of the ambulance operations must register their emergency vehicles with the Department of Public Health at a cost of $10 per vehicle in order to have their vehicles licensed to handle emergency patients. Non-profit organizations who file with the state and federal governments are exempt from income taxes. Ambulance Operation B, however, apparently was not aware of this possibility a few years ago. Now that the service is aware of it, they are having trouble getting the I.R.S. to change their status, especially since their revenues have exceeded their expenses for the last three years.

The Ambulance Operations are required by the Department of Public Health to carry liability insurance of no less than $100,000 each person, $300,000 each accident for bodily injury, and $25,000 each accident for property damage. The cost figures vary in this study due to extra policies and different rates which may be a function of past driving records or local rate structures. The data in this study does not permit qualitative comparisons between ambulance operations.

Salaried Personnel: Some people in some ambulance operations are paid a wage or salary regardless of the number of runs which the emergency vehicles go out on. These wages and salaries are part of the fixed annual cost of running an ambulance operation, and they are a

function of the interrelationship between institutional arrangements and personnel arrangements. For example, both Public and Private institutional arrangements usually have salaried staff and generally the pay scale for the personnel in a Public ambulance operation is higher than that for a Private ambulance operation. See Appendix II-G for an explanation of the specific cost figures found in Table 11.

Training Costs: There are two parts to training. The attendants must first receive training to bring them up to the levels of advanced first aid or to Emergency Medical Technician. The total cost of this training to the ambulance operations or to the attendants themselves is a function of essentially the subsidies that are available. The annual cost of this initial training depends on the expected number of years that each attendant will remain with the ambulance operation.

The second part of training costs is "In-Service Training," designed to help attendants maintain their initial training skills. The costs associated with this training generally indicate two things: the degree of voluntary participation within a service, and the degree of concern which an ambulance operation places on providing quality service. Therefore, it is generally possible to say that a service that spends a relatively large sum of money on in-service training is attempting to provide quality care. On the contrary, it is not possible to conclude that a service that does not spend a relatively large sum of money on in-service training is not providing quality care.

See Appendix II-H for the specific calculations behind the figures in Table 11 for "Training Costs."

Overhead on Physical Plant: In rural Michigan, it is necessary for an ambulance operation to at least have a heatable garage large enough

to house their vehicles. The type of institutional arrangement can be very important in terms of who pays for the physical plant. Townships that run fire/ambulance operations or counties that run public operations usually pick up at least part of the rent, maintenance, and utilities. Since government facilities do not pay property tax, rental rates are generally lower.

Costs of an ambulance operation will also increase if the vehicles are not housed in the same location. This is true for Public Operation A in this study.

Ambulance operations that have attendants on duty around the clock usually have office/lounges with sleeping quarters which represent an additional expense, but probably also an improvement in the quality of service. Some ambulance operations believe that having an office/lounge complete with all the comforts of home is very important--especially if the attendants are volunteers. Ambulance lounges that have social amenities such as a color TV and a soft drink machine have the potential of becoming community centers which can assist in increasing local interest in and support of the EMS.

Appendix II-I lists the furnishings found in the office/lounge of Ambulance Operation C and also includes a discussion of how some other cost figures from Table 11 were calculated.

Professional Fees: These fees could include the services of accountants, lawyers, and collection agents. The larger an ambulance operation becomes, the more likely the operation will need such services, and the more likely that such services will not be donated.

Variable Annual Vehicle Costs: Although tires, tune-ups, and communications equipment all have certain aspects of cost-fixity to them,

nevertheless they predominately have the characteristics of variable cost factors for which the cost is a function of the miles which the emergency vehicles travel each year. The more miles a service covers in a year, the more gasoline must be purchased, the sooner tires must be replaced, and the sooner tune-ups must be performed.

Some services have the benefit of subsidized gasoline that is free of state taxes. Services also differ in the types of tires which they use. Steel-belted radials are generally more expensive than bias-ply tires, but both types generally deteriorate after four years and should be replaced. These generalizations are very broad. The lifetime of tires depends on many factors including the type and quality of the tire itself, the terrain over which the tire is used, the weight which thé tire carries, the maintenance the tire receives, and the way in which the emergency vehicle is driven. Since total mileage is relatively low for rural ambulances, the predominate constraint on the tire lifetime is just their age. As tires get old, they gradually rot and split. Replacement every four years appears to be typical in rural areas.

Office Supply Costs: These costs are a function of the following factors:

a) Whether or not a service charges for its calls, and thus must send out billings and keep track of receipts.

b) The number of billings which are in turn a function of the number of calls.

c) Whether or not a service sells subscriptions and has an annual membership drive. This method of partially financing an ambulance service can usually cover the cost of office supplies and postage without much difficulty, allowing the remaining revenue to provide

ready liquidity to the ambulance operation.

Appendix II-J explains the specific office supply costs that are given in Table 11.

Non-Salaried Total Personnel Costs: Some ambulance operations that do not pay their personnel a salary or an hourly wage, pay their personnel on a per run basis. These reimbursement schemes differ both in how they are set up and in their cash values. Appendix II-K describes the mechanisms found in the six systems in this study.

Social Events: The sum of money allocated to this last cost entry can be used in many different ways. For instance, ambulance operations may make donations to the town's Little League, buy coffee or subsidize the price of soft drinks for the office/lounge, or just pay for a series of parties or outings for the operation's volunteers.

These types of activities in large measure seem to be a relatively inexpensive substitute for salaries or at least higher pay scales for the volunteers. If effectively managed, social events can help to increase the interest in EMS (as did the lounge furnishings) and thus indirectly assist in working towards a higher quality of service.

Appendix II-L gives the calculations that went into some of the cost figures for "Social Events" in Table 11.

PART III. ANALYSIS OF THE COSTS ASSOCIATED WITH DIFFERENT LEVELS AND ARRANGEMENTS OF AMBULANCE OPERATIONS IN RURAL AREAS

Ideally, this section would be able to provide a comprehensive assessment of the emergency medical impact of various institutional arrangements. The linkage between alternative development strategies and different outcomes, however, has not been concisely defined. The development of such a production function requires, among other things:

1. High quality primary data on the performance of rural ambulance operations.

2. A methodology for measuring the benefits of EMS and for equating benefits to costs.

Unfortunately, neither of these two exist. Great strides have been made recently in fulfilling this second item, but much work still remains. In terms of the first component, early field visits showed that generally the necessary data does not exist in rural Michigan.

In light of the constraints on developing a comprehensive guideline for policy-formation, this paper will attempt to correctly place at least one piece into the puzzle by developing and then using a methodology for analyzing the costs associated with different levels and arrangements of ambulance operations in rural areas.

A. Comparison of This Study to Other Similar Cost Studies

1. This study is more methodologically rigorous, especially in the sampling procedure and in making explicit all costing procedures.

2. This study developed a methodology for depreciating the emergency vehicles at a rate which approximates the actual valuation over the lifespan of the vehicles to a higher degree of precision than that which is found in similar studies.

3. Although a rate is not specified for the opportunity cost of capital as is done in the Hsu and Doeksen studies, it is mentioned that such a rate should be applied to not only the investment in capital equipment, but also the investment in the training of personnel.

4. This study follows the recommendations for handling joint costs and valuing garage space which was mentioned in the literature and described on pages 15-16 of this study.

5. This study provides an analytic guideline for future cost studies which builds upon others found in the literature, and maintains an ease of workability.

6. The tools of analysis used in this study remained within the limits of sophistication of the raw data.

7. The total cost figures in Table 11 reflect the empirical work in this study. Those in Table 15 are based on budgeting techniques. These figures are within the range of costs for ambulance operations that other studies have found. The cost figures are charted in Table 2.

Note again, however, that these cost figures are not directly comparable due to a number of factors, such as different physical units,

which are listed on page 12 of this study.

8. This study presents a number of budgeting techniques to show the cost effects of certain changes in EMS operations. These techniques are described in the remainder of this section.

B. Cost Implications of Moving to the Basic Level of Service for the Six Ambulance Operations

What are the cost implications of meeting the standards listed on the following page which were recommended* by the Division of E.M.S.? Since this study focuses on the ambulance component of EMS, only those standards which have direct bearing on the costs of ambulance operations are included in the analysis. Table 13 on page 60 summarizes the cost implications of moving from present levels of service to the Basic Level for each of the six ambulance operations in the empirical study. The text below offers an explanation of these standards and their implications.

Standard 3: "Vehicles meet DOT standards. Improved distribution with tentative objective, one vehicle for 8,162 people for rural areas."

Operations A and B have vehicles that meet DOT standards. Other ambulance operations, however, are using "carryalls" which have passenger compartments that are smaller than those required to meet DOT specifications. Thus, Operations C and E will have to replace one vehicle each and Operation D will have to replace two vehicles.

Operation F, the Private ambulance service, has two vehicles that meet DOT specifications, but will have to add another DOT vehicle in order to meet the objective of one vehicle per 8,162 people. This service usually does have a third vehicle, but it is a carryall which does not meet DOT specifications.

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*The standards required by present legislation are less comprehensive than the Division of EMS' recommendations. Costs are attached to the recommendations because they form the basis for possible future legislation and the State desires to know the implications of such a comprehensive package.

Table 12

Initial EMS System Development Measurement Criteria

(Subject to Revision as Required)

Minimal Emergency Response System	Basic Life Support System	Initial Advanced Life Support System
1. A hospital with an emergency department within 30 minutes travel time.	1. A "General" Category hospital within 30 minutes travel time.	1. A "Major" Category hospital within 30 minutes travel time.
2. A maximum of 30 minutes station-to-scene ambulance response time for all calls.	2. Maximum response times: —within 30 minutes for 100% of rural calls —within 10 minutes for 95% of urban calls	2. Same as BLS system, plus average of 5 minutes response time to 95% of all calls for advanced life support.
3. One licensed ambulance vehicle per 10,667 population in rural areas and 1 per 40,000 in urban areas.	3. Vehicles meet DOT standards. Improved distribution with tentative objective 1 vehicle per 8,162 population.	3. Same as BLS vehicle standards. Improved distribution with tentative objective of one vehicle per 5,657 population mean for ALS systems.
4. One vehicle per 707 square miles for urban areas and 1 per 1,964 square miles for rural areas.	4. One vehicle per 79 square miles for urban areas and 1 per 1,964 square miles for rural areas.	4. Same as basic, plus 1 ALS-staffed vehicle per 20 square miles in advanced service areas.
5. - - -	5. - - -	5. At least 1 mobile intensive care unit available.
6. Six licensed ambulance personnel per vehicle for full-time paid services; 9 personnel per vehicle for volunteer services.	6. Nine licensed ambulance personnel per vehicle for full-time paid services; 17 personnel per vehicle for volunteer services.	6. Same as basic.
7. Two attendants on a rig, both with at least Advanced Red Cross training.	7. Two attendants on a rig, 1 with at least basic EMT training and the other with at least Red Cross Advanced First Aid and Emergency Care training. Development should proceed toward the objective of 2 basic EMT's per rig.	7. Same as BLS; plus, for advanced units, 2 attendants on a rig, 1 with advanced EMT training and the other with at least basic EMT training. Development should proceed toward 2 advanced EMT's per rig.
8. A basic EMT training program within 1 hour driving time (approximately 40 miles).	8. A basic EMT training program within the county.	8. An advanced EMT continuing education program within the county. A full advanced EMT training program is desired.
9. All vehicles have vehicle-to-hospital 2-way radio communications.	9. All vehicles radio-dispatched and having vehicle-to-hospital 2-way radio communication on HERN or designated UHF frequencies.	9. Same as basic, plus UHF with telemetry for ALS rigs.
10. An intensive care unit (ICU) within 30 minutes travel time.	10. An ICU and a cardiac care unit within 30 minutes travel time.	10. The following types of critical care units within 30 minutes travel time: —multiple trauma unit —cardiac care unit —perinatal unit —burn unit —access to a poison control center
11. State-recommended standard records and forms used.	11. Same	11. Same
12. Participation in state evaluation program.	12. Same	12. Same
	13. Utilizes written mutual aid agreements.	13. Same
	14. Utilizes written transfer agreements.	14. Same
	15. The area keeps records of and reports annually all patient transfers in and out.	15. Same
	16. The area educates the public on emergency access.	16. The area educates the public on emergency access and provides consumer information and training in early symptom detection for coronaries, CPR, and basic First Aid.
	17. All public safety personnel trained at least in Advanced First Aid with CPR.	17. All public safety personnel trained in Advanced First Aid with CPR, or Crash Injury Management with CPR.
	18. The county has a written disaster plan and conducts drills at least annually.	18. Same
	19. Consumer participation in EMS planning and policy-making.	19. Same
	20. Written confirmation of accessibility to care.	20. Same
	21. Central dispatch.	21. Same
	22. Central access to EMS system.	22. Same
	23. Central resource coordination.	23. Same
	24. All facilities categorized vertically and horizontally.	24. Same
	25. Rescue and extrication capabilities.	25. Same
ADDITIONAL ELEMENTS DESIRED FOR MINIMAL SYSTEM: 1. Use of written mutual aid agreements. 2. Use of written transfer agreements.	3. Written disaster plan and annual drills. 4. Public safety personnel trained in basic First Aid. 5. Consumer participation in EMS planning and policy-making.	6. Written confirmation of accessibility to care. 7. Facility categorization. 8. Rescue and extrication capabilities.

From: The Michigan Plan for EMS 1976 and the Future, pp. 121-2.

Annual Cost Implications of Moving from Present Levels of Service to the Basic Level of Service for the Six Ambulance Operations Studied

1977 Dollars Per Year

Ambulance Operation:	A. Public (County)	B. Independent Volunteer	C. Independent Volunteer	D. Fire	E. Fire	F. Private Paid
Standards						
3: Vehicles	0	0	1,431.11	2,862.22	1,431.11	2,291.41
6: Personnel	0	0	713.00	0	407.43	509.28
7: Levels of Training	0	57.14	0	845.71	0	527.14
9: Communications Equipment	0	400.00	0	200.00	0	600.00
21-23: Central Dispatch, Access, and Coordination	0	1,447.00	1,447.00	0	0	1,447.00
25: Rescue and Extrication Capabilities	106.19	106.19	106.19	106.19	106.19	106.19
TOTALS	106.19	2,010.33	3,697.30	4,014.12	1,944.73	5,481.02
Percent Increase in Present Annual Expenses to Meet these Standards.	.3	15	26	32.5	13	7

Table 13

Operation F has decided that the nature of their demand is such that only two vehicles are required, so the third vehicle sits up on blocks and is used for spare parts. This particular ambulance operation might be an excellent service to examine more closely in terms of the validity of the vehicle per square mile objective. Further study of the characteristics of the demand in Operation F's service area may reveal important factors which bear on the availability and response times of vehicles.

The costs listed in Table 13 for Standard 3 are the yearly depreciated values of a new van-type emergency medical vehicle that costs $23,000 fully equipped and whose salvage value is 15% of this purchase price. Appendix III-A provides a rough breakdown of the costs associated with a new fully DOT-equipped van and a fully DOT-equipped modular vehicle.

Standard 6: "Nine licensed ambulance personnel per vehicle for full-time paid services; 17 personnel per vehicle for volunteer services."

In order to meet this standard, four of the six operations in the case study would have to increase their staffs. The cost of this increase would consist mainly of "Initial" and the "In-Service Training" of personnel. Appendix III-B discusses the costs of these training programs and how the figures in Table 13 were calculated.

Standard 7: "Two attendants on a rig, one with at least basic EMT training and the other with at least Red Cross Advanced First Aid and Emergency Care training. Development should proceed toward the objective of two basic EMTs per rig."

Standard 7 does not specify what percentage of an entire ambulance crew must have at least basic EMT training. Therefore, it was not possible to attach a cost per ambulance operation that would be universally applicable. Appendix III-C describes the budgeting technique which was used to calculate the corresponding figures in Table 13.

Note that the costs figures include only the financial costs of the training program itself. No opportunity cost is attributed to the time which an ambulance attendant must spend in the training program, in transit to and from the program, and studying the course materials. The reimbursement mechanisms and personnel arrangements necessary to attract and keep ambulance drivers and attendants may be greatly influenced by this opportunity of labor.

It is hypothesized that as higher and higher training levels are mandated, the value attached to ambulance work by volunteers will change. Ambulance operations will face higher and higher rates of reimbursement which will be necessary to attract and keep ambulance drivers and attendants. The graphical presentation below illustrates a possible relationship between hours of training per attendant and the costs of personnel for an ambulance operation.* This graph shows that attendants will volunteer their time without remuneration up to a certain level of required training. The linear relationship is shown as discontinuous because it is hypothesized that beyond a certain point, attendants will no longer volunteer their time at some nominal rate of remuneration. Rather, they will require a salary or wage which is high enough to constitute a primary source of income.

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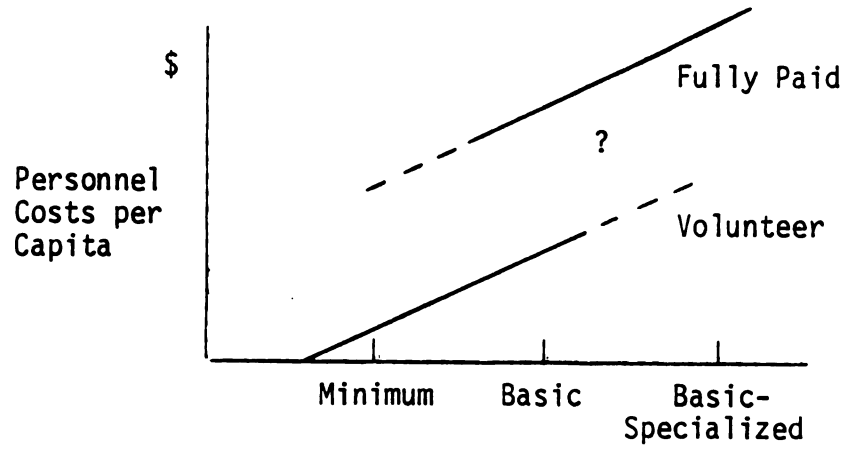
*Credit is owed to Dr. Stevens for the initial graphical conceptualization of this hypothesis.

Figure 14

Personnel Costs as a Function of Hours of Training



The exact nature of the relationship between training requirements and personnel costs is not empirically known. But an understanding of the possible forms it may take is important due to the direct relationship between personnel arrangements and institutional arrangements. The implication of this hypothesis is that higher standards might force rural communities to pay the ambulance personnel on a full-time basis, and that perhaps the future financial viability of certain institutional arrangements depends on the level of training mandated.

Standard 9: "All vehicles radio-dispatched and having vehicle-to-hospital 2-way radio communication on HERN or designated VHF frequencies."

Many emergency vehicles in Michigan have vehicle-to-hospital 2-way radio communcation capabilities. The HERN (hospital emergency radio network) requires specific frequencies, minimum output power, and the use of a digital dial encoder. Some systems that do not meet the frequency specifications can just replace the crystals in their radios at

a cost of about $200 each. This presupposes that all other standards are met and that the radio permits interchanging crystals. A digital dialer costs $200-$300.

Many services, however, will use the occasion of a frequency change to replace and update their radios at a cost of $200-$1400 per vehicle. They might also add a channel scanner for about $500. Appendix III-D gives the breakdown of the costs in the chart for Standard 9.

Standards 21, 22, and 23: "Central access to EMS. Central dispatch. Central resource coordination."

The definitions and implications of these three standards are given in Appendix III-E.

The economic costs of complying with these standards may be of secondary importance to political considerations, but they are not insignificant. There are three main components of cost attached to meeting this standard for centralized coordination. First, each ambulance service must lease from the telephone company their line into central access. These lines cost about $20 per month ($240 per year) each, including both fixed and variable charges. Second, the remote control console base station encoder, remote control base station, antenna, and tower, depreciated over ten years, cost annually between $850-$1,025. Third, one person to man the phones will cost 4 people x $2.65 x 42 hours x 52 weeks = $23,150.40 per year. If we assume that emergency calls referred to Ambulance Operation X constitute 5 percent of the central dispatch/access/resource coordinator's time, then the annual cost allocation to Ambulance Operation X is $240 + .05 ($1,000 + $23,150.40) = $1,447.52. This figure is in keeping with the $1,200 assessed to Ambulance Operation E in the empirical study.

Standard 25: "Rescue and Extrication Capabilities."

Many ambulance operations in rural areas carry a few pieces of extrication equipment such as crow-bars, window punches and screw-drivers. For major difficulties which an ambulance operation may confront, they often rely on local fire departments. This is certainly not a problem when fire and ambulance are combined operations. Other ambulance operations, however, may find it useful to possess, if not carry, the rescue-extrication equipment recommended by the Division of EMS (see list in Appendix III-F). In 1978, list price of this equipment is $1,592.80. This cost per year per ambulance service is $106.19 when the equipment is depreciated over 15 years.

To summarize the conclusions of this section, the reader is referred back to the chart on page 60. The chart shows that for the six ambulance operations in the empirical study, there is a range in cost from $106.19 to $5,481.02 for operation annually to meet the State's recommendations for the basic level of service. For some of the ambulance operations, there should be only minimal economic problems in meeting the higher standards. But for other services, the higher standards pose the real difficulty of increasing their annual expenses by up to 32.5 percent.

It should also be remembered that no costs were associated with the time which each attendant must devote to training. If the attendants in rural areas are adamantly opposed to the higher level of training that is required of them, then the cost that could be attributed to their time would be substantial.

This section also recommended that the necessity for and the intended benefits to be derived from two of the standards should be

reevaluated. Those standards were the vehicle to population ratio and the central coordination.

C. The Cost Implications of Moving from the Basic Level of Service to the Basic-Specialized Level of Service

This level of service has not yet been formally approved by the State. The Basic-Specialized level of service does not require additional equipment, it only requires a higher level of training of the personnel. The level of skills that EMT-Specialized personnel will be able to perform will include both the placement of esophageal airways and the placement of intravenous fluids.

No curriculum has been established yet, but it is assumed that the EMT-Specialized course will entail approximately 80 hours of class time beyond that of EMT-Basic training. This training would probably cost the student $50-$100. If we assume 7 years of service with this additional training, the added cost would be $\frac{34 \text{ attendants} \times \$75}{7} =$ $364.29 per year, assuming that the ambulance operation has 34 attendants, all of whom would be trained.

Again, the cost or benefit attributable to the time which the attendants must spend on the training has been omitted since it is so variable, being really a function of the attitudes of the attendants themselves. Any evaluation of the cost implications of moving from one level of service to another must take this factor into consideration.

D. The Cost Implications of Cutting Back from Two Emergency Vehicles to One

Many studies which seek to find the best use of EMS resources conclude that the costs per unit of service rendered could be substantially decreased without a proportional loss in the quality of service simply by expanding the population base in the service area (see the studies by Briese, Manz, Hsu, Waller, NCC EMS). Although this may be sound economic advice, it is usually made without due consideration to the political factors which define the present service areas. Changing the service area of an ambulance operation usually involves changing jurisdictional boundaries and this is oftentimes the least tenable change that an ambulance operation could possibly make.

Discussed in this section is a change which is thought to be more reasonable for an ambulance service to make in an effort to lower its costs without appreciably decreasing its level of service. If the contention presented in the literature that one vehicle is sufficient to handle a population of up to 40,000 people is accepted, and if the service areas of the six ambulance operations in the empirical study fall within this parameter, then it can be argued that room exists for the ambulance operations to cut costs.

This section will examine the aforementioned contention. It will establish a procedure for calculating the costs associated with operating a second vehicle. This section will also employ this costing procedure, calculate costs for each system, and discuss briefly the implications of cutting back to one vehicle from two vehicles on the performance on ambulance operations.

The studies which suggest that one emergency vehicle should be

sufficient to handle a population of up to 40,000 people do not adequately define "sufficient" (NCC EMS, p. 4). A maximum response time should be specified as well as a minimum population density figure for this generalization. This generalization is based, however, on the low statistical probability that more than one emergency need would occur at the same time in low volume service areas where there is an average of less than four calls in a given 24 hour day. In a service area of 40,000 people, one emergency call per day can be expected (NCC EMS, p. 4).

The six ambulance operations examined in the empirical study have population in their service areas ranging from 2,338 to 18,933. Thus, all of these ambulance operations fall within the parameters for one-vehicle ambulance operations that are defined in the literature. The costs for each of the six ambulance operations associated with operating the second vehicle are represented in Table 15.

The potential annual cost savings of dropping from two vehicles to one is a function of five variables that are listed in Table 15. The savings for our sample of six ambulance operations ranges from $710-$1,986 with an average savings of $1,651. The range in savings appears to be due primarily to the range in depreciation which is a reflection of vehicles that differ in age and cost. As a percentage of the total ambulance operation cost, the average cost savings is eight percent. The significance of this sum is a function of the benefits that will have to be foregone.

From the questionnaires that were administered to the limited sample of ambulance operations, the following information was obtained:

1. Only three of the six ambulance operations accept non-emergency transfer calls.

Table 15

Estimated Cost Savings Associated with Dropping from Two Vehicles to One for the Six Ambulance Operations Studied--

Annual Costs Associated with Operating the Second Vehicle in 1977 Dollars

	A.	B.	C.	D.	E.	F.	MEAN
Depreciation of Second Vehicle	1,580.20	674.51	622.22	0	366.00	997.25	
Depreciation of Vehicular Communi-cations Equipment	150.00	73.40	150.00	87.50	(donated) 0	(estimate) 80.00	
Depreciation of Other Vehicluar Equipment	100.00	75.00	75.00	51.00	51.00	75.00	
Vehicular Taxes and Fees	10.00	(estimate) 110.00	30.00	10.00	10.00	85.00	
Insurance	850.00	420.00	435.21	81.00	245.00	249.00	
Tires, Tune-ups and Repairs (estimate)	280.00	400.00	280.00	480.00	230.00	500.00	
Total Annual Cost of Second Vehicle	2,970.20	1,753.16	1,582.43	709.50	892.00	1,986.25	1,650.59
Second Vehicle Costs as Percentage of Total Annual Cost	7%	13%	9%	5%	9%	3%	8%

2. Down-time for the primary vehicle was anywhere from nine hours to four days per year.

3. The simultaneous use of both vehicles is rare. This simultaneous useage is greater for the Private operation since it handled a higher call load.

4. In the two Fire operations, the second vehicle served a function in addition to that of emergency ambulance. The vehicle accompanied all fire runs, if personnel were sufficient, and was there just in case a fireman or someone else needed it.

Otherwise, the second vehicle has the following functions:

a) Handled non-emergency transfers.

b) Goes out with primary vehicle when there are multiple injuries, such as a bad highway accident.

c) Covers for primary vehicle when it is being serviced or repaired.

d) Goes out when primary vehicle is already out.

e) Covers town social events where an accident might occur (e.g., Little League, football games, etc.)

All six ambulance operations defend having a second vehicle. Two of the three operations that handle non-emergency transfers claim that they would have to give up this activity if a vehicle is to always be ready for an emergency run. These two are the Independent Volunteer operations who find it not worth their donated time to assist on anything but a true emergency run.

The Public Operation in this sample is unique in that it has two

emergency vehicles based in different locations. If one of these vehicles were dropped, the vehicle in the other location would have to handle those runs. The response times for those runs would be much poorer due to the greater distances that must now be covered.

The Private Paid Operation, unable to handle all 845 runs per year, would possibly experience a loss in revenue. Some of these runs the local rescue squad would then cover, but no one would probably cover the non-emergency transfers. With high fixed costs, the decrease in runs per year would result in the increase in cost per run rather than the decrease in cost per run.

It has been argued that during those rare instances when a second vehicle is needed, mutual aid agreements with neighboring ambulance operations could adequately cover what was previously handled by the second vehicle. If a neighboring operation has also cut back to one vehicle under the aforementioned assumption, each ambulance operation might be reluctant to have their sole vehicle leave their area. The need for central coordination in any process which cuts back the number of vehicles is readily apparent.

The data in this study is inadequate to do more than just point out that a trade-off exists between the benefits and costs of a back-up vehicle. Better data concerning response times and incidence of accidents will have to be coupled with spatial and optimal location models. These models may have implications as to how the DOT should conduct its program of matching grants for the purchase of new vehicles and equipment.

Presently the DOT requires that services retain their old vehicle as a back-up if the ambulance service is to receive matching funds for

a new vehicle. These rules were probably designed to add to the rolling stock of emergency vehicles in rural areas. It is left to another study of response times and service areas to determine whether the benefits of these extra vehicles exceed the costs of maintaining them. This comment is pursued further on page 98 of the summary and conclusions.

E. The Effect of Different Institutional/Personnel Arrangements on the Costs of Ambulance Operations

The introduction to Part II. D. is equally applicable to this section. The interaction of many different factors is responsible for the differences in costs of the ambulance operations described in Part II. But changing some as opposed to others is both politically and economically more tenable.

A cost factor that is thought to fall in this latter category is the institutional and personnel arrangement of the ambulance service. These two distinct concepts (see the definitions on page 23) are linked together for the following reasons:

1. First and foremost, high quality data was not available which would have permitted or justified holding the personnel arrangement constant while various institutional arrangements were compared.

2. Second, institutional arrangements usually imply certain types of personnel arrangement. (The data, however, was not available to draw conclusions with greater statistical support.) An independent ambulance operation often has voluntary personnel who receive but a nominal remuneration. Public ambulance operations that are either single and joint function also employ volunteers, but these volunteers receive a higher level of remuneration, and private ambulance operations tend to employ full-time paid personnel.

An explanation for these implied linkages between institutional and personnel arrangements may be based on the motivations of individuals.

Persons do work for less with an organization that has decision-makers who also work at low levels of remuneration. Perhaps paid professionals prefer working with paid professionals in order to maintain a certain level of prestige.

In order to facilitate comparison of alternative institutional/personnel arrangements of ambulance operations, a "Typical Service Area for Two-Vehicle Ambulance Operations" will be defined and used. This "Typical Operation" fixes certain variables such as the number of runs per year, and the distribution and density of population in the service area. In the empirical study, the number of runs per year ranges from 82 to 845 and this variation is reflected directly in the variable cost of operating the ambulance services. Since the aforementioned variables have implications for average mileage and cost per run, they must be standardized.

The characteristics chosen for the "Typical Service Area for Two-Vehicle Systems" are an average or composite of those of the six ambulance operations in the empirical study. These characteristics are:

a) Population density: 83.25

b) Total population: 9,776

c) Square miles in Service Area: 133

d) Annual mileage for both vehicles: 10,630

e) Vehicles get 10 miles per gallon

f) Tires cost $564 and last four years

g) 369 runs per year

These characteristics, along with other cost factors that were found to be typical of the empirical studies, were used to calculate the "Constant Costs Among Arrangements" in Table 16 on the next page. This

Table 16

Comparison of Annual Costs Associated with Different Institutional/Personnel Arrangements for Ambulance Operations with Two Vehicles Having Controlled for Other Variables[a]

Decision-Making Unit:	PUBLIC			INDEPENDENT		PRIVATE
Type of Operation:	Separate	Joint(Fire)	Joint(Fire)	Separate	Separate	Separate
Personnel Arrangement:	Volunteer	Volunteer	Volunteer	Volunteer	Volunteer	Paid
Level of Service:	BASIC	MINIMUM	BASIC	MINIMUM	BASIC	BASIC
Operation Characteristics						
I. CONSTANT COSTS AMONG ARRANGEMENTS						
A. Variable Cost Elements						
1) Gasoline	638.00	638.00	638.00	638.00	638.00	638.00
2) Tires	141.00	141.00	141.00	141.00	141.00	141.00
3) Tune-up and Repairs	750.00	750.00	750.00	750.00	750.00	750.00
4) Laundry, Medical Supplies, and Equipment Maintenance	1,070.00	1,070.00	1,070.00	1,070.00	1,070.00	1,070.00
B. Fixed Costed Elements						
1) Depreciation of Second Vehicle	702.00	702.00	702.00	702.00	702.00	702.00
2) Depreciation of Communications and Other Major Equipment	1,024.00	1,024.00	1,024.00	1,024.00	1,024.00	1,024.00
3) Insurance on both Vehicles, DPH License	1,225.00	1,225.00	1,225.00	1,225.00	1,225.00	1,225.00
4) Maintenance, Telephones	2,000.00	2,000.00	2,000.00	2,000.00	2,000.00	2,000.00
5) Social Events	1,500.00	1,500.00	1,500.00	1,500.00	1,500.00	1,500.00
SUBTOTAL	9,050.00	9,050.00	9,050.00	9,050.00	9,050.00	9,050.00
II. VARIABLE COSTS AMONG ARRANGEMENTS						
1) Number of Drivers and Attendants	34	24	34	24	34	18
2) Personnel Licenses = f(# personnel)	51.00	36.00	51.00	36.00	51.00	24.00
3) Personnel Salaries, Training, and Physicals	6,593.00	1,625.00	2,093.00	463.00	655.00	53,303.00
4) Non-Salaried Personnel Costs	11,070.30	8,302.50	13,284.00	0	5,535.00	0
5) Workmen's Compensation	900.00	900.00	900.00	600.00	800.00	1,200.00
6) Depreciation of Primary Vehicles	526.75	526.75	526.75	526.75	526.75	1,054.30
7) State Motor Vehicle Registration	0	0	0	140.00	140.00	140.00
8) Rent and Property Tax	3,000.00	0	0	600.00	0	3,000.00
9) Income Taxes, Federal and State	0	0	0	0	0	4,700.00
10) Depreciation on Furnishings	0	20.00	20.00	200.00	200.00	200.00
11) Office Supplies and Public Relations	150.00	150.00	150.00	1,550.00	1,550.00	150.00
SUBTOTAL	22,290.75	11,560.25	17,024.75	4,115.75	9,457.75	63,771.30
TOTAL COST PER YEAR[b]	31,340.75	20,610.25	26,074.75	13,165.75	18,507.75	72,821.30
Cost Per Run	84.93	55.85	70.66	35.68	50.16	197.35
Cost Per Capita	3.21	2.11	2.67	1.35	1.89	7.45
Cost Per Mile	2.95	1.94	2.45	1.24	1.74	6.85

[a]These EMS system arrangements are based upon a total population of 9,776, a population density of 83.25, and annual mileage for both vehicles of 10,630. Other characteristics are described in the text.

[b]These total costs exclude the opportunity cost of capital.

table, as its title implies, controls for other variables so that the annual costs associated with different institutional and personnel arrangements can be compared without confusion being introduced by the other variables.

A problem associated with controlling for these other variables is that some of the influence of the institutional arrangements may be lost. For example, is it a fair assumption that volunteers with a sense of community and public service takes better care of vehicles and equipment than would fully paid managers--thus affecting replacement and maintenance costs? Such questions are the subject area for future research.*

Note also that the figures presented in Table 16 indicate the range of financial burden which ambulance operations place on rural areas. On a state-wide basis, this burden may be more acute in those areas that are more rural than those examined in this study.

There is one other simplifying assumption of Table 16 that should be specified. The Public Separate Ambulance Operation described in this section has both of its vehicles stationed at the same location, unlike the operation described in the empirical study.

Table 17, a "Comparison of Institutional Arrangements by Percentage of Cost Allocated to Different Budgetary Items," facilitates the comparison of the relative importance of different budgetary items among the institutional arrangements.

The number of drivers and attendants affiliated with each ambulance operation is also standardized to fit the standardized service area.

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*This paragraph resulted directly from discussions with Dr. Allan Schmid.

Comparison of Institutional/Personnel Arrangements by Percentage of Cost Allocated to Different Budgetary Items

Decision-Making Unit:	PUBLIC			INDEPENDENT		PRIVATE	
Type of Operation:	Separate	Joint(Fire)	Joint(Fire)	Separate	Separate	Separate	
Personnel Arrangement:	Volunteer	Volunteer	Volunteer	Volunteer	Volunteer	Paid	Mean
Level of Service:	BASIC	MINIMUM	BASIC	MINIMUM	BASIC	BASIC	
A. Depreciation on both Vehicles	3.9	6.0	4.7	9.3	6.6	2.4	5.5
B. Operating Expenses on both Vehicles	4.9	7.4	5.9	11.6	8.3	2.1	6.7
C. Laundry, Medical Supplies, Equipment Maintenance	3.4	5.2	4.1	8.1	5.8	1.5	4.7
D. Total Personnel Costs	59.4	52.7	62.6	8.3	38.0	74.9	49.3
E. Depreciation on Communication and Other Major Equipment	3.3	5.0	3.9	7.8	5.5	1.4	4.5
F. Insurance and Department of Public Health License, State Vehicle Registration	3.9	5.9	4.7	10.4	7.4	1.9	5.7
G. Utilities, Garage Maintenance, Telephones	6.4	9.7	7.7	15.2	10.8	2.7	8.75
H. Rent and Property Tax	9.6	0	0	4.5	0	4.1	3.0
I. Income Taxes, Federal and State	0	0	0	0	0	6.5	1.1
J. Office Supplies, Depreciation on Furnishings	0.5	0.8	0.7	13.3	9.4	0.5	4.2
K. Social Events	4.8	7.3	5.8	11.4	8.1	2.1	6.6
TOTAL	100.1	100.0	100.1	99.9	99.9	100.1	100

Table 17

For ambulance operations at the Basic level of service, it is recommended that per vehicle there be 17 volunteer attendants or 9 full-time attendants. This recommendation is reflected in the number of personnel assumed to be working in the "Basic" operations in the Table on page 76. The ambulance operations at the Minimum level were assumed to have 24 volunteer attendants.

The cost of personnel licenses is directly related to the number of personnel per ambulance operation. The Department of Public Health charges $3 per two years per attendant for licensure which is equivalent annually to $1.50 per attendant.

In addition to drivers and attendants, ambulance operations often have other people perform the tasks of management, clerical work, and dispatch. The number of total personnel in an ambulance operation is a function of the level of service, the institutional arrangement, and the personnel arrangement. For example, the number of volunteer attendants in a Basic level ambulance operation may vary according to a human factor such as the interest level or availability of volunteers within a given community.

Note the distinction between "personnel arrangement" and "institutional arrangement." The latter refers to the decision-making mechanism, whereas the former refers to the staffing patterns and remuneration mechanisms. These two notions are distinct. Independent services may have paid staff, and private organizations may utilize volunteers. In fact, it can generally be said that, given the fee structure existing in 1977, a rural ambulance operation cannot survive without the assistance of some volunteers. This is also true for most private, fully paid ambulance services in rural areas.

Personnel arrangements vary in terms of number of staff, methods of payments, and pay scales. The two major methods of payments are: a) hourly or yearly salaries; b) wages on a per run basis.

There is no a priori reason why the method of remuneration (e.g., annual salary or wage per run) will determine which personnel arrangement is more costly on an annual basis. It can be hypothesized, however, that service areas with low levels of demand could minimize costs, ceteris paribus, by reimbursing personnel on a per run basis, and that service areas with high levels of demand could minimize cost, ceteris paribus, by reimbursing personnel with an hourly wage or an annual salary.

Stated another way, the type of payment method which promotes the lowest cost per mile is a function of the number of miles the ambulance vehicles travel each year. This is true because ambulance operations with higher levels of fixed cost experience greater economies of size than those with lower levels of fixed costs.

Although personnel and institutional arrangements are distinct concepts, there are generally some connections between institutional and personnel arrangements. In a private service, there is usually a low level of volunteerism since the personnel are often either salaried or paid an hourly wage. The paid ambulance operation with a low degree of volunteerism in the Table on page 76 reflects this generalization. Independent ambulance operations are not only directed and governed by volunteers, but they are also administered and managed by volunteers. Public ambulance operations that are either single or joint function usually have both types of personnel arrangements. Attendants and drivers who go out on runs are usually reimbursed to some extent on a

per run basis. Administrative and clerical staff, however, are often reimbursed on the basis of either an annual salary or an hourly wage.

The costs associated with Personnel Salaries, Training, and Physicals are based on data and assumptions that are presented in Appendix III-F. There are cost differences among the ambulance operations with respect to initial training and physicals due to the level of service and the institutional arrangements. But these cost differences are insignificant.* What is significant, however, is the cost of personnel salaries. The Independent operations do not pay people to handle the chores of scheduling personnel, billing clients, replacement of supplies, or maintenance of equipment. The Public and Private operations pay for management and clerical assistance. The Private operation with a low degree of volunteerism pays its drivers and attendants a salary or an hourly wage which brings the annual cost of salaries up to $53,303.

With ambulance operations, Non-Salaried Personnel Costs are usually a function of the number of runs per year and the personnel arrangements of the different institutional arrangements--e.g., the number of people on each run, and the pay scale per person per run. Since the number of runs per year is the same for all of the ambulance operations in the Table on page 76 the cost figures represent direct comparisons of the personnel arrangements. See Appendix III-H for the derivation of these cost figures.

The cost of Workman's Compensation is calculated on the basis of the size of the payroll multiplied by a risk factor. The figures in the chart are rough approximations.

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*Remember that these costs would be higher if an opportunity cost was attached to the time that an attendant spends in training and skill maintenance. This value could vary from individual to individual.

The amount attributed to annual Depreciation on the Primary Vehicle is a function of DOT matching grants. DOT matching grants for the purpose of purchasing new emergency vehicles and equipment are still available to those services that are affiliated with public administrations. Thus, the Private Fully Paid Operation is excluded from matching grants. Independent Volunteer operations can meet this criteria if they set up their charters under the purveyorship of a governmental organization such as a township committee. The formulas used to calculate the annual depreciation are listed below:

$$\text{With DOT funding: } \frac{\$8{,}000 - \frac{\$8{,}000}{14.1}}{75{,}000 \text{ mi.} + \frac{10{,}630 \text{ mi.}}{2}} = \$526.75$$

$$\text{Without DOT: } \frac{\$16{,}000 - \frac{\$16{,}000}{14.1}}{14.1} = \$1{,}054.30$$

The explanation of these formulas is found in Part II, Section B, under "Vehicle Depreciation."

State Motor Vehicle Registration fees are not levied on vehicles of governmental organizations. Thus, Public operations are subsidized in this manner.

Rent and Property Tax are partially a function of the institutional arrangement. Governmental property is tax-free. Some ambulance operations, such as fire, are often able to share existing governmental quarters. This can be construed as a subsidy to the ambulance service. Note that Minimum level Independent operation's rent is only partially subsidized.

Private paid operations must pay Federal Income Tax and Social Security Tax.

Furnishing Costs reflect certain comforts that the ambulance base maintains. Furnishings are important as an indirect means to increase the quality of a service. Quality of a service can be improved by having a garage/office/club house that is nice enough that people will spend the day and the night on the premises. Response times will be decreased as a result. Those services that have sleeping facilities are assumed to spend $200 per year on furnishings and repairs of their garage/lounge. The two fire operations at least have a meeting room for weekend training discussions which costs about $20 per year to furnish.

The cost of Office Supplies and Public Relations is primarily a function of the financial arrangement which funds the ambulance operations. The two Independent operations solicit subscriptions to gain liquidity. The annual public relations for this activity is budgeted at $1,400 for each operation.

The cost of office supplies is based on the data in the empirical study. These costs, however, must be adjusted because the number of billings sent out is a function of the total number of runs per year. The equation used in this adjustment process is found in Appendix III-I. The adjusted figure yields an annual cost of about $150 per operation for Office Supplies.

The costs associated with Social Events differ greatly in the empirical study (see the Table on page 76). They range from $2,715 to zero. It is argued that a slush fund for coffee, soft drinks, parties, and community donations is an important means of creating public support, higher morale amongst the attendants, and therefore a higher quality service. Since this appears to be a function of individual

initiative rather than the institutional or personnel arrangement, the cost for social events is pegged at $1,500 per year for all of the ambulance operations.

Given the assumptions made concerning each type of ambulance operation, the data in the Table on page 76 yield the following conclusions:

1) Institutional arrangements often imply a certain type of personnel arrangement.

2) Both of the Independent Volunteer Ambulance operations are less costly in terms of total cost per year, cost per run, cost per mile, and cost per capita, than any of the other ambulance arrangements. There are essentially two reasons for this.

First, the wages paid to handle the chores of scheduling personnel, bookkeeping and billing, replacement of supplies, or maintenance of equipment are either low or zero in the Independent operations. The other ambulance operations pay their salaried personnel at a higher rate to handle these functions.

Second, the wages paid to non-salaried personnel by the Independent Ambulance operations are also generally less than those of other ambulance operations. The hypothesis is that personnel with an independent volunteer operation have a greater sense of volunteerism than those among the other operations and are willing to accept a lower rate of reimbursement.

3) The Public Separate Function Ambualnce Operation is more costly than the Public Joint Function Ambulance Operation which has essentially the same level of service. If the annual building rent of $3,000 is deleted, then the difference between the two operations is just $2,266, which is due to the higher rate of pay

commanded by the bookkeepers and secretaries in the county clerk's office. These arrangements are described in Appendices III-B and III-C.

4) The Private Paid Ambulance Operation at the Basic level of service is the most expensive institutional and personnel arrangement in terms of cost per run, cost per mile, and cost per capita. This operation is about 5.5 times more expensive than the least expensive alternative.

The high cost of the Private Ambulance Operation is due to a number of factors, but primarily to having full-time paid attendants. There are four other factors, ones which are not found in the other institutional arrangements that make the Private Fully Paid Ambulance Operation so expensive. First, this Operation must pay federal and state income tax which amounted to $4,700 per year. Second, the depreciation charge on the primary vehicle is $527.25 more than that charged to an ambulance operation that qualifies for a DOT matching grant. Third, the Private Operation pays an unsubsidized rental fee on the ambulance garage. Fourth, this non-governmental operation must pay state motor vehicle registration fees.

5) The Minimum levels of operation are less costly than the Basic levels of operation in their counterpart organizations.* The cost differential between the Minimum level Independent Volunteer Operation and the Basic level Independent Volunteer Operation is

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*Note that the term "Minimum" here refers to an ambulance operation with 24 attendants and drivers to man the two vehicles. The term "Basic" here refers to 34 attendants and drivers to man the two vehicles in volunteer personnel arrangements, and 18 attendants and drivers in the fully paid personnel arrangements. The distinction used here between Minimum and Basic is not as complex as that discussed in Section A of Part III.

$5,342 annually, or $14.48 per run, or $.54 per capita, or $.50 per mile. This is about a 29 percent difference in costs.

The costs directly associated with the difference in the number of licensed attendants between the Minimum and the Basic levels is small. The cost of Personnel Licenses, Workman's Compensation, Personnel Salaries, Training, and Physicals only show an increase of $407 per year from the Minimum to the Basic levels.

The factor which explains most of the increase in cost from the Minimum to the Basic level is the cost of paying Non-Salaried personnel. This factor is only indirectly associated with the increase in the number of staff to meet the Basic level since adding staff does not increase the runs per year and therefore should not affect the wages that are paid on a per run basis. But it seems realistic to assume that an ambulance operation that has more and better trained personnel might have to pay them $5 per person per run to at least cover their transport costs to and from the ambulance garage.

The two Joint Function Fire Ambulance Operations also present a contrast between the costs of operations at the Minimum and the Basic levels of service. The cost differential between the Minimum level Joint Function Operation and the Basic level Joint Function Operation is 21 percent, which is $5,464.50 annually, $14.81 per run, $.56 per capita, or $.51 per mile. These differentials correspond very closely with the magnitudes of those Minimum-Basic differentials for the Independent Operations which were mentioned earlier.

The costs directly associated with the difference in number of

licensed attendants between the Minimum and Basic levels is small--totally $483 annually. The cost of paying the non-salaried personnel, an indirect cost with respect to differing levels of operation, is the factor which explains most of the difference in cost between the Minimum and the Basic level Joint Function Ambulance operations. This was also true for the two Independent Ambulance operations.

6) The Joint Function Ambulance operation has the advantage over other institutional arrangements of being able to share certain facilities, equipment, personnel, and training, and thus be able to lower the cost attributable to each activity. For instance, the second vehicle is often taken on fire runs just in case a fireman gets injured.

A potential problem exists in that the personnel have a dual allegiance. In the event of an emergency requiring both fire and ambulance assistance, which activity will get priority?

7) A Public Ambulance operation has the institutional advantage of a firm financial base. This is important in rural areas, especially in light of the high cost of EMS. A drawback of this institutional arrangement is that the decision-makers and the actual ambulance attendants are not one and the same. This division could possibly stifle individual initiative and motivation which is so essential to EMS.

8) The Independent Ambulance operation avoids the aforementioned problem, but runs into the problem of finding leadership that is willing to donate time and effort to overseeing the ambulance operation. A major institutional advantage of the Independent

Ambulance operation is the substantial savings in cost resulting from the assistance which the volunteers give to this operation. They donate time to clean and repair the vehicles and the garage, and they also donate furnishings to make the ambulance lounge more comfortable. Personnel who work for all volunteer organizations seem more willing to accept a lower rate of reimbursement than those people who work for an operation that is related to a governmental body or is private.

This institutional arrangement, as well as the two previously mentioned arrangements, have the common problem of maintaining the skills of these volunteers that man the emergency vehicles.

9) The Private Paid Ambulance operation avoids to a certain extent the problem of maintaining skills. The fewer number of drivers and attendants are able to go out on more runs per person than are volunteers. It has been argued, however, that maintenance of skills is just as great a problem among full-time attendants as it is among volunteers. Some situations have low probabilities of occurring, but nevertheless are acute emergencies when they do occur. All attendants should maintain skills appropriate for relatively rare situations such as emergency childbirth or poisoning. Although full-time attendants generally go on more runs than volunteer attendants, the probability of encountering a statistically rare emergency remains low. Therefore, full-time attendants cannot rely on field experience to maintain all of their needed skills. They, like volunteer attendants, must periodically participate in clinics or courses to maintain their skills.

10) Paying personnel on a full-time basis, then, does not guarantee

the provision of service at a level better than that which volunteers could provide. Better service seems to be a function of the aptitudes of the attendants and their individual motivation to maintain their skills. It is not clear that one institutional arrangement is more conducive than another to this motivation. But fully paid ambulance operations face the problem of being able to offer the financial or other incentives necessary to keep personnel on a full-time basis.

11) Response times can be shortened if the drivers and attendants are based right at the ambulance garage, rather than being on call from their homes or places of work. Again, it is not clear that one institutional arrangement is more conducive than another to having an ambulance crew always at the ambulance garage. This personnel arrangement seems to be more a function of group solidarity, individual initiative, and a garage/office/lounge that is comfortable enough that the personnel enjoy spending time there.*

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*For further discussion of the relationship between the institutional arrangement and the quality of service rendered, the reader is referred to Roni Briese's 1974 study for the Division of EMS, Michigan Department of Public Health entitled "A Position Paper on the Economic Considerations for the Provision of Pre-Hospital Emergency Medical Services."

PART IV: SUMMARY AND CONCLUSIONS

A. Objectives and Accomplishments

In order to assist state, regional, and local administrators and planners in estimating the costs of ambulance operations in rural areas, this study has focused on developing an analytic guideline and its underlying methodology.

This study has:

1) Improved the methodology for analyzing the costs of rural ambulance operations. Relevant parameters were defined, and ambulance operations were conceptually differentiated based on both institutional and personnel arrangements.

2) Presented market information on the price of different types and levels of service and the costs that a service might incur if it changed institutional arrangements or levels of service.

3) Developed a set of analytic guidelines (see Appendix IV-A) which:

   i) Identify and define relevant cost variables that should be evaluated.

   ii) Recommend methods of depreciation of capital equipment.

   iii) Provide an easy-to-use format from which individual ambulance operations can compute their own costs.

4) Identified some of the linkages between structural arrangements and the conduct-performance of an ambulance operation.

B. Methodology

The cost methodology developed in this study was based upon an in-depth analysis of six ambulance operations. Economic and time constraints necessitated a case study approach rather than a comprehensive examination of all ambulance operations in rural Michigan. The methodology and techniques of analysis that were developed in this study were designed so as to facilitate, at some future date, a study of greater breadth. Such a study might help lead to linking alternative development strategies to the quality of service rendered.

The details of how and why the sample of six ambulance services were chosen is discussed in Part I, Section C of this study. In Part II, the empirical data collected during interviews with personnel of the six ambulance operations is presented. Section A describes in general how each ambulance service operates, and then the costs associated with each operation are compared in Section B.

Part III analyzes the costs associated with different levels of service, with different institutional and personnel arrangements, and with the use of one or two vehicles. The analysis of different institutional and personnel arrangements was based upon the identification of a "Typical" service area for two-vehicle ambulance operation.

C. Summary and Conclusions

1. Cost of Upgrading to the Basic Level of Service

a) Upgrading to comply with the State's recommendations for the Basic level of service would cost the six ambulance operations studied an additional $106.19*- $5,481.02 per year. This study indicates a range of increased annual costs of up to 32 percent. Another study using a broader sample would have to be taken to better judge the average cost statewide of meeting such standards.

b) The difference in annual cost between ambulance operations meeting the Minimum standard and the Basic standard of service was 29 percent for the two Independent Volunteer Operations and 21 percent for the two Fire Ambulance Operations. These figures are based on standardized data used for a "typical" service area. The Minimum and Basic levels were defined in terms of total number of attendants, 24 and 34 respectively.

c) Upgrading the ambulance operations so that all of the attendants move from the EMT-Basic to the EMT-Specialized level is estimated to cost each ambulance service an additional $364.29 per year.

2. Cost Savings Associated with Moving to One Vehicle

The estimated cost savings associated with dropping from two emergency vehicles to one for the six ambulance services studied range from $709.50 to $2,970.20 per year, or 3 to 13 percent per year. The effects of such a cutback in terms of quality of service would need to be evaluated on a case-by-case basis.

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*This cost may be severely underestimated if volunteerism collapses under higher training demands (see Item 3-e which follows).

3. The Effects of Institutional and Personnel Arrangements on Costs

a) No one particular institutional arrangement is best for all rural communities. The choice must be based on a number of factors, foremost of which are the needs and the resources of each community.

b) Institutional arrangements and personnel arrangements can be separated into distinct concepts. But institutional arrangements usually imply a certain type of personnel arrangement. These personnel arrangements, including what might be termed the degree of volunteerism, are related not only to the institutional arrangement, but also to the number of emergency runs per year in the service area.

c) Most of the differences in costs among institutional arrangements can be accounted for by the costs of different personnel arrangements and especially the degree of volunteerism. Some institutional arrangements utilize more volunteers and volunteers who work for less than do others. Whether this is due to the ability of different institutional arrangements to attract volunteers or to the exogenous interest levels of volunteers was not investigated.

d) Factors such as taxes, furnishings, and social events may differ from one institutional arrangement to another, but they are relatively unimportant in terms of the total costs of the ambulance operation.

e) As higher levels of training are mandated, and the demands on an attendants' time increase, hence rural communities might be forced to pay the personnel at higher and higher wage rates. If this cause-effect relationship really exists, then the future

viability of certain institutional arrangements depends on the level of training mandated. For example, demands for higher wage rates could change the structure of Independent and Private ambulance operations if they are unable to recoup the additional costs either through increased charges for service or from governmental subsidies. Even Public ambulance operations might find that their rural areas are unable or unwilling to bear a higher charge. The scenerio is increasingly probable given a political and economic climate which seeks to stop tax increases.

f) From the empirical data, the range in costs for the six rural ambulance services studied were for 1977:

Cost per run:	$40.98 - $108.04	(Independent Volunteer Operation low--Fire Operation high)
Cost per capita:	$ .93 - $ 5.39	(Independent Volunteer Operation low--Fire Operation high)
Cost per mile:	$ .99 - $ 5.36	(Independent Volunteer Operation low--Private Operation high)

g) From the standardized data for the "Typical System" defined in Part III, Section D, the range in costs was:

Cost per run:	$35.68 - $197.35	(Independent Volunteer Operation low--Private Paid Operation high)
Cost per capita:	$ 1.35 - $ 7.45	(Independent Volunteer Operation low--Private Paid Operation high)
Cost per mile:	$ 1.24 - $ 6.85	(Independent Volunteer Operation low--Private Paid Operation high)

h) An institutional arrangement which is relatively cost-effective in financial terms may not be cost-effective from a societal or economic perspective due to public or private subsidies.

4. The Effects of Non-Emergency Runs

Some economies of scale might be achieved, and revenues increased, if non-emergency runs were handled by the rural ambulance operation. Presently, decisions against such service are based on the high opportunity cost of attendants vis-a-vis their remuneration.

D. Comparison of This Study to Other Similar Cost Studies

This study has refined and made explicit a cost methodology for rural ambulance operations. This methodology includes an improved formula for depreciating the emergency vehicles as well as ways of budgeting for different levels and types of service.

E. Potential Needs for Administrative or Legislative Action

1) The State administrators should always bear in mind the motivations of the personnel who cover medical emergencies. This motivation, which is not solely a function of the level of financial remuneration, affects the quality of service rendered. Programs and institutional arrangements should be structured so as to both reinforce and be sensitive to these motivations.

Recent legislative changes amount to a reallocation of rights and privileges. The State is now setting EMS standards and operation procedures for rural areas which raises the minimum level of service which a community should provide, and thus limits the opportunity set of rural communities.

Presently, attendants in rural areas are exercising their "voice" option. In general they are participating in the rule-making process and making their opinions known. But higher mandated levels of training shift right the demand curve for hours of labor and training of ambulance attendants. If an upward sloping supply curve is assumed, as the demand increases, the equilibrium supply price will also increase. This reflects an increase in the opportunity cost of labor.

If the level of remuneration for the attendants is not permitted to increase, the possibility exists that rural ambulance attendants will exercise their "exit" option, whereby they refuse to participate in the rule-making process. Another exit option, whereby the attendants withdraw their voluntary services, would have much more severe consequences (see Figure 14).

Among the possible consequences, the following should be evaluated:

a) The annual cost of a full-time paid ambulance crew, for instance, is at least $53,000. This is more than three times the cost of personnel in many ambulance operations that employ volunteers.

b) The State can mandate a certain level of EMS if the service exists. But is the State ready to mandate the service when rural areas can no longer provide the service due to a lack of funds?

c) With the probable linkage between higher mandated levels of service and demand for higher rates or remuneration by EMS personnel, the State should explore carefully a number of implications.

Care should be taken by EMS administrators when they attempt to prevent EMS personnel from exercising the "exit" option. For example, direct financial assistance by the State to rural ambulance operations might transform independent operations into a public operation; hence, the expected rates of remuneration might increase to levels equivalent to that of other government workers.

2. Legislation and rule-making must, by necessity, be uniform and thus is usually directed at the majority. But the minorities, such as rural areas should not be forgotten since it is upon these areas that the highest cost of new EMS standards is felt.

3. Efforts should be continued by the Division of EMS to develop a uniform reporting form for all ambulance operations. The importance of pilot testing in the field, whatever systems are used, cannot be overstressed.

Data reporting systems workable in the field will aid in improving the quality of data available for analysis. Better data is necessary

for a comprehensive study of ambulance operations in rural areas of Michigan.

4) One of the rules in the Department of Transportation's program which provides matching grants for the purchase of new emergency vehicles and equipment should be reviewed. The rule states that when a new vehicle is purchased with matching funds, the ambulance operation must hold onto its old vehicle and use it as a back-up vehicle. This rule has the effect of increasing the number of emergency medical vehicles in rural areas. The question is whether this goal of increasing vehicles per capita is the most cost-effective way of increasing the availability of high quality emergency care.

5) Consideration should be given to establishing a special category in the EMS legislation for non-emergency transfers. Some argue that the hearse-type chassis is more appropriate for non-emergency transfers. Some of the equipment carried on a DOT-equipped van or modular may be superfluous to such runs, and the comfort to the passenger over long distance transfers might make the hearse-type chassis preferable.

This proposal to set up a new category of EMS care with separate requirements could improve the quality of care, but might also increase the costs of EMS care, since hearse-type chassis could only be used for non-emergency runs and therefore van-type or modular-type chassis would still be needed.

6) Two standards included in the Basic level of service which are recommended in The Michigan Plan for EMS . . . should be reviewed. Standard 3 recommends a minimum of one emergency vehicle per 8,162 people. The need for some flexibility if not total reworking of this

standard was pointed out in Part II, Section A, under the discussion of Standard 3.

Standard 8, which recommends "a basic EMT training program within the county," needs to be reworked. This recommendation should probably be stated in terms of travel time to a training site. When required levels of training increase, the state could partially counter the objections of rural attendants that they do not have the time to go through more training by making the training more accessible.

7. Further technical assistance made available by state or regional levels of government to rural ambulance operations could help them in the following ways:

a) Aid in estimating their costs over the next few years so they will know their financial requirements.

b) Aid in improving funding such as through better bill collection arrangements which will insure funds sufficient to meet problems of both short- and long-term liquidity.

c) Aid to rural EMS administrators in identifying the availability of and the means of obtaining funds from state and federal sources.

d) Assist rural EMS administrators budget their resources more cost-effectively. This might entail anything from the dissemination of information on low-cost new or used equipment, to different personnel arrangements, to different billing rates, to economies of scale that can be achieved through consolidation or coordination with other EMS operations.

8. The Department of Public Health's "Inventory of Ambulances Licensed in Michigan" should be redone so that the institutional classifications reflect the definitions such as presented in this study which more clearly describe the types of operating systems.

F. Recommendations for Future Study

1. More information is needed on the cost and other trade-offs between major increases in the overall quality of an ambulance service and slower response times. This trade-off is likely to be one of the central issues in any discussion concerning consolidation and centralization of ambulance operations.

2. More quantitative information is needed concerning the relationship between the levels of training of personnel and the quality of care such as the correct assessment of a patient's conditions.

3. More information is needed concerning the relationship between the attendant's assessment of a patient's condition and whether or not the treatment rendered was appropriate. Are attendants matching their assessments of a patient's condition with the appropriate treatment for that condition?

4. Management's role should be examined in greater depth to identify those factors which contribute positively to the quality of service and can be replicated through some structural mechanisms.

5. Further research is needed to test the hypothesis that as the level of training required of attendants increases, the need for higher rates of remuneration will increase.

6. Further study is needed of the remuneration mechanisms to test the hypothesis that payment on a per run basis is cost-effective in areas of low demand, while payment on a set annual fee basis is cost-effective in areas of high demand.

7. A broader sample is needed to examine the linkages between various institutional and personnel arrangements.

8. The hypothesis that higher levels of volunteerism yields better care of vehicles and equipment needs to be tested.

9. Many of the problems and their underlying variables of ambulance operations are similar to those for other community activities such as fire, police, or judicial services. Economies of scale, degrees of volunteerism, and levels of professional should all be examined as to their impact on the costs of community services. A comparision of studies about fire services (Harvey), police service (Sinclair), judicial services (Broder), and ambulance services (Navin) provide a foundation for a more general study of services in rural areas.

10. Further research is needed to find institutional mechanisms to promote volunteerism. For example, research is needed into the replicability of the institutional arrangements in the Scottsdale, Arizona Fire Department. This urban fire department is unique in that it has replaced most of the full-time firemen with part-time auxiliary firemen. This has substantially reduced the fixed cost of the fire operation without diminishing the quality of service.

APPENDICES

Appendix I-A

Research Design for a Study of the Economics of Rural Ambulance Operations in Michigan

I. REVIEW THE STATUS OF EMS IN MICHIGAN TODAY AND PLANS FOR THE FUTURE.

This will be based primarily in the "Michigan Plan for EMS," and other relevant documents supplemented by discussions with EMS administrators.

II. ESTABLISH PROCEDURES FOR ESTIMATING AND COMPARING RELEVANT COSTS.

A. Continue review of the literature. Data will come from general or scholarly literature and material identified as pertinent and currently available from state, regional, or local organizations or authorities.

B. Interviews with those people in Michigan who are knowledgeable on this subject--including, but not limited to, Dr. Wiegenstein, Wayne McKenna, Neal Andrews, Joe Hull, John Hubinger, and Chuck Bower.

C. Statement of General Objective--To furnish Emergency Medical Service decision-makers at the state, regional, and local level with an analytical guideline which will help them to better estimate the costs of providing different levels of service to rural areas.

D. Specific Objectives

1. Description of the economics of four or five rural EMS.
2. Specify the costs associated with moving from the presently existing levels of ambulance operation to the Basic Life Support Level, and then to the Basic Specialized Life Support Level. Some major implications of moving to the Advanced Life Support Level will also be given.
3. Analysis of the effects of alternative personnel arrangements on the costs of EMS. These personnel arrangements include:
   a) Public (county) ambulance service.
   b) Independent volunteer ambulance service.
   c) Fire ambulance service.
   d) Private service.
4. Commentary on potential changes in legislation or rules.

Appendix I-A (cont.)

E. Economic Framework of Analysis

To carry out the analysis, the following framework will be used. It specifies the categories of information which will be required, the data needed for each variable, and the sources of the data. This framework is summarized in the chart on the following page.

III. METHODOLOGY FOR SAMPLING AMBULANCE OPERATIONS

Using the framework for analysis in the previous section, the following methodology involving two steps will be used to identify four or five representative rural ambulance operations for intensive study.

Step 1: For purposes of this study, a rural ambulance operation will be defined as one based in a city of population less than 25,000.

Step 2: The frequency of occurrence of various personnel arrangements of rural ambulance operation will be estimated from the "Inventory of Ambulances Licensed in Michigan."

Step 3: Ten to fifteen rural ambulance operations will be identified as meriting closer examination. Criteria for inclusion in this sample includes the following factors: typical population size for a rural EMS, system close to the mode in number of emergency vehicles, personnel arrangements typical of viable systems, evidence of availability of data of sufficient quality.

Step 4: From closer examination of the systems identified in Step 3, including on-site visits, four or five EMS will be chosen for detailed study. Criteria for final selection include: reasonable quality of data in the categories required, evidence of cooperation with the study, representation of Minimal, Basic, and Basic Specialized Life Support levels of operation.

IV. DATA GATHERING TECHNIQUES

Data gathering may include some or all of the following techniques as applicable:

A. Interviews with EMS personnel, emergency room personnel, hospital management, and county officials.

B. Open-ended questionnaires which the interviewer will fill out during interviews.

FRAMEWORK FOR DATA COLLECTION IN AN ECONOMIC ANALYSIS OF FOUR OR FIVE RURAL AMBULANCE OPERATIONS IN MICHIGAN

CATEGORY OF INFORMATION	DATA REQUIRED	DATA SOURCES
I. Structural Characteristics of Area Served		
A. Population Characteristics	1. Total population and transient characteristics in service area	Census
	2. Population density	State, regional, and local E.M.S. planning records
B. Physical Conditions Unique to Area	3. Climate	State E.M.S. planning records
	4. Roadways	State E.M.S. planning records
	5. Hospital location	State E.M.S. planning records
C. Other Community Characteristics	6. Industrial configuration	State E.M.S. planning records
D. Demand for E.M.S.[1]	7. # of critical highway accident calls/year	Local E.M.S. dispatch, run, emergency room, billing reports
	8. # of other critical emergency calls/year	Local E.M.S. dispatch, run, emergency room, billing reports
	9. # of non-transport first aid calls/year	Local E.M.S. dispatch, run, emergency room, billing reports
	10. # of transfer calls/year	Local E.M.S. dispatch, run, emergency room, billing reports
	11. Average mileage per run for each category 7-10	Local E.M.S. dispatch, run, emergency room, billing reports
II. Nature of E.M.S.		
A. Formal and Informal Rules	12. Federal mandates	State E.M.S. planners and their records
	13. State regulations	State E.M.S. planners and their records
	14. Regional and local standard operating procedures; chain of command	Local E.M.S.
B. Vehicles	15. # by type, condition, and cost	Local E.M.S.
	16. # per square mile	Local and regional E.M.S.
	17. Population per vehicle, mileage per vehicle per year	Local and regional E.M.S.
C. Equipment	18. Extent of meeting DOT equipment recommendations and cost	State and local records
	19. Level of 2-way communications system and cost	State and local records
	20. Usage of Ham or UHF designated frequency	State records
D. Personnel	21. # of personnel by level of training and pay scales	Regional and local records
	22. Method of financing	Local records and interviews
	23. Non-monetary incentives	Local interviews
	24. Availability of training programs and cost (in-service, advanced)	State and regional records
	25. Institutional arrangement (staffing pattern)	Local interviews
E. Garage and Administrative Costs	26. Square ft. and cost attributed to garage and office space	
III. Performance of E.M.S.		
A. Response Times[2]	27. Response time	Local records
	28. Service time	Local records
	29. Round trip time	Local records
B. Service Provided	30. Same as 7-10 above	Local records
C. Costs Per Unit of Service	31. Dollars per run	State, regional, and local records and interviews
	32. Dollars per mile	State, regional, and local records and interviews
D. Costs of Major Malfunctions of Ambulance Operation	33. Frequency and probability of ambulance accidents; implications including insurance impact in terms of costs	Local records
	34. Frequency of probability of ambulance breakdowns; cost implications	Local records
	35. Frequency and probability of difficulty in locating victim; cost implications	Local records
	36. Frequency and probability of encountering impassable roads; cost implications	Local records
E. Effects of Having Only One Vehicle	37. Budget down from two-vehicle system	

[1] Alternate classifications will be considered. Final selection will be based on cost implications and format of available data.

[2] Other measures may be used as available such as notification time, on-scene time, transport time.

Appendix I-A (cont.)

C. Formalized questionnaire approved by the Office of EMS in Lansing.

D. Administrative and data records of local services.

Appendix I-B

Step A: Which institutional arrangements are "typical" in rural areas?

To answer this question, the December 31, 1977 "Inventory of Ambulances Licensed in Michigan" was used. Since this list contains all ambulance operations, both urban and rural, the urban systems had to be screened out. This was done by excluding all ambulance operations that are based in cities of population greater than 25,000 people. This procedure eliminated 54 operations, leaving 319 "rural" operations. The breakdown of these rural ambulance operations by institutional arrangements was as follows:

1)	Public Fire Department Services	28%
2)	Independent Volunteer Ambulance Service	24%
3)	Private Ambulance Service	16.3%
4)	Public (county based) Ambulance Service	7.2%
	Total for the four major institutional arrangements	75.5%

Some of the remaining institutional arrangements were:

5)	Private Funeral Home	5.6%
6)	Private Hospital/Medical Facility	5.6%
7)	Public Hospital/Medical Facility	1.6%
8)	Police/Sheriff	4.4%
9)	Mixed Public/Private/Volunteer	7.5%
		24.7%*

*See Appendix I-C for the raw data.

Appendix I-B (cont.)

Step B: Focus on four institutional arrangements.

A decision was made to focus the study on the four most typical types of institutional arrangements. Furthermore, the sample screened out the following categories of ambulance operations: 1) Those in the Upper Peninsula due to time and financial limitations in the study; 2) Those with data of poor overall quality; 3) Those ambulance operations that might not have been willing to participate in the study based upon the judgement of knowledgeable individuals.

This screening of the 319 rural operations was done by an individual with 16 years of experience with the ambulance systems in Michigan. His knowledge made possible the paring of the list down to 77 ambulance operations.

Step C: With this sample of 77 ambulance operations which were estimated to have available good quality data, selection was needed of institutional arrangements which were typical of those found in rural Michigan.

In order to select the sample of ambulance operations for detailed study, a chart of these 77 operations (see Table 5) was made identifying these operations not only by their institutional arrangement and their number of vehicles, but also by their level of service. Personal knowledge was used to classify the EMS operations as providing either the Minimum level or Basic level of service. Some that were thought to be in between were classified as "Minimum/Basic" or "Basic/Advanced."

The sample of 77 ambulance operations includes only the four major institutional arrangements. Row A gives the percentage breakdown of the

Table 5

Distribution of the Judgement Population of Ambulance Operations with Potentially Good, Accessible Data by Number of Vehicles, Institutional Arrangement, and Level of Service

Number Vehicles	Level Service	Institutional Arrangements				Totals
		Fire	Independent Volunteer	Public	Private	
1	Minimum	2				7
	Minimum/ Basic		1			
	Basic	1	1	1		
	Basic/ Advanced	1				
2	Minimum	4	1		2	38
	Minimum/ Basic	2	0		0	
	Basic	10	9	6	1	
	Basic/ Advanced	1	1		1	
3	Minimum					21
	Minimum/ Basic		1	3	3	
	Basic	2	5	4	3	
4	Minimum					5
	Minimum/ Basic					
	Basic	1	2	2		
5	Minimum					4
	Minimum/ Basic	1		1		
	Basic		1	1		
6	Minimum					1
	Minimum/ Basic					
	Basic				1	
7	Minimum				1	1
	Minimum/ Basic					
	Basic					
TOTAL NUMBER		25	22	18	12	77
A. Percentage		32%	29%	23%	16 %	100%
B. Percent of Institutional Arrangements for Just the Four Arrangements Based on the Data for 319 Rural Operations		37.3%	32%	9.3%	21.3%	100%

Appendix I-B (cont.)

77 according to these institutional arrangements. Row B's percentages are based on the data from the 319 "rural" ambulance operations. These percentages, however, compare just the four major institutional arrangements found in "rural" areas of Michigan, excluding the other arrangements.

For example, the Fire Ambulance Operation represents 28 percent of the 319 rural ambulance operations, but it represents $\frac{28}{75}$ = 37.3 percent of the 75 percent of the 319 ambulance operations which are the four major ambulance operations.

These biases suggest that Public operations were judged to be willing to cooperate with a study and/or that they have better quality records than Private operations. Better quality data in Public operations may partially be a function of having administrators who are used to keeping good records for other public activities.

Step D: How well does the sample of 77 reflect the number of vehicles per ambulance operation which are typically found in rural areas of Michigan?

The following Table displays the distribution of all rural ambulance operations by their number of vehicles:

Appendix I-B (cont.)

Table 6

Distribution of Operations by Number of Vehicles

	All Rural Ambulance Operations in Michigan		Sample of 77
Number Vehicles per Ambulance Operation	Number of Ambulance Operations	Percent	Percent
1	148	45	9.1
2	112	34	49.3
3	42	13	27.3
4	13	4	6.5
5	6	2	5.2
6	3	1	1.3
7	2	.6	1.3
	326*	100%	100%

A comparison between the sample of 77 and all rural ambulance operations reveals that this sample under-represents systems with one vehicle. A hypothesis can again be put forward that the quality of data in one-vehicle operations is poorer than that in multi-vehicle operations.

Step E: Focus on two-vehicle operations.

It is assumed that the costs of running ambulance services will be higher if more vehicles are used. This cost variable, the number of vehicles in an ambulance operation, was eliminated in order to facilitate comparison of the costs associated with institutional arrangements.

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*This figure is greater than the 319 rural ambulance services in the state due to some double counting of services that operate in two or more counties.

Appendix I-B (cont.)

Two-vehicle operations were therefore selected because they represent the second largest number of services and it would be possible, with data from two-vehicle systems, to estimate the costs of one-vehicle systems.

Step F: Delete those ambulance operations categorized as Minimum/Basic or Basic/Advanced from the sample of 38 so that comparison between levels will be more distinct.

Restricting the sample to two-vehicle operations reduces the sample from 77 to 38. Deleting those five operations classified as Minimum/Basic leaves 33. See the Table on pages 114-5 for a list of these 33 ambulance operations.

Step G: Although our sampling procedure so far has excluded all services based in cities of population greater than 25,000 people, this alone was not stringent enough to constitute a working definition of rurality. Consideration of population density allowed for a more precise means of defining rurality.

In order to understand the meaning of population density figures in the context of Michigan, we looked at the mean and modal characteristics of county density statistics for three section of Michigan--the Upper Peninsula, Northern Lower Michigan, and Southern Lower Michigan. These results are presented on page 116. The data is summarized below:

Appendix I-B (cont.)

County Population Densities for 1970

	Mode	Mean
Northern Lower Michigan	21	28
Southern Lower Michigan	100	190

Note that the three counties comprising metropolitan Detroit were excluded from these calculations, but other cities were not. With these mean and modal statistics in mind, we were then better able to define what constituted a rural area in Michigan. Essentially, we used the rule that any area with a population density near or below the modal density for the corresponding region of Michigan was considered "rural."

Step H: Delete Urban Service Areas from the Sample of 33 Two-Vehicle Ambulance Operations.

In order to use the aforestated population density rule for deletion of "urban" ambulance operations, it was necessary to determine the population density associated with each ambulance operation's service area. This required determining both the square miles and the population within the irregularly defined ambulance services.

Telephone interviews with the 33 ambulance operations yielded this information. The number of square miles in each of these areas was then calculated from maps of townships provided in Fall and Winter Fun in Michigan, Clarkson Map Company, Kaukauna, Wisconsin, 1971. Population data by township was found in Number of Inhabitants, Michigan, 1970 Census of Population, U.S. Department of Commerce, Bureau of the Census,

Table 7

Distribution of Sample of 33 Two-Vehicle Ambulance Operations with "Good Data" Differentiated by Type and Level of Service

	Total Population	Population Density	Average Population Density
I. BASIC LEVEL			
A. Fire			
1.	15,234	100	
2.	13,795	533	
3.	37,000	1,000	
4.	35,000	urban	
5.	12,000	6,000	
6.	20,000	1,500	1000
7.	11,342	urban	
8.	3,330	urban	
* 9.	2,557	18	
*10.	2,934	815	
B. Independent Volunteer			
11.	9,074	335	
12.	9,252	154	
13.	10,034	130	
14.	19,313	77	
15.	25,590	853	262
16.			
17.			
*18.	15,420	107	
19.	14,521	90	
C. Public			
*20.	8,593	27	
21.	3,252	42	
22.	8,722	61	46
23.	6,981	56	
24.	6,344	63	
25.	6,434	24	
D. Private			
26.	18,923	117	117

Table 7 (cont.)

	Total Population	Population Density	Average Population Density
II. MINIMAL LEVEL			
A. Fire			
*27.	2,338	65	
28.	10,000	83	151
29.	36,468	293	
30.	3,767	164	
B. Independent Volunteer			
*31.	10,449	102	102
C. Public			
D. Private			
32.	8,374	58	106.5
33.	29,070	155	

*The Ambulance operations examined in detail in the study.

Table 8

Distribution of Population Densities
by Region and County in Michigan

Region of State	Population Density Per County																	
	1-10	11-20	21-30	31-40	41-50	51-60	61-80	81-90	91-100	101-150	151-200	201-250	251-300	301-350	351-400	400-450	451-500	501-650	651-700
Upper Peninsula (15 counties)	7	3	2	3															
Northern Michigan (27 counties)	6	6	7	6	2	1		1											
Southern Michigan (38* counties)	6					14				6	2	3	4	2	1	0	2	1	0

*Excludes the three metropolitan Detroit counties of Oakland, Wayne, and Macomb

Appendix I-B (cont.)

Final Report PC(1)-A24, U.S. Government Printing Office, Washington, D.C., 20402, p. 24/21-24/34.

The distribution of the estimated population densities for our sample of 33 two-vehicle systems is summarized in Table 9.

Step I: Selection of 13 ambulance operations for preliminary visits. The purpose of the initial site visits was to:

1) Verify the classification into which the operation had been placed.
2) Get a feel for the types and quality of data that exist in the field so that systems with extreme data problems could be avoided.
3) Identify systems that would be willing to participate further in the study.
4) Confirm the organizational patterns and identify any peculiar problems that exist in rural EMS.

The sites for initial visitation were selected on the basis of:

1) Population density under 200 (with one exception which had a population density of 460).
2) An ambulance operation representative of each of the four major institutional arrangements and the two levels of service (basic and minimum).

Step J: Recategorization of some ambulance operations on the basis of field visits during which a questionnaire was filled out (see example in Appendix I-D).

Table 9

Distribution of Sample of 33 Two-Vehicle Ambulance Operations According to Level of Service, Region, and Population Density and Total Population (total population per service area)

INSTITUTIONAL ARRANGEMENT	FIRE			INDEPENDENT VOLUNTEER			PUBLIC (County)			PRIVATE			Systems with Population Density >200
POPULATION DENSITY	<30	30-99	100-200	<30	30-99	100-200	<30	30-99	100-200	<30	30-99	100-200	
AREA AND LEVEL OF SERVICE													
Northern Michigan													
Minimum													
Basic	2,557						*8,593						
Southern Michigan													
Minimum		*2,335 10,000	3,767			*10,449					8,374	29,070	36,462
Basic		*2,934	15,234		14,521 7,103 19,313	*15,400 9,254 10,034 7,472	6,434	6,981 8,722 3,252 6,344				*18,923	9,074 12,000 25,590 20,000 13,795 11,500 37,000 3,500 35,000

*Indicate the six ambulance operations chosen in the final sample.

Appendix I-B (cont.)

The initial field visits and administration of the preliminary questionnaire revealed that some of the ambulance operations did not correspond with the four major institutional arrangements as had been previously believed. These operations were then recategorized so that the final selection process, based in part upon choosing operations of specific institutional characteristics, could proceed.

The inaccuracy in the initial categorization in the "Inventory of Ambulances in Michigan" was not due to error, but rather to the methodology which included as "volunteer" all ambulance operations that simply used the word "volunteer" in their titles.

In summary, then, the four institutional arrangements that will be compared in this study reflect different groups of decision-makers who potentially have different incentives, motivations, skills, and conflicts with other activities which will have bearing on the outcomes and their respective costs. This statement constitutes an hypothesis that will be explored in this study.

Step K: Selection of final sample of six ambulance operations for thorough cost analysis.

Deleting seven of the thirteen operations from the sample was very easy. The site visits revealed major deviations from the criteria that had previously been set up. The remaining six ambulance operations were those that best fit the criteria of this stratified sample. A summary of the entire sampling process is presented in Table 8. Table 9 identifies the final sample of six rural ambulance operations in this study.

Appendix I-B (cont.)

Step L: Field visits and the completion of a detailed questionnaire (Appendix I-E).

Distribution of Rural Ambulance Operations
in Michigan by Institutional Arrangement*

	Public	Volunteer	Mixed Public/ Volunteer	Private	Mixed Private/ Volunteer	Total
Ambulance Service Only	23	76	3	52	2	156
Funeral Home	0	0	0	18	0	18
Fire Department	89	4	1	1	0	95
Police/Sheriff	14	0	0	0	0	14
Hospital/Medical Care Facility	5	0	0	18	1	24
Other	3	0	0	9	0	12
TOTAL	134	80	4	98	3	319

*Data drawn from December 31, 1977 "Inventory of Ambulances Licensed in Michigan" where systems based in cities with populations greater than 25,000 were screened out.

Appendix I-D

DATE:

EXPLORATORY QUESTIONS FOR FIELD VISITS, STAGE I

I. Identification of the System
   - A. Name of Service
   - B. Address
   - C. Telephone
   - D. Names of Key Personnel
   - E. Type of Institutional Arrangement

II. Nature of EMS
   - A. Formal and Informal Rules, Chains of Command
   - B. Vehicles
     15. Type Age Mileage Equipment Cost at Purchase
     16. Number per square mile (define the service area)
     17. Population per vehicle (population in service area)
   - C. Equipment--What do you carry that is beyond the standards of DOT?
     18. Meet DOT standards?

         Siren, light, straps on stretcher, means of securing stretcher in vehicle.

         Stretcher type--number of positions, stair chairs, extrication equipment.

         Who does your maintenance and repair?

         Who do you order from/buy through? Price differences?
     19. Communications equipment and costs

         (Beepers, walkie-talkie, CBs, radio, HERN (to hospital), car-to-car radio only).
     20. Garage and office space--type, size, cost
   - D. Personnel--Number, level of training, and pay scales (salaried personnel, hourly, wage, cost/run, cost/mile, etc., personnel arrangement).
     21. Rate of turnover? Where do they go? Recruitment?
     22. Method of financing? Sources? Rates?

III. Performance--General Performance Data Including Response Times

Appendix I-D (cont.)

IV. Structural Characteristics
   A. Physical conditions unique to area. Special demand problems.
   B. Demand for EMS
      7. Number of critical highway accident calls/year
      8. Number of other critical emergency calls/year
      9. Number of non-transport first aid calls/year
      10. Average mileage per run for each category 7-9

V. Type and Quality of Records
   A. Number of years data goes back
   B. Uniformity
   C. Biases
   D. Types--dispatch, run record, emergency room, billing records, etc.

VI. Problems--Issues, New Legislation

Appendix I-E

COSTS OF AMBULANCE OPERATIONS IN RURAL MICHIGAN

QUESTIONNAIRE FOR FIELD VISITS - STAGE II

I. ADDITIONS AND CORRECTIONS TO STAGE I QUESTIONNAIRE.

A. Type of institutional arrangement. (To determine whether service is independent.)

1. Who decides when a new vehicle should be purchased?
2. Who decides personnel training and employment practices?

B. What hospitals used? What percentage of runs to each hospital?

1.	____%	4.	____%
2.	____%	5.	____%
3.	____%	6.	____%
			100 %

C. Demand Analysis

1. Total runs per year. 1977_____ 1976_____ 1975_____
2. Non-emergency calls ____%
3. Non-transport calls (dry runs or just first aid and release) ____%
4. Emergency calls ____%

100 %

   a. Transfers ____%
   b. Vehicular accidents ____%
   c. Other (e.g., home, work) ____%

100 %

5. Average mileage per non-emergency run.
6. What is the payment arrangement for non-emergency runs?
   a. Average charge or total earnings per year.
7. Frequency of runs according to hour of the day.

D. Population Characteristics, Unusual

1. Rate of turnover of population, both seasonal and annual
2. Composite socio-economic index (including age, race, sex)
3. Major medical problems
4. Major industries or other sources of employment

Appendix I-E (cont.)

E. How is Revenue in Excess of Expenses Used? or How is deficit financed?

II. FIXED COSTS

	Primary Vehicle	Second Vehicle
A. Vehicle and Major Equipment Costs		
1. Type, make, and year of model		
2. Value at purchase		
3. Value of major equipment included		
a. List of major equipment not included vehicle purchase price		
4. D.O.T. grant? If so, how much of the purchase price?		
5. Estimate of years useful life?		
6. Taxes, fees, insurance		
a. Cost of State motor vehicle registration per year		
b. Cost of E.M.S. vehicle authorization per year		
c. Cost of all insurance by coverage: bodily injury, property damage, comprehensive, deductible collision, etc.		
d. Other overhead costs		

Appendix I-E (cont.)

B. Costs of Communications Equipment by Type	Primary Vehicle	Second Vehicle
1. Types of vehicle communications capabilities and estimated years life		
a. Car to car?		
b. Car to County Sheriff?		
c. Car to hospital?		
d. Hern frequency?		
e. Car to ambulance garage?		

2. Estimated Central Dispatch Costs

Equipment	Cost at Purchase	Estimated Years Life	% Shared With Other Services
a. Remote Base Station			
b. Antenna, Tower			
c. Remote Control Radio Console			
d. Base Station Encoder			
e. Leased Phone Line			

3. Personnel receiver costs and estimated years life

Number	Type	Cost at Purchase	Expected Years of Life

Appendix I-E (cont.)

C. Annual Personnel Costs - Salaries and Benefits

	Managers	Salaried Attendants	Clerical	Dispatch
1. Number and function				
2. Salary/wage				
3. Benefit package:				
a. Workman's Compensation				
b. Other				
4. Licenses for Attendants, $1.50/ year/attendant				
5. Physicals for personnel				

D. Training Courses

Training Courses	Frequency	Average # Attending	Total Cost	Average Cost per Person
1. Training to Advanced First Aid Level				
2. Training from Advanced First Aid to EMT level				
3. Training from EMT to EMT-Specialized level				
4. In-service training types				

5. Average number and level of training of attendants on a run.

6. Average number of years that an attendant stays with ambulance operation.

E. Cost of Garage and Office Space

1. Garage

   a. Square feet

   b. Actual annual cost of garage space

Appendix I-E (cont.)

c. Actual cost of what similar quarters would cost without special subsidies or shared costs. (Estimated fair rental cost.)

d. Furnishings--total cost, amortization scheme (list of furnishings)

2. Utilities, annual average cost

3. Maintenance, annual average cost

4. Telephone, annual average cost

5. Property taxes, annual average cost

6. Other

F. Miscellaneous Fixed Costs on an Annual Basis

1. Insurance (other than auto which is on p. 2. E.g., business professional liability, malpractice)

2. Professional fees (e.g., legal, accounting, collection agency)

3. Public relations

4. Travel

III. ANNUAL VARIABLE COSTS

A. Vehicles	Primary Vehicle	Second Vehicle
1. Annual gasoline costs		
a. Average M.P.G.		
b. Average cost per gallon		
c. Average annual mileage		
2. Type and estimated lifetime of tires		
3. Cost of four new tires, specify type		
4. Annual cost of tune-ups		
5. Annual cost of repairs		

Appendix I-E (cont.)

B. Supplies and Equipment Costs

1. Medical
   a. Laundry and uniforms, annual costs
   b. Bandages and related items, annual costs
   c. Medical equipment maintenance and repairs (e.g., oxygen fill and test), annual cost
2. Communication equipment
3. Office--postage, stationary, etc., annual cost

C. Personnel Costs - Non-salaried

1. Management and administrative - rate of pay and annual amount
2. Billing and clerical - rate of pay and annual amount
3. Dispatchers - rate of pay and annual costs (share for EMT)
4. Attendants
   a. What are the methods of reimbursement?
   b. Average number of attendants and drivers who get paid per run
   c. Average cost of paying attendants per run
   d. Cost of attendants per year

IV. PERFORMANCE DATA

1. Dispatch and response time (Ambulance operations best estimates)
   a. Receipt of call to notification of attendants, average time _____.
   b. Notification of attendant to departure of vehicle, average time _____.
   c. Departure of vehicle to arrival at emergency, average time _____.
      i. Percentage of calls within 5_____, 10_____, 15_____, 20_____, 30_____ minute response time.
      ii. Frequency of difficulty in locating victim, _____% of runs.
2. Average time spent at emergency site, _____ minutes.
3. Average travel time from site of emergency to hospital, _____ minutes.

Appendix I-E (cont.)

4. Average travel time from hospital back to base station, _____ minutes.
5. Total average service time (total time that a vehicle is tied up on a run), _____ minutes.
6. Frequency of encountering impassable roads, _____% of runs per year.
7. Frequency and type of interaction with a physician
   a. Hours in training programs
   b. Number of discussions for triage
8. Number of times second vehicle was needed during the last year, when the first vehicle is already on a run or broken down.
   a. Average yearly down-time of primary vehicle, _____ hours or days.
9. Total present mileage on each vehicle,
   primary vehicle _____.
   second vehicle _____.
10. Average annual mileage on each vehicle,
    primary vehicle _____.
    second vehicle _____.
    a. For what reasons is the second vehicle used (e.g., non-emergencies, in conjunction with primary)?

V. ADDITIONAL QUESTIONS

A. Why Does Your Service Include (Exclude) Non-Emergency Transfers?
   1. Who handles these calls?
   2. What difference would it make if you included (excluded) non-emergency transfers?

B. What Difference Would it Make if You Only Had One Vehicle?

Appendix II-A

Average Response Times on 95 Percent of Runs

Operation A's relatively slow response time may be attributed in part to its large service area. The seven minute average response time can be attributed to a relatively low mileage per run of 20 and to having the attendants on call right at the ambulance garage. Operations B and C also have personnel stationed 24 hours a day at the ambulance garage, but this does not seem to be well reflected in these rough estimates of average response times.

Note also that Fire Operations D and E had 30 and 54 fire runs respectively in which their second vehicles went along as precautionary measures. The vehicular costs of these runs are attributed to the ambulance operations, while the personnel costs are attributed to the fire operations for purposes of this study. This is the method of accounting which is used by both of the Fire Operations. The net effect of this accounting methodology on Table 10 is that both the runs per year and the annual mileage are increased.

Appendix II-B

Average Notification to Arrival at Hospital Time

The Private Operation's time is relatively fast for this qualitative measure. This may be partially explained by the nature of the demand in which many of the calls, unlike the other service areas in this study, are Non-Emergency Runs (71%) that emanate from the base town which has almost five times more residents than the next largest town in the study. So it appears that all of the factors which define the nature of demand for an ambulance--total population, population density, total number of runs, breakdown of runs by type, population of towns in which based--all illustrate that the situation in which the Private Ambulance Service operates is different from that in the other case studies.

The service areas of the two Independent Volunteer Operations, however, are very similar to one another. So, too, are the service areas of the two Fire Operations. Given these similarities, comparisons within the two groups become significant. Using "Cost per Mile" as the objective function to be minimized, it appears that Operation B is more efficient than C, and Operation D is more efficient than E. In order to get some inkling whether the differences in cost per mile are due to differences in efficiency or to differences in quality of service, the components of the cost data will have to be examined in detail.

Appendix II-C

Derivation of Vehicle Depreciation

Presented below are the calculations that are behind the figures in Table 11. Note that the purchase prices for Ambulance Operations A, C, and E are only one-half of the retail price of the vehicles. This is due to matching grants that are provided by the Department of Transportation.

Annual Costs in 1977 Dollars

	Primary Vehicle Depreciation	Second Vehicle Depreciation
Ambulance Operation A	$\frac{\$6526 - \$1391}{9.38 \text{ years}} = \$547.21$	$\frac{\$16,600 - \$1777.68}{9.38 \text{ years}} = \$1580.20$
Ambulance Operation B	$\frac{\$14,850 - \$1350}{11 \text{ years}} = \$1227.30$	$\frac{\$6200 - \$770}{8.05 \text{ years}} = \$674.51$
Ambulance Operation C	$\frac{\$5000 - \$333.33}{15 \text{ years}} = \$311.11$	$\frac{\$10,000 - \$666.66}{15 \text{ years}} = \$622.22$
Ambulance Operation D	$\frac{\$11,500 - \$766.66}{15 \text{ years}} = \$715.55$	$0.00 (fully depreciated)
Ambulance Operation E	$\frac{\$8000 - \$533}{15 \text{ years}} = \$497.80$	$\frac{\$5400 - \$360}{15 \text{ years}} = \$336$
Ambulance Operation F	$\frac{\$10,000 - \$1122.30}{75,000 + \frac{16,833}{2}} = \$996.25$	$996.25

Appendix II-D

Costs of Communications Equipment

Since Operations B, C, and F have personnel right at the ambulance garages, they do not rely upon central dispatch, and therefore they have neither the costs associated with the fees of central dispatch, nor the cost of personnel toner-alerts.

Operations A, D, and E, however, must rely on central dispatch and toner-alerts. The cost of this service is completely subsidized and paid for by the county of Operation A. Operation D pays for the lease on the tie-in phone line, but pays nothing for the other equipment or for the personnel. Operation E has the highest annual cost, primarily because it receives no subsidy for central dispatch, having to pay $1,200 per year for that service.

The quality of the total communications system for B, C, and F is deemed inferior solely on the basis of the lack of central coordination. Central coordination would avoid the possibility of the left and right hands not being aware of the other's actions, thus risking the duplication of services and the wasting of scarce recourses. This is definitely a concern in urban areas where jurisdictional boundaries are unclear and ambulance services have been known to fight over a body.

In rural areas, however, the problems are different and the trade-offs involved in establishing central access, dispatch, and resource coordination should be carefully considered. Does the possibility of a slower response time due to a middle-man in the communications network and the potential for less accurate directions obtained by central dispatch outweigh the potential gain from having coordinated resources?

Appendix II-D (cont.)

This is a question beyond the scope of this paper, but worthy of further exploration.

The quality of the radio-to-hospital communications also varies from one service to another. Neither Ambulance Operation B nor F, the two with the lowest annual communications costs, has HERN radios. Operation D also has one vehicle without a HERN radio.

Both Operation A and E have communications systems which meet the State recommendations for a Basic level of service (see the next chapter). Operation A's system might be considered to be the better of the two because it includes a portable HERN. This Operation would also be the most expensive communications system if it were not for its county subsidy.

The calculations that went into the cost figures for the depreciation of communications equipment are summarized below:

Ambulance Operation A	$\frac{\$5425}{10 \text{ years}} + \frac{\$3360}{5 \text{ years}} = \$1214.50$ 1 portable HERN 2 portable toners 2 radios 1 console 20 tone-alerters
Ambulance Operation B	$\frac{2 \times \$734 + \$500 + \$219}{7 \text{ years}} = \$312.43$ 2 radios 1 console 1 scanner
Ambulance Operation C	$\frac{\$4,540.30}{10 \text{ years}} + \frac{4 \times \$160}{5 \text{ years}} = \$582.03$ 2 radios console encoder scanner walkie/talkie weather monitor
Ambulance Operation D	$\frac{\$1975}{10 \text{ years}} + \frac{\$3630}{5 \text{ years}} + \$241.44^{*} = \$1164.94$ 2 radios 22 tone-alerts 1 console *rental central dispatch phone line

Appendix II-D (cont.)

Ambulance Operation E	$\$1200 + 57\% \left(\frac{\$1430.50}{10} + \frac{\$3379.68}{5}\right) = \$1666.82$ central dispatch fee ambulance share of console, encoder, decoder 20 pager-receivers
Ambulance Operation F	$\frac{\$500 + \$3600}{10 \text{ years}} = \$410$ console 3 radios

Appendix II-E

AMBULANCE AND EQUIPMENT CHECK LIST

Estimated Average Cost to Equip an Emergency Vehicle to Meet DOT Specifications

Ambulance Operation License Number ____ Current Ambulance Sticker ( ) Yes ( ) No

Lic. Plate No. ____ Year ____ Make ____ Type of Vehicle ____

(Name of Ambulance Operation) ____ Vehicle Identification No. ____

(Street Address) ____ Replacement Vehicle ( ) Yes ( ) No

(City, Zip Code) ____ Date – State Police Vehicle Safety Inspection ____

EQUIPMENT – SUPPLIES		AVAILABLE ON VEHICLE YES	NO
* Siren	1		
* Flashing, rotating red light	2		
* Rear door for loading & unloading	3		
Ambulance Cot $430	4		
Straps (attached to cot) for securing patient to cot 3x $4 = $12	5		
* Means of securing cot to ambulance $5.00	6		
* Portable suction apparatus with wide bore tubing & rigid pharyngeal tip $316.75	7		
Hand operated bag-mask - Adult, child & infant. Valves must operate in cold weather & must be capable of use with oxygen supply Ambu Bag $84.00	8		
Oropharyngeal airway in adult, child & infant sizes 3x$.95 = $2.85	9		
Mouth-to-mouth ventilation airways for adult and children $4.00	10		
* (portable) Oxygen with adequate tubing & semi-open, valveless transparent masks in adult, child & infant sizes $284	11		
Sterile IV's in plastic bags with administration kits (Adv. life support)	12		
Hinged half-ring traction splint limb supports & padded hitch 2 per car $150	13		
Short spine board with accessories $15) $35) homemade	14		
Long spine board with accessories	15		
Fire extinguisher (UL approved) Minimum Rating 2-A-20 B.C. $75	16		
Mouth gags, commercial or 3 tongue blades (taped & padded) 3x$1.35 = $4.05	17		
5x$1.65 ea. = $8.25 Universal dressings - 10" x 36" folded & packaged	18		

EQUIPMENT – SUPPLIES		AVAILABLE ON VEHICLE YES	NO
30 per veh. 100/Box Sterile gauze pads 4" x 4" (12) $10.72	19		
Soft roller self-adhering type bandage 6" x 5 yard 32/car 5xo for $5.23 = $26.15	20		
Roll aluminum foil 18" x 25' sterilized & wrapped approx. $4.00	21		
1", 2" & Two rolls tape 3" wide $5.20	22		
Two sterile burn sheets 2x $5.25 = $10.50	23		
Two padded board splints 4½" x 3" $24	24		
Two padded board splints 3' x 3" Home-made	25		
Two or more padded boards 15" x 3" (option) cardboard, plastic, wire or canvas laced	26		
Uncomplicated inflatable splints in addition to item above or short boards $56.50	27		
4 Triangular bandages (3) 3x $1.20 = $3.60	28		
Large size safety pins $1.00	29		
Sheers for bandages 2x $5.00 = $10.00	30		
Sterile OB kit $10.00	31		
(refrig.) Poison kit $14.70	32		
$60 $10 = $70 Blood pressure manometer, cuff and stethoscope	33		
Pillows (2) 2x $3.00 = $6.00	34		
Communications (MDPH Approved)	35		
OPTIONAL EQUIPMENT Extrication equipment	38		

COMMENTS ____ TOTAL 2 vehicles x $1687.89 = $3375.78

*On vehicle from dealer

Signature of Person Interviewed ____ Signature of Health Department Representative ____ Health Department ____

Date of Inspection ____

:82 REV. 3/77

Green Copy: MDPH - Division of EMS
Yellow Copy: Local Health Department
White Copy: Ambulance Service

Appendix II-F

RETAIL PRICES OF EXTRA EQUIPMENT THAT AMBULANCE OPERATIONS CARRY

Quantity

Decision-Making Unit:		PUBLIC			INDEPENDENT		PRIVATE
Type of Operation:		Separate	Joint(Fire	Joint(Fire)	Separate	Separate	Separate
Personnel Arrangement:		Volunteer	Volunteer	Volunteer	Volunteer	Volunteer	Paid
Level of Service:		BASIC	MINIMUM	BASIC	MINIMUM	BASIC	BASIC
Equipment	$/Unit						
Saline Solution/Distilled H_2O	$4.00			1	1		1
Anti-Shock Air Pants	300.00			1			
Aspirin	.50						
Cough Syrup	1.00						
Blankets	5.00			1		1	
CPR Board	36.00				1		1
Ring Cutters	18.00			1			
Hot & Cold Packs each @	.90			12	1	3	
Cervical Collars set of 3	18.00			2	2		1
Cots	51.00	3		2	2	2	2
Stair Chair	123.75			1			
Urinal/Emesis Pans (free from hospital)				1	1	1	
Jump Kits - homemade @	50.00	3				1	1
Jaw Spreader	7.00						
Extra Oxygen (D) Cylinder	121.00	1 D					2 Ds
(E) Cylinder	70.00	1 E					
Scoop Stretcher	163.25	1			1		1
Laerdal Suction Unit	316.75			1	1	1	
Heart Monitor	450.00	1 (donated)					
Timer	6.00					1	
Portable Oxygen/Aspirator (Robertshaws)	320.00			1			
Extrication Equipment (see Appendix M for itemized list)				1 ($1076)		1 ($1076)	1 ($28)
Hand and Leg Restraints	8.91			1			2
Pen-Lights	1.25			6			2
Reflex Hammers	5.00						1
TOTAL COST		$657.25 (purchases only)	No Data	$2,328.71	$658.90	$1,558.45	$668.57

Appendix II-G

Cost Calculations for Salaried Personnel

Public (county) Ambulance Operation A:

$9,120 =	$400 x 12 months	manager
	$15 x 12 months	secretary at one ambulance base
	$4,140	county clerk half-time + 15% benefits

Fire Ambulance Operation D:

$945 =	$300/year	manager*
	$225/year	bookkeeper*
	$420/year	janitor*

*Both the manager (fire chief) and the janitor perform duties which benefit both the fire and ambulance operations simultaneously. These cost figures are 75 percent of their annual combined fire/ambulance pay since ambulance runs were 75 percent of all runs by Fire Operation D in 1977.

The bookkeeper's (township clerk's) salary is based on the fraction of his time devoted to ambulance work.

Fire Ambulance Operation E:

$465 =	$135 x 12 months x .25	managers, trainers*
	$60	clerical*

*This operation pays six people monthly stipends which add up to $135 per month. These people handle maintenance, training, purchase of supplies, record-keeping, and overall management. The share attributed solely to the ambulance side of their fire/ambulance operation was 25 percent.

The clerical cost is also just a percentage of the township's staff's time.

Appendix II-G (cont.)

Private Ambulance Operation F:

$53,762.16 =	$2.65/hour x 60 hours x 52 weeks	One full-time salaried person
	$2.65/hour x 276 hours x 52 weeks	Total hourly wages paid to attendants
	$2.65/hour x 10 hours x 52 weeks	Part-time bookkeeper
	$2.65/hour x 40 hours x 52 weeks	One full-time dispatcher/ clerk
	$571.36	Wages necessary to man the second vehicle

Appendix II-H

Derivation of Training Costs

Public (county) Ambulance Operation A:

Initial training average yearly cost =

$$\$219 = \frac{35 \text{ attendants} \times \$50/\text{course}}{8 \text{ years with operation}}$$

In-Service training = $3,300 = 11 attendants x $25 x 12 months

Operation A pays their personnel at one of the two bases $25 per person to participate in the monthly training sessions. The other base is at the hospital where they can maintain their skills without expense.

Independent Volunteer Operation B:

Initial training average yearly cost =

$$\$260 = \frac{52 \text{ people} \times \$25 \text{ (books)}}{5 \text{ years}}$$

In-Service training = $25 = 52 people x 60% (attendance) x $.10 (cup of coffee) x 8 meetings per year

Independent Volunteer Operation C:

Initial training yearly cost = $336.50 = $\frac{2 \times \$25}{4 \text{ years}} + \frac{18 \times \$90}{5 \text{ years}}$ for which there are two people trained at advanced first aid and 18 people at the EMT levels.

Fire Ambulance Operation D:

Initial training yearly cost =

$$\$61 = \frac{22 \text{ attendants} \times \$19.50}{7 \text{ years}}$$

In-Service training = $180 = 6 meetings per year x $30

Appendix II-H (cont.)

Fire Ambulance Operation E:

Initial training yearly cost = $205.26 = $\frac{\text{6 attendants x \$25}}{\text{9.5 years}}$ + $\frac{\text{20 attendants x 90}}{\text{9.5 years}}$ where 6 and 20 refer to attendants trained to advanced first aid and to EMT levels respectively.

In-Service training = $1,014 = 26 attendants x $3 x 13 meetings per year.

This data is extrapolated from other data.

Private Ambulance Operation F:

Initial training yearly cost = $105 = $\frac{\text{3 x \$25}}{\text{5 years}} + \frac{\text{5 x \$90}}{\text{5 years}}$ where attendants trained to the advanced first aid and EMT levels numbered 3 and 5 respectively.

Appendix II-I

Derivation of Overhead on Physical Plant

Independent Volunteer Ambulance Operation C:

$250/year for 10 years for depreciation of furnishings which include:

Color TV	Sofa
Radio	5 chairs
Soft drink machine	Curtains
Stove	Bedspreads
Refrigerator	2 desks
2 beds	Card table
20' x 20' rug	C.B. radio

Private Ambulance Operation F:

$3,700 maintenance costs really includes a number of different items which Operation F's record-keeping procedures did not permit breaking out. Part of the sum, however, could be allocated to both "Supplies and Equipment Costs" and to "Social Events."

Appendix II-J

Office Supply Costs

Operation D does not charge those who use their services, and therefore the billing costs are zero and the overall office supply costs are just $30--the lowest for the operations studied.

Ambulance Operations B and C have office supply costs that are almost as great as those for the Private Ambulance Operation which has almost three times their number of bills to send out. These high costs are due to the costs associated with their annual membership drives and subscription sales. These two operations believe that the liquidity which they gain is worth the expense.

Appendix II-K

Non-Salaried Total Personnel Costs

Public (county) Ambulance Operation A:

$9,144 = $172 runs x $27) + (300 runs x $15)

The two different bases in this ambulance operation each have a different rate structure. One base had 172 runs in 1977 for which the county reimbursed the attendants $27 per run. The other base, the hospital, had 300 runs in 1977. They charge the county $30 per run, but only half of this sum goes to cover the wages of personnel. The other half is used to cover overhead on physical plant, supplies and equipment, etc.

Independent Volunteer Operation B:

Neither attendants nor anyone else in this volunteer operation are reimbursed for their efforts or expenses.

Independent Volunteer Operation C:

$4,385 is approximately equal to three men being paid $5 each for the 308 runs during 1977.

Fire Ambulance Operation D:

$2,115 equals $45 ÷ 2 x 94 runs. The operation bills the county a flat fee of $45 per run of which half of it is used to reimburse personnel and the other half is used for social events.

Fire Ambulance Operation E:

$2,968 (having subtracted out $1,014 for In-Service training) is the total cost that was billed to the township on the basis of a formula

Appendix II-K (cont.)

which includes paying $3 per person for showing up for, or going on, a run; $6 per person for showing up for, or going on, a run after midnight; and $1 per driver or attendant for each hour of work after the first hour.

Appendix II-L

Social Event Costs

Public (county) Ambulance Operation A:

$1,548 = 172 runs x $9 per run

One of the two ambulance bases run under the auspices of Operation A receives $9 per run to be used as the ambulance service sees fit (i.e., for parties, donations, uniforms, some specialized equipment, training devices).

Independent Volunteer Operation B:

$1,385 was spent on a dinner party, a Christmas party, a picnic, free coffee, and soft drinks subsidized at 3 cents per can.

Fire Operation D:

$2,115 is the matching fund that is described in detail in Appendix II-K.

Appendix III-A

Cost of a New Vehicle

Van Type		Modular
$17,500-$18,500	(Ambulance chassis which meet D.O.T. specifications)	$22,000-$30,000
$ 1,200-$ 1,900	HERN RADIO with digital dialer, channel scan in higher price range	$ 1,200-$ 1,900
$1,800	Supplies and D.O.T. Equipment (D.O.T. required allowing for some homemade equipment and some army surplus purchases)	$1,966.75
$665	Extra Equipment (See summary sheet for extra equipment)	$665
$21,165-$22,865		$25,831.75-$34,531.75

Appendix III-B

Costs of Upgrading Training

There are a number of variables which make it difficult to say exactly what it will cost to train someone to the Advanced First Aid and Emergency Care level that is required for licensure by EMS. Some of these variables include:

1) Cost of the Red Cross Advanced First Aid Course. Here in Lansing, this course presently consists of two prerequisites plus the main course itself.

   a) CPR course -- 12 hours, fee of $5.00

   b) First aid course -- 8 hours, fee of $6.50

   c) Advanced first aid course -- 75 hours, fee of $25.00

Note that the fees cover the costs of the books and materials, but not the overhead for such items as the cost of instructors, administration, and the classrooms.

The total hours and the fees for an Advanced First Aid and Emergency Care course will vary throughout the State. It has been said that the Lansing program is probably more rigorous than that which is found in other parts of Michigan.

2) Opportunity cost of attending these courses. This cost consists of not only the value that a person places on the activity that he/she must give up to attend these classes, but also the transportation costs of getting to and from the classes. These costs will vary according to the location of the students vis-a-vis the class and the time available to the students.

A ball-park figure for these costs can be given if we assume that:

Appendix III-B (cont.)

a) The Advanced First Aid Course consists of 22 sessions lasting about 4 hours each.

b) $5.00 per session will cover the opportunity cost to the individual.

Thus the costs of training one person to the Advanced First Aid level are $36.50 (materials) + $110 (opportunity cost) = $146.50. This is the cost which accrues to either the individual or to the ambulance service. It can be depreciated annually to the ambulance service on the basis of length of time the attendant can be expected to stay with the ambulance operation. Empirical evidence in the study showed the average stay to be seven years. The cost to society in general would be much higher than the aforementioned figure since it would include the overhead costs of the course itself.

"In-Service" training requires a minimum of twenty hours per year. Assuming that this is met in six sessions of three hours duration, and that the operating cost is zero and the time cost is $5.00 per session, then the annual cost per person of in-service training is $30.00. This is very close to the norm in the empirical data.

The numbers in the chart for Standard 6 were calculated as done below for Operation C:

$(34 - 20) \times (\frac{\$146.50}{7 \text{ years}} + \$30) = \$713$ that must be spent on Initial Training and In-Service to bring Operation C up to Basic Level.

34 -- is the required number of staff for a 2-vehicle service that is staffed with volunteers

20 -- is the existing number of volunteers in the service

Appendix III-B (cont.)

Note that Operation F needs nine fully paid staff per vehicle. Since this operation is short one vehicle, as explained under Standard 3, nine people must be added to the staff register just for this additional vehicle.

Even though the staff register expands, the total salaries and wages would remain at the previous level. This is because the number of vehicles does not affect a priori the level demand, and therefore, the total amount in wages paid will not change. However, the composition of recipients will hopefully change, since this is the intent of the recommendation. It is hypothesized that attendants working more than 40 hours or so a week will become fatigued and possibly less effective on the job.

Although there are no cost implications for the Private Operation F in terms of increased salaries and wages, there will be increased costs to Operation F for both processing the paperwork for additional people, and the high initial rate at which the additional social security payments will have to be matched by Operation F. It is very difficult to budget appropriately for these additional costs. It is important at least to recognize that these represent real cost increases to the Private Operation.

Appendix III-C

Cost Implications of Standard 7

An approach to the cost implications of this Standard is to assume that if half of the number of attendants that are required of an ambulance service have EMT training, then this Standard is met. The fallacy of such an assumption is that the level of training of the staff does not guarantee what combination of personnel will run the vehicles, it only guarantees that theoretically a service will have enough staff of the designated level of training to meet State recommendations. Likewise, a service could have less than 50% of its attendants with EMT training, yet still have an EMT on each run. But as long as precise data on who has been on each run does not exist, then we will stick with the rule of thumb for the purposes of this cost analysis that 50% of the total pool of attendants must have EMT training.

The financial costs of EMT training vary across Michigan. These costs are a function of: frequency, location, prerequisities, hours in course, state, federal, and local subsidies, whether the EMT training is administered by hospitals, community colleges, or independent instructors. A rural ambulance operation will typically have an infrequent need for EMT training, in a location that is distant from hospitals or community colleges. These factors will tend to increase costs via diseconomies of scale and higher transportation costs for participation.

Some EMT training courses have Advanced First Aid and Emergency Care as a prerequisite. Apparently this is not widespread, and we will assume that it is not the case for the purposes of this study. The Federal Training Guidelines for EMS recommends Red Cross Advanced First Aid as

Appendix III-C (cont.)

a prerequisite. They stress that Advanced First Aid training and EMT training are distinct and serve different purposes.

The Division of EMS recognizes the value of having future attendants exposed to Advanced First Aid before being immersed in an EMT course. But the Division has not required any prerequisites to their EMT courses. The EMS administrators believe that the quality control that is built into their training programs and a uniform testing procedure for licensure of both instructor-coordinators and the EMTs themselves, will guarantee a satisfactory level of knowledge and skills.

The financial or out-of-pocket costs of EMT training range from $50-$200 per person according to a random sample. A college charges a $90 fee which apparently covers 30 percent of the economic costs of EMT Training per person. A freelance instructor charges $50 per EMT trainee if he/she does not have to travel to conduct the class. For $200 per EMT trainee, this same instructor will travel to any location that is convenient for a group of EMT students. This latter fee would thus cover the opportunity and transport costs incurred by the EMT instructor. The $50 fee and the $200 fee are equivalent if it can be assumed that the opportunity cost of travelling for the 25 four-hour sessions is $6 per session. Since people in most rural areas have to travel some distance to these classes, we will assume that the financial cost is $200 per EMT trainee for the purpose of this table.

The derivation of the cost figures for Standard 7 in the chart are derived as follows:

Appendix III-C (cont.)

Operations A, C, and E:

No additional cost since enough are already there.

Operation B:

2 people x $\frac{\$200}{7}$ = \$54.14

Operation D:

(17 people x $\frac{\$200}{7}$) + (12 x \$30) = \$845.71 where 17 is the number of people that must take EMT training; 12 is the number of new people that must be added to the service; \$30 is the annual cost per person for in-service training.

Operation E:

Total personnel recommended: 9 x 3 vehicles	=	27
Existing staff needed		- 8
New staff needed		19
Recommended number of EMTs		14
Existing EMTs		- 5
New EMTs recommended		9
New Advanced First Aid staff: 19 - 9	=	10

Standard 6: 10 ($\frac{146.50}{7}$ + 30) = \$509.28

Standard 7: 9 ($\frac{200}{7}$ + 30) = \$527.14

Appendix III-D

Derivation of the Costs in the Chart for Standard 9

The costs in the chart for Standard 9 were calculated as follows:

A. No change

B. 2-vehicles x $\frac{\$2,000}{10 \text{ yrs.}}$ new system to replace present system whose wattage is too low.

C. No change

D. $\frac{2,000}{10 \text{ yrs.}}$ HERN needed for just one vehicle

E. No change

F. $3 \times \frac{2,000}{10}$

Appendix III-E

Definitions and Implications of Standards 21, 22, 23

"Central access" consists of the following stages. First, a locality will have one telephone number that handles all emergency calls, including fire, police, ambulance, etc. This one number eliminates the cumbersome nature of multiple emergency numbers which might confuse or delay a person in alerting the proper authorities that emergency assistance is needed.

Second, in "central access," the local telephone number, either 911 or a local exchange number, should be answered by one person or one coordinated telephone answering service. Since each of the localities may have different district phone numbers instead of a standardized 911 system, all of these numbers must be tied into one switchboard. A protocol could be established in which the central answering service responds by using the name locality X when locality X's telephone exchange lights up on the switchboard, and uses the name of locality Y when Y's exchange number lights up. This telephone answering service in rural Michigan would typically be handled by the County Sheriff's Office, but it could theoretically be handled by any organization that has someone manning telephones 24 hours per day. In some states, nursing homes, Holiday Inns, or even non-organizations are used instead of the county sheriff's office if there is a question about biased dispatch.

"Central dispatch" in urban areas is often separate from "central access." "Central access" will just route a call to the proper dispatcher--be it fire, ambulance, policy, or town hall. It is then the function of central dispatch to identify and notify the appropriate

Appendix III-E (cont.)

emergency service of services given the nature and location of the call. This notification is usually accomplished by a signal sent out on a tone encoder, and then by voice communication by radio on a designated frequency.

In rural areas, a "central access" and "central dispatch" can typically be handled by the same person or group of people in a telephone answering service. This arrangement allows the needed emergency services to be notified as quickly as possible. For example, if there is a multiple-vehicle highway accident, central dispatch can simultaneously notify both policy (for traffic control) and ambulance operations that their services are needed. Without a system of central access and dispatch, a delay in notification would result from one emergency service having to relay the call for assistance to the other service.

"Central resource coordination" seeks to use emergency resources in a cost-effective manner. After an ambulance operation has had one vehicle dispatched to the scene of an accident, for example, the vehicle should communicate with the central resource coordinator to inform him/her that:

a) the ambulance operation's second vehicle should be dispatched, or,

b) the second vehicle plus a vehicle from an adjoining service should be dispatched, or

c) there is no problem.

Appendix III-E (cont.)

The central access/dispatch/resource coordinator might also want to communicate with the vehicle en route to notify them that the call has been cancelled or the directions verified and changed.

These roles which the Division of EMS has defined for central access/dispatch/resource personnel may conflict with what some rural communities view to be in their own best interests. Some communities would argue that their local channels of emergency communication already provide the best use of resources. Their three main arguments would be:

First, the problem of jurisdictional boundaries (e.g., two ambulance services fighting over one body) is strictly an urban problem where jurisdictional boundaries overlap or are unclear. Rather than this, rural areas may instead have the problem of gaps between jurisdictional boundaries.

Second, mutual aid agreements with neighboring ambulance services are organized well enough to be sufficient in providing back-up assistance when it is needed.

Third, central dispatchers, because they are unfamiliar with all of the localities within a county, often do not obtain and give out clear, precise locations of where emergency assistance is needed. A township, for instance, may have two Maple Streets that are ten miles from each other. Not realizing the potential problem, the central dispatcher will not be able to ask the harried caller to name a nearby landmark or intersection which would distinguish the two Maple Streets and thus save the emergency service from a long delayed response.

The Division of EMS argues, with respect to this last problem, that with good maps at their disposal, and training in the appropriate

Appendix III-E (cont.)

questions to ask, that central access/dispatch/resource coordinators could provide clear, precise information to the ambulance services. It thus appears that although theory suggests that the centralized system is best, implementation may prove to be a stumbling block. This is particularly so given the jurisdictions that would have to be changed.

Appendix III-F

1978 PRICES FROM DYNAMED CATALOGUE

RECOMMENDED MINIMUM EQUIPMENT FOR REGISTERED RESCUE-EXTRICATION VEHICLES

$36.00	2 ea.	cervical collars - small, medium, and large
	*1	4-ton porta-power with small jaws and pump (color coded) yellow
	*1	4-ton porta-power with large spreader jaws and pump (color coded) red
*$1076.	*1	2-ton rated come-a-long, chain or cable type
	*1	5 foot heavy-duty chain - 6200 lb. capacity
	*1	12 foot heavy-duty chain - 6200 lb. capacity
	*1	hacksaw with at least six (6) blades (carbide)
	*2	bailing hooks
	*1	heavy-duty electrician's knife (linoleum)
	*1 pr.	channel lock 10" pliers
	*1	standard screwdriver 8"
	*1	phillips screwdriver 8"
	*1	12" wrench with adjustable open end
$46.65	1 pr.	bolt cutters, 36" long with 1" jaw opening
	*1	partner pry axe or similar tool
$228.75	1	air chisel set with regulator, capable of 300 psi operations, from "SCOTT" or scuba tanks (set should include blades for cutting sheet metal as well as heavy metal support structures of automobile) recommend: 1 - T-bar blade (Panel Cutter) 1 - 7" flat chisel 1 - 15" flat chisel
$7.00	1	spring loaded center punch
Homemade	12	cribbing blocks 4" X 4" X 18"
Homemade	12	cribbing blocks 2" X 4" X 18"
$10.00	1	double face 5 lb. hammer 16"
$10.00	2	pinch bars (crowbar) 36"
$10.00	2	50 foot lengths of ½" synthetic rope
	*1	double action tin snip (minimum 8")
Army $1. Surplus	1	shovel - 49" with pointed blade
2X$71.75	2	asbestos or aluminized rescue blankets to protect victims
	1 set	gloves, hard hat, and goggles for each equipment operator

$2.10 $8.80 $1.55

Total $1,592.80

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Appendix III-G

The Costs of Personnel Salaries, Training, and Physicals for the "Typical Ambulance Operations"

Salaries	5,000[a]	0	0	5,000	5,000	53,000[b]
Training:						
Initial	437[c]	309[d]	437	309	437	231[e]
In-Service	1,020[f]	58[g]	82[h]	720[i]	1,020	0[j]
Physicals[k]	136	96	136	96	136	72
TOTAL	6,593	463	655	1,625	2,093	53,303

a) $5,000 = estimates cost of manager, secretary, and dispatcher.

b) $53,000 = cost of administrators and salaried attendants based on that found in the empirical study.

c) $437 = $\frac{\text{34 attendants x \$90 per EMT course}}{\text{7 years attendant will remain with operation}}$

d) $309 = $\frac{\text{24 attendants x \$90 per EMT course}}{\text{7 years attendant will remain with operation}}$

e) $231 = $\frac{\text{18 attendants x \$90 per EMT course}}{\text{7 years attendant will remain with operation}}$

f) $1,020 = 34 attendants x $5 per meeting x 6 meetings per year.

g) $58 = 24 attendants x $.40 coffee x 6 meetings per year.

h) $82 = 34 attendants x $.40 coffee x 6 meetings per year.

i) $720 = 24 attendants x $5 per meeting x 6 meetings per year.

j) $0 = all in-service training handled on the job.

k) Physicals are calculated at $\frac{\text{total \# attendants}}{5}$ x $20 which assumes that only 20% of the attendants will not have someone else to pay for their physicals.

Appendix III-H

Non-Salaried Personnel Costs in Standardized Systems

Public (county) Operation A: $11,070.00 = $30 x 369 runs per year

Independent Volunteer Operation B: There are no wages, salaries, or reimbursements to personnel in this personnel arrangement.

Independent Volunteer Operation C: $5,535 = 3 attendants x $5 x 369 runs

Fire Operation D: $8,302.50 = $22.50 x 369 runs

Fire Operation E: $13,284.00 = $3 x 12 people x 369 runs.

This system of dispatching personnel consists of notifying all personnel, resulting in usually 12 showing up at a time. This works well when runs per year are low (82) as in the empirical study. It avoids the complication of predetermining schedules. But this system would probably work less well and at a much higher total cost if there were 369 runs per year. With about one call per day, volunteers would be less willing to show up, and if they did, the costs would be very high, as is shown in the chart.

Private Paid Operation E: All personnel are salaried, none are paid on strictly a per run basis.

Appendix III-I

The Standardized Cost of Office Supplies and Public Relations

To adjust for the differing number of runs in the empirical study, the average annual number of runs used in this typical system is divided by the number of annual runs in the empirical study for each institutional arrangement, which in turn is multiplied by the original cost factor in the case study. For example, for the Private Paid Operation:

$$\frac{369}{845} \times \$540 = \$224$$

Appendix IV-A

Analytic Guideline - Procedure for Doing a Cost Study of an Ambulance Operation

The guide presented on the next four pages is a summary of the steps and techniques followed during a recent study. It is intended to be concise. Those people interested in the underlying rationale for the procedures should refer to the study entitled The Costs Associated with Different Levels and Arrangements of Ambulance Operations in Rural Michigan.

Note: Not all of the items mentioned in the Guide are applicable to every ambulance operation. Some small items that may be applicable have not been included simply for the sake of brevity. Cost items should be added or deleted as is appropriate for each ambulance operation.

SIMPLIFIED PROCEDURE FOR ESTIMATING ANNUAL COSTS OF AN AMBULANCE OPERATION[a]

I. OVERHEAD EXPENSES (expenses that exist regardless of number of runs per year)

A. Annual Depreciation for Capital Items Owned

1. Annual Vehicle Cost (if annual mileage for all vehicles divided by 2, the number of vehicles, is greater than 5,000 miles, use formula (a); if it is less, use formula (b). Make a calculation for each vehicle.)

Primary Vehicle $_____

Second Vehicle $_____

Third Vehicle $_____

(a) Formula = $\dfrac{\text{Purchase Price - DOT Subsidy - Salvage Value}^{b}}{75{,}000 \text{ miles} \div \dfrac{\text{Annual mileage for all vehicles}}{\text{Number of Vehicles}}}$

(b) Formula = $\dfrac{\text{Purchase Price - DOT Subsidy - Salvage Value}^{b}}{15 \text{ years}}$

2. Annual Communication Equipment Costs (excludes telephone at garage/office)

(a) $\dfrac{\text{Cost of personnel alert-toners}}{5 \text{ years}}$ $_____

(b) $\dfrac{\text{Cost of other communications equipment including garage and vehicle radios, encoder, scanners, CB's, etc.}}{10 \text{ years}}$ $_____

3. $\dfrac{\text{Annual cost of other vehicular capital equipment not included in purchase price of vehicles such as oxygen, cots, suction, splints, back-boards, etc.}}{10 \text{ years}}$ $_____

B. Fee Charged for Central Dispatch (such as by County Sheriff). $_____

C. Overhead on Physical Plant

1. Rent $_____
2. Utilities $_____
3. Maintenance $_____
4. Telephone $_____

D. Annual Insurance Costs

1. Primary Vehicle $_____
2. Second Vehicle $_____
3. Workmen's Compensation $_____
4. Other--specify _____ $_____

E. Annual Cost of Personnel Paid Salary or Hourly Wage (include cost of benefit package, approximately 15%; exclude costs of personnel paid on a run basis) $_____

F. Costs of Physicals for Personnel $_____

SUBTOTAL $_____

[a]The basic format for this procedure comes from one done by G. A. Doeksen in the Economics of Rural Ambulance Service in the Great Plains, USDA ERS, AER number 308.

[b]Salvage Values = .066 (purchase price - DOT subsidy)

SUBTOTAL from previous page	$_____
G. Training Costs	
1. Cost of training personnel to present level of proficiency / Average expected number years with service	$_____
2. In-service training costs	$_____
H. Annual Taxes and Fees (includes license fee of the Department of Public Health, personnel licenses, state motor vehicle registration fee, property and income tax, etc.)	$_____
I. Professional Fees (e.g., lawyer, accountant, collection agency)	$_____
J. Other Overhead Costs (e.g., public relations, bank box rental)	$_____
TOTAL Overhead Expenses	$_____
II. OPERATING EXPENSES (expenses that vary with the number of runs)	
A. Vehicles	
1. Gasoline (yearly mileage ÷ 10 m.p.g.[c]) x $_____ (cost per gallon)	$_____
2. Tires (cost of 4 tires ÷ 4 years) x number of vehicles	$_____
3. Annual Tune-Up Costs--including oil change and lubrication	$_____
4. Annual Repair Costs	$_____
B. Supply and Equipment Costs for One Year	
1. Laundry	$_____
2. Maintenance and repairs of communications equipment	$_____
3. Oxygen tests and refills, replacement of bandages, other supplies, misc. repairs	$_____
4. Office Supplies--records, billings, forms, fliers, postage	$_____
C. Non-Salaried Personnel Costs (number of runs times per run cost of personnel[d])	$_____
D. Costs of Social Activities (e.g., coffee and soft drink subsidy, donations to public organizations such as the Little League)	$_____
TOTAL Operating Expenses	$_____
Plus Total Overhead Expenses	$_____
III. GRAND TOTAL EXPENSES PER YEAR (excluding any interest charges)[e]	$_____
Total Cost per Run--(Grand total expenses per year ÷ number of runs)	$_____
Total Cost per Capita--(Grand total expenses per year ÷ population in the service area)	$_____
Total Cost per Mile--(Grand total expenses per year ÷ total mileage during year)	$_____

[c]Or the appropriate rate for your vehicles.

[d]Or other appropriate calculation.

[e]Private or public services may wish to include an additional cost for interest paid on any loans or a cost equal to the interest which could be earned on the average value of all capital owned by the service.

SIMPLIFIED PROCEDURE FOR ESTIMATING ANNUAL COSTS OF AN AMBULANCE OPERATION[a]

I. OVERHEAD EXPENSES (expenses that exist regardless of number of runs per year)

A. Annual Depreciation for Capital Items Owned

1. Annual Vehicle Cost (if annual mileage for all vehicles divided by 2, the number of vehicles, is greater than 5,000 miles, use formula (a); if it is less, use formula (b). Make a calculation for each vehicle.)

(a) Formula = $\frac{\text{Purchase Price - DOT Subsidy - Salvage Value}^{b}}{75{,}000 \text{ miles} \div \frac{\text{Annual mileage for all vehicles}}{\text{Number of Vehicles}}}$

(b) Formula = $\frac{\text{Purchase Price - DOT Subsidy - Salvage Value}^{b}}{15 \text{ years}}$

Primary Vehicle	$ 5472.21
Second Vehicle	$ 1530.20
Third Vehicle	$ 0

2. Annual Communication Equipment Costs (excludes telephone at garage/office)

(a) $\frac{\text{Cost of personnel alert-toners}}{5 \text{ years}}$ — $ 672.00

(b) Cost of other communications equipment including garage and vehicle radios, encoder, scanners, CB's, etc. $\frac{\quad}{10 \text{ years}}$ — $ 542.50

3. Annual cost of other vehicular capital equipment not included in purchase price of vehicles such as oxygen, cots, suction, splints, back-boards, etc. $\frac{\quad}{10 \text{ years}}$ — $ 402.30

B. Fee Charged for Central Dispatch (such as by County Sheriff). — $ 0

C. Overhead on Physical Plant

1. Rent	$ 5,870.00
2. Utilities	$
3. Maintenance	$ 1,250.00
4. Telephone	$

D. Annual Insurance Costs

1. Primary Vehicle	$ 850.00
2. Second Vehicle	$ 350.00
3. Workmen's Compensation	$ 300.00
4. Other--specify _____	$ 0

E. Annual Cost of Personnel Paid Salary or Hourly Wage (include cost of benefit package, approximately 15%; exclude costs of personnel paid on a run basis) — $ 9,120.00

F. Costs of Physicals for Personnel — $ 250.00

SUBTOTAL — $15,774.21

[a]The basic format for this procedure comes from one done by G. A. Doeksen in the Economics of Rural Ambulance Service in the Great Plains, USDA ERS, AER number 308.

[b]Salvage Values = .066 (purchase price - DOT subsidy)

SUBTOTAL from previous page	$ 6,774.21
G. Training Costs	
1. Cost of training personnel to present level of proficiency / Average expected number years with service	$ 219.00
2. In-service training costs	$ 3,200.00
H. Annual Taxes and Fees (includes license fee of the Department of Public Health, personnel licenses, state motor vehicle registration fee, property and income tax, etc.)	$ 59.00
I. Professional Fees (e.g., lawyer, accountant, collection agency)	$ 500.00
J. Other Overhead Costs (e.g., public relations, bank box rental)	$ 0
TOTAL Overhead Expenses	$ 26,893.21
II. OPERATING EXPENSES (expenses that vary with the number of runs)	
A. Vehicles	
1. Gasoline (yearly mileage ÷ 10 m.p.g.[c]) x $ _____ (cost per gallon)	$ 80.00
2. Tires (cost of 4 tires ÷ 4 years) x number of vehicles	$ 166.50
3. Annual Tune-Up Costs--including oil change and lubrication	$ 200.00
4. Annual Repair Costs	$ 400.00
B. Supply and Equipment Costs for One Year	
1. Laundry	$ 350.00
2. Maintenance and repairs of communications equipment	$ 100.00
3. Oxygen tests and refills, replacement of bandages, other supplies, misc. repairs	$ 1,600.00
4. Office Supplies--records, billings, forms, fliers, postage	$ 178.00
C. Non-Salaried Personnel Costs (number of runs times per run cost of personnel[d])	$ 9,144.00
D. Costs of Social Activities (e.g., coffee and soft drink subsidy, donations to public organizations such as the Little League)	$ 1,545.00
TOTAL Operating Expenses	$ 14,038.50
Plus Total Overhead Expenses	$ 26,893.21
III. GRAND TOTAL EXPENSES PER YEAR (excluding any interest charges)[e]	$ 40,931.71
Total Cost per Run--(Grand total expenses per year ÷ number of runs)	$ 86.77
Total Cost per Capita--(Grand total expenses per year ÷ population in the service area)	$ 4.76
Total Cost per Mile--(Grand total expenses per year ÷ total mileage during year)	$ 2.53

[c]Or the appropriate rate for your vehicles.

[d]Or other appropriate calculation.

[e]Private or public services may wish to include an additional cost for interest paid on any loans or a cost equal to the interest which could be earned on the average value of all capital owned by the service.

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