EMERGENCY MEDICAL SERVICES IN MOSCOW

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1. Introduction

1.1 Background

At the invitation of the Soviet Committee for Systems Analysis, I visited Moscow in May 1975, to discuss mutual research interests with Soviet scientists and managers. One of the discussion sessions focussed on emergency medical services (EMS), centering in particular on ambulance and associated services in the city of Moscow. Though brief, this session provided a valuable exchange of information, research results, and ideas. It also provided a useful basis for future discussions.

This paper presents main points about Moscow's EMS distilled from the session, augmented by parallel research, and notes areas that could fruitfully be pursued in further discussions.

1.2 First Impressions--Quality Services

Worth emphasizing at the outset is the apparent quality of Soviet activity in this field, highlighted by the material presented in the session. As this paper indicates, emergency medical services in the Soviet Union receive more attention and more resources than do EMS in other advanced countries. And, though confirmation was not possible in the brief session, the results appear to be of commensurably high quality.

In terms of systems analysis, experts in the session revealed the existence of a sizeable body of research; from the limited information thus far made available, parts of this appear to be conceived more broadly, executed more

thoroughly, and applied more successfully than comparable work elsewhere. In practical terms, though time did not permit viewing actual service delivery, examination of the central ambulance dispatching center, followed by discussion of central management and operating issues, also yielded favorable impressions.

1.3 Others' Impressions

Moscow is proud of its emergency medical services, and Western observers have been appreciative. At least five accounts [3, 4, 5, 10, 11, 12] share my impressions. The Chicago Tribune's Moscow correspondent is particularly laudatory: Jackson [3] terms the Moscow ambulance service "among the world's best," and approvingly quotes an observer who calls it "one of the smoothest and best organizations in Moscow," with "crews superbly trained."

Osnos [5] cites the "demonstrated skill and speed of Soviet emergency rescue services," and describes how American researchers seeking to test an experimental drug (hyaluronidase) to reduce the amount of lasting injury from specific forms of heart failure chose Moscow's EMS, in part because of the large numbers of surviving "heart attack" victims. American physicians Storey and Roth [4] are also favorable, though focussing more on Leningrad and Kiev; their information on Moscow is second-hand.

Australian physicians Petrovsky and Maxwell, in concluding an informative but brief review [10] based on a 1972 trip to the Soviet Union, remark "We were most impressed with the equipment and staffing of the specialized ambulances and the quick, efficient cover provided for medical emergencies." The brief articles by Scribner, Raithaus, and Ivanov [11 and 12, identical except for discussion following 12] reflect greater experience; these two Americans and one Russian had worked in the system. Their summary notes: "Emphasis has

been placed on the areas in which the Soviet system seems superior to those that are only now emerging in the United States."

These publications confirm my initial impressions of high quality service and provide worthwhile information supplementing that presented at the session. But all are quite brief and--to a scientific reader--vague about details. The picture of the Moscow EMS that emerges is favorable, but disappointingly incomplete.

1.4 Needed Developments

The operational director of Moscow's EMS, Dr. Nikolai M. Kaverin, has stated that he finds Western EMS specialists surprisingly ill-informed about Moscow's policies and practices. Indeed, Moscow's EMS should be much better known and more widely studied. Whatever the reason for the over-general and incomplete reporting thus far, it would seem greatly to Moscow's advantage to help remedy it.

If the quality and advanced state-of-the-art that appear to be present in the Moscow EMS are truly to be acknowledged and accepted by naturally skeptical scientists and managers in other countries, the impressions reported to date will need to be seriously confirmed, then supported, reinforced, and documented with data, analytical and scientific details, and further observations.

An immediate approach would be to make research reports, materials, and further operating information available for wide dissemination as analytical examples and practical cases in the IIASA state-of-the-art Monograph, "Systems Analysis, Planning, and Management of Municipal Emergency Services [1]." In addition, reports with important results could be approved for external distribution or publication.

Scientifically documented, these analyses and service details could attest to Soviet accomplishment in an important

health and life-saving area. And they could potentially benefit analysts, service managers, and ultimately citizens in many countries.

1.5 Comments

This paper presents a draft of material that, with the additional information noted in the preceding section, could be included in the monograph [1]. It also provides a written basis for mutual clarification and further discussions.

Readers' suggestions to improve the paper will be especially appreciated. The oral exchange in the initial discussions, with translation of questions from English to Russian followed by translation of answers from Russian to English, through relatively non-technical interpreters, may have introduced misunderstanding or errors. All corrections, additions, and criticism are welcome.

2. Initial Discussions

2.1 Participants

Participating in the session at the Ministry of Health Care of the USSR, Moscow, 29 May 1975, were:

1. Dr. Sergei A. Sigayev, a senior official of the Ministry of Health Care responsible for Emergency Medical Services;
2. Dr. Nikolai M. Kaverin, Chief Medical Officer, Emergency Health Service, City of Moscow;
3. G.F. Tserkovny, of the Ministry of Health Care, involved with national technical planning in EMS;
4. L.G. Sudarikov, Ministry of Health Care;
5. I.M. Beskrovny, the Sklifasovsky Institute for Emergency Medical Service, Moscow;
6. V.G. Zaporischenko, Institute for Medical and Medical-Technical Information, Moscow;
7. V.F. Marynenko, The Semashko Institute, Moscow;
8. Mrs. Svetlana Gladysheva, a translator with the International Scientific Organizations group at the Institute of Control Sciences, Moscow. (She graciously served as interpreter, hostess, and guide for much of the visit.)
9. Miss Tanya ----, a translator with a heart-research institute in Moscow.

This paper owes much to them for their time, interest, and cooperation, which are sincerely appreciated.

2.2 Next Steps

As the first part of the initial discussions neared a close, the senior Soviet official present (Dr. Sigayev) suggested a follow-up seminar in Moscow for the Autumn of 1975. For the agenda, he suggested discussion of results

developed and synthesized in IIASA's work that might be applicable to the Moscow emergency medical service, coupled with more intensive discussions of research and practice in Soviet EMS. Dr. Sigayev's suggestion was strongly seconded, then, and in subsequent discussions, by Dr. Kaverin.

Such a seminar and mutual exchange could prove most worthwhile, particularly if details of Soviet research analyses, and operations are made available for dissemination. Part of a possible list of topics for such discussion is outlined in Section 6.

3. Moscow EMS--Organization

3.1 Prologue

The author's paper, WP-75-137 [2], outlines the general structure of EMS, noting their role in the health care system, alternative points of entry, and key determinants of quality in operations. Throughout that paper are explicit and implicit prescriptions for effective EMS performance. These are drawn from analyses of the EMS system and specific services, and distilled from operational practices in a number of leading cities around the world.

To my knowledge, no emergency medical service in any city now follows all these prescribed policies and practices. A number of excellent services apply quite a few. And of these, the Moscow EMS appears, from the information thus far available, to employ the greatest number.

Whether this is a suitable index of quality may, of course, be debated; more specific and detailed performance measures are not yet available. Certainly it does not imply perfection. Indeed, the director of the Moscow EMS and his colleagues have stated publicly that many features of the service still need improvement, and sizeable new programs are underway. Yet, as noted earlier, the Moscow EMS merits examination.

This section describes the Moscow EMS's organizational setting and roles. Section 4 discusses the level of service provided, and some analyses that seem to have been done. Section 5 examines control systems--dispatching and over-all quality control--again noting supporting research. Finally, Section 6 notes some areas where the Moscow EMS may yet be able to improve its services, based on research and experience elsewhere, and outlines some major questions that should be pursued in further discussions.

3.2 Background

The capital and largest city of the USSR, Moscow is estimated to have about 7,200,000 people residing within its city limits, which cover roughly 870 km^2 (or about 340 mi^2). Approximately another million people daily commute to the city from surrounding suburbs. In size, therefore, Moscow is comparable to New York City (which has about ten percent more people in about seven percent less area) and Greater London (which has roughly the same population in eighty percent more area).

The form of Moscow's city government, and its budgetary and political relations with higher levels of government, are, of course, very different from those of either New York City or Greater London, flowing as they do from the highly centralized style of the Soviet Union and Moscow's special role as a national focal point. Compared with New York and London, for example, Moscow's city government appears quite large, for it includes many activities that in Western countries are performed by the private sector.

Yet, despite this size, as Ofer [6] shows, "An outstanding feature of the Soviet economy is the relatively small volume of services produced. The place of most types of services in the economy is notably small when the USSR is compared with other countries at the same or even lower levels of development." This "service gap" is observed to hold for public administration as well as for trade, etc. In part, Ofer notes, this situation stems from Marxist doctrine that services are "unproductive," and thus not appropriate areas for investment. One minor result is that one may find, for example, some firemen and police listed in official figures under "housing industry" [6, p.26].

Ofer's figures show that health services, in general, also have fewer personnel per capita than other comparably

advanced countries. But the USSR has a very large number of highly trained health service personnel, especially doctors. Out of a total population of approximately 250 million, the USSR has an estimated 560,000 physicians and persons with equivalent training, comparatively many per capita and a high proportion of all skilled and professional workers*. And within health services, emergency medical services receive special emphasis nationwide [7].

3.3 National Context

Emergency medical services in the USSR are organized as an integral element of a formal, centralized national health care system, with local operational flexibility. At the top of the system, responsible for shaping and guiding all health care activities throughout the country, stands the national Ministry of Health Care of the USSR (Ministerstvo Zdravookhraneniya SSSR, also translated as Ministry of Public Health of the USSR), centered in Moscow. Just below the Minister of Health Care ranks the national chief administrator for Emergency Medical Services (Skoraya Meditsinskaya Pomoch); his standing is equivalent to those who administer national medicine, surgery, research institutes, and outpatient clinics, placing EMS at a high level, indeed.

The national ministry plans, coordinates, and makes general policy, and oversees research and development needed to advance the state of the art. It also has central budgetary authority and concomitant power to enforce its plans, which are carried out at regional and local levels. In EMS,

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*The Statistical Abstract of the United States reports (pp. 807-808 in the 1972 edition) 1969 Soviet figures showing 555,400 physicians, yielding a ratio of roughly 450 persons per physician; this compares quite favorably with ratios of 700 persons/physician in the United States and 600 in Germany, for example. The figure of 640,000 physicians given in [4] and picked up in [11] and [12] includes dentists, and thus is not the most appropriate number to use in discussing EMS.

for example, the entire national EMS budget is allocated first to the central Skoraya directorate in the Ministry of Health Care [11]. It then parcels out the money to the Ministries of Health in the constituent republics, which are responsible for translating the national plans, goals, and service standards into detailed plans for particular regions. For Moscow (and a large part of the rest of the Soviet Union), the cognizant intermediate authority is the RSFSR Ministry of Health, which operates in a formal chain of command through the Head of the City Department of Health.

The local EMS director apparently reports through two chains of command--to the City Department of Health, in which EMS is one division, and to the Skoraya directorate in the national Ministry. In spite or because of this, he seems to retain considerable local discretion in the use of funds, equipment, and manpower, within the norms established nationally. In particular, the number and positioning of ambulances are the responsibility of local authorities [11].

Having set standards and allocated funds, the national Ministry then monitors and evaluates the local Departments of Health for quality control and for compliance with national requirements. In EMS, national analytical staff (e.g., from the Semashko Institute) work with local services on problems of national importance as well as on quality control. Moscow EMS have their own analytical staff for purely local problems; in small cities, the national or regional Ministry presumably assists with local consulting, as well.

3.4 Organizational Objectives

Throughout the USSR, Skoraya is charged with five official functions [4]:

(1) Prompt response to calls for emergency assistance, to bring the best medical care to the site of accidents (e.g., wounds, fractures, burns, poisoning)

and sudden, life-threatening illness (e.g., sudden loss of consciousness, acutely developing cardiac dysfunction, acute respiratory difficulty, hemorrhage). It is to provide service at the site, and to transport to appropriate hospitals all patients in need of immediate hospitalization.

(2) Assuring the transport and hospitalization of pregnant women when labor has begun, or earlier if a doctor indicates possible pathologies or problems.

(3) Maintenance of registration data on all hospital beds in the service area, keeping track of daily census and patient flow.

(4) Delivery of preserved blood in urgent cases.

(5) Organization of services and posting of medical personnel at events with concentrations of large numbers of people.

Of these functions, three (#1, 2, 5) are performed in some form by EMS in most countries. Function #1 is ambulance operation, as described in section III of WP-75-136; #2 handles a special emergent problem, presumably attempting to anticipate (and minimize) potential complications; #5 pre-positions services temporarily in locations where (probabilistically, and because of possible interactive effects in crowds) they seem especially likely to be needed.

The City of Moscow EMS has augmented these official objectives and assumed additional responsibilities. In carrying out function #3, for example, Moscow dispatching center personnel telephone all receiving hospitals in the City four times each day for up-to-date information on available beds. They also use the detailed records kept on all patients to maintain a file noting where each patient (including those admitted to the hospital directly) is at a given time, so that doctors, anxious relatives, visitors, etc., can locate anyone readily [10].

In its ambulance service, Moscow has carried further the national emphasis on bringing medical care to the site of serious incidents. A major objective for its service is to provide as much medical assistance as possible at the site, and to transport and hospitalize only people truly needing continued medical attention. This distinctive objective strongly influences its policies and practices--affecting the composition of crews, the types of vehicles used and the equipment supplied to them, the training of command-and-control personnel, dispatching and control procedures, and the numbers of crews and vehicles supplied. On this last point, for example, more service at the site means longer service times which, with Moscow's high demand for service, require greater resources to maintain the same availability under peak loads.

The vast majority of patients who need to be hospitalized are brought to one of the five major emergency hospitals dispersed about the city [11]. Moscow has few large general hospitals; indeed, throughout the Soviet Union hospitals tend to be much more specialized than those in most Western countries. Within the emergency hospitals, there are specialized clinics that handle the non-routine cases in the major categories of emergency medicine: trauma and resuscitation (termed "reanimation" in Russian); neurology (e.g., strokes); cardiology; acute abdomen (e.g., appendicitis); toxicology (e.g., poisoning); psychiatric emergencies; and pediatric.

To maintain high-quality medical practice, these specialty clinics are linked professionally through Institutes of Traumatology, Neurology, Toxicology, etc. Since emergency medicine is considered a full-fledged field in itself, there is also an Institute for Emergency Medical Services--the Sklifosovsky Institute, which comprises the main emergency hospital (with 600 beds) and a sizeable research and teaching center. The central ambulance station and dispatching center adjoin the Sklifosovsky Institute, and maintain close ties.

By treating emergency medicine as a major specialty and giving it elevated status (with clout) in the health care hierarchy, the Soviet Union appears to have obviated some of the coordination and follow-through problems that afflict EMS in many other countries. In the emergency hospitals to which EMS patients typically are brought, Skoraya physicians have a central role and close working relationships with the in-hospital specialists. In their training, Skoraya physicians rotate through the specialty wards (and potentially the specialty institutes), and emphasize diagnostic training to help them assign emergent patients to the correct specialists [12]. And in these hospitals, Skoraya shares responsibility and authority for quality control.

This central role is also important at the intake end, when help is first requested. The fire service and police (militia) do not have separate EMS vehicles; they must use Skoraya, with which they are linked directly via radiotelephone. When appropriate, the militia may accompany the EMS to the hospital, but only occasionally (e.g., a loud drunk who has bruised himself) will the military cars take people directly to the hospital themselves. Moreover, Skoraya provides the central and ultimate service for the auxiliary medical posts around Moscow independently operated by institutions, factories, stores, hotels, and the subway system. The Moscow METRO, for example, has special medical posts manned by feldshers (advanced nurses) in major stations and station complexes*; these have instant (dedicated line) telephone access to the Skoraya dispatching center.

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*This is what was interpreted as having been said in the meeting. Storey and Roth [4], however, state that each of Moscow's 80 METRO stations has a post with 5 feldshers. While not critical, this discrepancy should be cleared up.

Skoraya also plays a central role in accident prevention. It is responsible for registering all accidents with the Division of Traffic, the Police, the Moscow Soviet, the City Health Department, the Department of Education, and other organizations concerned with particular aspects of public safety [4]. Its staff analyze street and home accidents, develop preventive measures jointly with the appropriate agencies, and participate in programs for preventive education [4]. [Whether these preventive activities have been assessed to determine their effectiveness has not been noted. Nor is it clear how much effort, including detailed analysis and planning, is really devoted to prevention, which most response-oriented services stress as an objective but tend to slight in operations.]

Finally, the Moscow Skoraya operates a sizeable Department of Patient Transportation, as do most major ambulance services throughout the world. This Department contains several specialized divisions, including the mandatory service for expectant mothers and a special service for transporting infectious patients. Transport service is provided only on a doctor's request. [Little more seems to have been published about the transport service, which does not appear to receive the emphasis in Moscow that it does in comparable cities in other countries. It would be useful to know how this Department is viewed officially, (e.g., as an important service to Moscow's moderately ill or disabled citizens or as a necessary but minor service that distracts resources from true emergencies) and whether analyses (e.g., scheduling and routing algorithms) have been applied to it.]

4. Levels of Service

One clear indication of EMS' role and status in Soviet health care is the high level of service provided--a level that requires large numbers of highly trained personnel and large quantities of technical equipment. This section describes the types of EMS units supplied, their crews and equipment, the numbers and locations of the units, with approximate performance indicators, and some service level criteria that appear to be used, with an incomplete example of how they have been applied analytically.

4.1 EMS Units, Crews, and Equipment

At least since 1961, Soviet EMS have used three types of units to respond to calls. The type of unit sent is matched to the probable nature and urgency of the call, as evaluated by the dispatcher.

The least serious calls receiving a response (some callers are simply referred to a clinic) are sent a house-car, a radio car manned by a feldsher (nurse) or doctor that makes house calls to people who sound as if they may be sick (e.g., with a fever, persistent cough, or moderate pains) but not in need of emergency care [12]. This service then treats the patient and/or refers him to a clinic or specialists for further treatment. Similar services exist in other countries, e.g., the Funk Ärzt in Vienna.

General urgent or emergency calls are dispatched a line ambulance, a two-stretcher van manned by one doctor, one or two feldshers or nurses, and a driver. Most of Moscow's ambulances fall into this category. Jackson [3] notes that in practice the line ambulances are sometimes short-handed and must go out without a nurse, pressing the doctor and driver to assist as stretcher bearers.

When the dispatcher decides that a particular call indicates a very serious, specialized problem, she may

assign one of the limited numbers of specialized ambulance teams (termed "specialty brigades"), which respond with an "emergency room on wheels." Specialty brigades have been organized in Moscow for

- o Cardiological emergencies
- o Trauma, anti-shock, resuscitation
- o Toxicological emergencies (poisoning)
- o Neurological emergencies (mainly "stroke")
- o Acute abdomen
- o Pediatric emergencies
- o Obstetrical emergencies;

in addition, there is a psychiatric brigade (manned by psychiatrists) for mental emergencies. These teams comprise two doctors (one a specialist), one feldsher or nurse (trained to serve also as a laboratory assistant), a medical orderly, and a driver.

All EMS units are connected with the dispatching center and the emergency hospitals by radiotelephone. Each vehicle has its own channel in a band reserved nationwide for Skoraya.

Governing the medical equipment the ambulances carry are special guidelines promulgated nationally and extended in major cities such as Moscow. Line ambulances typically carry stretchers, artificial respiration apparatus, suction equipment, a range of drugs, splints and bandages, etc., anaesthetic (e.g., nitrous oxide), intravenous supplies and equipment, oxygen, and selected kits for on-site emergency operations (e.g., tracheotomies, obstetrics). The line ambulances are deliberately kept relatively Spartan inside, and their ride is reputedly hard and jerky, but swift [3]. Specialized ambulances carry a range of appropriate laboratory equipment and specialized equipment and drugs such as defibrillators, electrocardiographs, poison antidotes, etc.

The presence of at least one physician on every ambulance follows naturally from the objective of providing as much

service as possible at the site. Having a doctor present immediately ensures the best feasible on-site treatment without delay. It also presumably minimizes the chance that a patient in need of immediate help will be misdiagnosed and subjected to handling and transport that will worsen his condition. And doctors on the site can treat quickly cases that turn out to be minor, discharging the people rather than transporting them and burdening hospital emergency rooms. Indeed, 70 percent of the calls for line ambulances in Moscow are so treated; only 30 percent of the cases need to be brought to a hospital [3, 4].

Though medical education is shorter than in most Western countries, EMS doctors in the USSR have extensive training [11, 12]. Typically, men and women (roughly 50% of the doctors are women) become physicians about age 22. After graduating, those interested in EMS take a six-month course in emergency medicine at a major emergency hospital. They then begin service as Skoraya generalists, working three to four months out of the year in various specialty brigades to gain experience. After about a year, they can become Skoraya specialists, working 3-4 months of the year on the specialized ambulances and spending the remaining time in the specialty wards of emergency hospitals. Weekly conferences, often with case reviews and analyses, form the backbone of a continuing education program.

When on the ambulances, Skoraya physicians typically work an average of about 40 hours per week, in shifts of about 12 hours each followed by a day or more off. The time between runs seems most often spent simply relaxing. Most of the doctors on the ambulances are said to be relatively young; one might expect that they eventually tire of emergency responses and pursue more serene practices. Once doctors have become established in Skoraya, however, the odds are that they will remain with Skoraya in one capacity or another for the rest of their careers [12].

Doctors are outnumbered by nurses and paramedical personnel about 2 or 3 to 1, in various parts of the system. Curiously, however, the ambulance driver is given next to no medical training and is not considered part of the team; indeed, drivers are formally not even EMS personnel.

4.2 Unit Numbers and Locations

On a typical day, between 3000 and 6000 Muscovites call their EMS for emergency service--an annual average of nearly one call for every five people living and working in the city. Driven by this enormous demand, Moscow supplies large numbers of ambulances and crews--currently about 600 line ambulances, one for every 12,000 people*. All 600 are staffed and on duty during the 12-hour day shift; only half that number are left to serve at night, when call volumes are lower. This number of ambulances has tripled since 1970, when there were 200 [4], and plans call for expanding the fleet over the next few years to about 720, to attain a level of one emergency ambulance for every 10,000 people.

Though Moscow covers a large area, for ease of command and control the ambulances are grouped into 27 substations (each with 20-25 ambulances) distributed about the city; this number is up from 22 only a few years before. [The methods used to determine the number and locations of these new substations would be of considerable interest.] Each substation covers a specific region (response area) with a radius of about 3.3 km, forming a quasi-independent dispatching unit for about 270,000 people. The number of ambulances assigned to a substation depends on the demand for service in the region it covers.

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*The number has apparently increased so fast that Jackson [3], writing only 3 months before my visit, was cited a figure of 500.

Average response distances run about 3 km and maximum travel is restricted to under 12 km. These distances, together with Moscow's comparatively light traffic, yield maximum total response times (measured from the time the call is first received) on the order of 8 to 12 minutes. These times are viewed as not fast enough.

A leading Soviet resuscitation specialist, Dr. Armen Bunatian, has stated [3], "The first five minutes are all-important." Based upon such thinking, the USSR has begun programs to train nearly all citizens in basic first-aid techniques [9]. Similar efforts on a smaller scale in the United States appear to have had successful results, as have programs focussed on automobile accidents in the Federal Republic of Germany and Sweden. As [2] notes, immediate first-aid by fellow citizens at the scene is often crucial to keeping seriously injured or ill victims alive long enough to benefit from professional help.

Staffing the 600 emergency ambulances are 2000 doctors, supported by 4000 additional EMS personnel, excluding drivers (and excluding the Department of Patient Transportation)*. By way of comparison, in the year ended 31 March 1973, the Greater London Council Ambulance Service (now operated through Great Britain's National Health Service) provided 404 emergency ambulances (capable of carrying 2 to 4 stretchers) with a total crew staff of 2091 [8], only a fraction of whom were full-fledged physicians.

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*Assuming each ambulance always carries one doctor implies 3.33 doctors per position. To staff a position 168 hours per week with people working 40 hours per week, allowing for vacations, sickness, and various official absences requires at least 4.4 people (in New York City, it requires closer to 5). On the average, then only 75% of the positions could be staffed around the clock. It thus seems clear that, as described above, Moscow continues to staff half its ambulances 24 hours per day, and half 12 hours per day, as [4] notes it did in 1970.

In our conversation following the formal session, Dr. Kaverin noted that the Moscow Skoraya emergency service budget totalled 15 million rubles for 1974, of which 70 percent was designated for personnel*. In comparison, London's budget for 1972-73 was £8.5 million, of which 64.4 percent went for personnel [8]. At an official exchange rate then of about £1 = R2, Moscow's budget charge per person would be roughly one-third London's--illustrating the difficulty of comparing monetary figures, especially salaries, across quite different economies.

4.3 Service Level Criteria and Analyses

4.3.1 Theoretical Background

As explicated in chapters prepared for [1], the basic purpose of emergency services is to provide a form of physical insurance against risk. All people pay relatively small, certain costs (e.g., public expenditures) for a degree of protection against potentially very costly, uncertain events that might afflict some of them. Emergency services thus provide both protection--in the form of physical services to minimize the adverse impacts of events that do occur--and security, in the form of reduced uncertainty (and potential anxiety) about the future.

Basic criteria for determining service levels thus must include (a) minimization of serious risk and (b) assurance of the desired degree of certainty. Unlike fire protection, where the risk level should a fire occur varies significantly with building type, age, occupancy, etc., and thus with location, the inherent risk in events requiring EMS (e.g., potential

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*Assuming doctors earn roughly twice what the others are paid (Western ratios are nearer three), the average salaries would be about R2600/yr. for the doctors and R1300/yr. for the others.

severity or possibility of death) varies only slightly with geography. Calls from accident-prone intersections, blocks with concentrations of elderly people, etc., may be somewhat more likely to represent serious conditions. But, in general, EMS planners may assume that potential risk from demands is relatively homogeneous geographically*, and focus attention on the call rates themselves.

Emergency service theory shows how demand patterns affect decisions about numbers and locations of service units. First, there must be enough units and enough different locations to provide the required spatial coverage--i.e., to ensure that all sites of potentially serious demands will have units close enough (in latent response time) to them. The actual locations are likely to be chosen to minimize some weighted disutility--perhaps response time (t), weighted by call rate (λ) [and, more generally, by potential loss, risk, or hazard], or some function of response time f(t) thought to represent better the impact of delay on the waiting patient. In Great Britain, for example, the location standard now being considered for smaller cities and suburban areas stresses the tail of the response time distribution: It requires 50% of all responses to be made in 8 minutes or less and 95% in 20 minutes or less.

Second, there must be enough manpower to handle large events (e.g., building collapse). This poses no problem for large cities such as Moscow. Finally, there must be enough units to serve peak-period demands and yet retain minimal coverage. That is, when call rates are highest, there must be enough units not busy to keep tolerably low the probability that response to a new serious incident would be unacceptably delayed.

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*One should, of course, test this assumption by plotting or otherwise comparing the spatial distribution of calls that turned out to be serious or resulted in lasting injury or death. (Transient collective risks such as sporting events are already covered by EMS policy; see section 3.4, item 5.)

4.3.2 Moscow's Practices

As described in the session, the criterion used to set the number of ambulances in Moscow is peak-period coverage--in particular, the probability that a person applying for help would find at least one ambulance free. A minimally acceptable (or "cut-off") level for this probability is stipulated. Then the number of ambulances needed is determined through a queueing model, given the distributions of call rates and service times, and system protocols (pertaining especially to call priorities, possibly including shunting or queueing of low-priority calls, and inter-district dispatching).

Just what protocols are used, what queueing models are applied, and what cut-off probability is stipulated remain to be clarified. From the information that was presented, however, we may conjecture that they are roughly as follows:

(a) Call priorities are reflected mainly in the choice of vehicle type and crew (Section 4.1). Obvious low priority calls are shunted to house-cars at all times (except, perhaps, at the slowest hours in the middle of the night), and calls appearing to require a line ambulance are not permitted to queue. Inter-district dispatching is only a last resort under normal conditions. However, ambulances will be sent from several substations when a large number are needed at one time, so that no one area will be stripped.

(b) Though service times are not distributed exponentially (lognormal, or a Fischer Type III distribution, is usually closer to measurements elsewhere), one can adequately represent the probability that at least one ambulance will be available by the classical

formulae for the queueing system M/M/c (c, FIFO).* Let us define

$\lambda \equiv$ Average number of calls per hour in the region requiring line ambulances;

$1/\mu \equiv$ Average time an ambulance is unavailable while serving a call;

$c \equiv$ Number of ambulances serving the region;

$P_A \equiv$ Probability that at least one ambulance will be free;

$P'_c \equiv 1 - P_A \equiv$ Probability that all the ambulances will be busy.

Then the well-known "Erlang loss formula" gives

$$P'_c = \frac{e^{-\lambda/\mu}(\lambda/\mu)^c/c!}{\sum_{j=0}^{c} e^{-\lambda/\mu}(\lambda/\mu)^j/j!} \qquad (1)$$

If calls are allowed to queue (be held to await a free ambulance) when all ambulances are busy, then one may use the model M/M/c (∞, FIFO), which yields an equally well-known formula for P'_c which we need not reproduce here. This value for P'_c is obviously larger than (1), since the queued calls absorb local capacity not absorbed by calls shunted to another substation. Indeed, as c increases for a given λ/μ, $P'_c(\infty)/P'_c(c)$ converges from below to $1/(1 - \lambda/c\mu)$.

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*This shorthand means Poisson-distributed arrivals (calls), exponentially distributed service times, c equivalent servers (ambulances), total capacity only for c customers at one time (i.e., no holding of calls waiting for a free ambulance), and First-In-First-Out (i.e., order-of-arrival) service discipline.

Peak-period call rates can be estimated from two pieces of information presented at the session:

(a) Call rates range approximately between 3000 and 6000 requests for line ambulances per day city-wide; and

(b) During busy periods, ambulances typically make 16 to 20 responses per day.

In addition, it was noted that--as in other large cities--call rates in Moscow vary significantly with month (season), day of the week, time of day, and region within the city.

From (a), one can estimate the peak λ for a region of 270,000 people served by one substation:

$$\lambda \approx \frac{6000 \text{ calls}}{7200000 \text{ people}} \sim \frac{1 \text{ call/day}}{1200 \text{ people}} \sim \frac{225 \text{ calls/day}}{270{,}000 \text{ people}} .$$

Assuming 60% of all calls are received in the peak 9-hour period (roughly 1500 to 2400 with the heaviest rates between 1600 and 2200), one obtains for peak hours

$$\lambda \approx \frac{(225)(0.6)}{9} \approx \frac{15 \text{ calls/hr.}}{270{,}000 \text{ people}} .$$

Using (b), assume the same hourly distribution for the full-time ambulances in the peak period. Taking a middle figure of 18 calls per day, with 1 full-time ambulance per 24,000 people, yields a peak

$$\lambda_F \approx \frac{(18)(0.6)}{9} \frac{\text{calls/hr.}}{24{,}000 \text{ people}} \sim \frac{13.5 \text{ calls/hr.}}{270{,}000 \text{ people}}$$

for the full-time ambulances alone. In addition, an equal number of dayshift-only ambulances operate in the peak period. These two pieces of data thus seem to yield rather different estimates. Better, more detailed information is clearly necessary if we are to be able to represent this part of the planning process accurately and fairly.

The average service time (from receipt of the dispatch by the ambulance to discharge of its patient--probably not including time for cleanup and restocking supplies) was cited as 40 minutes, which may reflect the 70% rate of discharge at the scene (see Section 4.1). Thus $\mu \approx 1.5$ per hour. For $\lambda \approx 15$ per hour, $\lambda/\mu \sim 10$; for $\lambda \approx 27$ per hour (assuming $\lambda \approx 2\lambda_F$), $\lambda/\mu \approx 18$. Standard tables and charts for $P'_c(\infty)$ and $P'_c(c)$ [e.g., A.M. Lee, Applied Queueing Theory, Macmillan, London, 1966; p. 240] show

For $\lambda/\mu \sim 10$, $P'_c(\infty) \sim 0.004$ for $c = 20$ $\quad P'_c(20) \sim 0.002$

$P'_c(\infty) \sim 0.001$ for $c = 22$

For $\lambda/\mu \sim 18$, $P'_c(\infty) \sim 0.06$ for $c = 26$ $\quad P'_c(26) \sim 0.018$

$P'_c(\infty) \sim 0.0065$ for $c = 30$ $\quad P'_c(30) \sim 0.0026$

Since Moscow has chosen values of c generally in the range 20-25, we may surmise that peak values of λ/μ now lie between 10 and 18--probably about 13--and that the "cut-off probability" or design level of P'_c is 0.001. [Surmisal is, however, not a satisfactory substitute for the facts.]

Using these estimates, we can also shed some light on response times and possible gains from redeployment into more widely distributed locations. The typical total response time is probably now about 8 to 8 1/2 minutes, of which about 2 1/4 minutes are consumed in the dispatching center (see the

next section), about 1 1/2 minutes are consumed in "turnout time" (from receipt of the dispatch order to when the ambulance has its full crew aboard and out onto the street, accelerating), and about 4 1/4 to 5 minutes are taken to travel the average distance of 3 km at 35-45 km/hr. average speed (assumed faster than the average speed in more congested cities). For a substation having 25 ambulances and $\lambda/\mu \sim 13$, the average number of ambulances available during peak periods is 12. From the "square root law,"* applying American results for travel-time versus travel-distance**, one can estimate that the travel time component could potentially be reduced by 2 1/2 to 3 1/2 minutes--which would reduce the total response time to more like 5 minutes, and possibly to as low as 4 1/4 minutes once the new dispatching system is operational.

Analysts at the session argued that saving "1 or 2 minutes" was not justified in terms of the cost of new substations, and that wider dispersion was "not resonable." [Perhaps that is so--but it should be examined in detail, scrutinizing whatever studies in this area Moscow's EMS has done, together with deployment and dispatching strategies that follow from the work of this author and his colleagues.]

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*P. Kolesar and E.H. Blum, Management Science--Applications, 19, 1368-1378 (1973).

**P. Kolesar, Operations Research, 23, 603-613 (1975).
P. Kolesar, W. Walker, and J. Hausner, Operations Research, 23, 614-627 (1975).

5. Control Systems

This section describes Moscow's EMS dispatching system, outlines recent analysis of call priority assessment, and notes some means used for quality control.

5.1 Dispatching System

Persons needing EMS anywhere in the Soviet Union dial 03, which connects them directly with their local EMS dispatching center. Should they have dialed one of the other emergency number--01 for police or 02 for fire--they can be switched to the EMS center as soon as the answering officer discerns the nature of the call. Calling from a public pay telephone does not require a coin; a pushbutton bypasses the coin circuits for emergency calls.

In Moscow, calls come into a central dispatching office, currently located in the EMS administrative headquarters, which handles all operational command-and-control. Named "Centropunkt," it is staffed by a total of seventy women, all of whom have at least two years of medical training. These are organized into three groups:

(1) First are the 35-40 first-line dispatchers, who take the calls from the public. They are responsible for questioning the caller, referring him or her to a clinic or information desk for non-serious conditions, and assessing the need for a house-car, line ambulance, or specialty brigade for more serious conditions. In a minute or less, they must ascertain the nature of the condition that prompts the call, what attention, if any, it has received thus far, who is involved, where the problem is, and what EMS attention it is likely to require. In the course of talking with the caller, they fill out the front side of a standard card, a copy

of which is displayed in Figure 1. An English translation of both sides of the card forms Figures 2A and 2B. These forms are kept on file (with the information supplied by the ambulance crew that is added later), and are nominally available for analysis.

Once the first-line dispatcher has completed the card and decided what should be dispatched, the card is put into a clip on a conveyor belt that carries it into an adjoining room. (This conveyor is almost identical to that used in the pre-computer police dispatching system in New York City.)

(2) In this adjoining room sit 27 second-line dispatchers, each responsible for one of the ambulance substations. The card is routed to the appropriate woman [who determines which substation covers the location of the incident, and how, was not clear], who transmits the necessary information and the dispatch order via dedicated telephone line to the substation. She then maintains radiotelephone contact with the ambulances from her substation while they are out.

(3) In the front of the first room sits a panel of four to six physicians. These women are available to take calls where their expertise is needed to question the caller and make a tentative diagnosis to be used in dispatching the appropriate vehicle. They also offer medical advice to callers where it seems appropriate, to enable some preliminary first-aid to begin while the ambulance is enroute. Presumably, they can also advise callers not requiring an ambulance where best to seek help for their problems.

As one might expect for a system handling such a large volume of calls, Moscow is moving toward computer-assistance for the EMS dispatch process. Next to the current offices is

Front:

ВЫЗОВ №_____

КАРТА ВЫЗОВА СКОРОЙ (неотложной) ПОМОЩИ (ДЛЯ МОСКВЫ)

Учетн. ф. № 252
Утверждена Министерством здравоохранения СССР 15.VII 1954 г.

« » 197 г. Принял_____ Передал №_____ Подстанция

Принят в_____час._____мин._____
Передал _____час._____мин._____
Выезд через_____час._____мин._____
Возвращение_____час._____мин.
Продолжительность _____час. _____мин.

сообщено:

Срочные отметки _____
Докл. по городу_____час._____мин.
ОРУД _____ час. _____мин.
Справочн. _____ час. _____ мин.
Прочие _____

Адрес _____
Дом №_____ корп._____кв._____комната_____подъезд _____этаж _____
Название учреждения или предприятия _____
Общежитие _____ барак _____
Вход с улицы, со двора, направо, налево, прямо _____
Больной М. Ж _____ лет _____
Повод к вызову _____
Кто вызывает _____ тел. _____

Корь, ветрянка
Скорлатина
Записал
Эвакуатор

Back:

Фамилия _____ Ул._____ мес. _____
Имя _____ Отчество _____
Диагноз _____ Сопутствующие заболевания _____
_____
_____
_____ Доставлен в_____
Причина _____ Принял _____
_____ в сопровождении _____
_____ Оставлен на месте, сдан милиционеру,
_____ ложный отказ от больницы, не проехали,
_____ не застали, отказ от помощи, не нашли.
Врач _____ Примечание _____
Фельдшер _____
Медбрат _____
Шофер _____
Ст. врач_____Диспетчер _____ Статистик _____

Figure 1: Moscow Emergency Medical Service Call Record Form

Call No._____

EMERGENCY MEDICAL SERVICE CALL FORM

(City of Moscow)

Form No. 252
Ministry of Health Care of the USSR - Approved 16 July 1954

197_ DATE:

TIME OF CALL: ____HR. ____MIN.

TIME OF TRANSMISSION ____HR. ____MIN.

DISPATCH TIME: ____HR. ____MIN.

RETURN TIME: ____HR. ____MIN.

DURATION:

RECEIVING OPERATOR_____

TRANSMITTING OPERATOR_____ DIVISION

URGENCY NOTES _____

POLICE ON DUTY _____

TRAFFIC POLICE _____

INQUIRY _____

OTHER _____

ADDRESS _____

HOUSE NO._____ BLOCK _____ FLAT _____ DOOR _____ STORE _____

NAME OF INSTITUTION _____

DORMITORY _____ BLOCK NO. _____

ENTRANCE FROM STREET _____ YARD _____ TO RT. _____ LEFT _____

WHO INVOLVED: MEN _____ WOMEN _____ AGE _____

REASON FOR CALL: _____

WHO IS CALLING _____ TEL. NO. _____

INFECTIOUS DISEASE:

MEASLES

CHICKEN POX

SCARLET FEVER

WRITTEN BY:

EVACUATOR

Figure 2A: Moscow Emergency Medical Service Call Record Form
(Front - English Translation)

FAMILY NAME _____ AGE _____

FIRST NAME _____ SECOND (PATRONYMIC) NAME _____

DIAGNOSIS _____

CAUSE _____

DOCTOR _____

FELDSHER (Nurse) _____

AMBULANCE TECHNICIAN _____

DRIVER _____

SENIOR DOCTOR _____

DISPATCHER _____

HELP GIVEN _____

WHERE DELIVERED

WHO ACCEPTED

WHO ACCOMPANIED

[IF NOT TRANSPORTED]
Left at the Scene (Discharged)

GIVEN TO POLICE
REFUSED TO GO TO HOSPITAL
WERE NOT ABLE TO REACH
PERSON NOT FOUND AT THE PLACE
REFUSED HELP
PLACE NOT FOUND

SPECIAL NOTES _____

STATISTICAL OFFICER

Figure 2B : Moscow Emergency Service Call Record Form
(Reverse - English Translation)

being constructed a seven-story modern headquarters building, which will contain a large computer center and a redesigned dispatching operation. When the computer system is operative, all the stations and substations will be connected to the dispatching center with display terminals. All dispatchers will have display consoles, into which the telephone information will be entered. The computer will then retrieve and display the "necessary dispatch information," presumably identifying the substation nearest the address, the number of beds available in the likely specialty area in nearby hospitals, the status of the crews (e.g., how many line ambulances in the nearest substation are available for dispatch, or where the nearest available specialty brigades are located).

[It would be useful to know what else the computer will retrieve, or be able to retrieve, and what specific assistance, if any, it will be programmed to provide, in addition to status and record bookkeeping. Will the computer assist in scheduling and routing transport services, for example? Will it be programmed to suggest diverting lower priority calls to neighboring substations if one seems in danger of being stripped? Will it assist in telephone interrogation and dispatch decisions, using analytical tools such as those described in the following section? When is the computer dispatch system expected to go into use?]

5.2 Call Priority Assessment

One of the most critical steps in the dispatch process is evaluating the information given by the caller to determine what EMS response should be made. The dispatcher has the following range of policy alternatives:

(a) Send no EMS vehicle, and refer the caller to a clinic or other source of medical care and/or counselling. Then the caller may not seek care, or may receive care much later, should there actually be a serious problem.

(b) Send a house-car, which is likely to reach the caller within 30 to 120 minutes, depending on the volume and nature of the calls assigned house cars and the number of cars available. Should the condition then prove more serious than had been thought, the nurse or doctor in the house car can call for an ambulance, but the time between initial call and arrival of the ambulance will be very long.

(c) Send a line-ambulance, which will reach the person within 8 to 10 minutes and be able to provide good care then, but may not be able to cope with truly serious, specialized emergencies. The line ambulance can call for a specialty brigade, but another 10 minutes or more will elapse before the specialty brigade can reach the scene.

(d) Send a specialty brigade, which can handle very difficult situations in its specialty, and will reach the person within 12 to 15 minutes. One must be sure to send the appropriate specialty brigade, however. And, if one dispatches the specialty brigades too often to calls for which they are not needed, one risks tiring the physicians (thus lowering their ability to handle subsequent calls) and possibly delaying their response to serious calls by having them responding to or handling calls that line ambulances could have handled when serious calls come in.

(e) Send several ambulances, perhaps with specialty brigades, at once. These situations are usually clear: natural disasters, building collapse, explosion, train derailment, etc. When the call indicates multiple victims, Moscow's dispatchers always send several vehicles. On one occasion, Storey and Roth [4] report, several dozen ambulances were sent within 15 minutes of the initial call.

Any decision based on imperfect information, such as is supplied over the telephone by medically untrained citizens, some of whom may be anxious, or even in panic, will be subject to statistical type-I and type-II errors. That is, sometimes more capability will be dispatched than is needed, and sometimes less. The balance is a difficult one between averting risks to the immediate caller and keeping available resources that may be needed more the next time the telephone rings.

The basis for the decision is essentially a discriminant function--either the dispatcher's experienced judgment or a statistical function, or some combination of the two--that weights the information received in a way that best discriminates (i.e., minimizes the overlap) between the several options. The sharper the discrimination that is possible, the better the decision is likely to be, and the less intricate the dispatching strategy needs to be to minimize over-all risk.

Two kinds of information are available to aid in the discrimination: *a priori* estimates based on historical data, and information elicited from the particular caller. Extrapolating from historical data, of course, builds in important assumptions about stationarity of patterns, and gives only statistical estimates. Yet, since alarm patterns in Moscow are said to vary significantly by time of day, day of week,

season, and locality, one should be able to gain significant a priori estimates of the probability that a given call will require a line ambulance, or will need a specialty brigade. [If such analyses have been done, they would be of considerable interest. Both the methods and the data would be important in illustrative examples for the book.]

Going further, Dr. Beskrovny and his colleagues in Moscow have developed methods to evaluate the content of calls by analogy with past experience. That is, they have gone through large numbers of call-record cards, comparing the initial information the dispatcher received with the final hospital diagnosis. Using decision theory and factor analysis, they have developed discriminants for the call contents that best indicate high-priority situations. A check list of critical indicators has been developed for the dispatchers; when the caller reports symptoms on the list, a line ambulance (or, when indicated, a specialty brigade) must be sent. In balancing possible errors, they try to keep low the risk of rejecting true emergency calls.

The discriminant need not be employed as often in low-demand periods, when dispatchers feel freer to send more capability than may be needed, and thus avoid risk to the caller. In high-demand periods (EMS "rush hours"), it is more important. Trials are now underway using these analytical results in Moscow's rush-hour dispatching. In the session, it was claimed that these trials showed excellent results. Without analysis, dispatchers made roughly 1 error (dispatching too little) in every 50 calls; with the analysis, this rate had been reduced by 94 to 96 percent--i.e., to roughly 1 error in 1000 calls.

This analysis seems clearly to be one of the leading examples of applying decision-theoretic techniques to the crucial problem of dispatching discrimination. It should clearly be reported, in at least some methodological detail,

in the state-of-the-art monograph [1]. Though it has been said that publication should await the results of the testing now underway, expected to be completed in mid-1976, partial publication in the monograph, with appropriate credits and caveats, would seem quite valuable for Moscow. Using this analysis as one of the "case studies," representing it as "being tested for possible operational use," if that were its status at the time of publication, would show clearly the advanced state of analytic and managerial art in Moscow, and help give its EMS the recognition it would appear to have earned.

5.3 Quality Control

An important feature of EMS management in Moscow is quality control, particularly with regard to the medical care provided. One means of effecting quality control is through systematic evaluation of a random sample of cases. An evaluation group is set up with one person from each substation. A sample of cases is drawn from the records and examined in detail. Analysis is done, for example, to compare the crew's diagnosis and treatment with the diagnosis ultimately made in the hospital and the patient's resulting condition. In addition, the cases are discussed for their medical features, as part of a program in continuing medical education. [How often this is done, with how many cases, was not stated. Any evaluation of these evaluations would also be of interest.]

At a higher level, special analyses are undertaken by the central Skoraya office in the Ministry of Health Care. These use "exchange cards," records from one jurisdiction given to another to analyze. From these are developed studies that examine the interface between the EMS and the hospitals to which they bring their patients, and also look critically at the follow-up care in the hospitals.

6. Agenda for Action

The preceding sections show, albeit with less than scientific detail, that the Moscow Emergency Medical Service:

- o May be among the best such services in any large city;
- o Has carried out and applied system analytic studies in several important areas, some of which appear to be on the forefront of the state-of-the-art;
- o Desires and should obtain for its accomplishments in analysis, planning, and management wider recognition among Western experts;
- o Should be described in detail as an illustrative "case study" of high-quality, advanced practices in the IIASA state-of-the-art monograph, "Analysis, Planning and Management of Urban Emergency Services." Such a description could help achieve considerable recognition. To present and document it, however, requires additional information.

Details of specific needs for additional information are noted at intervals throughout the paper. This section summarizes these open questions (referring to the corresponding points in the paper) in the form of an agenda for one part of follow-up meetings and discussions.

The second part of this section notes some major points that the author could present as part of a comprehensive discussion of research advances and practices in other countries. A brief outline of the possible comprehensive discussion forms the third part of this section.

Together, the parts of this section present an agenda for a further exchange of information and ideas, one that should lead to action in the form of a documented "case study" of applied systems analysis to be presented in [1].

6.1 Open Questions

(1) What preventive activities are carried out by the Moscow EMS? How many people are assigned to them? Have any evaluations or assessments of these activities been conducted? If so, what methods were used, what data were collected and analyzed, and what were the results? If the analysis is considered worthwhile, can its details be made available? (Reference: p. 14)

(2) How many specialty brigades of each type are now provided? Does the number vary with time of day, day of the week, etc.? If so, in what manner? How many specialty brigades of each type are planned for the future? What assessment of their value has been made, and what did it show? (Reference: p. 16)

(3) What methods were used to determine the number and location of new ambulance substations, when the expansion took place from 22 to 27 over the past few years? If analytical models were used, are details available to be documented as part of an applications "case study?" (Reference: p. 18)

(4) What queueing models are used to determine the number of ambulances that must be provided at each substation? What are the system protocols (rules) for call priorities, queueing of low-priority calls, shunting of calls to other services or neighboring substations, inter-district dispatching? How are these reflected in the analyses? What values are used for the "cut-off" probability in the models? (Reference: p. 22)

(5) What are the actual data for call rates (classified by type of incident) by time of day, day of week, season, etc.? Can data be released to provide illustrative examples for a "case study," with whatever analyses have been done to analyze trends, to forecast expected future demands, to determine the *a priori* probabilities of call types by time of day, etc.? (Reference: p. 24)

(6) What studies have been done to assess the marginal value of decreased response time for ambulances? Have studies been done of the possibility of increasing the number of ambulance substations substantially (e.g., from 27 to 100)? If so, can details be made available for inclusion in the "case study?" (Reference: pp. 25-26).

(7) In the present dispatching system, who is responsible for determining which substation covers the location from which a call has been received? What means are used to make this determination (e.g., a street-address directory)? Will this matching of location with substation be done automatically in the new computer dispatching system? (Reference: p. 28)

(8) What are the functional specifications for the new computer dispatching system--that is, what things will it do that are now done manually? Will it contain algorithms to assist the dispatchers with complex decisions, or will it mainly retrieve pre-planned and pre-programmed lists of information and do routine bookkeeping? Can the details of the new system be explained for description in the "case study?" (Reference: p. 32)

(9) Even though testing of the analysis continues to be done, can the details of the important work analyzing the content of calls to help discriminate among dispatching alternatives be described for inclusion in the "case study?" What models have been used? What data was collected, and what analysis of it was done? What tentative results have been obtained? What have been the preliminary results of testing to date? What are the questions the dispatcher is instructed to ask, and what are the corresponding interpretations in terms of probable diagnosis? What risk levels have been used to make the trade-off between the possibility of dispatching less than is needed and the chance of making unavailable an important unit that may be needed more for a subsequent call? (Reference: Section 5.2)

(10) Can an example case analysis used for quality control be made available for examination? (Reference: Section 5.3)

6.2 Principles That Might Be Tested in the USSR EMS System

Some examples of principles that might be discussed, for possible testing in the USSR EMS system, include:

(A) Computer-aided diagnosis, both with and without the use of bio-telemetry;

(B) Use of helicopters in urban areas and urbanized regions;

(C) Deployment of ambulances in more widely distributed patterns to reduce response times, with dynamic positioning strategies and algorithms that could be used in the new computer system to achieve operational gains perhaps not now possible;

(D) Dispatching strategies to be combined with the discriminant analysis to reduce further risks in the use of ambulances and specialty brigades;

(E) Possible variations in manpower policies to enhance service effectiveness.

Details can be presented for the topics of greatest interest.

6.3 International Research and Practice

Building on information obtained in ten advanced nations, it may be of interest to describe findings being synthesized from research and practice in the following general areas:

- Principles of management for services
- Methods of long-range planning in emergency services
- Methods for analyzing complex systems within which EMS operate
- Assessment of preventive programs, and development of possible new preventive policies

- o Policies for dispatching and dispatching management
- o Policies for reducing the time from occurrence of severe injury or disease until service begins
- o Development of new technologies
- o Uses of computers in emergency operations and management.

Details can be presented for the topics of greatest interest.

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