
System Status Management

The Strategy of Ambulance Placement

System status management refers to the formal or informal systems, protocols, and procedures which determine where the remaining ambulances will be when the next call comes in. Whether elaborate or simple, written or remembered, every system has such a plan — the question is, does it make sense and does it work?

Author Jack Stout is a regular contributor to *jems* and will have a monthly column beginning in the June issue. He has long been involved in designing and implementing EMS systems, most notably the public utility model concept. With his company, The Fourth Party, he has been involved in the establishment of sophisticated ambulance systems in Little Rock, Arkansas; Tulsa, Oklahoma; Kansas City, Missouri; and most recently, Fort Wayne, Indiana.

Some of the most earth-shaking concepts seem merely interesting when they first emerge into view. Some go nearly unnoticed. The force and impact of the idea may change our lives without our ever knowing that it was *that* idea that did it.

The well-known Eisenberg studies certainly caught our attention, but did you know that those studies are subtly but powerfully impacting the very structure of the entire ambulance industry? Legally imposed response time standards are no longer arbitrary or entirely subjective, and the courts are upholding ordinances with stringent response time requirements based, in part, upon the Eisenberg studies. The right of private ambulance companies, or public agencies for that matter, to deliver life-threatening response times has been seriously weakened. The life expectancies of low-

performance ambulance organizations, and even entire classes of ambulance systems, have been dramatically shortened by the new knowledge. Almost unnoticed, the forces have been set in motion.

In the February 1983 issue of *Medical Care*, Dr. C. Gene Cayten and others upped the ante even further with the publication of a research project summary entitled, "Clinical Algorithms for Prehospital Cardiac Care." This well-written article describing a truly fine piece of research is, perhaps with less fanfare than the Eisenberg studies, another blockbuster. Whether an EMS system should go to the trouble of developing and documenting detailed step-by-step procedures for patient care versus relying more heavily

upon paramedics and medical control physicians to "invent" algorithms on the spot used to be a matter of "professional preference." While the debate is bound to go on, Cayten's evidence is powerful and on the side of planned and documented clinical procedure.

As our infant industry matures, we are learning that some ways are better than others, and that everything isn't a matter of opinion. Eisenberg showed us that, for certain patient conditions, both fast BLS and slow ALS are deadly. Dr. Cayten and his colleagues have now shown us that well-documented clinical algorithms not only help paramedics retain their technical skills, but actually can be traced with statistical significance to changes in patient outcome.

Gradually, very gradually, we are learning what some have suspected all along. We are learning that life-saving system performance is hard to come by. Not even money can necessarily buy it. Smart people with good intentions and expensive equipment are not enough. Our business is more like pro-football, gorilla warfare, or (closer to home for this writer) — heavy weather sailing — all depend upon first recognizing that a variety of events are going to happen very quickly, your responses to those events must be perfectly selected and executed, and that you can't possibly predict what's really going to happen. Then with painstaking

by Jack L. Stout

diligence, you try to predict everything that could happen anyway, and you figure out what you would do if it did happen, and you write it down and you think it through and prepare yourself and you practice, practice, practice. When things do start happening, you hope most of what you do goes according to plan, leaving you and your crew free to concentrate your intelligence and creativity upon a limited and more manageable set of unforeseen circumstances.

The concept common to all of these activities is the goal of reducing, as much as possible, the need to invent protocols and procedures on the spot. Think it through *before* it happens. Plan the response while the pressure is off, while the advice of others is available, while mistakes can be made and corrected in the hypothetical — not in a ditch under a car in a foot of water covered with a shiny film of gasoline.

And practice. Cayten noticed that the number of paramedics treating the patient influenced patient outcome, and had to adjust the analysis to account for this and other variables. But having lots of paramedics at the scene doesn't automatically help the patient. You can't outnumber an attack of ventricular fibrillation. Paramedics make a better team because they all know what's going on, what's next, and how to help. But how many two-tiered systems have even written down, much less practiced, team task descriptions and protocols so that BLS crews know how to really join the team when assisting an ALS crew?

High Performance in Dispatch

The term "dispatcher" is used in the commercial trucking industry, the taxicab industry, and defines the job of the 18-year-old clerk who sends out the Xerox repair man, the plumber, or the exterminator crew. And back when "as soon as we can, ma'am" was soon enough ... the same era when "in the best of hands" and "all that could be done was done" was the measure of good medical care ... dispatchers dispatched ambulances, too.

But just as we are learning that highly ordered and practiced action in the field makes for better management of patient care, we are also beginning to learn that the management of the entire system can be

dramatically improved by similar refinements in the control center.

I remember a conversation I once had with an experienced dispatcher in a large urban system. I was watching the operation of the dispatch center late one night when I heard the dispatcher say to a telephone caller, "what is your telephone number?" Later I asked that dispatcher if the caller was phoning from the caller's own home. The answer was, "no." The dispatcher had asked, literally, for the caller's own phone number. What the dispatcher wanted to know was the callback number. I suggested that if you want to know what number the caller is calling from, then you should say the words, "what number are you calling from?" No other words are as good.

There still exist throughout the country major ambulance service systems, some even ALS, where the conversation between the "dispatcher" and the caller is more like a chat than anything else. Each dispatcher has his or her own approach to the conversation — a far cry from the orderly and reliable telephone protocols (i.e. information gathering algorithms) of Dr. Jeff Clawson's Salt Lake City Fire Department operation (see Dr. Clawson's article, "Medical Priority Dispatch — It Works!" February 1983 *jems*).

Sloppy and extemporaneous telephone protocol makes for misunderstanding, faulty information, and missing information; yet the system's entire initial response is based upon that information.

In some of our better managed EMS systems, medically trained dispatchers employ clinically sound and thoroughly thought out telephone protocols to gather infor-

mation and to advise the caller with prearrival instructions, and in multi-tiered response systems, these same protocols extend to guide the selection of ambulances and first-responder units. All essential, but what about the management of the system itself — the system whose *configuration* when the phone rings can often make the critical difference? What about the management of system status?

"System status management refers to the formal or informal systems, protocols, and procedures which determine where the remaining ambulances will be when the next call comes in." Whether formal or informal, elaborate or simple, written or remembered, every system has a "system status management plan." The only question is, does your system status management plan make sense and does it work?

Effective Unit Hour Utilization

Think of it this way. Every ambulance system can afford to place only a limited number of ambulances on the street. Because ambulance demand patterns usually follow a weekly cycle, I like to think in terms of "unit hours per week." A "unit hour" is simply a fully equipped and manned ambulance on the street for one hour. A dispatcher trying to match supply with demand must utilize the available "unit hours" in the best way he or she can to squeeze the highest response time performance possible out of the unit hours available.

At the most basic level, there are two extreme forms of unit hour deployment. At one end of the extreme, the system could run the *average* number of unit hours available per week all the time, i.e.

Figure 1

HOSPITAL DROP TIME BY HOSPITAL						
FOR MONTH: 12/82, SYSTEM: KANSAS CITY MO/MAST EMS, HOSPITAL: ST. JOSEPH — KC						
	Count	Ave Time Arrive Hospital To In Service-1st Resp	Over 15 Min Count Per %	Ave Time Arrive Hospital To In Service—All	Over 15 Min Count Per %	
Priority One	35	15.51	12 34.3	22.06	19 54.3	
Priority Two	24	12.25	7 29.2	34.04	14 58.3	
Priority One and Two	59	14.19	19 32.2	26.93	33 55.9	
Priority Three	22	16.23	8 36.4	18.77	12 54.5	
Priority Four	0	0.00	0 0.0	0.00	0 0.0	
Priority Three and Four	22	16.23	8 36.4	18.77	12 54.3	
Priority All	81	14.74	27 33.3	24.72	45 55.6	

the same number of ambulances on the streets 24 hours a day, seven days a week. At the other extreme, but not much more foolish, you could put all the unit hours on the street at the same time for one hour, if you owned that many ambulances.

Since all of the calls don't come in during one hour a week, it would obviously be stupid to use up all of your precious unit hours during one 60-minute period each week. But at the same time, demand for ambulance service fluctuates wildly by time of day and day of week, so it wouldn't be much more intelligent to run the same number of units all the time. Somewhere in between is a solution that makes sense. The Demand Analysis Report for Kansas City (page 30, from the American Ambulance Abstract Service — AAAS) illustrates the normal and unusual patterns of fluctuation, by time-of-day, and day-of-week, for life-threatening emergency calls, non-life-threatening emergency calls, and non-emergency calls for all the Thursdays for four months ending

December 1982 in Kansas City, Missouri. Look it over and think about how you might spend unit hours on Thursdays in Kansas City.

Taking surplus unit hours off the street when they aren't needed, and adding these unit hours during times of overload or wild fluctuation makes sense. But the question of where to put these ambulances remains. If you assume that the geographic pattern of demand is fairly constant, or completely random, chances are you will be wrong, and from some patient's perspective, dead wrong.

Every ambulance system has strategy for placing its ambulances, ranging from the Pollyanna approach of giving every ambulance a permanent "home base" and leaving it there except when dispatched, all the way to automated deployment systems which utilize different deployment plans for each hour of the day and each day of the week, complete with mini-deployment plans within each hour depending upon the number of ambulances

then left available in the system.

Maps "A" and "B" show the location of all emergency requests in the City of Tulsa over a period of several weeks. The difference is that Map "A" shows the geographic emergency demand pattern for the time between 9:00 a.m. and 10:00 a.m. Thursdays while Map "B" shows the geographic demand patterns just one hour later on the *same day* of the week. (This is *not* a computer model, but rather an actual plot of real emergencies experienced by real patients.)

If you see a "G" on the maps, it means a life-threatening emergency where the system responded in eight minutes or less. If you see a "B" (i.e. bad), it means a life-threatening emergency with a response time over eight minutes. An "O" means a non-life-threatening emergency with a response time under ten minutes, while a "P" (i.e. poor) refers to a non-life-threatening emergency with a response time over ten minutes. (Other maps use different response time tolerances for different purposes.)

Notice that during Hour 10 on Thursdays, activity concentrates heavily along the west end of Skelly Drive, with scattered activity in the southcentral part of the city, while almost nothing happens up north during Hour 10 on Thursdays.

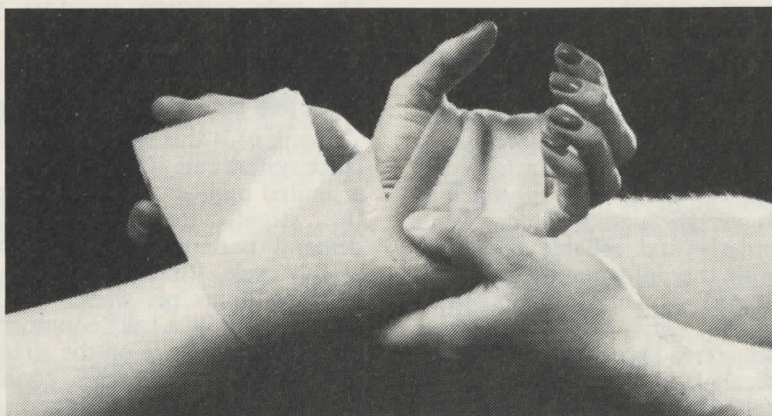
Now compare that with what goes on during hour 11. Not much happening on Skelly Drive, but you'd better be ready to head north. You can't cover the north, however, at the expense of the near south.

Maps "A" and "B" show how different things look in the same city, on the same day, just two hours apart. Now let's look at the same hour (i.e. Hour 11, 10 a.m. to 11 a.m.) during Fridays. Map "C" shows the plan that worked for Hour 10 on Thursdays will be absolutely wrong for Hour 10 on Friday. Hour 10 on Friday is not only tougher geographically, but Tulsa's Demand Analysis Report (not shown) also tells us that this geographically scattered demand will fluctuate in volume as well. Hour 10 on Friday is expensive to cover, revenues are mediocre, and you can expect to move the crews around more than usual to keep things covered.

A more sophisticated system status plan is simply a plan for dealing with different demand patterns by basing the around-the-clock deployment of

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unit hours, and the geographic deployment of remaining units available upon the historical, geographical and time-of-day fluctuations in demand patterns. Of course, for some hours in some areas there almost is no pattern to be found. The "O's," the "B's," "P's" and "G's" scatter all over everywhere, and demand volumes hit everywhere except on the average. But this is a type of pattern itself, the toughest of all to deal with, and so we are forced to get out the checkbook, spread out our units, and when the last unit is all we've got, park it near a freeway exchange where it can't get to any location very fast, but can cover the whole city with some reliability.

When I go through this process, I get my latest AAAS Maps and Demand Analyses, along with several other useful reports and sit down with the most experienced dispatchers and street people I can find. I show them the maps and the demand analyses for one hour of the day, one day of the week, and ask them the following question: "Knowing the frequency and fluctuation of demand for this hour, and seeing the maps of historical demand and response time performance, if you only had one ambulance left in the system, where would you like it to be located?"

This, as it turns out, is an amazing question. The "system status committee" may often argue and struggle for some time to come up with an answer. They pick a spot and then someone notices that, at that time of day, the ambulance would be upstream of the hotspot, and in rush-hour traffic. Someone else notices that another location would be downstream from traffic relative to a potential hotspot, but would have a helluva time reaching the occasional call on the other side of the city. *But notice carefully: if it takes that much analysis and discussion to make the decision when the pressure is off, when all the data is available, and when the most experienced people in town are making the decision, how on earth does anyone think a single dispatcher, under pressure, with no time and limited information, and with six calls in progress is going to do any better?*

When we are done figuring out where one ambulance should be, if it's the only ambulance left and it's 4:30 in the afternoon on a Friday, then I ask what should be done if you had two ambulances left. Then three,

then four, and so on.

Then we figure out, at each level of remaining capability, which ambulance posts have the lowest priority, and should therefore be used for dispatching non-emergency calls. This effort helps to preserve the best possible remaining coverage while minimizing post-to-post moves.

While we are at it, we recheck the demand fluctuation for that hour, and ask ourselves what level of vehicle coverage is so low that non-emergency dispatches should be suspended until another unit comes back into service. Finally, we "make a wish" as to how many ambulances we think would be necessary for safe and effective coverage during that hour of the day, that day of the week — i.e. how many "unit hours" shall we "spend" on this one of 168 hours of the week?

When this is done, we move on to the next hour, and 167 "plans" later, we have a pretty good idea of what the best and most experienced dispatchers and street people in the system think should be done. We find some hours where the volume of demand fluctuates so wildly, and where the geographic distribution takes on no pattern at all, and during these hours we know coverage will be expensive and difficult; we will have to make up for the losses somewhere else.

But we also find other hours where demand volume is highly predictable and where geographic patterning is relatively concentrated. During these hours, coverage is easier to achieve and if the system is heavily dependent upon fee-for-service revenues, the "profits" made during that hour will help cover the "losses" incurred in other hours.

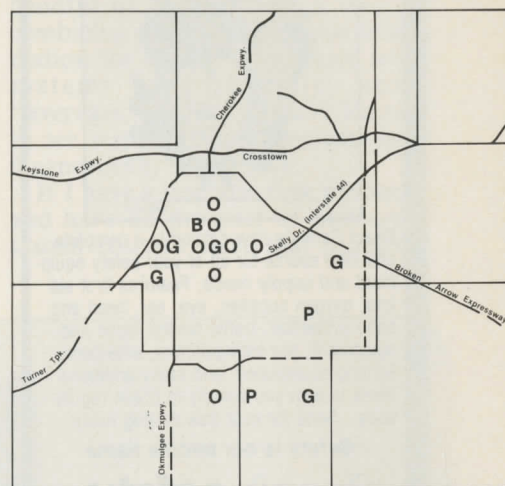
If the whole thing sounds difficult, boring, frustrating, and sometimes seemingly not worth the effort, you are beginning to understand. High performance is hard to come by unless money and "unit hours" are no object, and even with a blank check on unit hours, real high performance may still elude a system. In any case, when we are done with the process, everything is written down and displayed in a flipchart or entered into a small computer programmed (i.e. Micad or Minicad) as a system status management aid, and the result is the beginning of a "system status plan."

When complete, this plan serves dispatchers as a sort of algorithm for

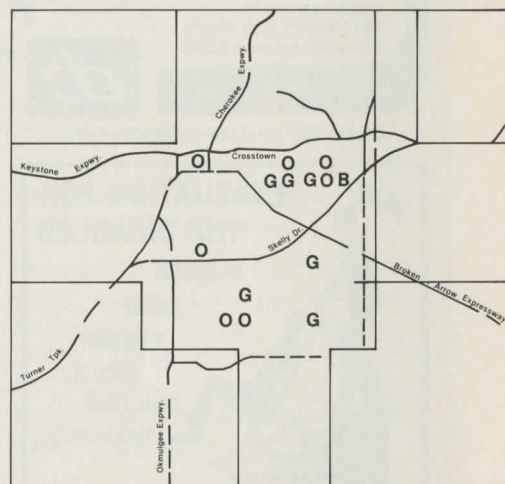
Response time limits (call received to arrival):

Priority 1: G = 0-8 min. B = 9-over min.

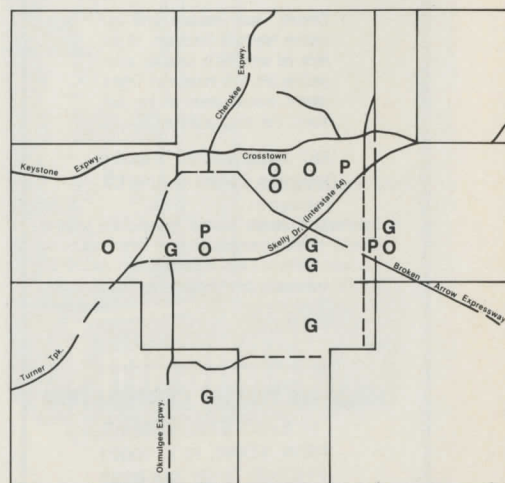
Priority 2: O = 0-10 min. P = 11-over min.



Map A: For Day 4 — Thursday; for Hour 10

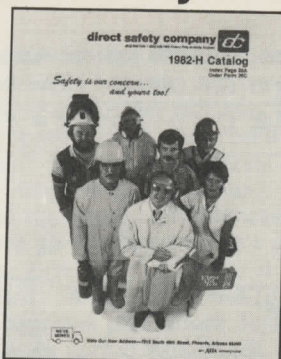


Map B: For Day 4 — Thursday; for Hour 11



Map C: For Day 5 — Friday; for Hour 10

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on-line management of system deployment, just like a clinical algorithm guides a field paramedic. It minimizes seat-of-the-pants redeployment, and benefits from the experiences of many instead of a few. Perhaps best of all, its effectiveness can be measured and evaluated, and the plan continuously improved and fine-tuned. As long as every dispatcher does his or her own thing, there is no "plan" to evaluate — only dispatchers.

Every System Has a Plan, However Silly It May Be

Before we first began our work in Kansas City, the plan then in use, though not exactly written down anywhere, went something like this:

There will be 14 ambulances on the street, 24 hours a day, 7 days a week, for a total of 2352 unit hours of coverage a week. Every ambulance crew shall be on a 24/48 hour shift, and shall show up for work at a permanently assigned ambulance post, and shall relieve the crew on duty either on time or whenever that crew returns to its post. There shall be no rules governing suspension of non-emergency transfer work or out-of-town dispatches. If there are 13 calls in progress and only 1 ambulance left in the system, even though the emergency load may be about to peak, it's okay to send the last ambulance out of town or to dispatch it to a non-emergency transfer call. Furthermore, if the only ambulances left in the system are stationed at the most remote and least active posts, while all the other ambulance crews in the system are working their tails off, it won't be necessary to relocate any of the remaining ambulances, especially if it is late at night and the outlying crews are asleep. Finally, whenever any ambulance completes a run, its crew shall return to its permanently assigned post, regardless of whatever else may be going on in the system at the same time. (If a dispatcher would like to experiment from time-to-time by relocating ambulances during a shift, no rules would prevent such experimentation, no policies would guide such experimentation, and if the crews got mad because of the inconvenience, or if the fuel bill were to rise noticeably, lord only knows what might happen.)

The multimillion dollar ambulance company that used that plan is now out of business. But the "plan" is not all that uncommon. It is easy to see why systems using system status plans like Kansas City's now discarded plan usually don't write them down. This plan and variations on its theme, had been used in Kansas City for years, even in the presence of a million-dollar plus federal grant to centralize dispatching of the old multiple provider system.

Most systems use formal or informal plans that lie somewhere in between the old Kansas City model and the most sophisticated models

around. Unfortunately, most are far closer to the old Kansas City model than to the higher performance end of the spectrum.

Deployment Isn't Everything

Our first experience with really sophisticated system status management was the result of being squeezed between a stringent city-imposed response time requirement and a several hundred thousand dollar increase in union wages. Revenues were fixed, costs were going up, and response time performance *had* to be maintained. We had no choice except to squeeze more performance out of fewer unit hours per week.

Our second experience with system status management occurred when we were asked to help a system equalize an otherwise good response time record throughout various neighborhoods of the city. An effective and primarily black consumer group demanded an investigation of that system's response time performance in the poorer neighborhoods of the community. We were initially called in to perform that investigation, and the data showed that while the black community was receiving comparatively good response time performance, it could be better. But surprisingly, there was a remote and wealthy neighborhood experiencing chronic response time performance problems. It seemed to us that response time performance could be better equalized throughout all areas of the city using some of the deployment and management techniques we had then recently developed elsewhere.

We went through the whole process with dispatchers and field people just as discussed above, and after some reshuffling of crews, posts, and shifts, a new system status plan was installed. The result was an improvement in overall response time, and even greater improvement in equality of performance throughout the city. (That system had focused its attention, partly by the ordinance, upon *average* response time performance — a practice which we now know results in more life-threatening response times for patients at the dangerous end of the distribution curve, and also promotes geographic inequity in response time performance.)

Everyone was generally pleased with the initial results, and after a few months of operating with the

new system, fine tuning began. Using more AAAS maps and reports, we began to identify problem times of day and neighborhoods which needed extra attention. We started by locating areas and times of day where we apparently had surplus production capacity. (AAAS "solution maps" highlight geographic areas and times/days where response times are unusually fast and where the eight-minute *maximum* is virtually never exceeded. The purpose is to locate surplus unit hours which can be reassigned either geographically or by time of day to cover peaks and overload conditions.)

As we proceeded with this fine-tuning process, we ran into some really stubborn performance problems that didn't seem to be solved by any amount of ambulance coverage. Looking more closely at the records of these specific runs, we began to learn that the problem wasn't always a lack of ambulances, or even a lack of *nearby* ambulances.

With the help of our little MICAD computer aid, we were able to recreate a record of the status of the system at the time any given call came in. That is, we can produce a report which tells us, for example, that when the problem call came in at 12:35 a.m., there were seven ambulances in the system, one with mechanical problems, two on emergency calls, one on a non-emergency call, and the remaining three ambulances were available for dispatch — one at Post 12, one at Post 13, and one en route from County Hospital to Post 3. With that kind of information available to us, we could then take a look at the dispatcher's vehicle selection, the conformance of the system with the original plan, and when we really were short of ambulances when a call came in, we could begin to find out why.

Sometimes the problem was simply a lack of sufficient ambulances to achieve coverage, or the placement of remaining ambulances in the wrong locations. But not always. We began to identify a whole list of factors which impact response time performance, some of which cost money to deal with, but most of which do not.

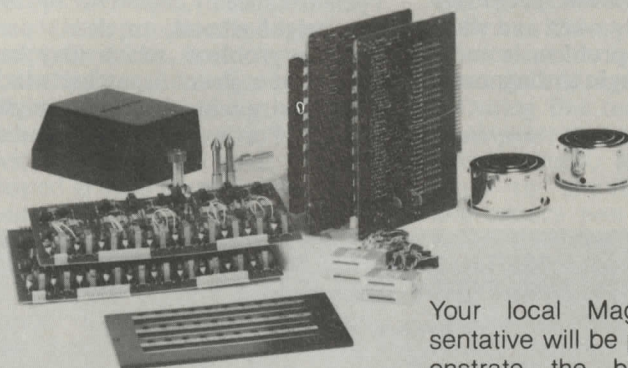
If money is no object and you have a response time performance problem in some neighborhood or during some time of day/day of week, you can simply buy another

ambulance, hire another crew, and add another "unit hour" at the right time and place. Sometimes that will solve your problem, and sometimes it won't.

Ambulance system response time performance is not "good" or "bad," in general. If you are having response time problems, they are almost always occurring at some times of the day/day of week but not at others, and problems often repeat themselves in fairly predictable geographic patterns. These patterns

are obscured by the fact that *where* the response time problem is occurring will change depending upon *when* it is happening. Since only a handful of systems have a way of combining and displaying this information for analysis, and since most systems rely heavily upon "averages," few of us have learned to see response time problems in a diagnostically useful way.

If I have a response time problem, and have no prospect of increasing system costs to solve that problem,



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then I must exhaust every possibility for solving the problem before I resort to simply adding equipment and crews, or even to going through the hassle of revising schedules and shift assignments. I must first pinpoint the time and location of the problem, and then proceed to diagnose the causes. Only then can I devise a solution. The process I use relies extensively upon statistical information from the AAAS reporting service, and I follow a step-by-step path that is too lengthy to be detailed here. However, several of the most productive steps can be described as follows:

1. *Define the problem specifically.* I must know exactly when and where the response time problem is occurring before I can begin to diagnose it. Is there a pattern?

2. *Bona fide system overload?*

Was the dispatcher out of ambulances when the call came in? Were the available ambulances too far away? If so, why? Where were all the other ambulances at the time, and what were they doing?

3. *Plan followed or violated?* Did the problem occur because the system status plan is faulty or because the plan wasn't being followed?

4. *Dispatcher error?* Was the nearest ambulance dispatched? Were the routing instructions accurate? Is the crew or dispatcher unfamiliar with that neighborhood? (One AAAS report analyzes response time performance by dispatcher by district or neighborhood, to detect performance problems which may be the result of a given dispatcher's lack of familiarity with a specific neighborhood. For example, white dispatchers may sometimes spend less time in black neighborhoods than in other parts of the city, and therefore may be less familiar with primarily black neighborhoods. If that is the problem, no amount of extra ambulances will solve it.)

5. *Are unit hours being wasted?* Are there plenty of ambulances on duty that hour, given the number of calls received, but for some reason availability is lacking? Figure 1 shows a sample "Hospital Drop Time" report from the AAAS service designed to detect hospitals whose method of receiving patients excessively delays ambulance crews. As a result of this particular report, a "uniform hospital drop policy" may be developed and adopted by all hospitals, reducing unnecessary out-of-service time to the tune of thousands of dollars in lost unit hours per year.

Figure 2 analyzes "Hospital Drop Time" too, but this time by senior paramedic. There is no "right" time at the scene, and there is no "right" hospital drop time either. Every call is different. But when you are looking at 40 or 50 runs per medic, and one medic averages twice as long at the hospital as everyone else in the company, it's worth a conversation. Most medics in our systems are used to these reports, and posting alone seems to do the trick. But believe me, the first time we ran these reports, the numbers were all over the place.

If you think all hospitals are about the same in hospital drop times, think again. In one city, we found a hospital that averaged triple delays in drop times, no matter who the medics were. This added up to over \$150,000 per year in lost unit hours due to that hospital's methods of accepting patients. Other reports detect bad habits which hurt system performance. I call one such report the "paramedic honey locator" report, since it can detect a paramedic who is normally fast in hospital turnaround time, but who routinely takes longer at a particular hospital that is normally fast for everyone else. I presume the presence of a "honey."

6. *Equipment failure?* Are we plagued by equipment failures? How long does it take to get a unit back in service? How often does one ambulance assist another because the former's cardiac monitor won't work, etc.?

7. *Demand pattern change?* Has

Figure 2

HOSPITAL DROP TIME BY EMT
FOR MONTH: 12/82, SYSTEM: KANSAS CITY MO/MAST EMS

Senior EMT Id#	Priority			Ave. Time Arrive Hospital To In			Ave. Time Arrive Hospital To In		
	#1	#2	1&2	Service-1st Resp	Over 15 Min Count	Per %	Service-All	Over 15 Min. Count	Per %
204	14	7	21	13.90	7	33.3	15.00	9	42.9
247	17	11	28	15.54	0	35.7	22.86	15	53.6
258	22	20	42	18.45	24	57.1	19.29	29	69.0
260	4	1	5	5.00	0	0.0	11.20	1	20.0
261	1	0	1	18.00	1	100.0	8.0	1	100.0
262	3	1	4	8.25	0	0.0	11.00	1	25.0
264	6	8	14	15.29	5	35.7	20.50	7	50.0
266	0	3	3	8.00	0	0.0	8.00	0	0.0
417	2	2	4	9.25	0	0.0	2.50	0	0.0
419	7	8	15	13.20	4	26.7	22.60	7	46.7
213	12	17	29	13.72	0	34.5	8.48	18	62.1
214	15	15	30	20.53	20	66.7	25.80	22	73.3
405	24	17	41	10.00	7	17.0	4.66	17	41.5
215	18	15	31	13.18	8	25.8	4.74	10	32.3
256	16	11	27	14.48	11	40.7	18.63	18	66.7
209	23	10	33	13.27	8	24.2	25.85	29	87.9
217	16	13	29	13.24	10	34.5	37.66	19	65.5
208	4	6	10	17.80	6	60.0	9.60	8	80.0
407	22	16	38	17.92	21	55.3	19.39	22	57.9
218	17	14	31	14.45	10	32.3	30.23	14	45.2
219	22	14	36	15.17	16	44.4	19.89	25	69.4
220	26	19	45	13.67	7	37.8	18.49	26	57.8
259	2	0	2	14.50	1	50.0	29.50	2	100.0
221	21	14	35	11.26	4	10.4	15.54	7	20.0
203	12	16	28	17.82	11	39.3	20.21	13	40.4
252	4	2	6	8.67	0	0.0	18.00	2	33.3
257	22	16	38	13.82	11	28.9	22.18	26	68.4
210	15	15	30	19.70	17	56.7	21.93	21	70.0
223	6	8	14	11.79	5	35.7	17.86	8	57.1
250	5	4	9	13.00	2	22.2	15.44	3	33.3
415	2	2	4	10.75	0	0.0	11.75	1	25.0
207	12	10	22	13.41	4	18.2	22.64	14	63.5
205	24	15	39	13.26	1	28.2	18.54	22	56.4
226	11	26	37	13.22	9	24.3	15.14	14	37.8
253	4	5	9	13.89	4	44.4	16.67	6	66.7
227	0	1	1	37.00	1	100.0	37.00	1	100.0
231	0	1	1	11.00	0	0.0	17.00	1	100.0
254	12	21	33	14.45	15	45.5	16.82	19	57.6
235	12	7	19	14.58	10	52.6	19.63	13	68.4
239	7	5	12	16.67	6	50.0	18.92	6	50.0
241	13	10	23	14.96	8	34.8	21.04	12	52.2
413	25	19	44	15.52	20	45.5	17.07	23	52.3
242	2	0	2	9.00	0	0.0	10.00	1	50.0
249	19	12	31	13.71	10	32.3	18.26	18	58.1
Totals:	534	453	987	14.44	350	35.5	19.73	541	54.8

the demand pattern begun to change for this location and time of day/day of week? Was there a seasonal fluctuation that we can prepare for? Was there a special event that we failed to account for?

8. *Traffic flow problem?* Were we upstream when we should have been downstream?

9. *Out-of-chute time?* One standard AAAS report routinely displays average times from unit alert to en route status, organized by senior paramedic name and number. For life-threatening calls, this time should be under 30 seconds on the average, and never over one minute. Lost time leaving the chute can never be made up, no matter what you do. In one case, we found what should have been obvious to everyone — an ambulance post location where the crew quarters were on the second floor and at the other end of the hall from where the ambulance was parked. With brilliance, we moved the crew quarters and solved the problem. Sometimes our work isn't very sophisticated.

10. *Dangerous non-emergency cutoff level?* Is the problem repeatedly happening when several non-emergency transfer runs are in progress? Could the problem be fixed by simply raising the non-emergency cutoff point to a safer level?

11. *Change post locations?* Could we solve the problem simply by moving an existing ambulance from a less frequently utilized post location into the problem area? This is the simplest move, since it requires no reshuffling of shift schedules. However, care must be taken since you may simply relocate the response time problem to the other side of town. The AAAS "solution maps" help make this decision by locating neighborhoods where problems rarely occur and where response times are extra rapid. We will deliberately adjust the system to eliminate emergency response times over eight minutes, even if doing so results in a slight increase in either overall average response times or slightly decreased coverage in an apparently overserved neighborhood.

When first starting out, the past plan of deployment is normally so poorly documented, poorly conceived, poorly followed, or all three, that it makes no sense to use the past system as a basis for refinement.

Most of the time, you can do better by simply abandoning the past structure in favor of an initial system status plan developed by your most experienced dispatch and field personnel, utilizing the process discussed earlier in this article, together with the essential displays of demand pattern history.

Every time we have tossed out an old deployment plan and replaced it with a new system status plan designed that way, the improvement has been instantaneous and dramatic. Kansas City, for example, (a 100 percent paramedic system providing both emergency and non-emergency work), has managed consistent improvements in response time performance, both citywide and by the city's mandated councilmatic districts, while shrinking unit hour coverage from 2352 unit hours per week down to the level currently reported at 1600 hours per week. For financial reasons, the system had to drastically cut either unit hours or wages, due to a declining city subsidy and a badly needed commercially financed \$2-½ million total equipment replacement. In that city, late runs cost the operator \$10 per minute in payment deductions, and chronic late runs would cost the entire contract. Under such circumstances, performance is almost inevitable, or at least mandatory. (Jay Fitch, manager of Medevac's Kansas City operations, believes that 1600 unit hours is about rockbottom for that city, and future fine tuning will focus upon stabilizing coverage, seasonal fluctuations, and reduced post-to-post movement.)

Implementation of the first sophisticated system status plan (SSP) usually requires a major reshuffling of everything from ambulance post locations to shift schedules, compensation plans, crew change methods, inventory control, and just about everything else that is sacred in any established ambulance service. It is traumatic.

Furthermore, during the earlier stages of the plan, there will be quite a few seemingly unnecessary post-to-post vehicle movements, mostly occurring in the middle of the night when a 24-hour crew is trying to sleep. The tendency will be for dispatchers to delay a post-to-post move if another crew is nearly ready to clear from a hospital; to the extent that the delays are frequent, the SSP isn't being tested at all. The result

might be that you finish a difficult two or three months of initial experience only to find out that, whatever else you may have done, you have not actually implemented the SSP, and you can't be sure whether the problems you are still having are the result of the SSP or the result of not following the SSP. If you don't follow the SSP, you can't fine tune it.

Fine tuning your system status plan is, I think, fun. In the first round of planning, everything was based on the expert judgment and prediction of the most experienced people available, with benefit of detailed demand maps and demand analyses. The second time around, adjustments to the plan can be based upon the initial plan's actual results.

During fine tuning, you can shift some posts around, shift some unit hours around, and take numerous steps to simultaneously reduce unnecessary post-to-post movement while squeezing out any remaining performance problems.

In most systems, you will need about three months of data per fine tuning cycle, which means that you must stick with the current plan as closely as possible. Of course, the initial plan should be watched very closely during the first few weeks to detect any obvious glaring flaws which may need midcourse correction. (In this case, it is good to "stay the course," but not at all costs. The important thing is that, if a mid-course change is necessary, it should take the form of a change in the plan — not an authorized departure from the plan. That way, subsequent data can be used to assess the effectiveness of the revised plan — not the old plan that was abandoned.)

With enough time and experience, and enough quarterly fine tuning efforts, the plan will begin to take on seasonal variations, and will account for special events such as Fourth of July, Christmas, New Year's, and Rolling Stones concerts. After a year or so of development and fine tuning, you will have squeezed, poked and prodded about all of the performance you can get out of your system, at least in terms of response time performance per unit hour. From then on, small semi-annual adjustments should do the trick, and probably without fanfare or too much gnashing of teeth.

The reality of instituting sophisticated system status management is

considerably harder than you might think. Dispatcher duties and responsibilities are more than doubled. Dispatchers of moderate ability will bite the dust. (The new job is so different that we hate to call these people "dispatchers," we prefer "system status managers.") The dispatcher training program must

absolutely involve extensive off-line simulations. Our system status manager certification test covers Salt Lake City-type telephone protocols, medical vocabulary, and a compressed 200-run system simulation covering every conceivable complication. Certification requires zero-defect performance.

We have had to completely overhaul labor contracts, shift schedules, compensation programs, and bonus plans, and we adapted a shift bid process from the way TWA bids flights for flight attendants.

We use eight-hour shifts, 10-hour shifts, 12-hour shifts, 24/48, and hybrids. In one city there was nearly

Analysis Report

Most people have never seen an analysis like this, and some surprises are usually in store. On Kansas City's reports, Priority I calls are "life-threatening emergencies"; Priority II calls are "non-life-threatening emergencies"; and Priorities III and IV are two kinds of non-emergency transfer.

"Total average" means the rounded off average calls per hour during that hour on several months of Thursdays. To calculate the "high average," we pick one Thursday out of each month having the highest number of calls that hour, and then average those together. "High average" is basically a normal high volume — you won't get it all the time, but you will get it about once a month.

"Low average" is like "high average," except we pick out the lowest volume Thursday of each month and average those. "Low average" is sort of a normal fluctuation too.

The "maximum" and "minimum" columns simply list the most and least calls we have had during a specific hour of all the Thursdays.

To help understand how to read this report, let's look at hour 12 (11 a.m. to noon on Thursdays). They've been averaging 1½ life-threatening emergencies, 2½ non-life-threatening emergencies, and only one non-emergency call during that hour.

Looking at "averages" this hour seems pretty easy to deal with. And in terms of fee-for-service revenues, things look pretty steady during that hour. But look again. Once a month the life-threatening emergencies will double, and so will the non-life-threatening emergencies. These fluctuations will be pretty common and if they begin to occur at the same time, you're in trouble.

Let's look further. Hour 12 isn't too rough as far as non-emergency transfers go, and non-emergency work is pretty steady. Furthermore, non-emergency demand both earlier and later in the day usually goes higher, so you should have some extra unit hours available if your system, like Kansas City's, is an all ALS system. In general, Hour 12 is going to be a problem, but some hours are much worse. One more thing: those "total averages" will tell you, pretty reliably,

how much fee-for-service income goes with the hour, while those "high averages" and "maximums" tell you how much you are going to have to spend to furnish coverage during that hour, if you don't want any response time failures, that is. If you break even

during Hour 11, you will be lucky.

Keep in mind that Thursdays don't look much like Mondays, Sundays don't look like Saturdays, and so forth. Every community has its own patterns, both geographically and around-the-clock. —Jack Stout

DEMAND ANALYSIS REPORT

FOR DAY 4 — THURSDAY

Hour	PRIORITY I					PRIORITY II					TOTAL EMERGENCY				
	Total Average	High Average	Low Average	Period Max	Period Min	Total Average	High Average	Low Average	Period Max	Period Min	Total Average	High Average	Low Average	Period Max	Period Min
00	1.00	2.00	0.00	2	0	0.50	1.00	0.00	1	0	1.50	3.00	0.00	3	0
01	0.50	1.00	0.00	1	0	0.50	1.00	0.00	1	0	0.50	1.00	0.00	1	0
02	0.50	1.00	0.00	1	0	0.50	1.00	0.00	1	0	1.00	2.00	0.00	2	0
03	1.00	2.00	0.00	2	0	0.50	1.00	0.00	1	0	1.50	3.00	0.00	3	0
04	0.50	1.00	0.00	1	0	0.00	0.00	0.00	0	0	0.50	1.00	0.00	1	0
05	0.00	0.00	0.00	0	0	1.00	2.00	0.00	2	0	1.00	2.00	0.00	2	0
06	0.50	1.00	0.00	1	0	1.50	2.00	1.00	2	1	2.00	3.00	1.00	3	1
07	1.00	2.00	0.00	2	0	0.50	1.00	0.00	1	0	1.50	2.00	1.00	2	1
08	1.00	2.00	0.00	2	0	1.00	2.00	0.00	2	0	1.50	3.00	0.00	3	0
09	0.50	1.00	0.00	1	0	2.50	4.00	1.00	4	1	3.50	5.00	2.00	5	2
10	1.50	3.00	0.00	3	0	0.50	1.00	0.00	1	0	2.00	4.00	0.00	4	0
11	1.50	2.00	1.00	2	1	1.00	2.00	0.00	2	0	2.50	4.00	1.00	4	1
12	1.50	3.00	0.00	3	0	2.50	5.00	0.00	5	0	4.00	8.00	0.00	8	0
13	1.50	3.00	0.00	3	0	1.50	3.00	0.00	3	0	2.00	4.00	0.00	4	0
14	1.50	2.00	1.00	2	1	1.00	2.00	0.00	2	0	2.50	3.00	2.00	3	2
15	2.00	3.00	1.00	3	1	1.00	2.00	0.00	2	0	3.00	5.00	1.00	5	1
16	1.00	2.00	0.00	2	0	1.50	3.00	0.00	3	0	2.00	4.00	0.00	4	0
17	1.50	3.00	0.00	3	0	1.50	2.00	1.00	2	1	2.50	4.00	1.00	4	1
18	1.50	3.00	0.00	3	0	1.50	3.00	0.00	3	0	3.00	5.00	1.00	5	1
19	1.50	3.00	0.00	3	0	1.50	3.00	0.00	3	0	2.50	5.00	0.00	5	0
20	1.50	3.00	0.00	3	0	1.50	2.00	1.00	2	1	2.50	4.00	1.00	4	1
21	1.50	3.00	0.00	3	0	2.00	4.00	0.00	4	0	4.50	7.00	2.00	7	2
22	1.00	2.00	0.00	2	0	2.00	3.00	1.00	3	1	3.00	5.00	1.00	5	1
23	1.50	3.00	0.00	3	0	1.00	2.00	0.00	2	0	2.50	4.00	1.00	4	1
Totals	1.13	2.13	0.13	3	0	1.19	2.17	0.21	5	0	2.21	3.79	0.63	8	0

TOTAL EMERGENCY

PRIORITY III-IV

TOTAL RESPONSES

Hour	TOTAL EMERGENCY					PRIORITY III-IV					TOTAL RESPONSES				
	Total Average	High Average	Low Average	Period Max	Period Min	Total Average	High Average	Low Average	Period Max	Period Min	Total Average	High Average	Low Average	Period Max	Period Min
00	1.50	3.00	0.00	3	0	0.50	1.00	0.00	1	0	1.50	3.00	0.00	3	0
01	0.50	1.00	0.00	1	0	0.00	0.00	0.00	0	0	0.50	1.00	0.00	1	0
02	1.00	2.00	0.00	2	0	0.50	1.00	0.00	1	0	1.00	2.00	0.00	2	0
03	1.50	3.00	0.00	3	0	0.50	1.00	0.00	1	0	1.50	3.00	0.00	2	0
04	0.50	1.00	0.00	1	0	0.00	0.00	0.00	0	0	0.50	1.00	0.00	1	0
05	1.00	2.00	0.00	2	0	0.50	1.00	0.00	1	0	1.50	2.00	1.00	2	1
06	2.00	3.00	1.00	3	1	0.00	0.00	0.00	0	0	2.00	3.00	1.00	3	1
07	1.50	2.00	1.00	2	1	0.50	1.00	0.00	1	0	1.50	2.00	1.00	2	1
08	1.50	3.00	0.00	3	0	1.50	3.00	0.00	3	0	3.00	4.00	2.00	4	2
09	3.50	5.00	2.00	5	2	2.00	3.00	1.00	3	1	4.50	6.00	3.00	6	3
10	2.00	4.00	0.00	4	0	2.50	4.00	1.00	4	1	3.50	6.00	1.00	6	1
11	2.50	4.00	1.00	4	1	2.00	3.00	1.00	3	1	4.50	7.00	2.00	7	2
12	4.00	8.00	0.00	8	0	1.00	2.00	0.00	2	0	5.50	10.00	1.00	10	1
13	2.00	4.00	0.00	4	0	1.00	2.00	0.00	2	0	3.50	6.00	1.00	6	1
14	2.50	3.00	2.00	3	2	2.00	4.00	0.00	4	0	4.00	6.00	2.00	6	2
15	3.00	5.00	1.00	5	1	2.00	3.00	1.00	3	1	4.50	6.00	3.00	6	3
16	2.00	4.00	0.00	4	0	1.50	3.00	0.00	3	0	3.00	6.00	0.00	6	0
17	2.50	4.00	1.00	4	1	0.50	1.00	0.00	1	0	2.50	4.00	1.00	4	1
18	3.00	5.00	1.00	5	1	1.00	2.00	0.00	2	0	4.00	7.00	1.00	7	1
19	2.50	5.00	0.00	5	0	0.50	1.00	0.00	1	0	3.00	6.00	0.00	6	0
20	2.50	4.00	1.00	4	1	0.50	1.00	0.00	1	0	3.00	5.00	1.00	5	1
21	4.50	7.00	2.00	7	2	0.50	1.00	0.00	1	0	5.00	7.00	3.00	7	3
22	3.00	5.00	1.00	5	1	0.50	1.00	0.00	1	0	3.00	5.00	1.00	5	1
23	2.50	4.00	1.00	4	1	1.00	2.00	0.00	2	0	2.50	4.00	1.00	4	1
Totals	1.90	3.79	0.63	8	0	0.85	1.71	0.17	4	0	2.33	4.67	1.08	10	0

a strike due to the loss of some 24/48 shifts, while in another labor got mad because some eight-hour shifts were being lost to 24/48. In another case, crews had actually purchased homes near their permanently assigned posts. We eliminated permanent post assignments.

But the ultimate purpose of sophisticated system status management is very simple: we want our ambulance crews and equipment to be located where and when they are needed as often as humanly possible. What's the alternative? Being somewhere else.

Failure Guaranteed Four Ways

If system status management is such hot stuff, where has it been all this time? The uncomfortable but grownup answer is that organizations learn to do what makes money or what it takes to survive. You can count on one hand all the cities that fine their ambulance providers for poor response time performance. Government operations almost never compete for survival, and there's

always the average response time to hide behind.

System status management, done properly, takes a whole lot of work, requires constant attention, may strain labor relations, and is really easy to screw up. No wonder no one developed it until they had to.

There are probably hundreds of ways to prove that system status management won't work in any city. But there are four ways that are guaranteed to fail:

1. *Try buying part of it.* An organization will make system status management work when its financial stability and very existence depend upon it. Under any other conditions, system status management is just too much trouble. If your city wants good system status management, turn over your dispatching and field operations to a qualified operator, hold that operator financially accountable for every late run, forget average response times and focus upon maximums, and be ready to bury the operator for chronic performance failure. Then forget about

system status management, and you will get it.

As I always say in pre-bid conferences when asked by private ambulance operators how my client city wants the dispatching done, no one cares how many ambulances you put on the street, how you dispatch them, or what you do with the money we pay you. When the phone rings, we want a qualified paramedic talking to the caller, we want a full-blown paramedic ambulance on the scene within eight minutes 90 percent of the time, we want superb equipment and performance, and no one cares how you do it. If you can put a guru on a hill who can get two ambulances to handle thirty thousand calls a year, go to it. But screw up a little and it's ten bucks a minute. Screw up a lot, and you're out of business.

2. *Separate dispatching from operations.* The absolute key to system status management is the operation of the dispatch center and the quality of dispatch personnel. The company that does the dispatching and the company that runs the

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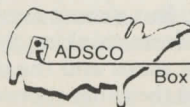


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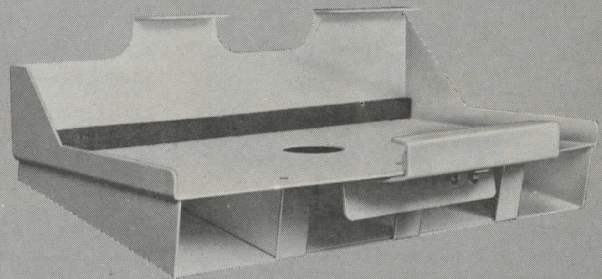
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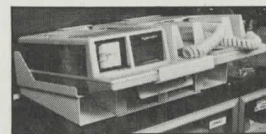


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ambulances have got to be the same company, and it's that company that must be responsible for developing, revising, and implementing the system status plan. It's just too complicated to work any other way. If you think it isn't that complicated, then you clearly don't understand, and you will probably never know what went wrong.

3. *Try it with employees who care little about their patients and less*

about their company. People get used to the old ways. Low performance is less work than high performance. I know for a fact there are ambulance personnel who have deliberately delayed an emergency response for the sole purpose of "proving" that the new plan won't work and that more unit hours are needed. These people are, perhaps without realizing it, dedicated to their own company's failure. And

they will jeopardize their own patient to make a point.

These are the same people who, rather than helping to work out the bugs, wag their fingers at dispatcher error, who make anonymous calls to reporters in hopes of making their company and its effort to improve performance look foolish, and who were recently caught driving 35 mph, red lights and siren on an open road and light traffic, on the way to an emergency. If you have such people in your company, you have a choice: get rid of them or cater to them. So long as they are on your payroll, they have the power to prove you wrong. I have seen them do it.

4. *Try computer simulation.* I do not recommend or support the use of computer simulation models to determine ambulance coverage patterns and post locations. Such models rely too heavily upon theoretical travel times to optimize distribution. Our experience has convinced us that a committee of experienced dispatchers and street people can outperform a computer simulation every time if they are provided with the demand pattern statistics, demand maps, and other informational tools which, when combined with human judgment and experience, take into consideration traffic flow patterns, complex street names/numbering systems, familiarity with area, and a hundred other factors that go far beyond the scope of practical computer simulation.

Conclusion

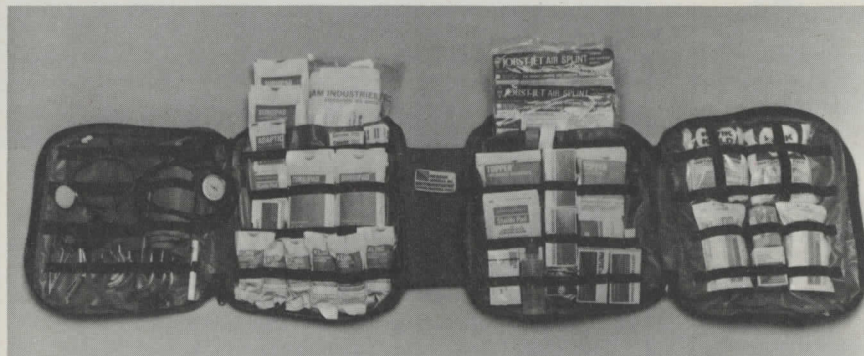
When thinking about system status management, keep in mind that regardless of how you staff and deploy your ambulances, you are using a system status plan. System status management isn't "good" or "bad" — it is inevitable. Your plan may be simple and stupid, complex and stupid, simple, yet effective, or possibly even complex and even more effective.

There are many good reasons for sticking with a more simplified approach to system status management. Only the best managed organizations with the most dedicated personnel should even attempt to use the most complex and sophisticated models. But almost every system can benefit from thinking things through with the maps and the demand analyses and the other reports, even if the result is an elegantly simple but more effective approach to deployment. □

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