# EMS Management Journal

*Presented by the National EMS Management Association and the National Association of State EMS Directors*

## PREMIER ISSUE

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# EMS Management Journal

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# EMS Management Journal

## Table of Contents

**Volume 1, Number 1** **January – March, 2004**

# An Evolution in Peer Reviewed Journals

**Mic Gunderson**
**Editor**

Peer-reviewed management articles and other forms of scholarly discourse for EMS administrators, managers, medical directors, researchers, and policy / decision makers are severely limited in scope and availability. The few peer-reviewed journals that publish EMS papers are focused on clinically oriented research. EMS policy and decision makers have a broader need for high quality peer-reviewed literature that provides an analysis and synthesis of information related to administration, management, operations, and policymaking. There is also a need to expose the EMS community to literature from other healthcare disciplines and the mainstream business community. These needs are not limited to the U.S.– they are international in scope. The goal of the *EMS Management Journal* (*EMSMJ*) is to fill this niche.

The introduction of a new peer-reviewed journal is a significant milestone for any professional discipline. Peer-reviewed journals are the venues in which the art and science of professional disciplines are defined, debated, and evolved through the publication of research, scholarly papers, editorials and position papers. However, we hope the *EMS Management Journal* (EMSMJ) will be a new step in the evolution of the peer-reviewed journal format itself.

*EMSMJ* is published through a collaborative effort between HealthAnalytics, LLC, the National EMS Management Association and the National Association of State EMS Directors. Our vision for *EMSMJ* is quite unique in terms of its content, format and features.

Instead of limiting the format and language used in *EMSMJ* manuscripts to the conventions of standard biomedical research, *EMSMJ* will draw from the formats and language of quality and management sciences. We encourage our authors to use the six sigma DMAIC (Define, Measure, Analyze, Improve, Control) framework for their structured abstracts and articles in the Performance Reports section – our area for original research. You are likely to see problem statements and descriptions of experimental methods illustrated with tools such as Ishikawa diagrams, Pareto charts, and process maps. Analyses of results are likely to be illustrated with statistical process control charts. Conclusions are likely to feature metrics like ROI (return on investment), sigma levels, and DPMO (defects per million opportunities).

Because of our focus on management and performance issues, along with our unique incorporation of performance improvement oriented language and reporting formats, we see *EMSMJ* as something that is more complementary than competitive with other peer-reviewed EMS journals. Admittedly, many EMS professionals are not yet familiar with some of these tools, formats, and the associated language. We hope to change that—permanently. In the meantime, we will provide footnotes, references and hyperlinks to more detailed information to help readers learn more.

## USING THE JOURNAL

*EMSMJ* is disseminated through email, PDF files and web pages. Readers will be notified of each new issue of the *Journal* through an email containing the annotated table of contents with links to the individual article files. Readers can also choose to download the entire issue as a single PDF file with 'bookmarks' to specific articles. Page numbering in *EMSMJ* starts with the cover and includes all types of pages, including advertisements, to conform to the way in which PDF files are structured.

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The articles themselves may contain links to file attachments for data, supplemental documents, sound, video, or demonstration files. The data file attachments are particularly intriguing from an academic perspective. In print, readers are limited to viewing summaries of investigational or project data as tables and graphs. *EMSMJ* envisions the authors of performance reports attaching their source data files, so that readers may scrutinize the information for themselves and even perform their own statistical analyses. This will take peer-review and scientific debate in EMS to an entirely new level.

*EMSMJ* has been designed to be read from your computer screen or by printing articles of interest on your own printer. If you read from your screen and are connected to the Internet, you will find a huge added benefit because the web addresses and internal references embedded in the articles and advertisements are fully functional links. These internal and external links are surrounded by light blue dotted lines (e.g. link to the *EMSMJ* website). If it is a link to a website or email address, the pointing hand cursor will have a 'W' on it (Windows) or a '+' (Mac OS) and show the web or email address. Clicking on a citation note in an article will take you to the endnote to see the full citation information at the top of the window. You can go back to the place you were reading in the article by using the 'back' button on the navigation bar of your Adobe Acrobat Reader. Clicking on the [link] information following an endnote will take you to an external resource if one is available, such as the abstract, journal, publisher or bookseller for the cited work via your web browser. Email links may also be included. Moving back and forth between reading the PDF and externally linked website will go much faster if you save the PDF file to your hard drive and then open it using Adobe Acrobat or Adobe Reader. Reading the PDF from within your browser often runs much slower.

There are innovations in the presentation of advertisements as well. Because some *EMSMJ* readers might choose to download only the articles they want to read, the ads in *EMSMJ* are located at the end of specific articles. This offers potential advantages for both readers and advertisers. A reader who downloads an article on a cardiac related process improvement project may have interest in an advertisement about a cardiac related product or service. This allows readers to see advertisements that are relevant to their interests and allows advertisers to precisely target ad placements. The ads themselves may contain text hyperlinks and/or graphic hyperlink 'hot spots.' Look for notes indicating the presence of hot spots and click on web addresses that might be included in the text of the ads.

We also will introduce a new innovation – sponsored access. An advertiser may choose to 'sponsor' access to a particular article or to an entire issue of *EMSMJ*. This will allow subscribers and non-subscribers alike to have full access to that particular article or issue. This is most likely to happen when an advertiser sees marketing value in having a particular article or issue become as widely read as possible.

On a more personal note, I can't help but feel a sense of déjà vu. In 1987, I was the editor / publisher of one of the very first peer-reviewed EMS journals. While still working 24/48 shifts as a paramedic/firefighter, I used a Macintosh Plus running Microsoft Word 1.0 and Aldus PageMaker 1.0 to produce the *Tampa Bay EMS Journal*, which subsequently became the *Journal of Prehospital Medicine*. Shortly thereafter, it merged with the *Journal of the World Association for Disaster and Emergency Medicine* and combined with the efforts of the National Association of EMS Physicians to create *Prehospital and Disaster Medicine*. Desktop publishing was seen as the 'bleeding-edge' of technology by most professional associations and publishers back then. With time, the innovations of desktop publishing became the accepted norm. I expect the same to happen again with electronic peer-reviewed journals link *EMSMJ* — for many of the reasons described above and more. *EMSMJ* has an extraordinary group of people serving on the editorial board. It was great to ride on the crest of a wave of innovation with a dedicated group of people back then and I'm sure it will be another great ride with this group and *EMSMJ*.

We hope you enjoy and benefit from having access to an innovative electronic peer-reviewed EMS management journal as much as we do in preparing it for you. We are looking forward to your feedback. Click on the link to email me at mic.gunderson@healthanalytics.net.

# Improvement of Cycle Time for State Issuance of Emergency Medical Services Personnel Certification

**Dia Gainor, MPA**

## ABSTRACT

**DEFINE**: A core administrative process for almost every state and territorial emergency medical services (EMS) office is the credentialing of prehospital care personnel. The per event cycle time (how long it takes the state EMS office to issue each card) was selected by the Idaho EMS Bureau as a process improvement project. The charter developed during the Define phase revealed that the actual performance of the state EMS office from 1999-2001 was an average of 22.8 business days with a standard deviation of 21.9 days.
**MEASURE**: During the Measure phase, additional data was collected about applicants' and local EMS agency officials' expectations for performance and quality as part of a data collection plan.
**ANALYZE**: Reasons for delay in calendar year 2001 were evaluated, value analyses of process steps were performed, and baseline sigma on the same data indicated that with an upper specification limit of 10 days, the process was performing at 1.18 sigma and the average processing time was 16.2 days.
**IMPROVE**: Failure to determine root causes for delay using data analysis led the team to focus on process overhaul during the Improve phase. Results from a failure modes effects analysis as well as customer requirements guided configuration of the revised process.
**CONTROL**: Controls monitoring the performance of the process, once implemented statewide, included defined detailed procedures for staff and expectations for analysis. The resulting performance during calendar year 2003 was 2.2 days.
**CONCLUSIONS**: A detailed process and data analysis revealed that the process was riddled with non-value added steps, rework loops, and as such was unsalvageable. A dual-pronged approach of process analysis and data analysis moved the team away from old (and erroneous) beliefs and allowed for innovation with accountability.

*Keywords*: administration, certification, licensure, emergency medical services
*Citation*: Gainor D: Improvement of Cycle Time for State Issuance of Emergency Medical Services Personnel Certification. *EMS Mgmnt J* 2004 Jan-Mar 1(1):7-19.

## DEFINE

A core administrative process for almost every state and territorial emergency medical services (EMS) office is the credentialing of prehospital care personnel. This activity is often grounded in a legislative mandate aimed at protecting the public through the assurance that a minimum level of knowledge and skill proficiency is possessed by every EMS provider, and may include other assessments associated with "fitness for practice," such as criminal background checks. Many states have administrative rules dictating the specifics of this requirement, as well as establishment of application process(es), fees, and other requirements.

In less populous states, the number of EMS certifications* issued per year may be as low as

*Throughout the health professions, "licensure" is the term most commonly used to refer to the credential issued to an individual health care provider. In EMS, however, most states refer to this credential as "certification". This term will be used throughout the article for consistency with state practices.

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several hundred, while in states with larger populations, thousands of certifications may be issued every year. Regardless of the volume of certifications processed, this act is an essential component of state EMS systems' human resources deployment ( i.e., making otherwise eligible providers available for local EMS agencies' use as soon as possible or desired). The exact methodology of process is centralized or decentralized.

Without regard to these state- and territorial-specific variations, a key characteristic of quality that is critical to the applicant is how long it will take to receive their card. How or if each state notifies the applicant of the anticipated wait time is unknown. In Idaho, where the improvement project described in this article was conducted, the actual anticipated performance of the certification processing system was unknown, although data was being captured on actual elapsed cycle time since January of 1999.

The Certification Cycle Time (CCT) improvement project began as an initiative of the Idaho EMS Bureau in January of 2002. This coincided with the author's fellowship at the Juran Institute in a four week Six Sigma Black Belt training program. ‘Black Belt’ is a term that Six Sigma leadership at General Electric, Motorola, and other corporations coined (Breyfogle et al [2001]) to describe the leader within a process improvement team following the Define-Measure-Analyze-Improve-Control (DMAIC) methodology .

A well-written charter was the essential first step of launching the CCT project. The format and development of the charter followed principles recommended by the Juran Institute and published templates and associated worksheets (Williams et al [2000]; Pande et al [2002]). A charter lists the business case, estimate of benefits, resources, scope, and boundaries of the project. Other essential statements in the charter included a problem statement, a goal statement, and deadlines for completion of each of the phases. It should be noted that not all Six Sigma or DMAIC-based texts address the utility or construct of a charter. This is an omission that causes important focus and definition to be lost on the team. The first draft charter for the CCT team was developed by the author both to gain approval for the project workload from the State Health Officer and to guide initial CCT team meetings.

The core of the charter was the following problem statement: “A retrospective review of processing time data for all applications for initial certification during calendar years 1999-2001 revealed that the elapsed time for the EMS Bureau to issue certification was an average of 22.8 business days with a standard deviation of 21.9 days. Fifty percent of all applications had an elapsed time of 18 business days or longer. The overall goal of this project was to reduce elapsed time from certification eligibility to deployment by reducing certification processing time to within 10 days of the date the application is received by the EMS Bureau. When processing time duration is longer than the expectations or business needs of the applicant or ambulance service, telephone inquiries to both the regional and central offices of the EMS Bureau result in interruption of work processes, internal conflict among employees, and frequently do not yield any additional information about or expediting of the application. Ambulance services in urban areas with a high demand for additional personnel and rural areas experiencing critical manpower shortages resort to attempts to circumvent or request special consideration during the application and certification processing phase. Unofficial feedback channels report the occasional use of unlicensed personnel, usually in a desperate or defiant mode, which is a violation of the laws and rules governing emergency medical services in Idaho, and ultimately could be prosecuted as a felony violation of the Medical Practice Act.” The full project team charter document is shown in Appendix A.

The value in pursuing this project was immediately recognized among state EMS office staff. Not only was the actual processing time longer than previously perceived, this was a common source of dissatisfaction and contention between state EMS staff and anxious candidates for EMS certification or the local EMS agency officials waiting to deploy the personnel. Historical attempts appeared to have some success, but the changes made were little more than tampering. Typical approaches made in 2001 included asking individual employees involved in the process where the bottlenecks were and asking them to modify their procedures accordingly. Two examples of changes made were the discontinuation of lamination of certification cards, and no

longer making a photocopy of the certification card and letter for the applicant's local EMS agency. While the processing speed appeared to improve (Figure 1), there was no way to confirm if in fact that performance improvement was a result of those changes.

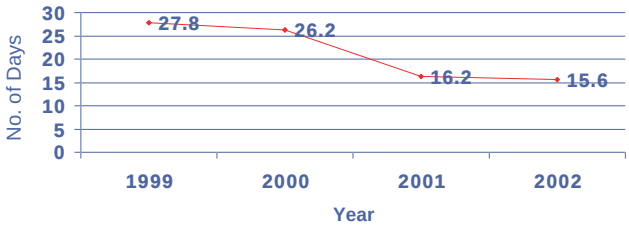


**Figure 1** - Average Business Days to Certification by Year

Team member selection was congruent with the certification process. A representative of each of the types of positions which had any procedural or policy role in the state EMS office related to issuance of certifications were selected to participate: the Certification & Licensure Coordinator, a Technical Records Specialist from the Certification & Licensure Program, an EMS Regional Consultant, and a regional EMS office Administrative Assistant. The team was lead by the author, then a Black Belt in training, and staff of the State EMS Office Analysis & Planning Program who were undergoing Juran Institute DMAIC training through distance learning.

A work product of initial CCT team meetings included the creation of a SIPOC diagram that allowed the team to visualize and document the suppliers, inputs, processes, outputs, and customers in graphical form (Figure 2). The group also developed a high-level process map (Figure 3). Although team members were all familiar with the overall process associated with generating certification credentials for applicants, this activity created a valuable learning opportunity for team members, a tool to portray a simplified version of the process to stakeholders, and a means

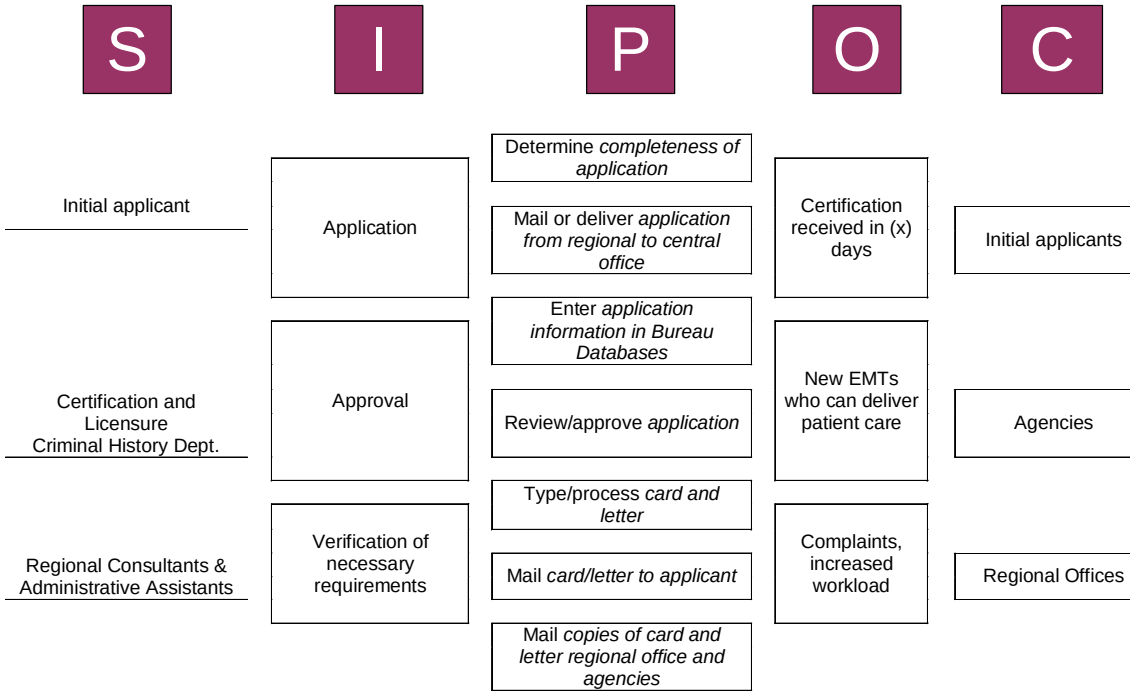


**Figure 2** - SIPOC (Suppliers, Inputs, Process, Outputs, Customers) Diagram for certification process

for confirmation that the scope of the process being considered did not exceed the boundaries established in the charter.

The final resource developed in the Define phase was the "Voice of the Customer." Real conversations with the customer, in this case, applicants for EMS certification and their local EMS agency officials, were occurring on a regular basis throughout the state EMS office. Brassard & Ritter [2001] suggest that complaint information and interviews with these parties should form the basis of determining what characteristics are critical to quality ("CTQs") in the customer's view. The CTQs allow for the conversion of the team's opinion (at this phase) about the customers' preferences into measurable factors that can be used in later phases of the project.

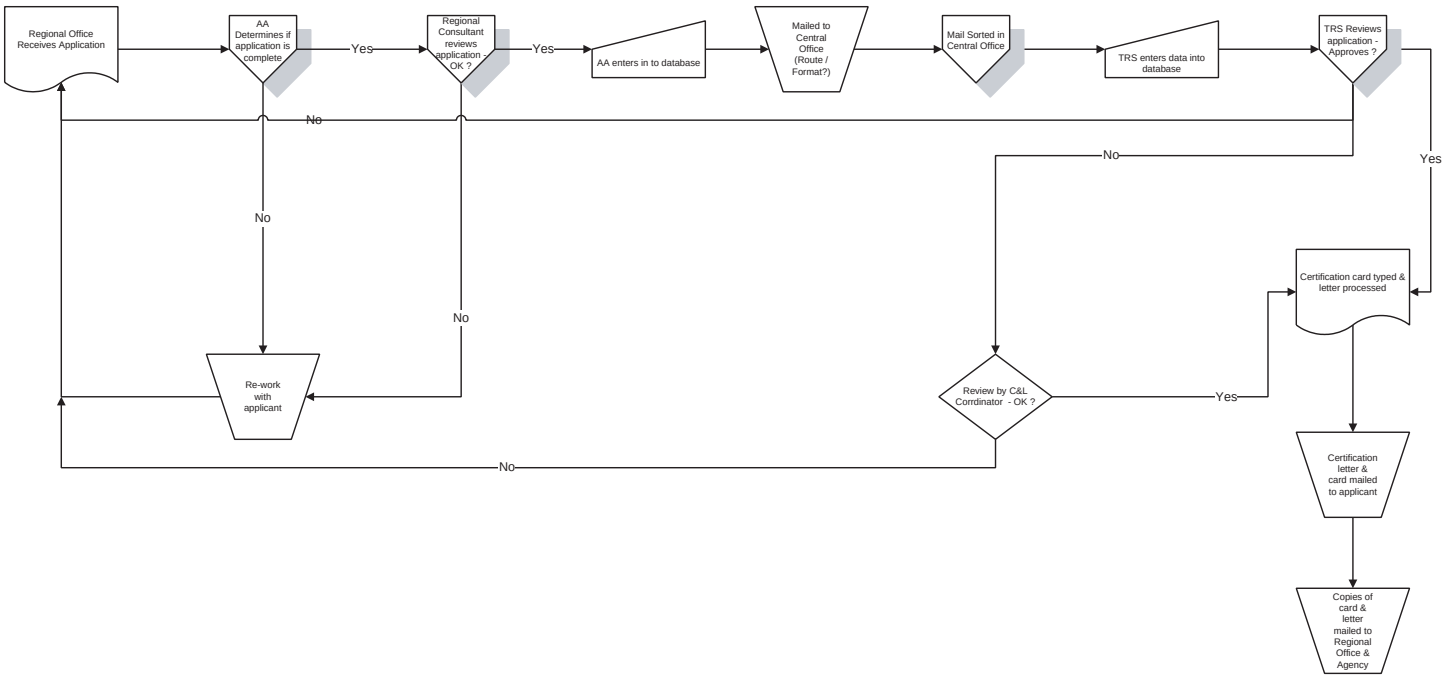


**Figure 3** - Certification Application Process Map - AA = Administrative assitant; TRS = Technical records specialist; C&L = Certification & Licensure Program; *(Editor's Note: Use a higher level of magnification in your PDF viewer (e.g., Acrobat) to see details in this figure.)*

## MEASURE

The state EMS office had several apparent advantages that were expected to serve as resources to the CCT project team:

1. Data and several variables of interest were already being collected upon issuance of each certification;
2. The regional EMS office staff, through whom applications were submitted by candidates, had initiated a project in mid-2001 to collect data on "reasons for delay"; and
3. The state EMS office had control over applications and other tallying points to be able to introduce temporary data collection as needed.

The team chose to utilize calendar year 2001 data (the entire population of applicants for the year) for analysis of cycle time.

Bertels [2003] acknowledges that while DMAIC is a linear process, discoveries in a given phase may cause a revisit to the decisions or assumptions made in earlier ones; this project was no exception. Each team meeting was started with "Just-in-Time" training (JITT) about methods or tools that would be used at each meeting. The same text also acknowledges that Just-in-Time is a failed American industry quality effort of the 1980s, but the phrase lent itself well to the adult learning event that needed to take place in order for all team members to understand and participate fully in CCT project meetings. An example of one of the first JITT sessions was an overview of the uses and characteristics of control charts. Since the team was assessing performance over time, the control chart was a far more revealing graphical method of display than the historical approach of showing a monthly mean in a bar chart (Figure 4). The control chart of calendar year 2001 indicated multiple instances of "special cause variation" (Breyfogle et al [2001]) indicated by multiple points above the upper control limit. This indicated that the certification issuance process itself was unstable (Figure 5).

The data collection plan developed by the CCT team included the following activities and decisions:

- Validate historical data in hand
- Confirm that key stratification variables were part of each record
- Validate ability to retrieve, access and sort data

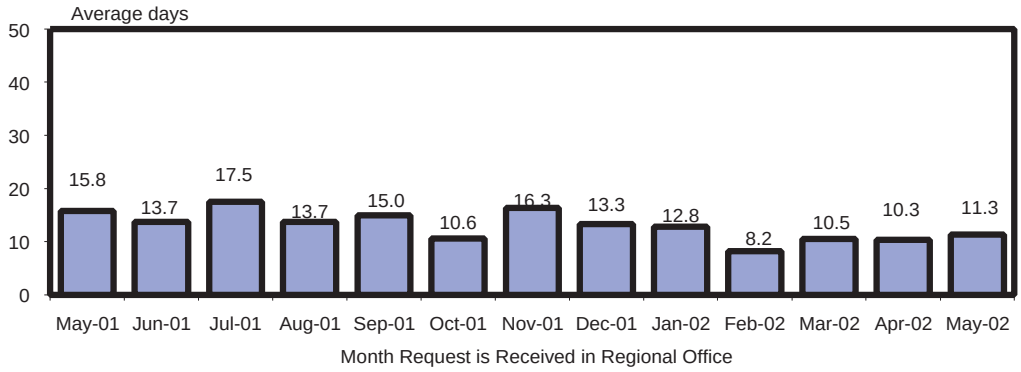


**Figure 4** - Certification Cycle Time Bar Chart - Average number of days from receipt of a certification request in the Regional Office to the date mailed from the Central Office to requestor. Data are revised monthly to reflect certifications completed after the previous management indicator reporting month

- Verify rules used by collector to count days
- All analysis and graphical display would be done in Minitab™ statistical software

Measurement system analysis of the "reasons for delay" data determined that it was unusable. The methods used to classify reasons for delay, and a lack of underlying definitions as these conditions were tracked by ten different people in five regional offices throughout the state compromised the data for accuracy, repeatability, and reproducibility (Williams et al [2000]). The CCT team knew, however, that identifying reasons for delay among recently processed applications could yield important insights about failure points or problematic policies in an objective fashion.

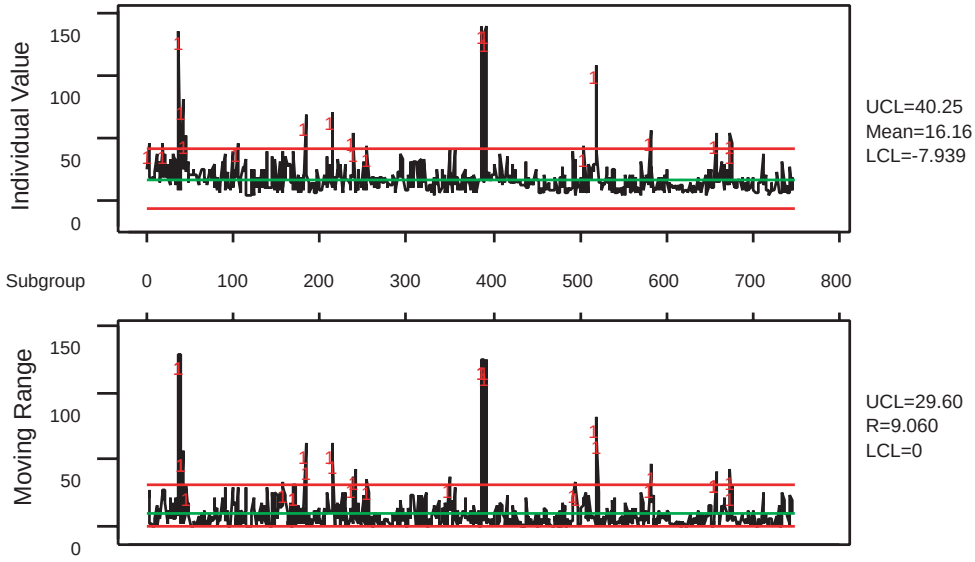


**Figure 5** - 2001 Certification Cycle Time Statistical Process Control Charts

The CCT team had no problem developing the VOC and CTQs, yet at the outset of the measure phase they recognized that they had no idea how the process was performing as it related to those customer-specific characteristics, nor which (if any) of those CTQs carried more weight for the customer. It was essential for the team to transcend the fact that these customers were beholden to a monopoly, and as such were not selecting the provider of this service. The primary CTQ, believed to be speed of processing at the time, could serve as a proxy for cost and value to the customer by translating other high scoring characteristics as ones for which the customer would presumably be willing to wait longer. Planning and measuring process performance (against customer requirements), along with the establishment of defect measures by which to determine a baseline about the process itself (Pande et al [2002]) became the focus of the CCT team activities during this phase.

Identification of variables of interest for use in the Improve Phase was conducted to conclude the CCT team members' estimation of applicant CTQs. The team brainstormed what, if any, CTQs

may have been overlooked during the define phase and determined which requirements should be actively assessed to determine their relative priority for customers. Additional key measures were determined (e.g., classification of respondents by whether or not they were an EMS volunteer, assessment of the waiting time the customer expected, etc.) and built into a survey instrument (*Link to survey instrument [MS Word document format; 39K])*. The plan also identified state EMS office staff that would conduct the interviews as well as the inclusion criteria for customers to be surveyed.

The regional staff of the state EMS office was provided with instructions and a script to use during telephone interviews with each applicant certified by the state in the prior two months. An additional telephone interview was attempted with the chief administrative official of the service with which the applicant was affiliated using a similar instrument. Results were tabulated and presented graphically in the form of stacked bar charts (Figures 6 and 7). The most striking finding was that lamination of cards and copies of certification materials being sent to the local EMS agency had a higher median value than processing speed among provider responses. The CCT team made the significant observation that if the results were construed as representative of all applicants' CTQs, the state's prior tampering with the certification process actually eliminated key characteristics of quality in the blind attempt to increase processing speed.

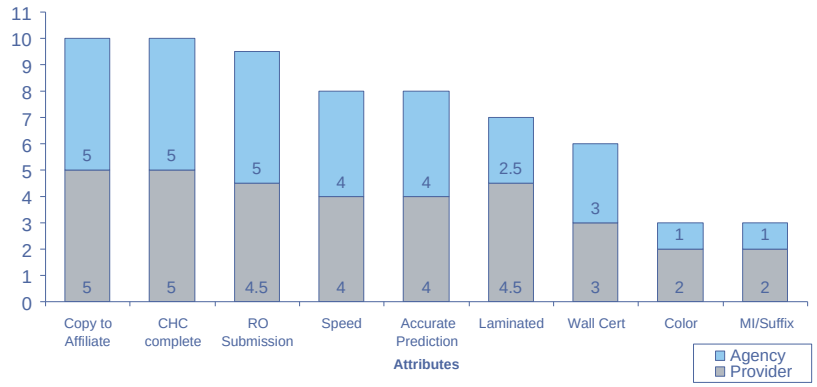


**Figure 6** - Perceived Quality of Certification Services in 2002. CHC = criminal history check; RO = regional office; Wall Cert = wall certificate; MI = middle initial

The team migrated to process mapping in a more detailed fashion than what was displayed in the SIPOC. Although this was a labor-intensive activity, it yielded considerable insight into the procedures, and more importantly the variation, among the staff that had any role in generating certifications for EMS personnel (Figures 8 and 9). In addition to defining the concrete steps, hand-offs, and re-work loops, the process map provided a valuable baseline measure about the function: each individual certification event was executed in 30 (or more) steps, 6 inspections, and surprisingly, 15 sorting events. Sorting events included points in the process where applications were manually regrouped alphabetically, in the order received, or by level of certification. The process maps were then set aside for use in the Analyze Phase.

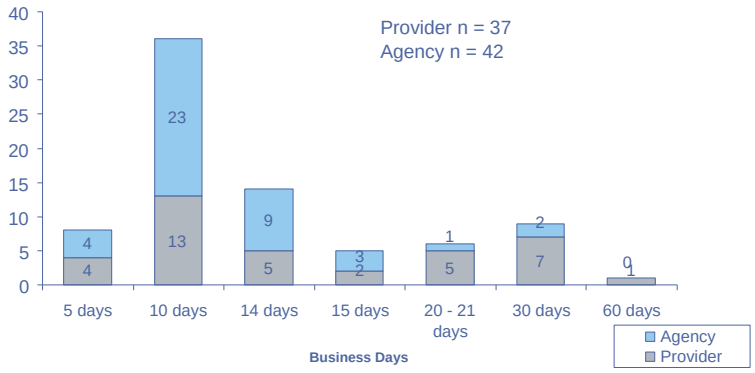


**Figure 7** - Process Time Expectations

The final deliverable of the Measure Phase was to calculate baseline sigma of the certification processing speed. Capability analysis, a method of graphic and statistical assessment of process performance against a specification limit, was performed using Minitab™ on 2001 data. The CTQ survey results indicated that 63% of applicants and chief administrative officials expected the certification to be processed within 10-14 days, so the CCT team selected 10 days as an upper specification limit. The lower bound of values was set at zero.

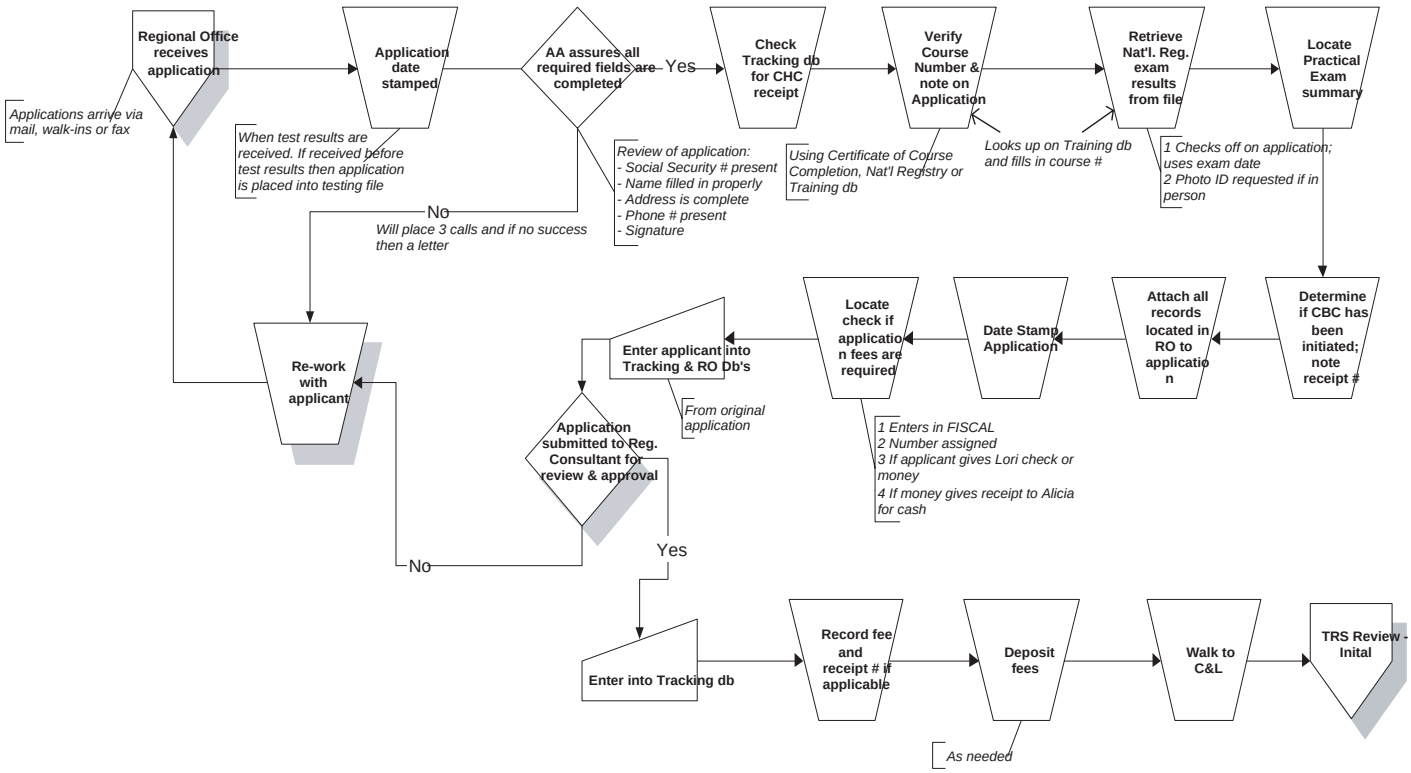


**Figure 8** - Process Map Details for Certification Processing at Regional EMS Offices by the Administrative Assistant Position

Capability analysis findings were that in 2001, the certification issuance speed was performing at 1.18 sigma*. Only 37% of all applications resulted in certification issuance within that 10 day goal . Actual performance was actually worse, since the outliers were removed to simulate the process capability once special cause variation was eliminated.

Armed with acute awareness about the overall performance of the certification processing speed, the CCT team proceeded with analysis.

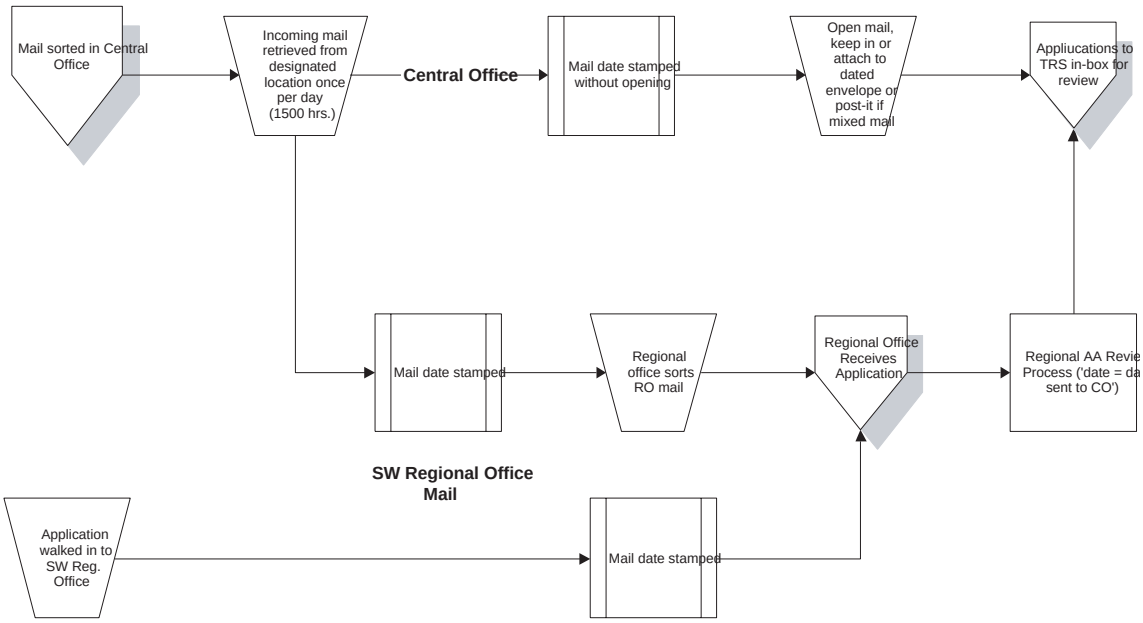


**Figure 9** - Process Map Details for Sorting and Routing of Certification Application at the Central EMS Office

* Sigma is a metric for the rate of defects that come out of a process. A proces that operates at 6 sigma has 3.4 defectcs per million opportunities (DPMO). A 1.18 sigma process operates with approximately 630,000 DPMO. More information...

## ANALYZE

The Analyze Phase proceedings were a combination of data analysis and process analysis approaches. The data analysis objectives were to use stratification to quantify for root cause, test for normality and perform analysis of variance/test for equal variances correlation.

The process analysis objectives included:

- Identify differences among regional offices and those due to lack of defined procedure
- Value added/non-value added assessment of the detailed process maps generated in the measure phase
- Prioritization of the contributors to delay displayed on an Ishikawa diagram

In an effort to identify and eliminate special cause variation within the current process, let alone any improved process, assessment of the applications that resulted in processing time in excess of the upper control limit was done. Even though the population being studied was small (n=16). a data collection plan was devised and agreed to by the CCT team members, including selection of the individual to assess the records, operational definitions of the categories expected to be found, and a process defined to classify findings that were not anticipated. Findings indicated that 62.5% of the applications with excessive elapsed times were related to incomplete applications and 25% were the result of applicants initiating their criminal history checks late. This information was later used in the Improve Phase in order to introduce corrective actions to prevent both special causes from occurring.

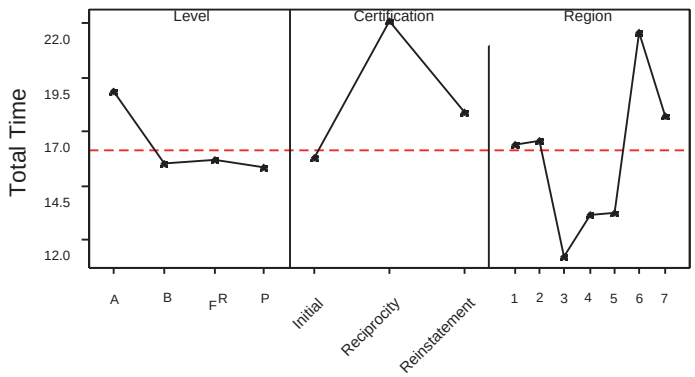


**Figure 10** -Graphical Display of Data Means for Total Certification Processing Time. Includes stratifications by leve of certification, certification process type and region where the certification was applied for. A= Advanced EMT; B = EMT-Basic; FR = First responder; P = Paramedic

The CCT team had been energetically proposing theories (in layman's terms) throughout the meetings in the preceding phases about the presumed causes of delays in processing certifications; the Analyze Phase became the time to declare them in the form of hypotheses. Four (4) hypotheses were proposed to subject to statistical analysis:

1. There is no difference in processing speed among the regional offices
2. There is no difference in processing speed among levels of certification (e.g., Emergency Medical Technician, Paramedic, etc.)
3. There is no difference in processing speed among types of certification (e.g., initial, reciprocity, etc.)
4. There is no relationship between processing speed and the volume of applications received.

Formally stated in the "null" voice as in the list above, these hypotheses occlude the fact that the CCT team members firmly believed that statistical analysis would reveal that the alternate hypotheses should be accepted. In other words, team members' perceptions were that in reality there were differences within the stratification of applications that were the culprits, and this analysis would reveal where the "problem children" were found. In part, this belief was spurned by the historical practice of comparing means in a graphical way (Figure 10). Calculation of group averages for processing time historically indicated that the Advanced EMT, reciprocity candidates, and one regional office had means higher than the other groups, therefore these were the areas warranting improvement focus.

The variables contained within the hypotheses above were believed to be critical to understand or predict the performance of certification processing speed. But as the analysis of data to

test the hypotheses proceeded, those with statistical significance (indicating that the CCT team should accept the alternate hypothesis) didn't necessarily have practical significance. As a result, the team members were forced to dismiss some long held beliefs about delays being the result of poor performance in certain regions, out of state applicants slowing down the process for everyone, or a certain level of certification being fraught with policy problems.

The CCT team returned to the process maps generated in the measure phase and conducted a value-added analysis (Pande et al [2002]). It was essential to use a classification system that included "value-enabling" as a category, since meeting regulatory requirements set in state law or rules would not normally meet value-added criteria, but were nonetheless essential for the team to consider. The findings are noted as self-explanatory abbreviations within each symbol on the process diagrams.

A cause-and-effect, also known as an Ishikawa, or "fishbone" diagram was developed (Figure 11). In addition to filling the fields with the myriad factors that contribute to delay in processing, the team chose to use multi-voting among team members to select 10 most critical factors from the Ishikawa diagram. The team then conducted a failure mode effects analysis (FMEA) to explore and prioritize those 10 factors which resulted in 40 scenarios with indications of great enough risk to single out the causes and create preventive or corrective action plans. An FMEA allows for ranking of all predicted or potential errors or problems and associated causes by scoring each on its severity, frequency (of occurrence), and degree to which detection mecha-

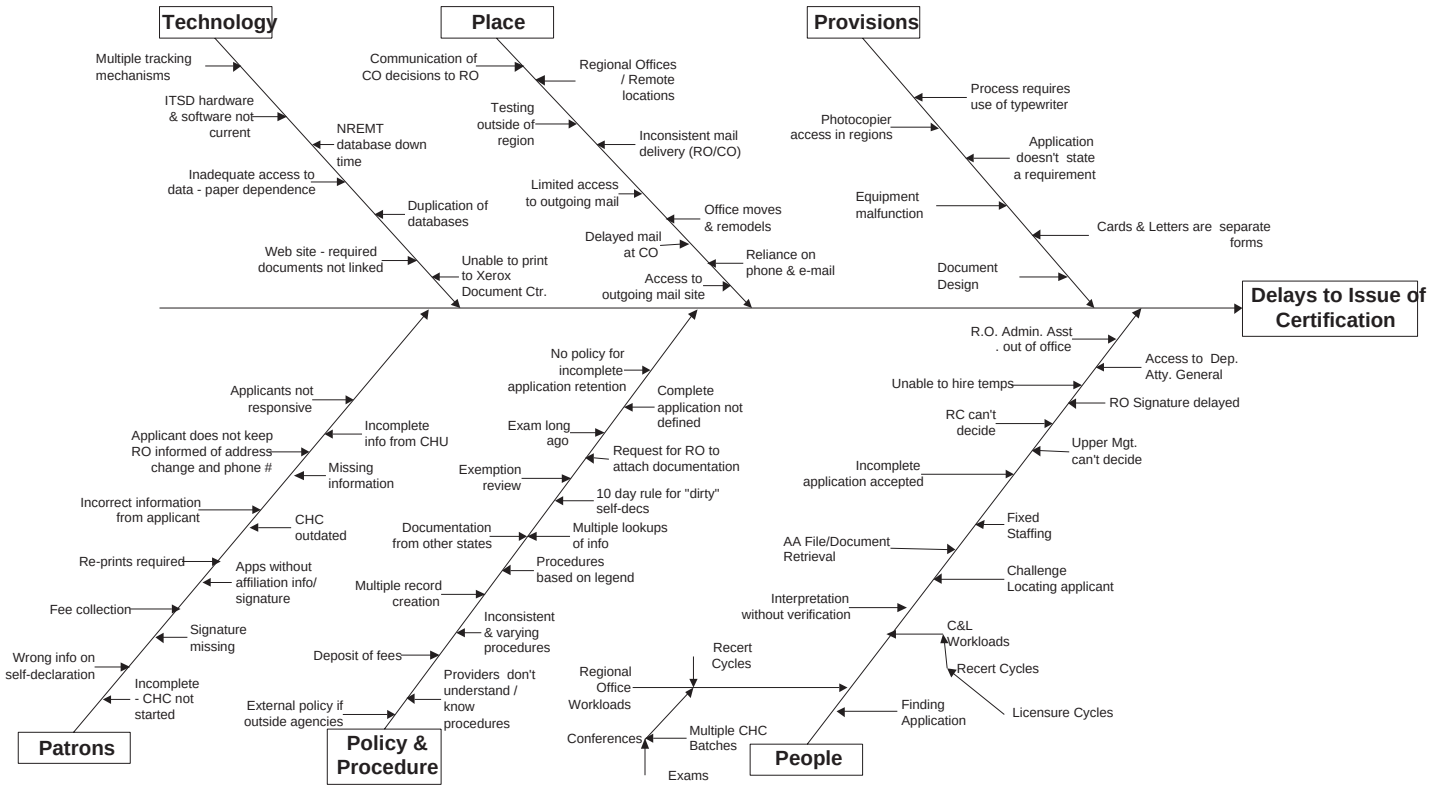


**Figure 11** - Ishikawa (Cause and Effect) Diagram of Factors Contributing to Delays in Certification. RO = Regional Office; CO = Central Office; RC = Regional Consultant; CHC = Criminal History Check

nisms are in place. Four out of the five highest scoring failure modes depend on detailed written procedures to standardize practices and prevent excessive variation.

The CCT team concluded that the existing process was unsalvageable. Instead of attempting to repair the existing process, the team chose to enter the improve phase with the goal of re-engineering the entire process, centered on the CTQs.

## IMPROVE

The charter specified boundaries for any improvements or solutions created by the CCT team: no new staff, no fees, and no disregard for regulatory requirements. The first obstacle tackled was the result of findings from the CTQ survey that indicated that the applicants were not getting information about the application requirements and associated processes from credible (i.e., state EMS office) sources. So the team crafted informational materials to be sent directly to potential applicants while they were still in training courses as an educational tool and to establish a relationship between the potential applicant and an authoritative resource. The application itself was overhauled to minimize any chance for the applicant to miss required sections and to include key data collection fields related to reasons for delay and other variables of interest.

The other root cause contributing to delays was obviously grounded in the often over-simplified and occasionally unwritten guidance for the state office employees to use when processing certifications. As a starting point for designing revised procedures, the CCT team revisited the process diagrams developed in the measure phase. The historical process involved a handoff of applicant materials from the regional office to the central office; the team was unable to identify what value was added as a result. A new SIPOC and high level process map was crafted through team consensus and as a communication tool for state EMS office staff about the proposed change.

New comprehensive guidance and procedures were written; specific attention was paid to the failure modes identified in the Analyze Phase in order to address what were now predictable poor quality or unacceptable scenarios and resolution instructions for the staff. The CCT team routinely revisited the content, even after the initiation of the pilot to assure that the work instructions and foreseeable consequence with associated procedures for handling them were as complete as possible. A regional office not directly involved in the CCT team proceedings was selected for the pilot to minimize any chance of detailed knowledge resulting from months of inspection of and deliberation about the process to overlook any omissions in the written guidance or materials provided. Nominal capital equipment purchases in the form of identical printers and standardization of core correspondence was also accomplished by the CCT team.

A date was selected for initiation of the pilot, and a CCT team member trained the regional office staff in the new procedures. The revised process was reassessed to quantify the steps, sorting events, and inspections and compare the values to the existing process. A new data collection plan specified the location and method for information management to confirm the performance of the revised process and indicators where additional tweaking of the written guidance, applications, correspondence, or the data collection instrument should be made. The CCT team reviewed actual performance of the pilot at what became weekly team meetings at this point to facilitate rapid refinements and policy decisions as the new certification process was being tested. The team also reviewed overall processing speed by reviewing the data on a control chart.

The regional office conducting the pilot researched and reported on all outliers, and the CCT team verified that the new procedures or new applications and correspondence addressed the factors contributing to the delays. Only 190 applications were expected in the first three months following the initiation of the pilot, so data submission and review of every event was essential. Once all identified change needs were addressed, rollout of the new process occurred statewide, with training provided by the same CCT member.

## CONTROL

The Control Phase had a defined endpoint, but in fact key control activities continue beyond the life span of the project. Pande et al [2002] aptly points out that discipline is a key characteristic for this phase. Human desire to check that the process is working and then walk away to the next crisis must be overcome. The goal for this project as set forth in the original charter was to achieve 2.0 sigma (this process was performing at 1.18 sigma initially), which would be a 69.5% improvement. At 2.0 sigma, almost 70% of all applications would be processed in less than 11 days. Instead, as of data collected through the end of August, 2003, the process is performing at

3.44 sigma (a 192% improvement with 97% of all applications being processed in less than 11 days). In an effort to push the sigma value even higher, analysis of certification processing data occurs monthly, with immediate investigation of outliers to determine cause. Pareto analysis of delay data readily prioritizes corrective actions, and staff can analyze which methods of resolution for incomplete applications are most effective. A process dashboard is still under development.

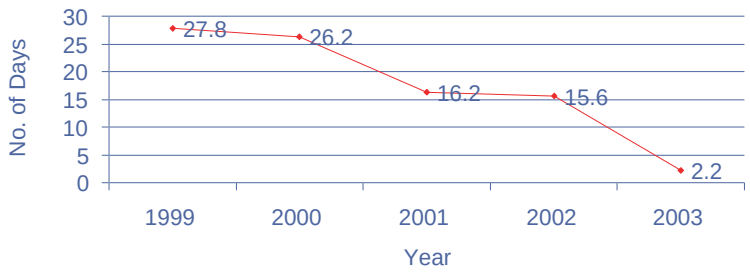


**Figure 12** - Average Business Days to Certification by Year

Identification of an on-going process owner is essential, as well as responsibility in a process management plan, or Process Control Plan. Brassard & Ritter [2002] identify a "Plan-Do-Check-Act Cycle" as a method to execute during the control phase when variation or other unexpected outcomes occur. The team celebrated the improved performance (Figure 12), returned oversight to the process owner, and dissolved.

## DISCUSSION

A key limitation to the project design was that initial CCT project meetings were scheduled on monthly intervals. This proved to artificially delay the project progress as illustrated in the charter when comparing the target completion dates of each phase to the actual dates. Subsequent project designs have been modified to accelerate progress by holding team meetings more often. Another observation made too late in the project was that the regional office practices related to date stamping, which "started the clock" on measuring elapsed time varied slightly between offices, and the project did not include a freeze to assure that those practices did not change during the project. The biggest weakness in the project analysis was the inability to use the most robust means of analysis as a result of the continuous data not being normally distributed.

## CONCLUSION

The CCT team acknowledged that the data analysis failed to identify root causes among variables believed to be critical. The corresponding process analysis drove the conclusion that the process was riddled with non-value added steps, rework loops, and as such was unsalvageable. A critical conclusion was that attempts to speed up the certification processing in the two years prior to the project had a negligible effect on improving processing time while the EMS bureau staff unwittingly compromised CTQs, which were unknown to the state EMS office at the time.

DMAIC offered a structured, thorough, and defensible approach to solving a persistent problem. The CCT team knew what to expect as the overall objectives of each phase and could measure its own performance against the target dates in the charter. Toll gate reviews at the end of each phase allowed organizational leadership to assess progress of the team as well. Most notable was manner in which the dual-pronged approach of process analysis and data analysis that moved the team off-center of old (and erroneous) beliefs and allowed for innovation with accountability.

## APPENDIX A - CHARTER DOCUMENT FOR THE CERTIFICATION CYCLE TIME PROJECT TEAM

PROBLEM STATEMENT:
Customer concerns about the length of time required for an otherwise eligible provider to receive certification have been a persistent problem. A retrospective review of processing time data for all applicants for initial certification during calendar years 1999-2001 revealed that the averaged elapsed time for the EMS Bureau to issue certification was an average of 22.8 business days with a standard deviation of 21.9 days.

Fifty percent of all applications had an elapsed time of 18 business days or longer. When processing time duration is longer than the expectations or business needs of the applicant or ambulance service, telephone inquiries to both the regional and central offices of the EMS Bureau result in interruption of work processes, internal conflict among employees, and frequently do not yield any additional information about or expediting of the application. Ambulance services in urban areas with a high demand for additional personnel and rural areas experiencing critical manpower shortages resort to attempts to circumvent or request special consideration during the application and certification processing phase. Listening posts report the occasional use of unlicensed personnel, usually in a desperate or defiant mode, which is a violation of the laws and rules governing emergency medical services in Idaho, and ultimately could be prosecuted as felony violation of the Medical Practice Act.

BUSINESS CASE/EXPECTED BENEFITS:
Reduced elapsed time from certification eligibility to deployment. Reduction in net staff hours per certification event. Soft benefits include reduced internal and external customer inquiries about the expected issuance date/status of certification requests; reduced rework of applications, reduced customer complaints; improved customer satisfaction; incremental increases in capacity; and decreased interruptions for regional and central EMS Bureau staff. The consequences of not engaging this project are continued customer dissatisfaction and manpower compromises for local EMS agencies.

GOAL STATEMENT:
To reduce certification processing time to within 10 days of the date the application is received by the EMS Bureau by improving our process capability from the current rate of 781,657 defects per million opportunity to 2 sigma (a 69.5% improvement) by November 1, 2002.

PROJECT SCOPE:
The project team will focus on the initial certification process, which starts from the date an application is received in any EMS Bureau regional office and concludes on the date that certification documentation is mailed to the applicant. Augmentation of staff time available to certification activities and changes in state laws or rules governing EMS certification are beyond the scope of the project. All team members will continue to perform their regular duties during this project.

PROJECT CTQs:
- Timeliness of certification issuance
- Accuracy of certification documentation
- Laminated cards
- Documentation of certification provided to affiliation
- Accurate prediction of card issuance date

RESOURCES / TEAM MEMBERS:
- Black Belt-in-Training (will also serve as project team leader)
- Green Belts-in-Training
- Certification Program Manager and Technical Records Specialist
- EMS Regional Consultant and Administrative Assistant
- Subject Matter experts used as needed:
  - EMS Regional Operations Program Manager
  - Other EMS regional office staff

Once chartered, the team will meet on a monthly basis for 3 hours to review progress, analysis findings, plan next steps, and assign between-meeting objectives. DMAIC training will also be provided during these meetings.

| **PRELIMINARY PLAN** | **Target Date** | **Actual Date** |
|---|---|---|
| Start Date | 12-11-01 | 12-18-01 |
| DEFINE | 01-14-02 | 01-18-02 |
| MEASURE | 02-21-02 | 03-01-02 |
| ANALYZE | 03-29-02 | 05-31-02 |
| IMPROVE | 04-12-02 | 11-01-02 |
| CONTROL | 05-01-02 | 12-02-02 |
| Completion Date | 02-01-03 | |

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## ADDITIONAL INFORMATION

- Survey document used to help determine certification applicant's 'critical to quality' factors (MS Word document format; 38K) [Link to document]
- PDF file generated from a PowerPoint file used by author for presentations on this project. Contains additional graphs, process diagrams and charts not used in this article (PDF format; 586 KB) [Link to document]
- Links to sites with additional information on six sigma methods, terminology and references:
  - American Society for Quality's Six Sigma Forum
  - General Electric's Six Sigma Resource Site
  - iSix Sigma Healthcare Portal

## ACKNOWLEDGMENTS

Imagine having all of this statistical capability and not be able to quantify the gratitude and admiration I have for Master Black Belt Joe Duhig of the Juran Institute for teaching adeptly and bestowing passion for Six Sigma, both its tools and its merits. The entire team as listed on the charter is due extensive credit for their diligence and stamina. John Cramer, BS, and Kay Chicoine, MPA, of the state EMS office Analysis & Planning program were invaluable contributors of graphical support and selection and distribution of just-in-time training materials. The support of the entire Regional Operations Program, led by Jim Alter, was critical to the success of the project both through data collection and ultimate implementation of an effective new process that delights our customers!

# Operations Research Models for the Deployment of Emergency Services Vehicles

**Jeffrey B. Goldberg, MS, PhD**

## ABSTRACT

This paper is a review of the development and current state of the art in operations research for deployment and planning analysis pertaining to Emergency Medical Services and Fire Departments. These public safety systems have received a great deal of attention in the operations research community since they provide important services to people and the problems are amenable to mathematical modeling and solution. The concentration here is on both analytical work and applications. Modeling and problem assumptions are emphasized rather than clever solution procedures and mathematical derivations. This paper is organized both chronologically and by modeling approach / problem issue, so the interested reader can easily trace the chain of modeling improvements that are most closely applicable to their particular problem. The bibliography contains over 115 relevant books, articles, and web sites that represent over 35 years of work from all of the leading operations research analysts and practitioners in the field.

*Keywords*: deployment, ambulances, dispatch, emergency medical services
*Citation*: Goldberg J: Operations Research Models for the Deployment of Emergency Services Vehicles. 2004 Jan-Mar *EMS Mgmnt J* 1(1):20-39.

## PROBLEM MOTIVATION AND BACKGROUND

The design and operation of emergency service vehicle systems has been a vibrant area for operations research (OR) professionals since the mid 1960's. The primary concern of operations research is to develop and solve mathematical models to help make decisions. In this applications area, there have been 100's of journal papers covering models for important decisions such as:

- the location of fixed position fire stations and possibly variable position ambulance bases;
- the dispatching of vehicles;
- the number of vehicles of different types, staffing and equipment being carried; and
- how and when to re-deploy resources under different system states.

The reason for the large amount of work is quite simple. The systems are important to the public and hence designing and operating them well leads to a clear sense of purpose for the researcher.

The goal of this paper is to share this body of knowledge with emergency medical services (EMS) managers, fire service (FS) mangers, and their physician medical directors; three groups that may not be familiar with this body of work from the operations research field. In the past, there have been many papers reviewing this literature; however these have generally been targeted at operations research professionals. The approach of this paper is different in that it is organized along tasks and problem areas that are necessary for designing and operating effective systems. The focus is on the problems and the underlying modeling assumptions as opposed to the specific mathematics of the models. Once the capabilities of the models are known, then the interested reader can get more information as needed. Also, the paper contains sections covering work on

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*Manuscript received:* 09 November 2003; *Accepted for publication:* 14 November 2003
*Online Access:* http://www.emsmj.com/v1n1/deployment/default.htm

data collection, building valid models, successful applications, and past review papers. Potential gaps in the literature are discussed where appropriate. The discussion for each topic proceeds chronologically to give the reader a feel for the progressive improvements in the body of work. For simplicity, each paper is contained in only one section, however, there are instances where there could be alternatives and the most appropriate section has been chosen.

The discussion centers mainly on EMS, however much of the material is relevant to the FS as well. One section contains models for managing multi-equipment types and here both FS and EMS are mentioned. Police deployment models are often fundamentally different in that they must allow for a patrolling vehicle as opposed to the stationary vehicles normally seen in FS and EMS situations. The materials in this paper are generally applicable to any system where the vehicles sit at a location and wait to be called into service.

## SYSTEM OPERATION AND PERFORMANCE CRITERIA

The scope of this paper is based on the standard emergency call process:

1. The call (demand) comes to the system via 911 or some other mechanism.
2. The severity of the call is estimated.
3. The dispatcher evaluates the system status and determines the appropriate vehicle(s) to send to the scene.
4. Upon arriving on scene, service is provided.
5. The vehicle(s) may or may not provide transport to a hospital.
6. After completion of service (and transport) the vehicle goes into an idle state and returns to a predetermined location to await another call.

The decisions of dispatching and vehicle location are critical factors in system success. If one cannot do both of these well, there will be inefficiencies in the system. Note that both types of decisions must be made in a dynamic environment. However, significant planning can be done a priori. For example, standard dispatch strategies (such as "send the closest idle vehicle") can be evaluated for situations where they might not be the best policy. When these situations arise, the dispatcher can be alerted to go off of the standard strategy and onto a contingent strategy. Vehicle base locations can also be evaluated using specifics of situations and again, the system manager can be alerted on cases where it is better to go off of the standard plan.

The primary objective of EMS and FS deployment is to get the appropriate equipment to calls in a safe and timely fashion. The issues of selecting the appropriate equipment are not the focus of this paper. Generally, the dispatcher has some tools to make these decisions, based on the phone triage process and the state of the system. Also, vehicle safety is not considered here because it is assumed that the vehicle will arrive on scene in a safe manner. The final issue of timeliness is the primary objective that is used in operations research models. All of the OR typically makes the following assumptions:

- There is a standard time, T, such that if the first vehicle arrives on scene within T minutes, then the call service is deemed a success. The specific value of T may vary with the type of call as more serious calls have lower T values.
- The area is partitioned into zones. These zones may take on any shape, but all calls from a zone originate in the population center. All travel to and from the zone is measured from the zone center point. Data is collected and aggregated at the zone level.

There are many ways that timeliness is measured. For example, one can operate to:

- Minimize the total or average time to serve all calls.
- Minimize the maximum travel time to any single call (ensures that no demand point is too far from equipment).
- Maximize Area Coverage - cover as many zones in the area as possible within T minutes of travel.
- Maximize Call Coverage - cover as many calls in the area as possible within T minutes of travel.

Note that the 3rd and 4th examples are not equivalent since some zones in the area may have markedly different call loads. In reality, each of these examples are surrogates for the true objective of reducing as much morbidity and mortality as possible. The assumption is that if calls are answered and serviced quickly, then this will lead to better clinical outcomes, patient satisfaction and compliance to regulatory standards for response time performance.

Besides timeliness, there are other objectives of EMS and FS deployment systems. These include:

- Minimize Cost – Cost is primarily a function of the amount of labor (man-hours) needed to staff the unit-hours used per year, the number of base stations that must be opened and maintained, and the number of vehicles that must be purchased, supported, and serviced. Labor is typically the largest cost (ReVelle [1989]).
- Maximize Coverage Equity – Here, the system manager must balance area performance against the performance in a smaller group of zones. For example, it may not be acceptable to have zones that are poorly served while having the area at a reasonable level and some zones that are extremely well served. By changing decisions, more equitable systems can be designed. Marsh and Schilling [1994] contains a broad review of coverage equity issues in EMS and FS systems.
- Maximizing Labor Equity – Here it is important for the system manager to balance the workload for all employees in the system. This reduces employee burnout and hard feelings.

## MODELING ISSUES - GRANULARITY, DATA REQUIREMENTS, AND VALIDITY

It is often difficult and expensive to experiment with an actual system. Mistakes are costly both in money and in potential morbidity and mortality. Collecting data to verify a good system might take months of data collection. Instead of experimenting on the actual system, OR professionals generally build models of systems that can be implemented and experimented with on a computer. System errors can be found on the model before they are implemented on the actual system. It is generally well worth the cost of building the model, collecting data, and running the model as opposed to trying to experiment on the actual system.

When using a model to help make decisions, there is significant work that must be done before any analysis can begin. First one must structure the granularity of the model and define zones. Next, one gathers demand, service, and travel time data based on that structure. Dai, Wang, and Yang, [1994] discuss a decision support system and data base structure that can be used for planning and for operational decisions. Third, the model is implemented; usually in software. Finally, one validates the model to convince the decision maker that model output has some correlation with the output of the actual system. Each of these steps has been the topic of OR studies.

### GRANULARITY OF THE ZONE STRUCTURE

The zone structure is often formed based on the convenience of the model builder or the data collection system. Since most urban and suburban EMS and FS systems have tens of thousands of calls per year, it is impossible to model down to the call level. Instead, all calls in a "small area" are aggregated to a single zone.

At first glance this looks like a minor issue in modeling, however, looks can be deceiving. Consider the aggregation in Figure 1. Here, we have 9 calls, one in each of the nine address blocks. Instead of using these individual locations, we aggregate all calls to the center of the blocks and this is our zone.

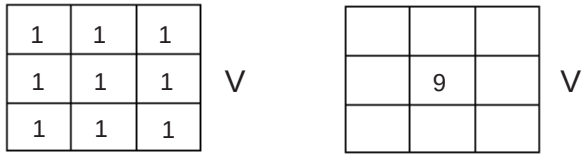


**Figure 1** - Call Aggregation with a Vehicle Location

The problem here is that timeliness measured on the aggregated system may greatly overestimate the timeliness of the actual system. Consider the 8-minute call coverage criteria typically used in EMS systems and assume that a single vehicle is located exactly 7.5 minutes from the center of the blocks directly to the right. In the aggregated problem, all calls would be considered covered since the vehicle is 7.5 minutes away. In the actual problem, calls in the left column and calls in blocks directly above and below the center block may not be covered as these travel values may be larger than 7.5 minutes. Similar examples using travel time or vehicle utilization as the criteria can easily be constructed. As the zones become smaller, the inaccuracies due to aggregation become smaller as well. Currently, it is reasonable to solve problems with 100's of zones (depending on the model).

This problem was first realized in Hillsman and Rhoda [1978] and they defined 3 specific types of errors:

- A errors – errors in distance measurement for the call since the original call location is not the location of the aggregated calls.
- B errors – errors in distance measurement due to not knowing the true location when a vehicle or facility is located at an aggregated zone.
- C errors – errors in dispatching due to not knowing the correct distance from vehicles or bases to calls in aggregated zones.

When the criteria is total system travel distance, Current and Schilling [1987] show how to eliminate A and B errors, and Hodgson and Neuman [1993] use a GIS approach to eliminate C errors. Francis and Lowe [1992] derive bounds on how poorly the model approximates the actual objective. Erkut and Bozkaya [1999] discuss A and C errors and give practical strategies for reducing the errors and setting up models that have small errors. Note that as computing power increases and larger models can be formulated and solved, less aggregation is needed and this problem becomes less critical. At this time, aggregation can still cause problems in models that use coverage or travel time objectives.

## Travel Time Modeling

Models require estimates of travel time to make decisions concerning dispatching order, determine coverage areas, and compute estimates of the criteria. Without accurate travel time estimates, most models would have little predictive value and the decisions that they suggest would be suspect at best. There has been little OR work in this area, especially given its importance (there is surely additional work in the transportation literature, but that is not the focus of this paper). Travel time is generally assumed to be known exogenously and occurs on a street network. When solving real problems, this simply is not sufficient. Often this data exists (at least in rough form) at a county government agency responsible for traffic management and planning.

Volz [1971] uses linear regression to determine speed coefficients on different road types (for example, freeway limited access roads, four or more lane roads with at least two lanes in each direction, three lane roads with a left turn lane, and local two lane streets) and then uses these coefficients with an estimate of the road types on the travel route. Goldberg et. al. [1990] uses this approach in predicting the mean and standard deviation of base to zone travel times in the Tucson EMS system. Kolesar [1973 and 1975] presents models based on regression studies in New York. For short trips, Kolesar [1975] suggests that, travel time is proportional to the square root of the distance traveled, while for longer trips, travel time is proportional to the distance traveled. Chelst and Jarvis [1979] estimate the probability distribution of resulting travel times (after the model is solved, these will be the travel trips one expects to realize) for urban emergency service systems. Their work is based on the results obtained from the Hypercube model of Larson [1974] used to predict the probability of different system busy states. Repede and Bernardo [1994] perform a detailed model of travel in Louisville using a 47,000 call database and the UNIFIT curve fitting package. Recently, Van Buer et. al. [1996] considered the problem of locating 1-way streets and cul-de-sacs so as to enable all emergency services reasonable access while reducing crime.

## Demand Data Modeling and Prediction

The ability to predict demand is of paramount importance; however there has been little systemic OR study in this area. The typical approach is to tally past demand for each zone over some time period (a year or six months), and then assume that future demand will behave similarly to past demand. Similarly includes both quantity and spatial similarity. Even when the quantity of demand is changed, this is usually done in a proportional manner (for example, assume that demand in each zone will increase by 10%).

The initial study in the OR literature is Kamenetzky, Shuman, and Wolfe [1982]. They develop a regression model with four independent variables; area population, area employment rate, % of the population white and married, and housing units per area resident. They perform transformations on these variables and develop a model with an excellent $R^2$ value of .92. They also predict demand by category of call. Mabert [1985] models the demand for police calls in Indianapolis. Box-Jenkins time series models are used to predict the number of calls per day, however there is no attempt at predicting the spatial distribution.

Although not within the scope of this paper, there has been work in this area in the healthcare literature. Puig-Junoy, Saez, and Martinez-Garcia [1998] formulates a utility theory model to explain why people use the emergency room as a substitute for their primary care physician. This approach might be used to help explain why people use the 911 system for "less than emergency" calls. Also, growth and city planning models could be used to estimate demand for zones that have no call history.

## Model Validity

Model validity refers to the model's ability to predict output and to make decisions that will work as well as predicted in the actual system. This is a key step in the modeling process. Unless the model makes valid predictions then the model will have little to no value.

Almost all models have "face validity" where the model looks reasonable to the casual observer. The next level is "replication validity." Here, the analyst inputs data on past operation of the actual system and the model replicates the operation of the system including:

- Predicting coverage and travel time close to those realized in the actual system.
- Making the same dispatching decisions as the actual system made.
- Predicting vehicle utilization close to that realized in the actual system.

The final level is "prediction validity" where the analyst inputs data for a future system and the model predicts how the future system will behave. Often future validity cannot be fully placation determined until the system is implemented. Hence if the model has face and replication validity, then the decision maker is generally convinced of the quality of the model's output.

There have been many studies in model validity since the typical models used in planning require making significant assumptions (these will be discussed later). In Jarvis [1975], it is shown that a spatial queueing model can predict vehicle utilizations usually to within a few percent. Halpern [1977] shows on small systems that when you assume that all calls have the same service time then the vehicle busy probability estimates may not be accurate when the assumption is not satisfied. Goldberg et. al. [1990], Valenzuela et. al. [1990], and Repede and Bernardo [1994] write about high precision validity studies with actual data in Tucson and Louisville. ReVelle [1989] discusses modeling developments to improve the validity of models that use area coverage and call coverage criteria. Borras and Pastor [2002] compare the output of probabilistic covering models to the output of more detailed previously validated models. They show that the probabilistic models are highly accurate. Saydam and Aytug [2003] show how to improve accuracy when measuring expected coverage. Chiyoshi, Galvao, and Morabito [2003] show that when vehicles are busy a high percentage of the time, then popular covering models do not predict coverage well even when they include features specifically designed to remedy the accuracy problem.

## RAND REPORTS

In the late 1960's and the 1970's, a powerful group of OR analysts worked at the RAND Institute in New York. The works that they did were strong both in theory and in application and covered a wide spectrum of uses in EMS, FS, and police planning and operations. The following models were distributed and used extensively throughout the country (Chaiken [1978]):

- PAM - Parametric Allocation Model - used for planning the number of fire bases or ambulances that were needed in an urban area.
- FHSEM - Firehouse Site Evaluation Model - covering model to determine firehouse locations
- FIRESIM - Simulation Model of Fire Department Operations - detailed simulation model to evaluate a single deployment of base locations
- Hypercube Queueing Model - a model that tracks the status of vehicles and predicts the fraction of time that the system is in each state (to be discussed later as this is one of the foundation OR models for EMS deployment)

There is a large body of work that came out of RAND during this period and some of it was also published in the general OR literature. The NFPA Fire Station Location Bibliography [1996] has a large list of these papers including technical reports, users manuals for software, and applications reports. We do not provide additional details here as these models have become a bit dated, however they form much of the basis of the initial thoughts on the problems of designing and operating EMS and FS systems.

## COMPUTER SIMULATION MODELS

The term "computer simulation model" is used in the OR literature to describe models that have a high degree of detail and try to precisely mimic the operation of the actual system. These are generally tied to a detailed database and coded in a computer language that is tailored for building detailed models. They have a high degree of face validity and can obtain extremely accurate replication validation results.

These models are descriptive in that they take a system design and set of operating rules and then compute the performance of that single system on any desired criteria. To find high quality solutions, one must embed the simulation model in a search routine to test different designs and rule structures. The difficulty with these models is that they often take large amounts of computer time to obtain estimates of system parameters and hence this search routine is also a long process. If one has the computing resources, the detailed data set and the time to search for solutions, then simulation is an excellent tool for obtaining high quality designs and operating rules.

Savas [1969] and Fitzsimmons [1971] were early users of simulation modeling for EMS systems. Berlin and Liebman [1974] used simulation to evaluate solutions that they obtained from a simple covering model. This approach of using simulation on a small set of solutions found by other less precise modeling tools is a popular approach. Monarchi, Hendrick, and Plane [1977], Fitsimmons and Stikar [1982], and Repede and Bernardo [1994] all have an approach similar to Berlin and Liebman in that they use simulation to evaluate decisions made with the help of other models.

Trudeau, Rousseau, Ferland, and Choquette [1989] cover a solution process that includes data collection as well as simulation modeling for planning and operation of an EMS system. Erkut and Polat [1992] built a detailed simulation model that was used in Istanbul, Turkey to help minimize total travel time and the percentage of calls that are served late. Goldberg et. al. [1990a] discuss a similar model used in Tucson, AZ to help validate another faster less detailed model. Zaki, Cheng, and Parker [1997] describe a detailed model that was used in the Richmond, VA area. Also, this work has the ability to consider pre-empted calls and contains a validation study as well as estimates for travel time distributions.

## ANALYTIC MODELS FOR PLANNING

The large majority of OR work is in the area of "models for planning." Here, the decisions are generally for determining the location of vehicle bases and the equipment assigned to each base. The problem is static in that a single set of demand and travel time data is used in the model. Mathematical programming is generally used to find optimal solutions to the models and when the models are difficult to solve, heuristic procedures* are used. The term "optimal solution" is in some sense misleading. The solution is only as good as the underlying assumptions of the model. If these assumptions do not produce a valid model, then the solution found may have little correlation to optimal solutions in the real problem. There is generally a modeling tradeoff in that high validity high precision models (e.g., simulation models) cannot be easily searched for optimal solutions. To guarantee optimality, usually one must have a rather stylized model with a significant assumption set. Larson and Stevenson [1972] suggest that "real problems" have rather flat objective functions and many solutions exhibit near optimal behavior.

Toregas et. al. [1971] first proposed the "set covering model." Their objective is to minimize the number of vehicles needed to cover all zones. In essence, they are minimizing cost and ensuring a fair coverage. Each potential vehicle location has a set of demands that it covers. All demand points are equally important, and a single static covering distance (or time) for each demand is used. If even one vehicle covers a demand, then that is sufficient, even though sometimes the vehicle may be busy. Hence this model generally overestimates coverage. This model typically looks like laying out "travel circles" to cover all demands. Neebe [1988] finds all solutions to this model as the covering distance standard varies. As expected, as you increase the covering standard, then fewer vehicles are needed.

Church and ReVelle [1974] take somewhat of a dual approach. They hold the number of vehicles fixed (and hence fix costs) and then locate the vehicles to cover as many calls as possible. The model is called the "maximal covering model," and this objective can result in some zones that are not covered. As in Toregas et. al. [1971], a zone is covered if even one vehicle is located within the travel standard. There is no allowance for busy vehicles.

In both the set covering model and the maximal covering model, it is assume that there is a single time period. Since location decisions often involve extensive capital costs, one might want to consider a multiple period problem over a long horizon (multiple years and decades), Schilling [1980] considers a model that is divided into time periods (years for example). The work extends the maximal covering model to consider a different location set for each time period. The model is multi-objective in that there is an objective to maximize total demand covered in each period. It includes constraints that limit the total number of vehicles placed in each time period and ensure that if you locate a vehicle at a site in time period t, then you will also use the site in time periods t+1, t+2 … T. Current, Tatick, and ReVelle, [1997] model the case of locating a set of vehicles over a long horizon when the total number of vehicles and facilities is uncertain. They concentrate on finding the locations for near-term decisions so that the system will be in a good situation when the next decision is to be made. The model objective includes construction and operations costs.

Both set covering and maximal covering are "integer programming models" since all decisions are required to be integer valued (either you locate at a site or you don't, there is no "half location"). Typically, these types of problems are mathematically difficult. ReVelle [1993] shows that even though the problems can be difficult, in most instances the solution can be obtained by readily available software for real sized problems (100's of demand points and 50 potential vehicle sites). Galvano and ReVelle [1996] discuss a Lagrangian heuristic for cases when the maximal covering model is difficult. A Lagrangian heuristic is a process where one relaxes restrictions (constraints) on the solution in order to get a starting point to generate alternatives that satisfy all restrictions. The technique is commonly use to solve problems where the decisions are constrained to be integer valued.

The key deficiencies in the set covering and maximal covering models are:

*Heuristic procedures may find good solutions, but are not necessarily the best and are often performed by trial-and-error

- The use of a single objective, when in fact, both cost and performance are key criteria.
- The inability to consider sometimes busy vehicles and therefore uncovered demands even though the model claims full coverage. This also leads to the assumption that the closest vehicle to each zone is the only vehicle that ever answers calls for that zone.
- Each call requires a single vehicle and only a single type of equipment is considered. The real problem has multiple equipment types that cooperate and share calls.
- All demand, travel time, and service time data are assumed to be deterministic. In the real problem, demand timing and location are both random (but somewhat predictable and modelable based on past data). Service times and travel times also are random and sometimes highly varying.
- Using a single set of data leads to a single set of locations and hence these models have no ability to analyze dynamic real-time decisions such as repositioning.

Works that try to remedy these deficiencies are discussed below.

### MODELS THAT INCORPORATE MULTIPLE OBJECTIVES

Many of the models discussed in the remainder of section 4 include multiple objectives. Often these objectives are combined into a single objective using a weighting factor. For example, if f(x) and g(x) are objective functions, then if w is between 0 and 1, then:

$$w * f(x) + (1-w) * g(x)$$

is a combined objective (this is called the “weighting method”). Another approach with multiple objectives is to find the set of non-dominated solutions (called the “Pareto set”). A solution x is non-dominated if no other solution is better or equal to x on all objectives. The final approach used is called "goal programming." Here, each objective is a goal with a prescribed level for success. For example, if the goal is to minimize average travel time, then a specific level might be to have average travel time less than or equal to 8 minutes. The user then specifies the "cost" if the goal is not met and this cost may be related to the magnitude of the unmet amount. Usually, the total cost of unmet goals is minimized. The difficulty in goal programming is in specifying the cost of not meeting the goal.

Schilling, ReVelle, Cohen, and Elzinga [1980] extend the maximal covering model by dividing the demand in each zone into two call types, each with a different priority. They then formulate two objectives - maximize the covering of the highest priority calls and maximize the covering of next lower priority of calls. They then find the set of non-dominated solutions. They also consider two vehicle types as well as a budget constraint for purchasing new equipment. Daskin and Stern [1981] extend the set covering model to include an objective of maximizing the number of zones that are covered by more than one vehicle. They first solve a set covering problem to find the minimum number of vehicles needed for covering. Since there are usually multiple sets of locations that attain full coverage with this minimum number of vehicles, they then choose a particular solution by finding the location set that maximizes the number of zones with multiple coverage. One can also use the weighting method to combine the objectives of minimizing the number of vehicles and maximizing the number of multiple covered zones. Taylor, Baker, and Clayton [1989], develop a model for allocating ambulances to sectors in a county. The model is more of a macro location rather than specific site location since it has only 10 sectors. Goal programming is used with objectives of minimizing system response time, staying within a pre-specified budget, and keeping vehicle workloads low.

Revelle, Schweitzer, and Snyder [1996] extend the maximal covering model to the case where facility sites may not be used to cover their own zones. This model has application in disaster situations where if a zone has a call, then everything within the zone is hit, not just a single element within the zone. The multiple objectives considered are maximizing the demand covered and maximizing the number of vehicle sites that are at least double covered. Badri, Mortagy, and Alsayed [1998] develop an extensive goal programming model that includes minimizing fixed and recurring operating costs, maximizing demand coverage, minimizing system travel distance and maximum travel time, and minimizing the use of areas where water availability might be a problem (application in Dubai, UAE).

When appropriate, works that use multiple objectives will be noted in the remaining subsections.

## Math Programming Models that Incorporate Back-Up Coverage and Busy Vehicles

Church and Weaver [1985] extend the maximal coverage model and develop the "vector assignment p-median model." Here, it is assumed that a zone's demand will be served x% of the time by its closest vehicle, y% of the time by the 2nd closest vehicle, …One must estimate these %'s using another model or past experience. The model locates a fixed number of vehicles so that the total travel distance is minimized. Clearly the approach is not valid when the %'s change based on the specific set of locations chosen.

Hogan and ReVelle [1986] extend the maximal covering model and the set covering model by adding a second objective to maximize the number calls covered by 2 or more vehicles. They combine the objectives using weighting factors and explore how the solution changes as the weight on each of the two objectives changes. Also, they add constraints to model a secondary coverage criteria so that all calls are covered within the secondary time limit (for example 15 minutes) while trying to maximize the number of calls covered within the shorter primary limit (for example 8 minutes). Gendreau, Laporte, and Semet, [1997], develop a search for a model that maximizes the number of double covered calls.

Pirkul and Schilling [1988] model the objective of maximizing covered calls subject to limits on the number of calls that each vehicle can answer (as measured by the number of calls it may serve in the study horizon) and a requirement for backup coverage. Narasimhan, Pirkul, and Schilling [1992] extend the model to include the objective of maximizing the number of covered calls of different service levels. They include constraints on the number of vehicles, the call capacity of each vehicle, and defining coverage for different levels of service. Here, a vehicle may provide, primary, secondary, or both levels of service and each level may have a different coverage time standard.

Daskin [1983] assumes that each vehicle is busy with probability equal to p. One can estimate p accurately by estimating the total workload (travel and service time) divided by the total work time available. Given p and the number of vehicles that cover a demand zone, one can estimate the probability that the zone is covered by computing the probability that at least one of the covering vehicles will be idle. This computation is simplified by assuming that the vehicles operate independently and this is generally called the "independence assumption." It is clear that the assumption is not entirely valid since as nearby vehicles are busy, it is more likely that a vehicle is busy since it now has a large primary coverage area. Daskin develops a heuristic procedure for finding the best set of locations assuming that the number of vehicles is fixed. The model maximizes the expected demand covered (the model is called the "maximal expected covering model") and hence is builds on Church and ReVelle [1974]. The paper also considers how the coverage changes as the number of vehicles changes.

ReVelle and Hogan [1989] extend the maximal expected covering model. First, all vehicles are assumed to have equal busy probability. Then a constraint is formed to ensure that each zone is covered with probability p. For example, assume that vehicles are busy 20% of the time and you want a zone covered 95% of the time. Then if only one vehicle covers the zone, the probability of coverage is only 80% since 20% of the time, the covering vehicle is busy. If you have 2 vehicles covering, then the zone is covered 96% of the time; 80% by the first vehicle and 16% (80% of the remaining 20% ). So, to meet the 95% constraint, you need 2 or more covering vehicles for the zone. For any busy probability and any coverage level, it is simple to compute the number of covering vehicles required. The model is then extended to include the case where vehicles have unequal busy probabilities; however it is still assumed that for any zone, all vehicles serving that zone have equal busy probabilities (called the "zone based busy" assumption). Then one can form the identical constraints to the first model, but the number of covering vehicles required for each zone may be different (if the busy probability is lower, then fewer vehicles are required to get to p since the closest vehicles answer a higher fraction of calls). This assumption

on equal busy probability for all vehicles covering a zone is problematic in that the same vehicle is assume to have two different busy probabilities depending on which zone it is covering. Ball and Lin [1993] formulate a model similar to ReVelle and Hogan [1989] as it includes a constraint on the number of covering vehicles to ensure that calls are covered with probability p. This model also uses the zone based busy assumption to derive the coverage reliability constraint. ReVelle and Hogan [1989a] use a similar approach to extend the set covering model to include coverage probability.

Marianov and ReVelle [1994] extend the set covering model to ensure that each demand has a vehicle actually available within the time standard, with probability p. The objective of minimizing the required number of servers remains the same. Queuing theory is applied to the development of the availability constraints so that one does not need to assume that vehicles are independent (as was done in Revelle and Hogan [1989] and Daskin [1983]). Instead, the model uses the zone based busy assumption. Silva and Serra [2003] extend the Marianov and Revelle [1994] work to include multiple call priorities. Marianov and ReVelle [1996] extend ReVelle and Hogan [1989] by using queuing theory to develop the required coverage constraints. The zone based busy assumption is still required. Marianov and Serra [1998] extend the work of Marianov and ReVelle [1996] to include decisions on base location and decisions on allocating customers to bases. The bases behave as queuing systems so calls may wait in line. Marianov and Serra [2002] use the techniques in their [1998] work and extend the set covering model to include minimizing the number of facilities and the number of vehicles. Constraints on queue length are also included. In all of the Marianov papers in this paragraph, all demands assigned to a base must go to that base, regardless of the busyness of the base. This limits the validity of these models in an EMS situation.

## Models That Consider Multiple Vehicle Types And Multiple Vehicles Per Call

Schilling et. al. [1979] extend the maximal coverage model and consider both facility location and equipment allocation to facilities. Their model is called "FLEET" and considers two types of equipment (ALS and BLS for example). The objective is to maximize the amount of demand that is covered by both types of vehicles. There is a fixed number of each type of equipment and a fixed number of sites to open. Each equipment type has a different coverage standard. Facility location costs are assumed to be equal for all possible site locations, so once the number of sites is fixed the location cost is fixed.

Charnes and Storbeck [1980] consider a goal programming model. They locate a fixed number of ALS and BLS vehicles so that the goal for ALS coverage is met for each zone and the goal for BLS coverage is met for zones that are not covered by ALS vehicles. There is an implied cost of not meeting the different coverage goals and the model tries to minimize the overall cost of not meeting coverage goals. The model builder must determine the specific cost of not meeting goals. Also, Storbeck [1982] uses a goal programming model to evaluate the tradeoff in having some zones with multiple coverage and some zones with no coverage given the cost of having no coverage is known. Moore and Revelle [1982] considers the "hierarchical service location problem." This model is an adjustment of the FLEET model and considers a demand covered if it is covered by either type of vehicle as opposed to both types. The goal is to minimize the amount of demand that is not covered. Instead of fixing the number of vehicles of each type, a constraint is included to ensure that the budget is not violated. The model uses an assumption that the potential site locations are known. One can solve the model for a number of budget levels and see the tradeoff between coverage and expense.

Marianov and ReVelle [1992] model the simultaneous location of engines and ladder trucks and includes limits on the number of vehicles at each location. The approach is an extension of Hogan and ReVelle [1986] model for double coverage. Coverage in this model requires two truck companies and three engine companies within the standard response distance. When busy vehicles are included in the model, then the coverage requirement is modified using an approach similar to that used in ReVelle and Hogan [1989]. ReVelle and Snyder [1995] construct the "FAST model" to locate both fire and ambulance vehicles. The model is multiobjective in that it attempts to

maximize call coverage for fire and call coverage for ambulances. Instead of finding one "optimal" solution using a weighting method, the approach is to generate all solutions that are "efficient" in that there is no other solution this is better on both objectives. This set of solutions (generally termed the "Pareto set" frontier) is given to the decision maker(s) who then make the trade-off and select a single alternative. Constraints include the number of vehicles of each type, a construction budget for stations, and the notion that each site can only be for ambulance or fire trucks. Jayaraman and Stinastava [1995] extend Daskin's maximal expected coverage model to include primary and secondary vehicles. The objective is to maximize the sum of calls that are primary and secondary covered. Primary coverage is defined to have "enough" primary within the primary time standard and secondary coverage is similarly defined. Constraints include limits on the number of primary and secondary vehicles and the number of facilities.

Serra [1996] defines the "coherent covering location model." Here, there are two types of vehicles, ALS and BLS for example. ALS vehicles can provide ALS and BLS service while BLS vehicles provide only BLS service. The model has two criteria, maximize call coverage by ALS vehicles and maximize call coverage by an ALS or BLS vehicle. There are limits on the number of ALS and BLS vehicles and a distance standard that ensures that BLS vehicles are located near ALS vehicles (this is the "coherent" part of the model). The notion of coverage depends on the service type as each has its own acceptable distance standard. Mandell [1998] considers a similar ALS/BLS system with the same coverage requirements. The model includes constraints similar to those in Revelle and Hogan [1989] to ensure reliable coverage in the presence of busy vehicles as well as a queuing model to estimate the precise probability of successful coverage. The work of Mandell represents the most advanced of the static planning models for ALS/BLS systems.

Amiri [1998] formulates a model to minimize the cost of setting up and operating facilities and includes primary and secondary vehicles and primary and secondary service levels. Each demand must be covered by both a primary and secondary vehicle. Marianov and Serra [2001] develop a model to locate high and low level servers and allocate zones to either type of server. The servers operate like a queuing system and calls may wait in line. The objective is to minimize the cost of opening and operating facilities. Both models have limited applicability to EMS systems as demands must go to the assigned facility and not the closest idle facility.

Batta and Mannur [1990] extend both the maximal covering model and the set covering model to the case where calls require multiple units of the same type. When multiple units are involved, coverage depends on the response order for the call. For example if a call requires 3 units, then the call can be considered covered if the first unit is within 5 minutes, the second unit within 7 minutes and the third unit within 10 minutes. The specific time standards can differ for any system and must be given for each call and each arriving vehicle.

## MODELS THAT CONSIDER PARAMETERS THAT ARE RANDOM

### Hypercube Approaches

Larson [1974] introduces the "Hypercube model" for evaluating the performance of a set of base locations. Like simulations, this model is descriptive and must be embedded in an optimization framework in order to search for good solutions. The model assumes that calls come to the system based on a Poisson process (as opposed to the deterministic assumptions of all previously discussed works in section 4) and that service time for each call is exponentially distributed with mean ì . (A Poisson process is a standard process used to model arrivals to a system. It is the result of having a large number of potential customers, *N*, where each has a small probability, *p*, of using the system in a short time interval. The product $N*p$, denoted by $\lambda$, is called the “intensity of the process” and is the average number of arrivals per unit time. Given $\lambda$, it is a simple matter to calculate the probability distribution on the number of arrivals in any time period, *t*, as this follows a Poission distribution with a mean of $\lambda*t$.). Larson uses these assumptions to formulate a large model. with a state for every possible combination of idle and busy vehicles. For example, if there are 5 vehicles, then the state (1, 0, 1, 1, 0) corresponds to vehicles 1, 3, and 4 being busy and vehicles 2 and 5 idle. If a call arrives when the system is in this state, then it will be served

by either vehicle 2 or 5, depending on the location of the call relative to the location of the two idle vehicles. In general, the model has $2^N$ states where N is the number of vehicles. When N is even 20, this is computationally difficult. The class of models is called “Markov Models” due to the assumption that the probability of going to any future combination of busy and idle vehicles is due only to the current combination and the probability that future events occur. The manner in which we arrived at the current combination is not relevant in predicting future states (this memoryless property in which the future does not depend on the past other than through the current state is called the “Markov Property”).

In Hypercube, each call is assumed to require one vehicle and it is assumed that each zone has a unique preference ordering of the available vehicles. This unique preference order simply implies that for any call, there is a dispatch preference order. The dispatcher will go down the order and dispatch the first idle vehicle on the list. Generally, the preference is distance based, but this is not required in the model. There could be a difficulty if two vehicles were equally preferred for a call and Burwell, Jarvis, and McKnew [1993] extend Hypercube to consider co-located servers and dispatch ties. The output of the Hypercubemodel is the probability of being in any state state (combination of busy and idle vehicles) and this irobability can then be used to compute the traditional criteria of system travel time, system coverage, vehicle workload and busy probabilities, and the number of non-first-choice dispatches in the system.

To remedy the computational difficulties of Hypercube, Larson [1975] develops the "A-Hypercube, the Hypercube approximation model." The model consists of equations to compute the busy probability of each vehicle. The key extension in this work is the development of factors (called "Q-factors") that can be included in models and used to relax the assumption that vehicle busy probabilities are independent. The model still requires that the mean service time be a single value for all calls, however one can do a calibration procedure to estimate the appropriate service time. Goldberg and Szidarovsky [1991] demonstrates the convergence of the computational methods used in A-Hypercube.

Batta, Dolan, and Krishnamurthy [1989] combine the ideas in A-Hypercube with those in Daskin's expected covering model. This new model remedies the independence assumption in Daskin's model by including Larson's Q-factors in the objective and the authors build a heuristic to find good sets of locations. Benveniste [1985] extends A-Hypercube by adding the objective of minimizing system travel distance and developing in an optimization strategy that selects server locations and service areas (what zones are first choice for each zone). Jarvis [1985] extends A-Hyprecube by including general call service times. This enables the modeling of systems where the call service times depend both on the serving vehicle and the demand zone. Validation studies on this model show that estimates of vehicle busy probabilities are extremely accurate (less than 5% error) when compared to busy probabilities of the actual system. Goldberg and Paz [1991] extend Jarvis' model by adding the objective of maximizing the expected number of calls covered (they estimate the probability that travel is less than the coverage time standard) and by embedding the new model in a location selection heuristic. The assumption of a fixed vehicle preference ordering for each zone remains.

## Queueing Approaches

Berman and Larson [1982] consider the situation where demand occurs according to a Poisson process, service is random and follows a general distribution that is independent of vehicle location. The model locates a set of vehicles to minimize total expected travel distance to serve all demands. The model considers the possibility that more preferred vehicles are busy and hence a less preferred vehicle must be sent and the possibility that the system is completely busy and call must queue or be sent to a system operating in parallel. The model is similar in spirit to the model proposed in Jarvis [1985]. Berman, Larson, and Parkan, [1987] decompose the model of Berman and Larson into a set of single vehicle problems. They then locate each server optimally. Information on shared workloads are passed between the single vehicle problems until the method converges to a stable solution. The goal is to minimize system travel and waiting time.

## Models That Consider The Dynamic Real-Time Nature Of The Problem

The models previously discussed in section 4 tend to be "single use" models. A user would solve the model for a single data set of demands, travel times, and service times, and obtain insight on good sets of locations for that data set. This is problematic in that the data is typically not stationary and has dramatic changes over the day, the week, and even the year.

One approach for dealing with the dynamic nature of the problem is to break the week into 168 hourly periods and solve the model for each hour. Here, a user will have to integrate solutions so that the system runs smoothly and is not jumpy with vehicles changing locations repeatedly. Also, one can use the models and do pre-planning for atypical situations. For example, if 25% of the vehicles are busy, one could solve a model with 25% less capacity and see how the system should be designed. This solution can now be used to help in deciding how to re-deploy. So, the typical strategy for dealing with the dynamic nature is to use the static models and do a great deal of experimentation to pre-plan for contingent situations. Unfortunately, one cannot anticipate every possible situation and one must still figure out how to integrate and implement the solutions from the different model runs.

There has been work in the OR literature on two dynamic problems; repositioning and dispatching. We close this section with a short discussion on each problem.

### Dynamic Re-positioning

For the short run problem (hours or real time), Repede and Bernardo [1994] extend Daskin's maximal expected covering model to allow different location sets at different times of the week. A set of constraints to limit the number of vehicles during each hour is also included to control costs. There is no constraint on how many times a vehicle may changes bases during a day. Amiri [2001] uses a similar approach when designing general service systems. The model also includes an objective that considers costs such as labor time, travel time, and the waiting time of calls. The decisions are the locations of the facilities and the available capacity at each open facility for the day, and the zones assigned to each open facility. Once a facility is opened and given capacity, then that capacity is fixed for the entire day. The zone assignments can vary with each hour. Gendreau, Laporte, and Semet, [2001], develop a model that considers the objective of maximizing double coverage of demand. The constraints include: the number of vehicles at each site, the moving of the same vehicle repeatedly, long travel trips, and round trips between two sites. The model has been used on data generated from the Montreal, Canada EMS system and is designed to be solved quickly in real time so that it can help with relocation decisions in real time. It is embedded in a software system that also considers dispatching as well as vehicle reassignment. This final work seems to be the only work on real-time repositioning decisions.

### Dispatching

The dispatching decision for EMS calls are generally quite simple in that the closest idle vehicle is usually dispatched to the call. There can be complications however and sometimes it may be better for the system if the second or more closest idle vehicle is sent. This event is most likely to occur when there are two (or more) vehicles that are approximately equal in travel time. Here, either vehicle can get to the call successfully, but there is little OR work done on dispatching of ambulances.

Fire calls are often a different matter Chelst and Barlach [1981] consider the decision when multiple vehicles must be dispatched. The work uses the ideas in the Hypercube and A-Hypercube models and the major concern is estimating the time of the first responder on scene. Swersey [1982] develops a decision model to deciding how many fire companies to dispatch to a call. Ignall, Carter, and Rider [1982] develop a model for determining how many and which fire companies to dispatch in a high workload urban system. Minimizing immediate response time and minimizing future losses are the criteria in both the Swersey and Ignall papers. Cuninghame-Greene, and Harries [1988] show that using the closest idle vehicle dispatch rule is optimal when

the criterion is minimizing average response time. Weintraub, et . al. [1999] present a model and application for assigning and routing repair vehicles for the Emergency Services Division of the electricity utility in Santiago, Chile. This system operates similarly to an EMS system in that it has random calls and various traffic patterns during the day. The key feature of real time routing is primarily of interest to EMS and FS operations managers.

## APPLICATIONS AND SOFTWARE SYSTEMS

There are numerous papers covering the actual application of planning and deployment models discussed in the previous sections. In this section, we include only those projects that are tied to specific cities or areas and papers that deal with strategies for implementation and have not been previously mentioned. We note that the usage of these models is international in scope and we have only sampled a subset of all of the actual applications.

When performing a successful study, it is important to know where problems might occur. Hogg [1968] first discusses a methodology for performing studies, defines the key problems that must be modeled, and discusses the approach in Bristol County, England. Chaiken [1978] provides key lessons for implementing OR studies in FS and EMS cases. Chaiken collected data that showed the extensive usage of RAND models for EMS and FS planning. Hypercube was extensively distributed and used. Issues such as extensive and accurate model documentation, the presence of an advocate in the organization, and data requirements enhance the model's usability and re-usability. Alternatively, Baker and Byrd [1980] write that if the study must be done quickly, sophisticated models may not be the appropriate approach as they can take substantial time. We organize this section by general modeling approach; math programming, queuing and simulation, and non-traditional approaches that have not been previously discussed.

Plane and Hendrick [1977] use maximal covering models to locate fire companies in Denver, CO. Schreuder [1981] uses mathematical programming to locate fire stations in Rotterdam. Eaton et. al. [1981], Eaton et. al. [1985], and Eaton et. al. [1986] use maximal covering models and the model of Daskin and Stern for locating ambulances in Columbia (South America), Austin, TX, and the Dominican Republic respectively. Badri, Mortagy, and Alsayed, [1998] describe a multi-criteria approach for locating fire stations in Dubai, UAE. The authors describe the entire solution process from setting the criteria to building a goal programming model, to assessing the current and suggested plans. Alsalloum and Rand [2003] use goal programming to model two criteria; cost as estimated by the number of vehicles, and the probability that a demand is actually covered. They use the approach in Riyadh Saudi Arabia and thoroughly discuss developing travel time models to estimate the probability that travel is within the coverage time limit.

Savas [1969] describes a simulation model that was used in New York to locate ambulances. The model suggested that locating ambulances near demand areas, rather than near hospitals, would increase performance. Fitzsimmons and Srikar [1982] use a location search routine and a simulation model to find based locations in Austin, TX. Brandeau and Larson [1986] describe applying the Hypercube model to locate ambulances in Boston, MA. Fujiwara, Makjamroen, and Gupta [1987] use Daskin's expected covering model on data from Bangkok, Thailand. They first find good locations with the model and then further evaluate these candidates using a detailed simulation model. Goldberg et. al. [1990] use Jarvis' spatial queueing model with search heuristic to find improved base locations in Tucson, AZ. Repede and Bernardo [1994] and Repede, Jeffries, and Hubbard [1993] use an adjustment to Daskin's expected covering model within a user-friendly software system to locate emergency medical vehicles in Louisville, KY. This is one of the first efforts to consider the "time" dimension explicitly in their modeling efforts as they adjusted their model for different times of the day and developed different sets of locations. Morabito and Mendonca [2001] use the Hypercube model to consider the deployment of ambulances in Brazil.

Carson and Batta [1990] use a scenario approach to locate a single vehicle on the Amherst Campus of the State University of New York at Buffalo. They consider 4 scenarios that model 4 periods during the day and try to find a location that minimizes area travel time for each scenario. McAleer and Naqvi [1994] use data analysis to help reduce area travel time in Belfast, Northern

Ireland. Swersey, Goldring, and Geyer, [1993] build a cost model to analyze the issues in merging fire and emergency medical units in New Haven, CT.

Two papers deserve mention even though they are not directly inline with the topic. Richard, Beguin and Peeters [1990] consider rural fire station location. This problem is different than urban location as the travel times are typically much longer. They consider three models for finding locations and one main result is that in these situations, having service equity can be expensive. Lane, Monefeldt, and Rosenhead, [2000] discuss a system dynamics model for a hospital emergency room. Even though this final model is not directly concerned with EMS and FS design and operation, the approach is an excellent example of model building and the system dynamics approach is applicable in many areas for medium and short term planning.

There are now many companies that provide significant EMS and FS modeling and analysis services and software systems. These companies work in all phases of EMS and FS planning and decision making including site and equipment location, dispatching and transport, and record keeping.

Isera uses its operations research scheduling technology to help model the vehicle loading problem and provide labor schedules for EMS and FS providers. Deccan International uses computer aided dispatch data to estimate necessary modeling parameters for their model - FIRE/EMS ADAM. EMS and FS personnel can use a drag-and-drop graphical-user-interface to experiment with different system designs (different equipment locations for example). Results are presented in easy to understand graphs, maps, and tables. Queues Enforth Development developed a graphical user interface for the Hypercube model and a computer aided dispatch program in the mid to late 1980's. They have expanded their product line to include training and products tailored to police applications. The Trapeze Software Group specializes in software for vehicle scheduling, dispatching, and reporting. They integrate intelligent vehicle systems with dispatch decision making to make patient pick-up and delivery systems more efficient.

## PREVIOUS REVIEW PAPERS

We conclude this work with the numerous efforts at review papers in the OR literature. All of these are targeted towards the OR researcher and hence are mathematically more advanced than what we have presented here. The length of the list and the long time span again emphasize the importance of the problem and the richness of the potential application.

- Revelle, Marks, and Liebman, [1970] - considers private and public location models.
- Chaiken, and Larson, [1972] - reviews of all of the RAND reports and work in ES, EMS, and police.
- ReVelle, Bigman, Schilling, Cohon, and Church, [1979] - reviews all of the set covering and demand covering work of the 1970's. This paper is context free in that it simply talks of location as opposed to EMS or FS location.
- Ahituv and Berman [1988] - covers in detail a large part of the OR work on service systems from the 1970's and 1980's. Problem areas such as dispatching, repositioning, and base location are included. The text is geared towards the researcher and the practitioner. Results and applications are presented in the main chapters while appendices contain the detailed mathematical analyses.
- Brandeau and Chiu [1989] - covers all the models of the 1970's and 80's including the queueing work that came out of MIT. This paper is primarily for the OR researcher and contains a discussion of current open research problems.
- ReVelle [1989] - primarily covers the work from Johns Hopkins University on covering models including the probabilistic models and multiple coverage models of the late 1980's.
- Schilling, Jayaraman, and Barkhi, [1993] - contains a comprehensive review of all facility location problems that involve covering an area.
- Swersey [1994] - Comprehensive review in a handbook in operations research for public sector decision making. Spans police, FS, and EMS deployment.
- Marianov and Revelle [1995] - contains a broad general review of math programming models for siting EMS and FS bases. Includes probabilistic as well as deterministic models.
- Hesse-Owen, and Daskin [1998] - considers work relating to strategic decisions over an extended time horizon. This work covers some dynamic problems as well as probabilistic problems where some of the data is not known with certainty.

- Brotcorne, Laporte, and Semet [2003] - considers past work in deterministic and probabilistic covering models and optimization approaches. This paper has a special section on dynamic re-positioning of vehicles and this sets it apart from much of the other work.

## DIRECTIONS FOR FUTURE WORK

Even though there has been a considerable amount of OR work applied in EMS and FS planning and operation, potentially fruitful areas for future research remain. As with the rest of the paper, the focus is on modeling approaches rather than model solution. It is clear that developing valid models with heuristic solution techniques is the correct approach rather than developing simplistic models with algorithms.

The major area of needed work is the real-time operation of EMS and FS systems. The decisions involved in vehicle relocation and dispatch are complex and simulation and analytic modeling can be used to help consider the impact of such decisions. For example, using simulation, one could "fast-forward" in time and evaluate the impact of relocation or dispatching decisions for the next 30 minutes or an hour. It may be possible to build a generic simulator that would accept various data and operational strategies as input. The key constraint on such an approach is computational time as the decision must be make quickly in real-time. Another off-shoot in this direction would be to build an "agent" that would look at system status and suggest relocation opportunities to the system manager. The agent could be running in background using the current system data as well as data from a traffic management system. Dispatching decisions would be automatically made along with any relocation needed.

Another area in daily planning that has had almost no attention is shift scheduling. It is not difficult to estimate the required number of vehicles needed per hour, however one must staff those hours with vehicles and crews. The goal is to meet the needed service level at minimum total cost. The difficulty of the problem is that each city has its own shift length and starting times and these must be used when doing the scheduling. In some sense, a problem has to be solved that fits shifts into each day to meet demand and then crews must be assigned to each shift so that the labor scheduling policies are viable. There has been considerable OR mathematical programming work in airline crew scheduling and the EMS scheduling problem has some similar attributes. Isera has worked extensively in this area, however their work is proprietary.

In the area of planning, there is little modeling work done in the design of ALS/BLS systems with the true cooperation and dispatching policy between the different types of vehicles. The mathematical programming work in this area has problems in that the dispatch policy of "send a BLS if an ALS is busy or further away" is not modeled since the busy and idle states of each vehicle are not modeled. This is difficult to do with analytical queuing models as well. Since computing power has increased significantly since 1974, it might be interesting to extend the ideas in Hypercube and A-Hypercube to the multi-vehicle type case as these might be computationally feasible.

The final area is data collection and modeling. If you cannot obtain data to run in the model, then there is little need for the model! Little work has been done on long term demand forecasting and hence long term capital investment models have little value. Most models use deterministic data or the average of a sample since there are few good estimating procedures to obtain distributions. Accurate travel and service time estimates are critical for building valid detailed models, but little OR work has been done in this area. Either this work must be brought from other areas (such as transportation engineering), or it has to be developed.

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# NEMSMA POSITION PAPER

# Scope and Philosophy of EMS Quality and Performance Management

## INTENT

This paper outlines the position of the National EMS Management Association on the appropriate scope and philosophy of approach to the management of quality and performance in EMS provider organizations, EMS systems and regulatory entities.

## CONTEXTUAL TERMINOLOGY

- *Quality* - characteristic of a system or process that reflects on how well the needs of a patient, client or other EMS customer is met
- *Cost* - the amount of money required by the system or process to meet a customer need or expectation
- Customer - recipient of a system or process output
- *Value* - 1. a measurement that reflects on the combined effects of quality and cost 2. dividend of quality divided by cost (i.e., quality / cost = value)
- *Performance* - a general term that encompasses measures of quality, cost and value
- *EMS Provider* - an organization that directly delivers EMS services, such as an ambulance service, fire rescue service, or private ambulance company.
- *EMS System* - a group of providers, regulatory entities, and political entities that work together in an organized manner to design, fund, manage and regulate the delivery of EMS to a community or service area.
- *System* - a group of interrelated processes that meet a broad need or expectation
- *Process* - 1. set of procedures used to meet a specific objective 2. a component of a system

## EMS INDUSTRY CHALLENGES

1. EMS systems and providers commonly focus their performance improvement efforts on clinical issues, to the neglect of other essential EMS and business processes. Good stewardship of EMS systems and providers assures that resources are used effectively and efficiently.
2. EMS systems and providers commonly focus their corrective actions on individuals rather than the system or process designs in which the problem had an opportunity to occur.
3. EMS systems and providers commonly focus on measurements and improvements to quality, to the neglect of measurements and improvements to cost and value.
4. EMS systems and providers do not commonly conduct assessments of overall EMS system and provider performance.

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*Citation:* National EMS Management Association: Scope andPhilosophy of EMS Quality and Performance Management. *EMS Mgmnt J* 2004 Jan-Mar 1(1):40-41
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5. EMS regulatory and oversight entities do not commonly have assessments made of their own performance.

## RECOMMENDATIONS

The National EMS Management Association recommends the following to all EMS providers, systems, and regulatory entities:

1. The scope of EMS performance improvement efforts include all key processes: clinical, operational and administrative.
2. EMS regulatory and oversight bodies within a given provider, system, region, state or at a federal level, should include clinical, operational and administrative processes in their scope of oversight and regulation.
3. EMS providers and systems should utilize performance measures that monitor process performance and prioritize correction of root causes in the process and system design that provided opportunities for errors and problems to occur. Correction of problems at an individual level should only be warranted in unusual cases, although many such cases may ultimately have root causes in the recruitment, orientation, training processes, or the organizational culture and correction of such issues should be an early priority.
4. The scope of performance measurement and improvement for a given process should include dimensions of quality, cost and value.
5. Some of the most important information about any organization, including an EMS system or provider, is un-measurable. Therefore, EMS providers and systems need to complement their use of 'hard' (objective) measurements with appropriate use of 'soft' (subjective) assessments to get a balanced evaluation of quality and performance.
6. EMS providers, systems, regulatory bodies, and purchasers of EMS services should utilize EMS performance assessment tools that consider the overall performance of the EMS provider or system. We recommend the use of the following tools or equivalents thereof to accomplish this goal:
   a. Early phases - Assure regulatory compliance at a local, state and federal level
   b. Intermediate phases - Achieve compliance to applicable accreditation standards (e.g., CAAS, CAMTS, NAED, CFSAI, ISO 9000, etc.)
   c. Continuing phases - Measurement of overall performance using the Malcolm Baldrige Criteria for Healthcare Excellence
7. Performance audits should be objectively conducted periodically on the regulatory / oversight bodies associated with EMS providers and systems, to include the regional, state, and federal levels.

## RESOLUTION

This position paper is officially adopted by the National EMS Management Association through resolution by its Board of Directors this 30th day of October, 2003.

# Open Source EMS Initiative's Performance Indicator Specification

**OSEMSI Performance Indicator Group**

This section of the Journal will provide detailed technical specifications for EMS related performance indicators that have been adopted by the Open Source EMS Initiative (OSEMSI) or other selected sources.

This document contains the format for development of EMS performance indicators, as approved by an open voting process involving the EMS community at large and the Open Source EMS Initiative's editorial board members. This version of the performance indicator format was officially accepted June 1, 2003. It is based on the healthcare performance indicator format developed by the Joint Commission on the Accreditation of Healthcare Organizations.

- **Indicator Name** – Name or title of the performance indicator
- **Key Process Path** – Starting with one of the predefined key process names, this item shows which key process and sub-process that the indicator reflects on
- **Patient or Customer / Need** – Indicators are designed to reflect on how well and/or how efficiently a given patient or customer need is being met. This item shows what patient or customer / need that the indicator reflects on
- **Type of Measure** – Structure, process or outcome
- **Objective** – Describes why an indicator is useful in specifying and assessing the process or outcome of care measured by the indicator
- **Indicator Formula** – The equation for calculation of the indicator. If applicable, separate sections will separately address the numerator and denominator of the indicator equation.
- **Indicator Formula Description** – Explanation of the formula used for the indicator. Where applicable, separate descriptions detailing the numerator and denominator will be provided.
- **Denominator Description** – Description of the population being studied or other denominator characteristics, including any equation or other key aspects that characterize the denominator
    - **Denominator Inclusion Criteria** – Additional information not included in the denominator statement that details the parameters of the denominator population
    - **Denominator Exclusion Criteria** – Information describing criteria for removing cases from the denominator

---

*From the Open Source Performance Indicator Group Editorial Board*: Jerry Allison, MD, Legaspi City, Albay, Philippines; James Cherry, BSN, REMT-P, St. Lucie County Fire/Rescue, St. Lucie, FL; William Dunwoody, MBA, EMT-P, Delta Ambulance, Waterville, ME; Jim Eastham, ScD, EMSED.com, Shrewsbury, PA; Bob Folden, BA, MA, EdD, EMT-B, Texas A&M University, Greenville, TX; Mic Gunderson, HealthAnalytics LLC, Lakeland, FL; Thomas Hall, BS, CQM, EMT-P, Mecklenburg EMS Agency, Mecklenburg, NC; Brian Maguire, MSA, EMT-P, University of Maryland - Baltimore County, Baltimore, MD; Lori Moore, DrPH, MPH, EMT-P, International Association of Fire Fighters, Washington DC; David Shrader, Polaris Group, Southern Shores, NC; Craig Stroup, BS, REMT-P, San Joaquin EMS Agency; San Joaquin, CA; Dave Williams, MS, LP, Austin-Travis County EMS, Austin, TX
*Citation:* OSEMSI Performance Indicator Group: Performance Indicator Specification. *EMS Mgmnt. J* 2004 Jan-Mar 1(1):42-46.
*Online Access:* http://www.emsmj.com/v1n1/Indicator/default.htm

    - **Denominator Data Sources** – Sources for data used in generating the denominator
- **Numerator Description** – Description of the subset of the population being studied or other numerator characteristics, including any equation or other key aspects that characterize the numerator
    - **Numerator Inclusion Criteria** – Additional information not included in the numerator statement that details the parameters of the numerator population
    - **Numerator Exclusion Criteria** – Information describing criteria for removing cases from the numerator
    - **Numerator Data Sources** – Sources for data used in generating the numerator
- **Sampling Allowed** – Indicates if sampling the study population is or is not allowed in calculation of this indicator.
- **Sampling Description** – If sampling is allowed, this will describe the sampling process to be used for this indicator.
- **Minimum Number of Data Points** – Tells how many data points are needed, at a minimum, for calculation of this indicator.
- **Suggest Reporting Format: Numerical** – The suggested way in which the numerical results should be expressed (i.e. decimal minutes, percentages, ratios)
- **Suggest Reporting Format: Graphical** – The suggested way in which reports should be presented in graphical format (i.e. pie charts, statistical process control charts, etc..)
- **Suggest Reporting Frequency** – Time frame, number of successive cases or other grouping strategies by which cases should be aggregated for calculating and reporting results
- **Testing** – Indicates if a formal structured evaluation has been performed on the various scientific properties of the indicator such as its reliability, validity, and degree of difficulty of data collection
- **Stratification** – Indicates if stratification has been applied to the indicator
- **Stratification Options** – Suggested stratification criteria for use with this indicator
- **Current Development Status** – Describes the amount of work completed to date relative to the final implementation of the indicator
- **Additional Information** – Further information regarding an indicator not addressed in other sections
- **References** – Citations of works used for development of the indicator
- **Contributors** – Listing of persons or organizations used in development and refinements to this indicator.

Using this format, the OSEMSI Cardiac Performance Indicator Section is working on a performance indicator specification for cardiac arrest survival rates based on the Utstein Criteria. This draft specification is shown below to illustrate use of the OSEMSI performance indicator format.

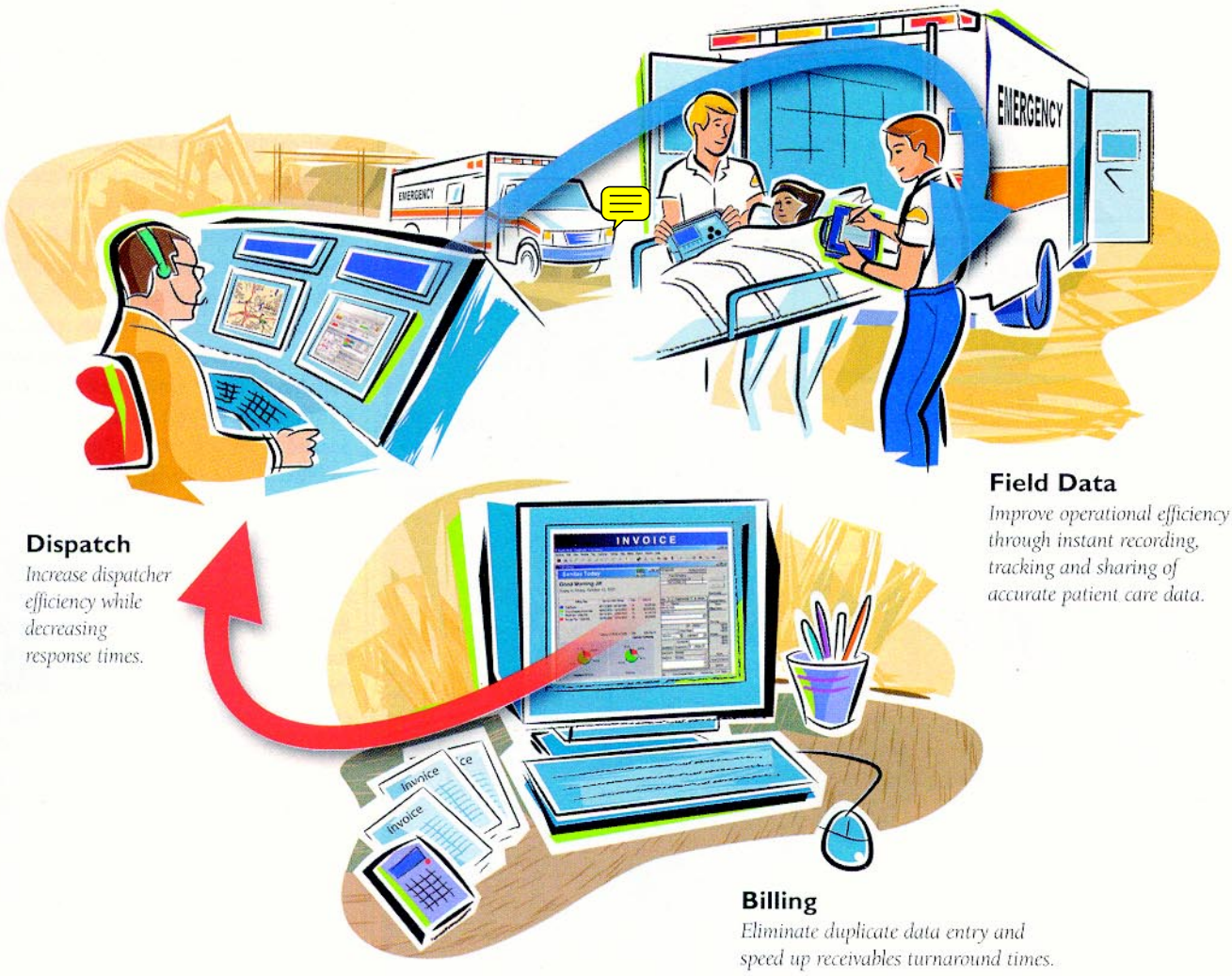
- **Indicator Name** – Cardiac Arrest Survival to Hospital Discharge Rate
- **Key Process Path** – Clinical / Cardiac / Resuscitation
- **Customer / Need** – Patient / Survival
- **Type of Measure** – Outcome
- **Objective** – Resuscitation from out-of-hospital sudden cardiac death is a key factor driving the design and clinical capabilities for EMS systems. This indicator includes several stratification criteria that allows for better comparisons between similar patient groups.
- **Indicator Formula** – # of patients that survived to hospital discharge / resuscitation attempts
- **Indicator Formula Description** – The numerator is a subset of the denominator that shows the portion of resuscitation attempts that survived, within the inclusion and exclusion criteria definitions.

- **Numerator Statement** – # of patients that survived to hospital discharge. This is a subset of the denominator.
  - **Numerator Inclusion Criteria** – N/A
  - **Numerator Exclusion Criteria –** N/A
  - **Numerator Data Sources** – Hospital discharge records or cardiac arrest registry
  - **Numerator Data Elements** – Hospital discharge status (alive, expired)
- **Denominator Statement** – Number of cases in which EMS attempted resuscitation
  - **Denominator Inclusion Criteria**
    - Chest compressions or defibrillation provided by EMS
    - Defibrillation or synchronized cardioversion provided a public access defibrillator followed by EMS care
  - **Denominator Exclusion Criteria**
    - No discharge information available
    - Resuscitation efforts discontinued by EMS personnel after resuscitation was initiated by non-EMS personnel for either a lack of evidence of an actual cardiac arrest or in cases where EMS crews immediately deemed that initiation of bystander resuscitation was inappropriate and discontinued it.
  - **Denominator Data Elements**
    - Procedures (chest compression, defibrillation, PAD discharge)
    - ECG rhythm
    - DNR status
    - Patient condition codes (i.e. major trauma, poisoning, overdose)
    - Bystander witnessed arrest event (y/n)
    - EMS witnessed arrest event (y/n)
  - **Denominator Data Source** – EMS medical record
- **Sampling Allowed** – No
- **Sampling Description** – N/A
- **Minimum Number of Data Points** – Series of 50 consecutive resuscitation attempt cases
- **Suggested Reporting Format: Numerical** – Percentage
- **Suggested Reporting Format – Graphical** – Run chart; statistical process control chart (p chart)
- **Suggested Reporting Frequency –** For each consecutive series of 50 cases
- **Testing** – Methodology published in peer-reviewed literature and numerous studies have applied the methodology.
- **Stratification** – Yes
  - **Stratification Options** – The following stratification options are applied to the denominator:
    - By bystander witnessed event status (y, n, aggregate)
    - By EMS witnessed event status (y, n, aggregate)
    - By presumed cardiac etiology (y, n, aggregate)
    - By bystander CPR status (y, n, aggregate)
    - Initial ECG rhythm (VF, VT, asystole, other, aggregate)
    - By public access defibrillator discharge status (y, n, aggregate)
    - By patient age bracket (neonate, newborn, infant, toddler, child, adolescent, teen, 20-39, 40-59, 60-79, >80, aggregate)
    - By EMS BLS response interval bracket (<4, <6, <8, <10, <12, >12 minutes, aggregate)
    - By EMS ALS response interval bracket (<4, <6, <8, <10, <12, >12 minutes, aggregate)
- **Current Development Status** – Draft only
- **Additional Information** – This indicator is based on the Utstein Style for reporting out-of-hospital survival data from cardiac arrest. Stratification options allow for compliance

to the various reporting categories from the Utstein Style Template. Additional stratification options were added to allow for ALS and BLS response intervals and patient age.

- **References** – Cummins RO, Chamberlain DA, et. al. (Task Force of the American Heart Association, European Resuscitation Council, Heart and Stroke Foundation of Canada and the Australian Resuscitation Council): Recommended Guidelines for Uniform Reporting of Data From Out-of-Hospital Cardiac Arrest: The Utstein Style. Circulation 1991;84(2):960-975
- **Contributors** – To be named

# We have ways of making you talk.

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# NEMSMA Update

The National EMS Management Association (NEMSMA) was created in March of 2003 from the vestiges of the National Association of EMS Quality Professionals (NAEMSQP). NEMSMA's mission is to catalyze improvements in the performance of EMS processes, organizations and systems. The emphasis of the old NAEMSQP organization had been on serving the needs of formally designated EMS quality improvement managers. However, the NEMSMA Board recognized that the philosophy, tools and techniques of quality and performance improvement are valid for every EMS manager who wants to improve their EMS system and the quality of care provided to the patients and communities they serve. This led to the decision to change the name and focus of the Association to a broader scope encompassing EMS leadership and management issues.

The current members of the NEMSMA Board of Directors are:

- **President** - Todd Hatley, MBA, MHA, REMT-P, Department of Emergency Medicine, University of North Carolina-Chapel Hill, Chapel Hill, NC
- **President-Elect** - Darryl Coontz, MBA, REMT-P, LifeNet, Texarkana, TX
- **Treasurer** - William Dunwoody, MBA, REMT-P, Delta Ambulance, Waterville, ME
- **Secretary** - Pat Brandt, RN, BSN, MHR, Orange County Fire / Rescue, Orlando, FL
- **Member at Large** - Dave Williams, MS, REMT-P, Austin-Travis County EMS, Austin, TX
- **Member at Large** - Thom Dick, REMT-P, Pridemark Paramedic Services, Arvada, CO
- **Member at Large** - George Ralls, MD, Orange County EMS, Orlando, FL
- **Co-Executive Director** (non-voting) - Mic Gunderson, HealthAnalytics, Lakeland, FL
- **Co-Executive Director** (non-voting) - David Lindberg, HealthAnalytics, Mesa, AZ

The Board decided to manage the association electronically for greater speed and efficiency with lower organizational operating costs. Without the constraints and expense of face to face meetings and conference calls, the Board and the various committees conduct the business of the association on a on-going basis through email discussion groups. The Board and each of the committees have their own members only email discussion group and archives built on Yahoo Groups platforms. NEMSMA also has an open email discussion group for those interested in EMS management, performance and quality issues at http://health.groups.yahoo.com/group/NEMSMA/. This is how most of the general information to NEMSMA members (and non-members) is disseminated.

## COMMITTEES

### CERTIFICATION

The NEMSMA Certification Committee is working to identify a desired body of knowledge for a Certified Prehospital Performance Manager (CPPM). This will become the basis for a certification program and will drive several other NEMSMA projects including a textbook and education programs. The CPPM body of knowledge is now in an early draft form that has drawn from the body of knowledge for the Certified Quality Manager (CQM) program from the American Society for Quality and the Certified Professional in Healthcare Quality (CPHQ) program offered by the National Association for Healthcare Quality. Certification Committee members include:

| | | | | | |
|---|---|---|---|---|---|
| Aehlert | Barbara | Barishansky | Raphael | Bollinger | Dave |
| Anderson Jr | John | Beauchemin | Greg | Bouffard | Jon |
| Arkins | Tom | Beers | Ken | Broomfield | Edward |
| Bailey | Sandy | Bollella | Gregg | Bumbak | Andrew |

*Citation:* NEMSMA Update. 2004 Jan-Mar *EMS Mgmnt J* 1(1):47-51
*Online Access:* http://www.emsmj.com/v1n1/NEMSMA/default.htm

| | |
|---|---|
| Catalano | Steven |
| Chambers | Rita |
| Chianca | Anthony |
| Collins | Thomas |
| Coontz | Darryl |
| Cox | Louis |
| Crosby | Fred |
| Doering | Garrett |
| Dostalek | Jeff |
| Duchesneau | Michael |
| Dunwoody | William |
| Ganss | Paul |
| Garner, Jr | Donald |
| Giard | Denise |
| Gillespie | Gordon |
| Hall | Thomas |
| Hathaway | William |
| Hatley | Todd |
| Hess | Don |
| Hunter | Karen |
| Kent | Greene |
| Kinsley | John |
| Klingensmith | Barbara |
| Larcheveque | Joseph |
| Lausell | Ana |
| Lindberg | David |
| Luedtke | Glenn |
| Lyle | David |
| MacInnes | Craig |
| Moore | Arnold |
| Munna, Jr. | Jerome |
| Nelson | Michael |
| Nudell | Nick |
| Paturas | James |
| Pelachik | David |
| Petrie | Richard |
| Podsiadlo | Benjamin |
| Raithby | Tom |
| Redelsteiner | Christoph |
| Riegner | Wendee |
| Riordan | Michael |
| Rowe | Dennis |
| Scribner | Holly |
| Smith | Jason |
| Stone | Mark |
| Stridfeldt | Carl |
| Tartt | John |
| Thomas | Tracy |
| Tomek | Scott |
| Van Vleet | Lee |
| Vause | William |
| Vickers | Greg |
| Waindel | David |
| Wait | Dudley |
| Walker | Janet |
| Williams | Dave |
| Wong | Sebastian |
| Young | Dennis |
| Zalkin | Joseph |
| Zimmerman | Lynn |

## Benchmarking

NEMSMA is collaborating with the Open Source EMS Initiative in the development of performance indicators and with HealthAnalytics in the development of the National EMS Performance Improvement and Benchmarking Network. Benchmarking committee members are now focused on indicator development. Benchmarking Committee members include:

| | |
|---|---|
| Arkins | Tom |
| Beauchemin | Greg |
| Beers | Ken |
| Berg | Michael |
| Beswick | Ralph |
| Bouffard | Jon |
| Brady | John |
| Broomfield | Edward |
| Bumbak | Andrew |
| Byard | John |
| Carter | Stephen |
| Catalano | Steven |
| Collins | Thomas |
| Coontz | Darryl |
| Cramer | John |
| Dostalek | Jeff |
| Dudgeon | Rob |
| Dunwoody | William |
| Easton | Kevin |
| Edwards | David |
| Epright | Steven |
| Gallet | Charles |
| Gianas | Peter |
| Gibson | James |
| Gonzales | Louis |
| Graveline | Joanne |
| Gresh | Frank |
| Griffin | Daniel |
| Hatley | Todd |
| Helmuth | Paul |
| Hess | Don |
| Hildebrand | Richard |
| Hillgardner | Joanne |
| Hutchison | Mack |
| Kanzler | Joseph |
| Kessler | Mark |
| Kirkwood | Howard |
| Larcheveque | Joseph |
| Lindberg | David |
| Luedtke | Glenn |
| Lundy | Don |
| MacInnes | Craig |
| Mattera | Connie |
| McAdams | Michael |
| McGinnis | Kevin |
| McHenry | Susan |
| McKenzie | C. Kent |
| Middleton | Greg |
| Monks | Doug |
| Moore | Arnold |
| Munna, Jr. | Jerome |
| Passow | Kate |
| Petrie | Richard |
| Podsiadlo | Benjamin |
| Rasmussen | John |
| Riegner | Wendee |
| Riordan | Michael |
| Roach | Kyle |
| Rogers | James |
| Rowe | Dennis |
| Stewart | Becky |
| Stone | Mark |
| Stouffer | John |
| Threadgill | Sherry |
| Vause | William |
| Vickers | Greg |
| Wesley | Keith |
| Williams | Lawrence |
| Wong | Sebastian |
| Zimmerman | Lyn |

## Membership & Marketing

NEMSMA will need a very active membership along with strong visibility and relationships with the rest of the EMS community to fuel the many projects on our agenda. NEMSMA needs members to serve on our Membership and Marketing Committee to recruit members, establish liaisons with other associations and promote NEMSMA throughout the EMS, emergency services and healthcare communities. The Membership Committee is just getting activated, but the committee roster includes:

| | |
|---|---|
| Clark | Doug |
| Corbin | James |
| Cox | Louis |
| Gibson | James |
| Grayless | Robert |
| Hatley | Todd |
| Lindberg | David |
| Lyle | David |
| McCoy | Deborah |
| Murphy | Brett |
| Nudell | Nick |
| Pelachik | David |
| Rogers | James |
| Slattery | Daniel |
| Waindel | David |

## Conference Committee

NEMSMA has already held two conferences, which included several preconference workshops and a post conference symposium. Many more are planned for the future. The conference committee will help in the process of choosing sites, themes, topics and speakers.

The Conference Committee members include:

| | | | | | |
|---|---|---|---|---|---|
| Bollinger | Dave | Hutchison | Mack | Tartt | John |
| Cox | Louis | Kirkwood | Howard | Thomas | Tracy |
| Crotty | Clara | Lindberg | David | Tomek | Scott |
| Darnell | Lee | Luedtke | Glenn | Trusty | Macara |
| Geedy | Adam | Lundy | Don | Wiemokly | Gary |
| Gibson | James | Munna, Jr. | Jerome | Williams | Dave |
| Goldstone | Marc | Nelson | Michael | Williams | Lawrence |
| Hatley | Todd | Rogers | James | Zimmerman | Lynn |
| Helmuth | Paul | Rutschman | Ross | | |

## Publications Committee

The publication committee advises and coordinates NEMSMA's publication efforts including those of the EMS Management Journal, NEMSMA's monthly column at MERGInet.com and other efforts. Publication Committee members include:

| | | | | | |
|---|---|---|---|---|---|
| Anderson Jr | John | Gillespie | Gordon | Redelsteiner | Christoph |
| Bailey | Sandy | Goldstone | Marc | Restuccia | Marc |
| Barishansky | Raphael | Hatley | Todd | Rogers | James |
| Baumgart | Marc | Hess | Don | Rowe | Dennis |
| Catalano | Steven | Kirkwood | Howard | Scribner | Holly |
| Clouatre | Anne | Lambrecht | Paul | Smith | Jason |
| Cronogue | Thomas | Landry | Al | Stouffer | John |
| Crosby | Fred | Lewis | Ryan | Thomas | Tracy |
| Darnell | Lee | Lindberg | David | Threadgill | Sherry |
| DeGraffenreid | Jeff | McCoy | Deborah | Tomek | Scott |
| Dick | Thom | McGinnis | Kevin | Wait | Dudley |
| Dostalek | Jeff | Moen | Carl | Walker | Laura |
| Duchesneau | Michael | Paturas | James | Wiemokly | Gary |
| Dudgeon | Rob | Phelps | Christian | Williams | Abigail |
| Easton | Kevin | Pinchalk | Mark | Williams | Dave |
| Gibson | James | Pristera | Ronald | | |

## Textbook Committee

NEMSMA plans to publish a comprehensive management textbook, which will have a strong linkage to the body of knowledge being defined by the Certification Committee for the Certified Prehospital Performance Manager program. Textbook Committee members will help guide the format, topics, and author selection for this major undertaking. Textbook Committee members include:

| | | | | | |
|---|---|---|---|---|---|
| Anderson Jr | John | DeGraffenreid | Jeff | Graf | Larry |
| Beers | Ken | Dick | Thom | Grandey | Jack |
| Berg | Michael | Dudgeon | Rob | Hathaway | William |
| Bouffard | Jon | Dunwoody | William | Hatley | Todd |
| Cartier | Steven | Epright | Steven | Hildebrand | Richard |
| Caulkins | Chris | Erdman | David | Hockert | Todd |
| Chianca | Anthony | Ganss | Paul | Kashman | James |
| Clouatre | Anne | Gibson | James | Kirkwood | Howard |
| Darnell | Lee | Goldstone | Marc | Klingensmith | Barbara |

| | | | | | |
|---|---|---|---|---|---|
| Landry | Al | Phelps | Christian | Vickers | Greg |
| Lewis | Ryan | Podsiadlo | Benjamin | Waindel | David |
| Liebnitzky | Dianna | Porter | Warren | Wait | Dudley |
| Lindberg | David | Raithby | Tom | Walker | Laura |
| Luedtke | Glenn | Redelsteiner | Christoph | Wesley | Keith |
| McDonald | David | Rogers | James | Wiemokly | Gary |
| Middleton | Greg | Rowe | Dennis | Williams | Abigail |
| Moen | Carl | Scribner | Holly | Williams | Dave |
| Munna, Jr. | Jerome | Smith | Jason | Wong | Sebastian |
| Nudell | Nick | Stern | Andrew | Zalkin | Joseph |
| Petrie | Richard | Tomek | Scott | | |

## Position Papers Committee

The Position Paper Committee will be charged with identifying topics and coordinating development of NEMSMA position papers. This may also involve development of joint position papers with other professional associations. Position Paper Committee members include:

| | | | | | |
|---|---|---|---|---|---|
| Arkins | Tom | Hatley | Todd | Pinchalk | Mark |
| Blankenship | Patti | Hildebrand | Richard | Pristera | Ronald |
| Broomfield | Edward | Hutchison | Mack | Restuccia | Marc |
| Bumbak | Andrew | Kirkwood | Howard | Rogers | James |
| Caulkins | Chris | Krohmer | Jon | Rowe | Dennis |
| Chianca | Anthony | Lindberg | David | Smith | Jason |
| Dick | Thom | Luedtke | Glenn | Threadgill | Sherry |
| Epright | Steven | Martin | Douglas | Wait | Dudley |
| Gallet | Charles | McKenzie | C. Kent | Williams | Abigail |
| Gartner | Jason | Middleton | Greg | Williams | Dave |
| Gibson | James | Moen | Carl | Wong | Sebastian |
| Goldstone | Marc | Nudell | Nick | | |

## Baldrige Committee

NEMSMA is developing a tailored version of the Baldrige Criteria for Healthcare Excellence that will specifically serve the needs of the EMS community in much the same way that individual states have their own versions and awards program based on the national-level Baldrige Criteria. Baldrige Committee members include:

| | | | | | |
|---|---|---|---|---|---|
| Akers | Diane | Kirkwood | Howard | Rasmussen | John |
| Albright | James | Lanier | Jim | Riegner | Wendee |
| Beauchemin | Greg | Lausell | Ana | Riordan | Michael |
| Byard | John | Lesher | Randy | Rogers | James |
| Chianca | Anthony | Lewis | Ryan | Rutschman | Ross |
| Cramer | John | MacInnes | Craig | Stern | Andrew |
| Darnell | Lee | Martin | Douglas | Stewart | Becky |
| Doering | Garrett | Mattera | Connie | Stridfeldt | Carl |
| Dudgeon | Rob | McAdams | Michael | Thomas | Tracy |
| Dunwoody | William | McDonald | David | Vause | William |
| Gartner | Jason | Munna, Jr. | Jerome | Vickers | Greg |
| Hall | Thomas | O'Neill | Brian | Wait | Dudley |
| Harmon | Judy | Pelachik | David | Walker | Laura |
| Hatley | Todd | Petrie | Richard | Woodard | Christine |
| Helmuth | Paul | Podsiadlo | Benjamin | Zimmerman | Lynn |
| Hockert | Todd | Pollock | Michael | | |

## Communications Committee

The NEMSMA Communications Committee is just becoming activated. This committee will be working to help design, build and maintain the electronic communications infrastructure that will be supporting most all of NEMSMA's current and future activities. Communications Committee members include:

| | | | | | |
|---|---|---|---|---|---|
| Clark | Doug | Hatley | Todd | Nudell | Nick |
| Corbin | James | Lindberg | David | Pelachik | David |
| Cox | Louis | Lyle | David | Rogers | James |
| Gibson | James | McCoy | Deborah | Slattery | Daniel |
| Grayless | Robert | Murphy | Brett | Waindel | David |

## NEMSMA STATISTICS

Number of members (as of 12/12/03): 262
Number of NEMSMA email discussion list members: 388

# EMS Quality Management

The following articles were selected from a literature search performed on the National Library of Medicine's PubMed database in September 2003 by *EMSMJ* staff. The results of the search were manually edited to only include those citations which were deemed pertinent to the general topic of EMS quality management and related issues in evaluation, outcome, assessment, data collection and any applicable tools or techniques used in quality management. The editing process was made by review of the title and journal in the citation - the actual source documents were not reviewed in this process.

Citations appear in approximate reverse chronological order with the most recent citations at the start of the list. The PubMed database only goes back to 1966, so citations pre-dating 1966 will not appear in this listing. To retrieve any of these citation via PubMed, go to www.pubmed.gov and type the PMID number into the search box.

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12. Morrison LJ, Cheung MC, Redelmeier DA.: Evaluating paramedic comfort with field pronouncement: development and validation of an outcome measure. Acad Emerg Med. 2003 Jun;10(6):633-7; PMID=12782524

*Citation:* Bibliography: EMS Quality Management. 2004 Jan-Mar *EMS Mgmnt J* 1(1):52-63
*Online Access:* http://www.emsmj.com/v1n/bibliography/default.htm

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# Capture the Competitive Edge: How Benchmarking Can Improve Your Ambulance Service

**Jack L. Stout**

The *Reflections* section of *EMSMJ* features reprints of significant articles from the archives of the EMS literature. In this issue, we present both segments of a two part article that was originally published in the September and October 1997 issues of the *Journal of Emergency Medical Services (JEMS)* written by Jack Stout.

Roger Bannister set a benchmark. Throughout all the centuries of prior recorded athletic history, no human being had been able to break the four-minute mile. Sheltered beneath this profoundly stable fact, experts boldly advanced elegant theories to explain why this barrier could not be broken. Human anatomy could not generate, sustain, or withstand the forces required. Generations of selective breeding might overcome these limitations, but short of that, the feat was physiologically impossible.

Then, on May 6, 1954, Roger Bannister did the impossible. To preserve their theories, experts postulated that Bannister was a genetic anomaly – a mutant. If so, the anomaly was epidemic in the late 1950's. Within one year, 37 other "genetic anomalies" broke the four-minute mile. The following year, 300 more followed suit.

Roger Bannister set a benchmark, and in so doing, he single-handedly (or footedly, if you will) changed our expectations of how fast a human being can run. Benchmarking changes expectations. It is our best tool for both discovering and advancing the possible. This two-part series introduces the fundamentals of benchmarking organizational performance in the ambulance service industry, with special emphasis on benchmarking key production processes.

## BENCHMARKING DEFINES A FRAME OF REFERENCE IN WHICH YOU CAN EVALUATE YOUR PERFORMANCE

Imagine you own an ambulance company. Your fleet operations manager reports a critical vehicular failure (CVF) rate of .87 per 100,000 fleet operating miles, and a total fleet operating cost of $1.87 per mile. Are these results cause for celebration, ho-hum, or cause for termination?

While pondering your fleet operating costs, your personnel director knocks at your door. She tell you that, on a scale of 1 to 5 with "1" meaning "strongly disagree" and "5" meaning "strongly agree", your senior paramedics and training officers averaged 2.8 when asked if they are satisfied with the clinical capability and customer service of new hires. Do you give your director of recruitment and orientation a bonus or a warning?

In the same conversation, you also learn that extraordinary overtime (i.e., overtime in excess of overtime built into normal shift schedules) is running at 12 percent of total field personnel payroll hours. Is this performance something to brag about or avoid mentioning?

You're beginning to sweat just thinking about it when your director of operations walks in. He says that during the past 12-week period, 7 percent of shift starts were delayed by an average of 33 minutes due to "make-ready" problems – i.e., the vehicle was not fully stocked, clean, fueled and otherwise ready for duty at the time of shift start. Paid unit hours lost due to this cause totaled 178. At your marginal cost per unit hour of $37, the economic loss from this single cause was $6,586 for the 12-week period. What's your response?

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*Online Access:* http://www.emsmj.com/v1n1/benchmarking/default.htm

Without a frame of reference to tell you how you are doing compared to the operator down the street or across the nation, it's tough to know how to respond. Experience certainly helps, but you don't have to be a thirty year veteran like I am to figure it out. You can define your own frame of reference and evaluate your performance by benchmarking.

There is another value to benchmarking. In a presentation to owners and managers of independent ambulance services recently, I said that one of the organizations represented in the room had the lowest fleet operating cost per mile. I further revealed that one of these organizations had the lowest vehicle failure rate, and that it just might be the same organization. Then, after acknowledging the absurdly obvious truth of these statements, I raised two questions: "Given these facts, is there anything you'd like to know, and why do you want to know it?"

Not surprisingly, my colleagues wanted to know who was outperforming the others on these obviously important measures. Why did they want to know? To learn how this superior performance is created, so they can consider incorporating those methods within their own operations. That is another value of benchmarking – to objectively identify, validate, and accelerate the spread of "best practices."

## BENCHMARKING ALLOWS YOU TO COMPARE YOUR PERFORMANCE OVER TIME AS WELL AS ACROSS ORGANIZATIONS

Vehicle failure rates, fleet operating cost per mile, and the other measures employed in the above examples are key performance indicators or measures of results. Comparison of key indicators is called benchmarking. When the same key indicator is compared over time for the same organization, the benchmarking method is "sequential" – i.e., a type of trend analysis. But when we compare the same key indicator for several organizations, the benchmarking method is "lateral."

World-class performance requires effective use of both sequential and lateral benchmarking. Using the example of athletic performance again, we all know that athletes compete with themselves "sequentially" over time, earning pride and satisfaction from their improvement. But as satisfying as individual improvement may be, it is not the same as comparing one's performance to others'. Breaking the four minute mile is a grand accomplishment; setting a world record of 3:44:39 is quite another.

Like athletes, world-class organizations must do more than improve; they must approach or exceed their most accomplished peers. World class performers willingly and routinely endure the discomfort of laterally benchmarking their own performance against the best in their field.

Since there are no EMS Olympics, how can we achieve lateral benchmarking? One way that single-site operators in other industries (including emergency department management) have done this is to participate in "blinded" lateral benchmarking projects. In blinded benchmarking, an independent party collects data submitted by participating organizations, and assigns coded identifiers prior to analysis and reporting. Each participating organization knows its code identifier, but not those assigned to other members. Thus, in viewing reports, participating organization know where they stand in relation to other organizations on each benchmarking measure but cannot identify the other organizations with which specific comparisons are made.

A comparative benchmarking system is currently being developed in the ambulance industry, and much of the information that follows is drawn from that project. For information on participating in this project, contact Ben Hinson, President, Mid Georgia Ambulance Service at benhinson@aol.com.

The first of these is outcome-oriented benchmarking, which measures the external effects of organizational performance. In the ambulance industry, examples of outcome-oriented key indicators include cardiac survival rates, measures of customer satisfaction, measured effects on down-stream health care costs

Output-oriented benchmarking measures the quantity, quality, or costs to the seller – not the buyer, of the products or services produced by the organization. In the ambulance industry, examples of output-oriented key indicators include fractile measures of response time reliability, measures of protocol compliance, clinical level of service, or the producer's cost per patient. In

practice, the line dividing process-oriented benchmarking from output-oriented benchmarking tends to blur as some key indicators are useful for both purposes (e.g., frequency of protocol compliance is both a measure of the output product and a factor in evaluating several key processes). This article deals primarily with process oriented indicators.

## MEASURING THINGS THAT MATTER

Knowing what to measure is at least as important as knowing how to measure precisely. In fact, it is preferable to imperfectly measure something that that really matters than to measure trivia with perfection (or measure nothing at all).

Things that matter are processes so important that, when not performed well, will prevent the organization from generating competitive value. These are called "key processes." The following six key processes are absolutely essential to delivering competitive value in the ambulance service industry.

### 1. UNIT HOUR PRODUCTION (UHP)

The aim of this key process is to produce quality unit hours at a competitive cost. A "unit hour" is every ambulance service's basic unit of production – i.e., an ambulance crew assigned to an ambulance vehicle for one hour. This single key process typically consumes about 70% of the organization's budget, and includes seven important sub-processes:

**Employee Recruitment and Orientation -** If you were made responsible for producing quality unit hours at a competitive cost, but were allowed to control only one thing, this would be it. Hire the right people, and you're more than half way home. Hire the wrong people, and it won't much matter what else you get right.

**CQI and Training -** If you've hired good people in the first place, a sound continuous quality improvement (CQI) and training program will earn you a competitive edge. If you haven't, the same CQI and training program may merely keep you afloat. Some managers prefer to separate the CQI and training functions, thereby allowing the CQI people to objectively evaluate the training program, as well as other internal operations.

**Fleet Operations -** The task of fleet operations is to serve field personnel by making available to them an ambulance vehicle of a type and design preferred by those who use it, that rarely if ever malfunctions in the field, and at a competitive operating cost (including amortized capital costs, fuel, maintenance and repairs, driver training, vehicular insurance – i.e., all the costs that would not be incurred if you could operate an ambulance service without ambulances).

**Materiels Management and Make-Ready -** The aim of this key process is to serve field personnel by ensuring that a fully-stocked, equipped, clean and fueled ambulance is available for each crew at the start of each shift, and at the location of the shift start. (Except at very low-volume remote rural stations, high performance ambulance services do not expect field personnel working at high productivity levels to perform these tasks.) Efficient mid-shift restocking is also included within this key process.

### OTHER TYPES OF ORGANIZATIONAL BENCHMARKING

This article describes several key indicators used in process-oriented benchmarking, in which the indicator, compared over time or across sites, reveals how well a key production process is being performed. There are two other types of benchmarking that are relevant to EMS.

The first of these is outcome-oriented benchmarking, which measures the external effects of organizational performance. In the ambulance industry, examples of outcome-oriented key indicators include cardiac survival rates, measures of customer satisfaction, measured effects on down-stream health care costs

Output-oriented benchmarking measures the quantity, quality, or costs to the seller - not the buyer, of the products or services produced by the organization. In the ambulance industry, examples of output-oriented key indicators include fractile measures of response time reliability, measures of protocol compliance, clinical level of service, or the producer's cost per patient served.

In practice, the line dividing process-oriented benchmarking from output-oriented benchmarking tends to blur as some key indicators are useful for both purposes (e.g., frequency of protocol compliance is both a measure of the output product and a factor in evaluating several key processes). This article deals primarily with process oriented indicators.

**Scheduling, Compensation, and Labor Relations -** The purpose of this key process is to develop and allocate work schedules which effectively meet two objectives. First, personnel must be scheduled so as to match customer demand by time-of-day/day-of-week, as requested by the manager of unit hour distribution, without generating unacceptable levels of "excess" unit hours. Second, to the maximum extent possible, shifts are designed to meet the personal and family preferences, and off-duty lifestyles of individual field personnel.

**Field Operations -** This key process is primarily used as a management-accounting cost center in which the direct labor costs of non-management field personnel are captured and reported. In addition, out-of-chute times, facility turnaround times, post facility expenses, and certain other items are tracked within this key process.

**UHP Management and Supervision -** Because unit hour production is so large and complex, it often requires its own "departmental" management and supervision. The quality, cost and scheduling of unit hours produced are the acid test of UHP management's effectiveness. The efficiency of UHP management is best tracked by the percentage of total UHP costs required to support this overhead function.

**TEST YOUR SKILL**

Using only the information contained in Scenario #4, it is possible to calculate this organization's total number of weekly shift starts. (The answer is 385.)

Competitive value is the ultimate benchmark — a combination of quality and price that is at or near the best service attainable from any supplier for the money spent.

## 2. MAXIMIZE "EFFECTIVE" UNIT HOURS

The purpose of this key process is to limit "lost" and "excess" unit hours. All "paid" or "produced" unit hours are not necessarily "effective" unit hours. In general, an effective unit hour is 60 minutes of paid unit hour production capacity available for posting and response, or assigned to a call. "Lost unit hours" are paid unit hours that, for various reasons, are not available for posting and response, or assigned to a call (e.g., unit out-of-service due to mechanical failure, or on-coming crew not available due to vehicle-not-ready at shift start). "Excess" unit hours are paid unit hours exceeding the coverage level requested by the manager responsible for unit hour distribution. Depending upon management's ability, from 6 to more than 30 percent of paid unit hours are lost or excess – a dangerous and costly source of waste.

## 3. UNIT HOUR DISTRIBUTION (UHD)

Sometimes referred to as system status management, this key process is exactly what its name implies: the task of distributing unit hours (by time-of-day/day-of-week, geographically, and to requests for service) to achieve on-time performance, fair and reasonable workload allocation, and competitive levels of productivity. Typically, clinical quality and customer-service aspects of the call-taking process are also included within this key process. While the direct cost of unit hour distribution is a small percentage of total costs (even where highly advanced technology is employed), the manager of this process determines productivity levels, and thus the number of unit hours required. Effectively, this manager holds the company checkbook, as well as the organization's ability to meet its response time obligations.

## 4. SERVICE PRICING AND CONTRACTING

Regardless of how efficient the organization may be, consistent pricing below average cost, or making contractual commitments that cannot be fulfilled, will eventually spell disaster. Professional business management has always been important, but the added complexities of managed care contracting are increasing the level of expertise required. Typically, marketing is also included within this key process.

## 5. PATIENT-ACCOUNTS MANAGEMENT

Having mastered the first four key processes, many organizations find they can survive and even prosper with little or no local tax support (and may be expected to do so). Increased reliance on earned income requires simultaneous achievement of competitive collection results (for local market conditions) and a humane corporate image.

## 6. CORPORATE MANAGEMENT AND ADMINISTRATION

The organization's ability to consistently generate competitive value while living within its means is the acid test of effective management. The efficiency of the organization's management is best tracked by the percentage of total costs required to support this overhead function.

Having a reasonably clear understanding of each of these key processes, we are now ready to design key performance indicators that will tell us how well each key process is being performed. The indicators will be the benchmarks against which we measure our performance.

In the second part of this series, we'll develop selected key performance indicators for several key processes, consider options for displaying the information, and discuss methods of obtaining and managing source data.

## PART II

In Part One in the September issue, we showed how benchmarking creates our sense of what is possible, what is admirable, what is acceptable, what is embarrassing. Consciously or unconsciously, we routinely benchmark when we compare ourselves to others, deciding if we are rich or poor, fast or slow, masterful or incompetent, hard-working or lazy, fair or ruthless. In Part One, we acknowledged that it was better to imperfectly benchmark things that really matter than to precisely benchmark trivia. We defined competitive, sequential and lateral benchmarking and revealed how organizations use blended benchmarking services to improve their performance. We defined process-oriented, output-oriented, and outcome-oriented benchmarking. We listed the key processes essential to generating competitive value. For each of these concepts, examples from the ambulance industry were provided.

Perhaps most importantly, we noted that with virtually no exceptions, world-class performers in athletics and business routinely endure the discomfort of benchmarking their performance – not merely over time (i.e., sequential benchmarking) – but against that of their most accomplished peers (i.e., lateral benchmarking). Part Two continues to look at process-oriented benchmarking, defines how it is done and suggests methods of obtaining and managing benchmarking data.

Having a reasonably clear understanding of those things that matter most (i.e., the key processes we intend to benchmark), we are now ready to design key performance indicators that will tell us whether and how well each key process is being accomplished.

Because management is, in part, a process of converting financial resources into useful goods or services, and because value is a subjective measure of the balance between quality and cost, key measures must measure both the quality and cost of each of each of the key processes. In addition, benchmarking relies on a third measurement unit called a "collateral impact indicator," which defines the relationship among key processes. Finally, in developing key indicators, it is important to find comparisons that permit lateral (cross-site) benchmarking. For example, comparing the number of critical fleet failures or the fleet operations budget of a large operation with those of a smaller operation is relatively meaningless. However, comparing the ratios of critical vehicle failures per 100,000 fleet operating miles of the fleet operating cost per mile can be highly informative, provided both operators use the same definition of 'critical vehicle failure" and the same accounting rules for calculating "fleet operating costs."

So there you have it – you can benchmark the key processes that contribute to your success by designing and measuring key indicators of quality, cost and collateral impact. Now, let's

identify those key indicators for a key process I defined in Part I, Materiel Management & Make Ready.

Materiels Management & Make-Ready (MM&MR) is a sub-process that falls under the broader key process of Unit Hour Production (UHP). The aim of MM&MR is to serve field personnel by ensuring that a fully stocked, equipped, clean and fueled ambulance is available for each crew at the start of each shift, and at the location of the shift start. Efficient mid-shift re-stocking is also included in this key process. When MM&MR is optimum, it serves to maximize the ambulance crew's percentage of on-duty time available. Sample key indicators for MM&MR are listed below. Note that these are suggestions based on my experience; you may think of other indicators that are also valid in measuring your MM&MR performance.

## HOW TO DESIGN QUALITY INDICATORS

Let's examine how I came up with the first quality indicator on the list: percent shift starts without delay because of make-ready defect.

A well designed key indicator of quality reveals how well a key process achieves its purpose. By "purpose" I mean the essential contribution this key process makes to the organization's ability to satisfy its customers.

Thus, I started by asking from the customer's point of view: What single measure would best reveal how well this key process achieves its primary purpose, as compared with the same organization's previous performance (sequential benchmarking), and with that of other organizations (lateral benchmarking)?

In high-performance systems using precision peak-load staffing, a request for 18 unit coverage during say, hour 60 of a 168 hour week means that 18 units will truly be needed at that time, and that a delayed shift start will almost surely result in a delayed response. Response time, clearly, is a measure of how well (or how poorly) an ambulance organization satisfies its customers.

High-performance systems typically operate with little or no tax support and cannot afford the cost of unit hours unavailable for service. If not tracked and controlled, make ready problems routinely waste 10 percent of more of paid unit hours, or put another way, nearly 10 percent of an operating budget. Furthermore, crews working high productivity shifts deserve the support of a responsive and reliable make ready program. In short, a delayed shift start caused by a make ready defect endangers and inconveniences patients, irritates and inconveniences institutional customers, wastes money and sends the wrong message to field personnel.

However, a raw count of delayed or on-time shift starts is not meaningful either in sequential or lateral benchmarking. As I suggested previously, what really matters is the ratio of shift starts delayed by make ready defect to total shift starts (e.g., 17 delayed shift starts divided by 208 total shift starts equals 8 percent shift starts delayed by make ready defect). Figure 1 charts this key indicator in lateral benchmarking for 46 organizations.

Before moving on, don't forget that key indicators need to be designed so that managers can tap into the necessary data to measure the key measures accurately. Are they available? Will they be difficult or costly to collect? Will capturing the data place an unreasonable burden on ambulance crews or other personnel? In other words, is this information really worth the effort required to obtain it?

When looking at shift start delays and make-ready defects, we need only count the total number of shift starts and during each reporting period and the number of shift starts caused by make-ready defects. Slight modification to existing documentation (e.g., vehicle checkout sheets or CAD unit setup records) will do the trick. (Some systems have solved this problem by using the CAD system's unit activation and log-off time stamps as the basic payroll time-keeping system for field personnel, with paper documentation required for other on-duty activity, such as in-service training and, of course, shift start delays.)

Finally, having developed our most valuable indicator of make-ready quality, we now ask ourselves another question, "If we could have just one more measure of make ready quality, and only one more, what would it be?" In practice, this process is seductive. Each key indicator seems

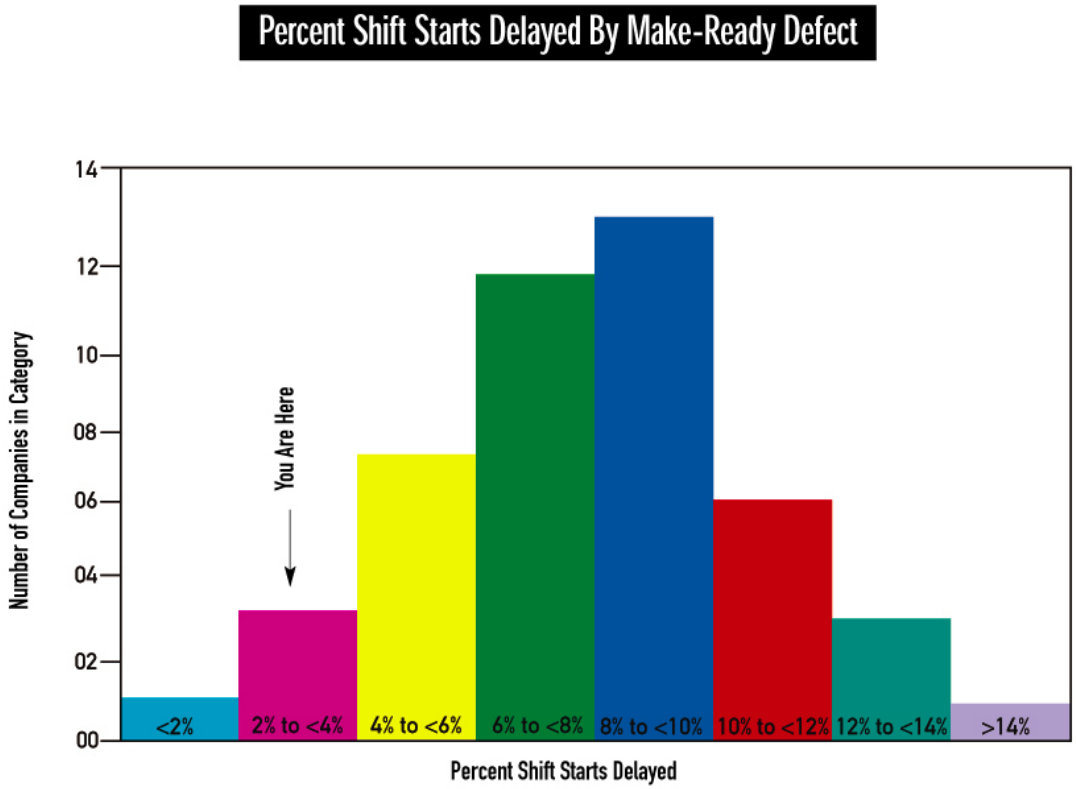


**Figure 1** - Key Process: Unit Hour Production; Sub-Process: Materiel Management & Make Ready; Quality Indicator: Percent Shifts Starts Delayed by Make Ready Defect

to point to another. To be of practical value, benchmark reports must be tightly focused on the things that matter most, easily understood and very brief. Tip: Limit yourself to an absolute maximum of eight key indicators (i.e., all cost, quality and collateral impact indicators combined) for each key process and sub-process. You'll be amazed at how challenging (and effective) this limitation can be.

## COST INDICATORS

Having developed means of measuring the quality of our MM&MR key process, we can now turn our attention to measuring the efficiency with which these results are achieved, i.e., their cost. Given a big enough budget, even incompetent managers can produce quality, so quality alone doesn't tell us anything. Key process benchmarking requires simultaneous understanding of quality and cost. But cost per what?

Just as a raw count of shift starts is meaningless, a comparison of MM&MR budgets alone would reveal little of value. Tracking the MM&MR cost per unit hour isn't appropriate either because it unfairly favors organizations using extended shifts (with fewer shift changes per unit hour). MM&MR cost per patient served would be better, but still of the mark. We need a unit-costing measure more closely related to the key process purpose: expediting the start of each shift in order to maximize the time that ambulance crews are available for patient response. Thus, the most useful costing measure for this key process will be the MM&MR cost per shift start. This indicator is illustrated graphically in Figure 2.

Since we are already counting the number of shift starts during each reporting period, we need only capture the costs for performing the key process itself to produce the cost indicator report. This can be accomplished with a management accounting system capable of tracking costs in a least two dimensions (i.e., line item category and key process category).

Cost accounting is an important part of the equation, and while an in-depth discussion of cost-accounting issues is beyond the scope of this article, two major issues are worth noting. First, lateral benchmarking of efficiency requires common rules for allocating costs among key pro-

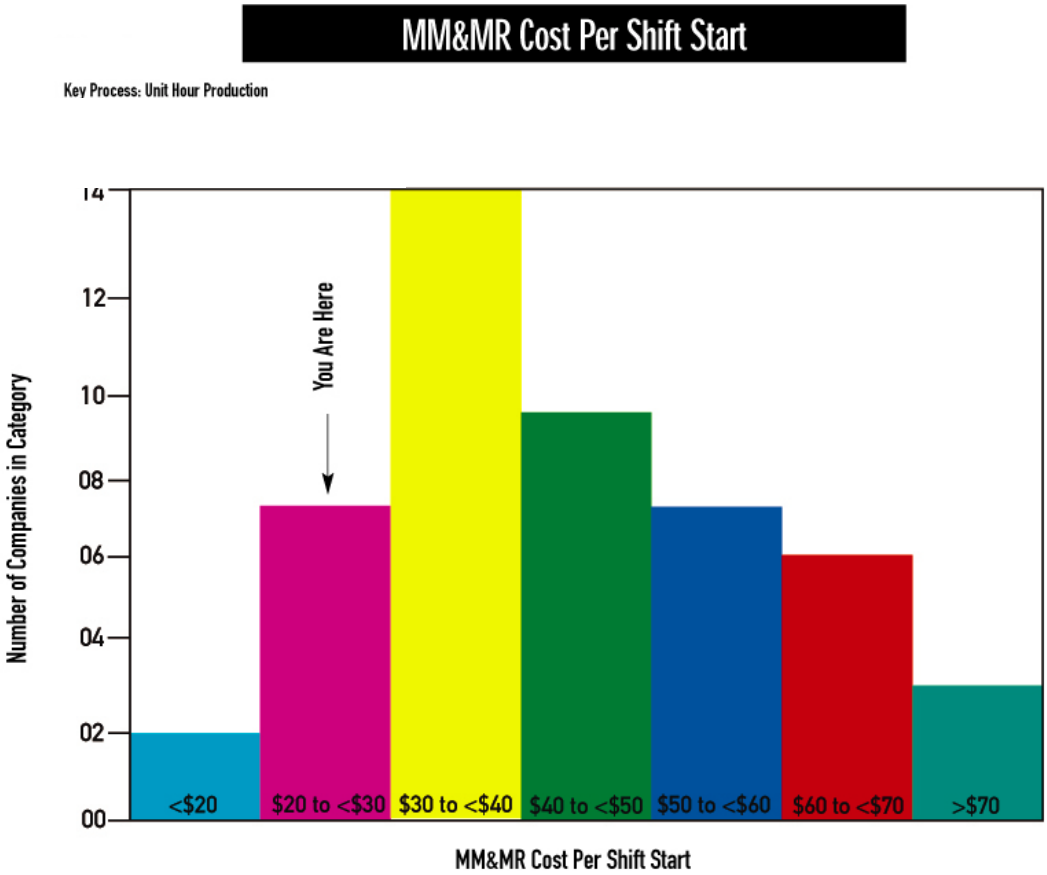


**Figure 2** - Key Process: Unit Hour Production; Sub-Process: Materiel Management & Make Ready; Cost Indicator: MM&MR Cost per Shift Start

cesses. Second, to assess the full effect of a change in production method, it is important that all significant costs of conducting that key process are allocated to that category.

For example, the use of vehicle service technicians (VSTs) to clean, stock and refuel vehicles between shifts, and to expedite mid-shift restocking, can easily save far more money than it costs to hire these folks because. Their work can dramatically reduce unit hours list both at the start of each shift (when the crews must perform these duties) and at shift's end (when it can be even most costly if the ambulance crew is working overtime). VSTs can also help reduce inventory losses. But unless the cost accounting system captures all of these costs within the MM&MR key process category, the wisdom of using VSTs may not be revealed.

Tip: When designing cost allocation rules, a good rule of thumb is to allocate all the costs to a given key process that would not be incurred if that key process were unnecessary. In the case of MM&MR, your costs are all those that would be saved if you never had to restock or clean the ambulance or refuel between shifts.

## WHAT ABOUT COLLATERAL IMPACT INDICATORS?

As discussed in Part 1, collateral impact is the effect of one key process upon the performance of another. Failure to track and understand these relationships can severely degrade management accountability and morale. \ Continuing with the MM&MR example, consider how a chronic pattern of shift start delays will adversely affect the primary cost indicator of field operations, i.e., the key process cost per effective unit hour. (As noted in Part 1, an "effective unit hour" is, in general, one hour of service by a crewed ambulance available for calls or assigned to calls). In an operation using a 10-hour average shift length, a 20 minute average shift start delay will increase the Field Operations direct labor cost per effective unit hour by 3.4 percent, i.e., for than $100,000 per year in a medium sized ambulance service, not counting the effect of extraordinary overtime resulting from related end-of-shift holdovers.

One way of tracking this effect is to benchmark the percentage of paid unit hours lost at shift start because of make-ready defects. This is a collateral impact indicator that works well for both sequential and lateral benchmarking purposes.

## DATA SOURCES AND REPORT GENERATION

Three strategies are available for organizing the production of benchmark reports. To discuss these options, it is essential to understand the difference between primary and secondary data, Primary data is captured at its original source without modification or interpretation. Secondary data is data derived from by processing or interpreting primary data. For example, "call received" and "arrived at scene" time stamps created by a CAD system are primary data elements while "response time" is a secondary data element derived by comparing those two primary data elements.

Of the three strategies available for generating benchmarking reports, the moist cumbersome and least accurate requires managers to collect and submit the required information in the form of secondary data. Using this method, the reports flow "upward" within the organization structure as a service provided by lower management for the benefit of upper management.

Still cumbersome, but slightly more accurate is the gathering and submission of primary data by key process managers, with processing and report preparation performed by others. Although somewhat useful for sequential benchmarking, neither of these methods is adequate to support reliable lateral benchmarking because of the vast differences in what and how data is gathered and interpreted. For example, one operation may track unit hours lost because of mid-shift restocking while another does not. Two operations may require crews to refuel near the end of their shifts, but one may count this time as lost hours and another may not. Lateral benchmarking based on comparisons may be misleading.

For these and other reasons, successful lateral benchmarking requires use of the third strategy – direct collection of 100 percent of most primary data by a single, independent source. Uniform rules governing exclusion and processing can then be applied by an unbiased party. This does not mean that all participating organizations must employ the same code structures, chart of accounts and other record keeping conventions. Each participating organization's "language' can be indexed to a universal data element dictionary. Primary data elements are then translated into this "universal language" prior to processing, then translated back for report generation.

Besides ensuring true compatibility of reports from different organizations, this third strategy is far less cumbersome than "bottom up" reporting. Most of the primary data elements needed the key processes discussed in Part 1 can be obtained by data transfer from existing CAD, payroll, accounting and billing system databases. Automated extraction of primary data enhances system integrity, avoids the time and expense of redundant record keeping and creates a "top down" management information system of real value to line managers.

## INFORMATION DISPLAY AND INTERPRETATION

Figures 1 and 2 provide sample displays of lateral benchmarking charts from the MM&MR quality and cost examples discussed above. (Sequential charts look the same, but show a single organization's performance over time.)

Even when viewing these charts for the very first time, we can quickly tell that the subject operation (i.e., the "you are here" arrow) is apparently more efficient than most and more effective as well. At the very least, we want to know more about that organization's methods.

A key process manager who reviews these charts routinely for five to 10 key indicators can gain a useful understanding of his or her key process performance in relation to others in less than 10 minutes. A general manager familiar with these reports can identify the greatest opportunities for organizational improvement in less than two hours, and a regional manager of multiple operations can rapidly identify "best practices" and operations needing help.

It is commonly assumed that differences revealed by lateral benchmarking measures are typically of a limited magnitude – perhaps 10 to 20 percent. This is not so in the ambulance

service industry. Ranges of 200,300 and even 400 percent in vehicle failure rates, on-time shift starts, productivity levels, response time reliability, lost unit hours, hospital turnaround times, out-f-chute times, extraordinary overtime, recruitment and orientations costs per successful new hire and many other key indicators are routine. No doubt these ranges will narrow as our customers demand better value as comparative information becomes more widely available. In the mean-time, such huge variations in quality and efficiency offer a tremendous advantage to individuals and organizations who understand what's possible and strive to achieve it.

Jack Stout, a renowned authority on EMS systems, probably wrote this article from the aft deck of his sailboat.

## ACKNOWLDEGEMENTS

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# Excerpts from the Baldrige Healthcare Criteria for Performance Excellence

**Baldrige National Quality Program, National Institute of Standards and Technology, Technology Administration, United States Department of Commerce**

*Externals* are articles, chapters, other documents or excerpts thereof that have been previously published elsewhere. They are reprinted in *EMSMJ* in an effort to bring important information from other sources to *EMSMJ* readers. Most of the content in this article has been excerpted from the Malcolm Baldrige Criteria for Healthcare Performance Excellence document.

EMS systems, provider organizations, regulatory agencies, institutional EMS clients, and the governmental bodies who have ultimate responsibility for EMS in their communities have a common need: to assure access and delivery of EMS in a safe, effective and efficient manner. To this end, the EMS Division of the National Highway Traffic Safety Administration, the lead Federal agency for EMS in the United States, worked with a diverse group of EMS community representatives and topic experts to develop a framework that could be used to assess and improve the quality of EMS. They discovered that the Baldrige Criteria for Healthcare Performance Excellence (BCHPE) would meet that need. They consequently used it as the basis for developing the Leadership Guide to Quality Improvement of EMS Systems. Despite its release several years ago, it seems that awareness and utilization of the Leadership Guide and BHCPE remains quite low. To help develop a broader awareness and understanding of the BCHPE, the following article provides major excerpts from the 2003 Criteria for Healthcare Performance Excellence document produced by the Baldrige National Quality Program at the U.S. Department of Commerce's National Institute for Standards and Testing (NIST). Readers should also note that the National EMS Management Association has established a Baldrige Committee for the purpose of creating an EMS industry specific version of the BCHPE that would work in much the same way that most of the states have established state-level Baldrige criteria and recognition processes.

*The following content is excerpted from the 2003 Malcolm Baldrige Criteria for Healthcare Performance Excellence:*

## HEALTH CARE CRITERIA FOR PERFORMANCE EXCELLENCE GOALS

The Health Care Criteria are designed to help organizations use an integrated approach to organizational performance management that results in:

- delivery of ever-improving value to patients and other customers, contributing to improved health care quality
- improvement of overall organizational effectiveness and capabilities as a health care provider
- organizational and personal learning

*Citation*: National Institute for Standards and Testing: Excerpts from the 2003 Baldrige Criteria for Healthcare Performance Excellence. 2004 Jan-Mar; *EMS Mgmnt J* 1(1):74-116.
*Online Access:* http://www.emsmj.com/v1n1/baldrige/default.htm

## Core Values and Concepts

The Health Care Criteria are built upon the following set of interrelated Core Values and Concepts:

- visionary leadership
- patient-focused excellence
- organizational and personal learning
- valuing staff and partners
- agility
- focus on the future
- managing for innovation
- management by fact
- social responsibility and community health
- focus on results and creating value
- systems perspective

These values and concepts, described below, are embedded beliefs and behaviors found in high-performing organizations. They are the foundation for integrating key organizational requirements within a results-oriented framework that creates a basis for action and feedback.

## Visionary Leadership

An organization's senior leaders (administrative and health care provider leaders) should set directions and create a patient focus, clear and visible values, and high expectations.

The directions, values, and expectations should balance the needs of all your stakeholders. Your leaders should ensure the creation of strategies, systems, and methods for achieving excellence in health care, stimulating innovation, and building knowledge and capabilities. The values and strategies should help guide all activities and decisions of your organization. Senior leaders should inspire and motivate your entire staff and should encourage all staff to contribute, to develop and learn, to be innovative, and to be creative. Senior leaders should be responsible to your organization's governance body for their actions and performance. The governance body should be responsible ultimately to all your stakeholders for the ethics, vision, actions, and performance of your organization and its senior leaders.

Senior leaders should serve as role models through their ethical behavior and their personal involvement in planning, communications, coaching, development of future leaders, review of organizational performance, and staff recognition. As role models, they can reinforce ethics, values, and expectations while building leadership, commitment, and

initiative throughout your organization.

## Patient-Focused Excellence

The delivery of health care services must be patient focused. Quality and performance are the key components in determining patient satisfaction. All attributes of patient care delivery (including those not directly related to medical/clinical services) factor into the judgment of satisfaction and value. Satisfaction and value to patients are key considerations for other customers as well. Patient-focused excellence has both current and future components: understanding today's patient desires and anticipating future patient desires and health care marketplace offerings.

Value and satisfaction may be influenced by many factors during a patient's experience participating in health care. Primary among these factors is an expectation that patient safety will be ensured throughout the health care delivery process. Additional factors include a clear understanding of likely health and functional status outcomes, as well as the patient's relationship with the health care provider and ancillary staff, cost, responsiveness, and continuing care and attention. For many patients, the ability to participate in making decisions on their health care is considered an important factor. This requires patient education for an informed decision. Charac-

teristics that differentiate one provider from another also contribute to the sense of being patient focused. Patient-focused excellence is thus a strategic concept. It is directed toward obtaining and retaining patient loyalty, referral of new patients, and market share gain in competitive markets. Patient-focused excellence thus demands rapid and flexible response to emerging patient desires and healthcare marketplace requirements, and measurement of the factors that drive patient satisfaction. Patient-focused excellence also demands awareness of new technology and new modalities for delivery of health care services.

### Organizational and Personal Learning

Achieving the highest levels of performance requires a well executed approach to organizational and personal learning. Organizational learning includes both continuous improvement of existing approaches and adaptation to change, leading to new goals and/or approaches. Learning needs to be embedded in the way your organization operates. This means that learning (1) is a regular part of daily work; (2) is practiced at

personal, department/work unit, and organizational levels; (3) results in solving problems at their source ("root cause"); (4) is focused on sharing knowledge throughout your organization; and (5) is driven by opportunities to effect significant change and to do better. Sources for learning include staff ideas, health care research findings, patients' and other customers' input, best practice sharing, and benchmarking.

Organizational learning can result in (1) enhancing value to patients through new and improved patient care services; (2) developing new health care opportunities; (3) reducing errors, defects, waste, and related costs; (4) improving responsiveness and cycle time performance; (5) increasing productivity and effectiveness in the use of all resources throughout your organization; and (6) enhancing your organization's performance in building community health and fulfilling its societal responsibilities.

Staff success depends increasingly on having opportunities for personal learning and practicing new skills. Organizations invest in personal learning through education, training, and other opportunities for continuing growth. Such opportunities might include job rotation and increased pay for demonstrated knowledge and skills. On-the-job training offers a cost-effective way to train and to better link training to your organizational needs and priorities. For health care providers, personal learning includes building discipline knowledge, discipline retraining to adjust to a changing health care environment, and enhancing knowledge of measurement systems influencing outcome assessments and clinical guidelines, decision trees, or critical pathways. Education and training programs may benefit from advanced technologies, such as computer- and Internet-based learning and satellite broadcasts.

Personal learning can result in (1) more satisfied and versatile staff who stay with the organization, (2) organizational cross-functional learning, and (3) an improved environment for innovation. Thus, learning is directed not only toward better health care services but also toward being more responsive, adaptive, and efficient—giving your organization health care marketplace sustainability and performance advantages.

### Valuing Staff and Partners

An organization's success depends increasingly on the knowledge, skills, creativity, and motivation of its staff and partners.

Valuing staff means committing to their satisfaction, development, and well-being. Increasingly, this involves more flexible, high-performance work practices tailored to staff with diverse workplace and home life needs. Major challenges in the area of valuing staff include (1) demonstrating your leaders' commitment to your staff's success, (2) recognition that goes beyond the regular compensation system, (3) development and progression within your organization, (4) sharing your organization's knowledge so your staff can better serve your patients and other customers and contribute to achieving your strategic objectives, and (5) creating an environment that encourages appropriate risk taking.

Organizations need to build internal and external partnerships to better accomplish overall goals. Internal partnerships might include cooperation between health care providers and other staff, and labor-management cooperation, such as agreements with unions. Partnerships with staff might entail staff development, cross-training, or new work organizations, such as high-performance work teams. Internal partnerships also might involve creating network relationships among your departments/work units to improve flexibility, responsiveness, and knowledge sharing and to develop processes that better follow patient care and needs.

External partnerships might be with customers, suppliers, business associations, third-party payors, community and social service organizations, and other health care providers. Strategic partnerships or alliances are increasingly important kinds of external partnerships. Such partnerships with other health care organizations could result in referrals or in shared facilities that are either capital intensive or require unique and scarce expertise. Also, partnerships might permit the blending of your organization's core competencies or leadership capabilities with the complementary strengths and capabilities of partners.

Successful internal and external partnerships develop longer-term objectives, thereby creating a basis for mutual investments and respect. Partners should address the key requirements for success, means for regular communication, approaches to evaluating progress, and means for adapting to changing conditions. In some cases, joint education and training could offer a cost-effective method for staff development.

## Agility

Success in today's health care environment demands agility—a capacity for rapid change and flexibility. All aspects of electronic communication and information transfer require and enable more rapid, flexible, and customized responses. Health care providers face ever shorter cycles for the introduction of new/improved health care services, as well as for faster and more flexible response to patients and other customers. Major improvements in response time often require simplification of work units and processes and/or the ability for rapid changeover from one process to another. Cross-trained and empowered staff are vital assets in such a demanding environment.

Today's health care environment places a heavy burden on the timely design of health care delivery systems, disease prevention programs, health promotion programs, and effective and efficient diagnostic and treatment systems. Overall design must include the opportunity to learn for continuous organizational improvement and must value the individual needs of patients. Design also must include effective means for gauging improvement of health status—for patients and populations/communities. Beneficial changes must be introduced at the earliest appropriate opportunity.

All aspects of time performance now are more critical, and cycle time has become a key process measure. Other important benefits can be derived from this focus on time; time improvements often drive simultaneous improvements in organization, quality, cost, patient focus, and productivity.

## Focus on the Future

In today's health care environment, a focus on the future requires understanding the short- and longer-term factors that affect your organization and health care marketplace. Pursuit of health care excellence requires a strong future orientation and a willingness to make long-term commitments to key stakeholders—patients and families, staff, communities, employers, payors, health profession students, and suppliers and partners. Your organization's planning should anticipate many factors, such as changes in health

care delivery systems, resource availability, patient and other stakeholder expectations, technological developments, new partnering opportunities, the evolving importance of electronic communication and information transfer, evolving regulatory requirements, community and societal expectations, and new thrusts by competitors and other organizations providing similar

services. Strategic objectives and resource allocations need to accommodate these influences. A focus on the future includes developing staff and suppliers, creating opportunities for innovation, and anticipating public responsibilities.

A major long-term investment associated with health care excellence is the investment in creating and sustaining an assessment system focused on health care outcomes. This entails becoming familiar with research findings and ongoing application of assessment methods.

### Managing for Innovation

Innovation means making meaningful change to improve an organization's services and processes and to create new value for the organization's stakeholders. Innovation should lead your organization to new dimensions of performance. Innovation is no longer strictly the purview of health care researchers; innovation is important for all aspects of your organizational performance and all processes. Organizations should be led and managed so that innovation becomes part of the culture and is integrated into daily work.

### Management by Fact

An effective health care service and administrative management system depends on the measurement and analysis of performance. Such measurements should derive from health care service needs and strategy, and they should provide critical data and information about key processes, outputs, and results. Many types of data and information are needed for performance management. Performance measurement should include information on health care outcomes; community health; epidemiological data; critical pathways and practice guidelines; administrative, payor, staff, cost, and financial performance; competitive comparisons; and customer satisfaction.

Analysis refers to extracting larger meaning from data and information to support evaluation, decision making, and operational improvement. Analysis entails using data to determine trends, projections, and cause and effect that might not otherwise be evident. Analysis supports a variety of purposes, such as planning, reviewing your overall performance, improving operations, change management, and comparing your performance with competitors', similar health care organizations', or with "best practices" benchmarks.

A major consideration in performance improvement and change management involves the selection and use of performance measures or indicators. *The measures or indicators you select should best represent the factors that lead to improved health care outcomes; improved customer, operational, and financial performance; and healthier communities. A comprehensive set of measures or indicators tied to patient/customer and/or organizational performance requirements represents a clear basis for aligning all processes with your organization's goals.* Through the analysis of data from your tracking processes, your measures or indicators themselves may be evaluated and changed to better support your goals.

### Social Responsibility and Community Health

A health care organization's leaders should stress responsibilities to the public, ethical behavior, and the need to foster improved community health. Leaders should be role models for your organization in focusing on ethics and the protection of public health, safety, and the environment. Protection of health, safety, and the environment includes any impact of your organization's operations. Also, organizations should emphasize resource conservation and waste reduction at the source.

Planning should anticipate adverse impacts that may arise in facilities management, as well as use and disposal of radiation, chemicals, and biohazards. Effective Planning should prevent problems, provide for a forthright response if problems occur, and make available information and support needed to maintain public awareness, safety, and confidence.

Organizations should not only meet all local, state, and federal laws and regulatory and accreditation requirements, but they should treat these and related requirements as opportunities

for improvement "beyond mere compliance." Organizations should stress ethical behavior in all stakeholder transactions and interactions. Highly ethical conduct should be a requirement of and should be monitored by the organization's governance body. Ethical practices need to consider nondiscriminatory patient treatment policies and protection of patients' rights and privacy. Public health services and supporting the general health of the community are important citizenship responsibilities of health care organizations. Practicing good citizenship refers to leadership in carrying out these responsibilities—within the limits of an organization's resources—and includes influencing other organizations, private and public, to partner for these purposes. For example, your organization might lead or participate in efforts to establish free clinics or indigent care programs, to increase public health awareness programs, or to foster neighborhood services for the elderly. A leadership role also could include helping to define regional or national health care issues for action by regional or national networks or associations. Managing social responsibility requires the use of appropriate measures and leadership responsibility for those measures.

### Focus on Results and Creating Value

An organization's performance measurements need to focus on key results. Results should be used to create and balance value for your key stakeholders—patients, their families, staff, the community, payors, businesses, health profession students, suppliers and partners, investors, and the public. By creating value for your key stakeholders, your organization builds loyalty and contributes to the community. To meet the sometimes conflicting and changing aims that balancing value implies, organizational strategy should explicitly include key stakeholder requirements. This will help ensure that actions and plans meet differing stakeholder needs and avoid adverse impacts on any stakeholders. The use of a balanced composite of leading and lagging performance measures offers an effective means to communicate short- and longer-term priorities, monitor actual performance, and provide a clear basis for improving results.

### Systems Perspective

The Baldrige Health Care Criteria provide a systems perspective for managing your organization to achieve performance excellence. The Core Values and the seven Baldrige Categories form the building blocks and the integrating mechanism for the system. However, successful management of overall performance requires organization specific synthesis, alignment, and integration. Synthesis means looking at your organization as a whole and builds upon key organizational requirements, including your strategic objectives and action plans. Alignment means using the key linkages among requirements given in the Baldrige Categories to ensure consistency of plans, processes, measures, and actions. Integration means the individual components of your performance management system operate in a fully interconnected manner.

These concepts are depicted in the Baldrige framework on page 5. A systems perspective includes your senior leaders' focus on strategic directions and on your patients and other customers. It means that your senior leaders monitor, respond to, and manage performance based on your organizational results. A systems perspective also includes using your measures and indicators to link your key strategies with your key processes and align your resources to improve overall performance and satisfy patients and other customers.

Thus, a systems perspective means managing your whole organization, as well as its components, to achieve success.

## LINKAGE OF THE HEALTH CARE CRITERIA TO THE BALDRIGE BUSINESS SECTOR CRITERIA

The 2003 Health Care Criteria incorporate the Core Values and Concepts described above and are built upon the seven-part framework used in the Business Criteria for Performance Excellence. The rationale for the use of the same framework is that it is adaptable to the requirements of

all organizations, including health care organizations. However, this adaptation does not assume that these requirements are necessarily addressed in the same way. This adaptation to health care, then, is largely a translation of the language and basic concepts of business excellence to similarly important concepts in health care excellence. A major practical benefit derived from using a common framework for all sectors of the economy is that it fosters cross-sector cooperation and sharing of best practices information.

## HEALTH CARE CRITERIA FOR PERFORMANCE EXCELLENCE FRAMEWORK

The Core Values and Concepts are embodied in seven Categories, as follows:

1. Leadership
2. Strategic Planning
3. Focus on Patients, Other Customers, and Markets
4. Measurement, Analysis, and Knowledge Management
5. Staff Focus
6. Process Management
7. Organizational Performance Results

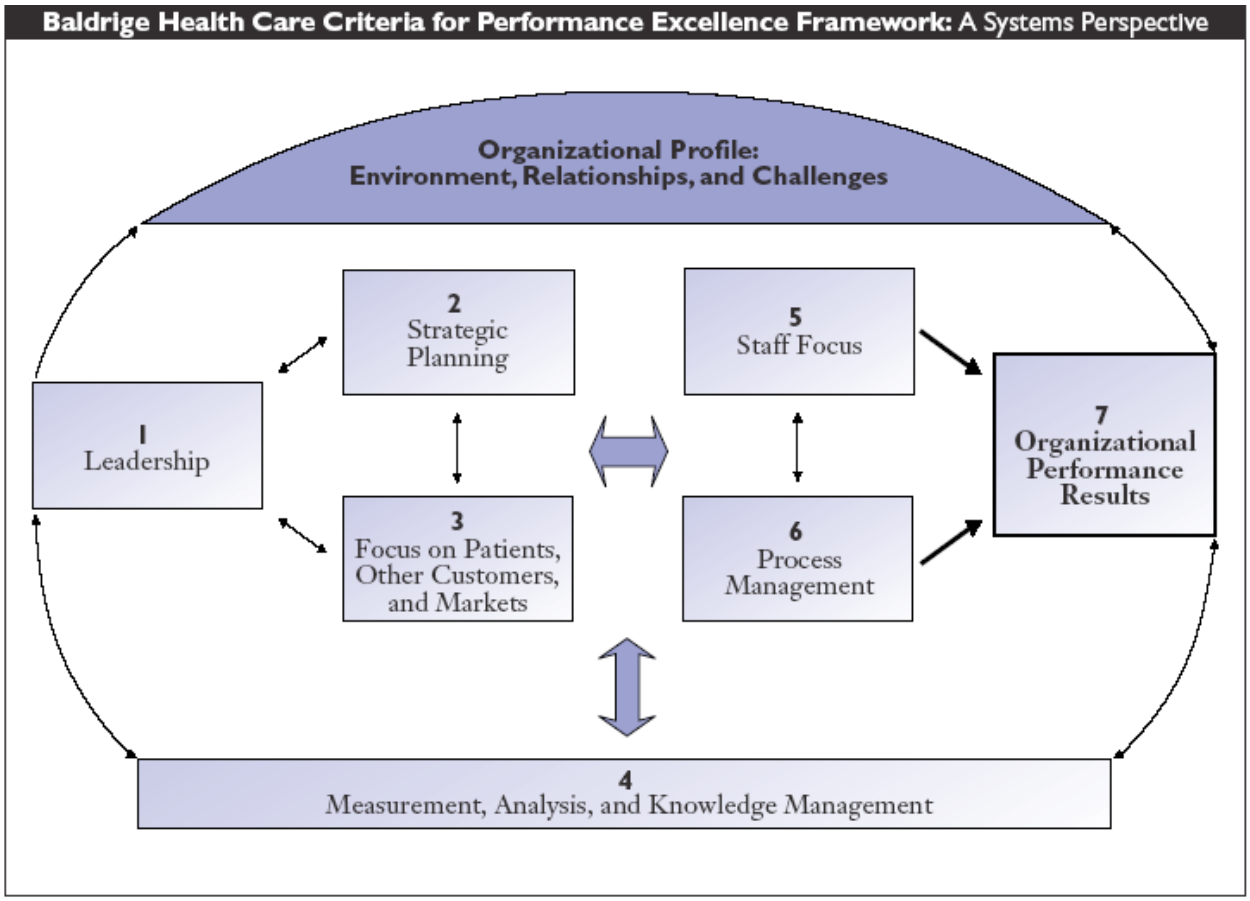



**Figure 1** – Baldrige categories framework

Figure 1 provides the framework connecting and integrating the Categories. From top to bottom, the framework has the following basic elements.

### ORGANIZATIONAL PROFILE

Your Organizational Profile (top of figure) sets the context for the way your organization operates. Your environment, key working relationships, and strategic challenges serve as an overarching guide for your organizational performance management system.

### System Operations

The system operations are composed of the six Baldrige Categories in the center of the figure that define your operations and the results you can achieve.

Leadership (Category 1), Strategic Planning (Category 2), and Focus on Patients, Other Customers, and Markets (Category 3) represent the leadership triad. These Categories are placed together to emphasize the importance of a leadership focus on strategy and patients/customers. Senior leaders set your organizational direction and seek future opportunities for your organization.

Staff Focus (Category 5), Process Management (Category 6), and Organizational Performance Results (Category 7) represent the results triad. Your organization's staff and its key processes accomplish the work of the organization that yields your performance results.

All actions point toward Organizational Performance Results—a composite of health care, patient and other customer, financial, and internal operational performance results, including staff and work system results and social responsibility results. The horizontal arrow in the center of the framework links the leadership triad to the results triad, a linkage critical to organizational success. Furthermore, the arrow indicates the central relationship between Leadership (Category 1) and Organizational Performance Results (Category 7). The two-headed arrow indicates the importance of feedback in an effective performance management system.

### System Foundation

Measurement, Analysis, and Knowledge Management (Category 4) are critical to the effective management of health care and operational performance. Measurement, analysis, and knowledge serve as a foundation for the performance management system.

## CRITERIA STRUCTURE

The seven Criteria Categories shown in the figure are subdivided into Items and Areas to Address.

### Items

There are 19 Items, each focusing on a major requirement. Item titles and point values are given later in the document.

### Areas to Address

Items consist of one or more Areas to Address (Areas). Organizations should address their responses to the specific requirements of these Areas.

## KEY CHARACTERISTICS OF THE HEALTH CARE CRITERIA

*The Criteria focus on organizational performance results.* The Criteria focus on the key areas of organizational performance given below.

Organizational performance areas:

1. patient- and other customer-focused results
2. health care results
3. financial and market results
4. staff and work system results
5. organizational effectiveness results, including key internal operational performance measures
6. governance and social responsibility results

The use of this composite of indicators is intended to ensure that strategies are balanced—that they do not inappropriately trade off among important stakeholders, objectives, or short- and longer-term goals.

*The Criteria are nonprescriptive and adaptable.*

The Criteria are made up of results-oriented requirements. However, the Criteria do not prescribe

- that your organization should or should not have departments for quality, planning, or other functions;
- how your organization should be structured; or
- that different units in your organization should be managed in the same way.

These factors differ among organizations, and they are likely to change as needs and strategies evolve.

The Criteria are nonprescriptive for the following reasons:

(1) The focus is on results, not on procedures, tools, or organizational structure. Health care organizations are encouraged to develop and demonstrate creative, adaptive, and flexible approaches for meeting basic requirements. Nonprescriptive requirements are intended to foster incremental and major ("breakthrough") improvements, as well as basic change.

(2) The selection of tools, techniques, systems, and organizational structure usually depends on factors such as organization type and size, organizational relationships, your organization's stage of development, and staff capabilities and responsibilities. (3) A focus on common requirements, rather than on common procedures, fosters better understanding, communication, sharing, and alignment, while supporting innovation and diversity in approaches.

*The Criteria support a systems perspective to maintaining organization-wide goal alignment.*

The systems perspective to goal alignment is embedded in the integrated structure of the Core Values and Concepts, the Organizational Profile, the Criteria, and the results-oriented, cause-effect linkages among the Criteria Items.

Alignment in the Criteria is built around connecting and reinforcing measures derived from your organization's processes and strategy. These measures tie directly to patient/customer value and to overall performance. The use of measures thus channels different activities in consistent directions with less need for detailed procedures, centralized decision making, or process management. Measures thereby serve both as a communications tool and a basis for deploying consistent overall performance requirements. Such alignment ensures consistency of purpose while also supporting agility, innovation, and decentralized decision making.

A systems perspective to goal alignment, particularly when strategy and goals change over time, requires dynamic linkages among Criteria Items. In the Criteria, action-oriented cycles of learning take place via feedback between processes and results.

The learning cycles have four, clearly defined stages:

(1) planning, including design of processes, selection of measures, and deployment of requirements

(2) execution of plans

(3) assessment of progress and capturing new knowledge, taking into account internal and external results

(4) revision of plans based on assessment findings, learning, new inputs, and new requirements

*The Criteria support goal-based diagnosis.*

The Criteria and the Scoring Guidelines make up a two part diagnostic (assessment) system. The Criteria are a set of 19 performance-oriented requirements. The Scoring

Guidelines spell out the assessment dimensions—*Approach, Deployment, and Results*—and the key factors used to assess each dimension. An assessment thus provides a profile of strengths and opportunities for improvement relative to the 19 basic requirements. In this way, assessment leads to actions that contribute to performance improvement in all areas, as described in the shaded box above. This diagnostic assessment is a useful management tool that goes beyond most performance reviews and is applicable to a wide range of strategies and management systems.

## INTEGRATION OF KEY HEALTH CARE THEMES

For the adaptation of the Business Criteria for Performance Excellence to health care, several important concepts have been given careful consideration. These concepts are addressed throughout the Health Care Criteria:

### MISSION SPECIFICITY

Although health care organizations share common aims, individual organizational missions, roles, and services vary greatly. Use of a single set of criteria to cover all requirements of all organizations means that these requirements need to be interpreted in terms of your specific organizational mission. This is necessary because specific requirements and key drivers of organizational performance differ from organization to organization. For this reason, effective use of the Criteria depends upon your setting your organizational context for responding to requirements consistently across the seven categories of the Criteria framework. In particular, the Strategic Planning Category (Category 2) needs to address all your key mission requirements, setting the stage for the interpretation of all the other requirements. Similarly, the results you report in the Organizational Performance Results Category (Category 7) need to reflect results consistent with your organization's mission and strategic objectives. The Health Care Criteria are most explicit in the area of delivery of health care, as this requirement is common to all organizations, regardless of specific mission. Despite this commonality, the focus of health care services and service development does depend upon your organizational mission. For example, the results reported by hospitals, HMOs, and home health care agencies would be expected to differ and to reflect each organization's mission. Nevertheless, all three types of organizations would be expected to show year-to-year improvements in their results to demonstrate the effectiveness of their performance improvement efforts.

It is recognized that some, but not all, health care organizations have a significant research and/or teaching commitment as part of their mission. If germane, these activities should be noted as part of your process management and operational performance results.

### CUSTOMERS

The Business Criteria for Performance Excellence use the generic term "customers" to reflect the buyers of products or services. Although marketplace success depends heavily upon buyer preference, other stakeholders also must be considered when setting organizational requirements. Successful operation of an organization may depend upon satisfying environmental, legal, and other requirements. Thus, meaningful criteria need to incorporate all relevant requirements that organizations must meet to be successful.

Health care organizations also must respond to a variety of requirements—all of which need to be incorporated into the Health Care Criteria. The adaptation of the Business Criteria to health care includes a specific approach for defining key customer requirements. The approach selected distinguishes between patients and other customers for purposes of clarity and emphasis. While not further differentiated from other customers in Category 3, the community (as a customer) receives special attention in Item 1.2. This has been done because health care organizations have a particularly strong sense of social responsibility, and role model behavior should include health care services to your organization's community.

Physicians, nurse practitioners, midwives, psychologists, and other health care providers may play a unique "staff" role as providers of health care and also may have relationships both as suppliers and customers of your organization. The Criteria are intentionally designed to be tolerant of these varying relationships and to allow your organization to respond based on your specific structure as described in your Organizational Profile.

Customers' requirements are of two types: (1) requirements that need to be reflected in your organization's health care services and (2) your customers' additional individualized requirements. For example, payors might require certain health screening services (e.g., mammography)

for their members (type 1) and certain computerized billing services for reimbursement (type 2). Many of the needs of your non-patient customers are needs that must be addressed in your organization's health care services. Therefore, the Health Care Criteria place primary emphasis on the delivery of health care.

### Senior Leaders and Staff

The Business Criteria for Performance Excellence use the term "senior leaders" to refer to an organization's senior management group or team. This typically consists of the head of the organization and his or her direct reports. In health care organizations with separate administrative/operational and health care provider leadership, "senior leaders" refers to both sets of leaders and the relationships among those leaders.

The Business Criteria for Performance Excellence use the generic term "employees" for those on the organization's payroll responsible for all aspects of product and service development and delivery. These Criteria place great emphasis upon employees as a primary strategic resource whose interests, satisfaction, motivation, and development are important to an organization's success.

These same themes are central to success in health care and are thus emphasized in the Health Care Criteria, beginning with the Core Values and Concepts. In the Criteria, the term "staff" of health care organizations includes health care providers, senior leaders, and administrative and support staff. It is recognized that health care providers are sometimes, but not always, employees of the organization. Nevertheless, as key providers of an organization's health care services, health care providers are considered staff for the purposes of the Criteria. By considering health care providers as staff, you are able to focus on the necessity of including their roles and responsibilities in discussing organizational leadership and human resources. The Health Care Criteria anticipate that all staff are integrated into your organization's management system and contribute to fulfilling your organization's mission.

### Business and Support Processes

While the Health Care Criteria place a primary focus on health care service delivery, they recognize that most health care organizations carry out a wide variety of activities that directly and indirectly support and/or impact success in the marketplace and the overall organizational mission and operation but that are not themselves primarily patient or health care related. Such activities are addressed in the Health Care Criteria as business processes (e.g., technology acquisition, information and knowledge management, and mergers and acquisitions) or support processes (e.g., patient support processes, such as housekeeping and medical records, and other support processes, such as finance and accounting, facilities management, security, billing, and purchasing). In general, there are two types of requirements such processes need to address in an integrated way: (1) requirements of key stakeholders, such as patients, staff, and payors; and (2) effective and efficient use of resources. The Health Care Criteria require that each process address both types of requirements.

### Primary Focus on Health Care

Although the Criteria framework is intended to address all organizational requirements, primary emphasis is placed on health care. This is done for two main reasons. First, improving or maintaining the quality of life is the universal goal of all health care organizations. Thus, sharing of successful health care strategies and methods would have the greatest impact on the nation's health care systems. Second, those who encouraged the creation of a Baldrige Award category for health care cited improvement in health care quality as their primary or only rationale for such an award.

## HEALTHCARE CRITERIA ITEMS AND SCORING SYSTEM

The next 31 pages are images of selected pages taken directly from the 2003 Baldrige Criteria for Healthcare Performance Excellence document. The *EMSMJ* page numbers are at the very bottom, and the original Baldrige document pages are just above them. These image files are in lower resolution to maintain a reasonable file size. The most current (2004) version of the Baldrige Criteria for Healthcare Performance Excellence PDF file, in high resolution, is available for download at the Baldrige site.

## 2003 Health Care Criteria for Performance Excellence—Item Listing

| | | | |
|---|---|---|---|
| **P** | **Preface: Organizational Profile** | | |
| | P.1 Organizational Description | | |
| | P.2 Organizational Challenges | | |
| **2003 Categories and Items** | | | **Point Values** |
| **1** | **Leadership** | | **120** |
| | 1.1 Organizational Leadership | 70 | |
| | 1.2 Social Responsibility | 50 | |
| **2** | **Strategic Planning** | | **85** |
| | 2.1 Strategy Development | 40 | |
| | 2.2 Strategy Deployment | 45 | |
| **3** | **Focus on Patients, Other Customers, and Markets** | | **85** |
| | 3.1 Patient, Other Customer, and Health Care Market Knowledge | 40 | |
| | 3.2 Patient and Other Customer Relationships and Satisfaction | 45 | |
| **4** | **Measurement, Analysis, and Knowledge Management** | | **90** |
| | 4.1 Measurement and Analysis of Organizational Performance | 45 | |
| | 4.2 Information and Knowledge Management | 45 | |
| **5** | **Staff Focus** | | **85** |
| | 5.1 Work Systems | 35 | |
| | 5.2 Staff Learning and Motivation | 25 | |
| | 5.3 Staff Well-Being and Satisfaction | 25 | |
| **6** | **Process Management** | | **85** |
| | 6.1 Health Care Processes | 50 | |
| | 6.2 Support Processes | 35 | |
| **7** | **Organizational Performance Results** | | **450** |
| | 7.1 Health Care Results | 75 | |
| | 7.2 Patient- and Other Customer-Focused Results | 75 | |
| | 7.3 Financial and Market Results | 75 | |
| | 7.4 Staff and Work System Results | 75 | |
| | 7.5 Organizational Effectiveness Results | 75 | |
| | 7.6 Governance and Social Responsibility Results | 75 | |
| | **TOTAL POINTS** | | **1000** |

**Note:** The Scoring System used with the Criteria Items in a Baldrige assessment can be found on pages 58–60.

### Importance of Beginning with Your Organizational Profile

Your Organizational Profile is critically important because

- it is the most appropriate starting point for self-assessment and for writing an application;
- it helps you identify potential gaps in KEY information and focus on KEY PERFORMANCE requirements and RESULTS;
- it is used by the Examiners and Judges in application review, including the site visit, to understand your organization and what you consider important; and
- it also may be used by itself for an initial self-assessment. If you identify topics for which conflicting, little, or no information is available, it is possible that your assessment need go no further and you can use these topics for action planning.

# P Preface: Organizational Profile

The ***Organizational Profile*** is a snapshot of your organization, the KEY influences on HOW you operate and the KEY challenges you face.

## P.1 Organizational Description

**Describe your organization's PERFORMANCE environment and your KEY relationships with PATIENTS and other CUSTOMERS, suppliers, and partners.**

Within your response, include answers to the following questions:

a. Organizational Environment

(1) What are your organization's main HEALTH CARE SERVICES? What are the delivery mechanisms used to provide your HEALTH CARE SERVICES to your PATIENTS?

(2) What is your organizational culture? What are your stated PURPOSE, VISION, MISSION, and VALUES?

(3) What is your STAFF profile? What are their education levels? What are your organization's workforce and job diversity, organized bargaining units, use of contract and privileged STAFF, and special health and safety requirements?

(4) What are your major technologies, equipment, and facilities?

(5) What is the legal and regulatory environment under which your organization operates? What are the applicable occupational health and safety regulations; accreditation, certification, or registration requirements; and environmental and financial regulations relevant to HEALTH CARE SERVICE delivery?

b. Organizational Relationships

(1) What is your organizational structure and GOVERNANCE system? What are the reporting relationships among your board of trustees, SENIOR LEADERS, and your parent organization, as appropriate?

(2) What are your KEY PATIENT and other CUSTOMER groups and health care market segments, as appropriate? What are their KEY requirements and expectations for your HEALTH CARE SERVICES? What are the differences in these requirements and expectations among PATIENT and other CUSTOMER groups and market segments?

(3) What role do suppliers and partners play in your KEY PROCESSES? What are your most important types of suppliers and partners? What are your most important supply chain requirements?

(4) What are your KEY supplier and partnering relationships and communication mechanisms?

**Notes:**

N1. Health care service delivery to your patients and other customers (P.1a[1]) might be direct or through contractors or partners.

N2. Market segments (P.1b[2]) might be based on health care services or features, geography, health care service delivery modes, payors, business volume, population demographics, or other factors that allow your organization to define related market characteristics.

N3. Patient and other customer group and health care market segment requirements (P.1b[2]) might include accessibility, continuity of care, electronic communication, and billing requirements.

N4. Communication mechanisms (P.1b[4]) should be two-way and might be in person, electronic, by telephone, and/or written. For many organizations, these mechanisms might be changing as marketplace requirements change.

**For definitions of key terms presented throughout the Health Care Criteria and Scoring Guidelines text in SMALL CAPS/SANS SERIF, see Glossary of Key Terms on pages 35–41.**

**Frequently, several questions are grouped under one number (e.g., P.1a[3]). These questions are related and do not require separate responses. These multiple questions serve as a guide in understanding the full meaning of the information being requested.**

**Item notes serve three purposes: (1) to clarify terms or requirements presented in an Item, (2) to give instructions on responding to the Item requirements, and (3) to indicate key linkages to other Items. In all cases, the intent is to help you respond to the Item requirements.**

## P.2 Organizational Challenges

**Describe your organization's competitive environment, your KEY STRATEGIC CHALLENGES, and your system for PERFORMANCE improvement.**

Within your response, include answers to the following questions:

a. Competitive Environment

(1) What is your competitive position? What is your relative size and growth in the health care industry or markets served? What are the numbers and types of competitors and KEY collaborators for your organization?

(2) What are the principal factors that determine your success relative to your competitors and other organizations delivering similar HEALTH CARE SERVICES? What are any KEY changes taking place that affect your competitive situation or opportunities for collaborating?

(3) What are your KEY available sources of comparative and competitive data from within the health care industry? What are your KEY available sources of comparative data for analogous PROCESSES outside the health care industry? What limitations, if any, are there in your ability to obtain these data?

b. STRATEGIC CHALLENGES

What are your KEY HEALTH CARE SERVICE, operational, and human resource STRATEGIC CHALLENGES?

c. PERFORMANCE Improvement System

(1) What is the overall APPROACH you use to maintain an organizational focus on PERFORMANCE improvement and to guide SYSTEMATIC evaluation and improvement of KEY PROCESSES?

(2) What is your overall APPROACH to organizational learning and sharing your KNOWLEDGE ASSETS within the organization?

**Notes:**

N1. Factors (P.2a[2]) might include differentiators such as technology leadership, accessibility, health care and administrative support services offered, cost, and e-services.

N2. Challenges (P.2b) might include cycle times reduced for health care service introduction; mergers and acquisitions; patient and customer loyalty and retention; staff retention; and electronic communication with staff, patients, and other customers.

N3. Performance improvement (P.2c) is an assessment dimension used in the Scoring System to evaluate the maturity of organizational approaches and deployment (see pages 58–60). This question is intended to help you and the Baldrige Examiners set a context for your approach to performance improvement.

N4. Overall approaches to process improvement (P.2c[1]) might include implementing the use of ISO 9000:2000 standards, six sigma methodology, Plan-Do-Study-Act (PDSA) improvement cycles, or other process improvement tools.

### Page Limit

For Baldrige Award applicants, the Organizational Profile is limited to five pages. These pages are not counted in the overall application page limit. Typing and format instructions for the Organizational Profile are the same as for the application. These instructions are given in the *Baldrige Award Application Forms* booklet. Ordering information is given on pages 67–68.

# 1 Leadership (120 pts.)

The ***Leadership*** Category examines HOW your organization's SENIOR LEADERS address VALUES, directions, and PERFORMANCE expectations, as well as a focus on PATIENTS and other CUSTOMERS and STAKEHOLDERS, EMPOWERMENT, INNOVATION, and learning. Also examined are your organization's GOVERNANCE and HOW your organization addresses its public and community responsibilities.

## 1.1 Organizational Leadership (70 pts.)

**Approach-Deployment**

**Describe HOW SENIOR LEADERS guide your organization. Describe your organization's GOVERNANCE system. Describe HOW SENIOR LEADERS review organizational PERFORMANCE.**

Within your response, include answers to the following questions:

a. Senior Leadership Direction

(1) HOW do SENIOR LEADERS set and deploy organizational VALUES, short- and longer-term directions, and PERFORMANCE expectations? HOW do SENIOR LEADERS include a focus on creating and balancing VALUE for PATIENTS and other CUSTOMERS and STAKEHOLDERS in their PERFORMANCE expectations? HOW do SENIOR LEADERS communicate organizational VALUES, directions, and expectations through your LEADERSHIP SYSTEM, to all STAFF, and to KEY suppliers and partners? HOW do SENIOR LEADERS ensure two-way communication on these topics?

(2) HOW do SENIOR LEADERS create an environment for EMPOWERMENT, INNOVATION, and organizational agility? HOW do they create an environment for organizational and STAFF learning? HOW do they create an environment that fosters legal and ethical behavior?

b. Organizational GOVERNANCE

HOW does your organization address the following KEY factors in your GOVERNANCE system?

- management accountability for the organization's actions
- fiscal accountability
- independence in internal and external audits
- protection of stockholder and STAKEHOLDER interests, as appropriate

c. Organizational PERFORMANCE Review

(1) HOW do SENIOR LEADERS review organizational PERFORMANCE and capabilities? HOW do they use these reviews to assess organizational success, competitive PERFORMANCE, and progress relative to short- and longer-term GOALS? HOW do they use these reviews to assess your organizational ability to address changing HEALTH CARE SERVICE needs?

(2) What are the KEY PERFORMANCE MEASURES regularly reviewed by your SENIOR LEADERS? What are your KEY recent PERFORMANCE review findings?

(3) HOW do SENIOR LEADERS translate organizational PERFORMANCE review findings into priorities for continuous and breakthrough improvement of KEY organizational PERFORMANCE RESULTS and into opportunities for INNOVATION? HOW are these priorities and opportunities deployed throughout your organization? When appropriate, HOW are they deployed to your suppliers and partners to ensure organizational ALIGNMENT?

(4) HOW do you evaluate the PERFORMANCE of your SENIOR LEADERS, including both administrative and health care leaders? HOW do SENIOR LEADERS use organizational PERFORMANCE review findings to improve both their own leadership effectiveness and that of your board and LEADERSHIP SYSTEM, as appropriate?

**Notes:**

N1. Senior leaders include the head of the organization and his or her direct reports. In health care organizations with separate administrative/operational and health care provider leadership, "senior leaders" refers to both sets of leaders and the relationships among those leaders.

N2. Organizational directions (1.1a[1]) relate to creating the vision for the organization and to setting the context for strategic objectives and action plans described in Items 2.1 and 2.2.

N3. Senior leaders' organizational performance reviews (1.1c) should be informed by organizational performance analyses described in 4.1b and guided by strategic objectives and action plans described in Items 2.1 and 2.2. Senior leaders' organizational performance reviews also might be informed by internal or external Baldrige assessments.

N4. Leadership performance evaluation (1.1c[4]) might be supported by peer reviews, formal performance management reviews (5.1b), and formal and/or informal staff and other stakeholder feedback and surveys.

N5. Your organizational performance results should be reported in Items 7.1–7.6.

Item responses are assessed by considering the Criteria Item requirements; your KEY organizational factors presented in your Organizational Profile; and the maturity of your APPROACHES, breadth of DEPLOYMENT, and strength of your improvement PROCESS and RESULTS relative to the Scoring System. Refer to the Scoring System information on pages 58–60.

For additional description of this Item, see page 42.

## 1.2 Social Responsibility (50 pts.)

**Approach-Deployment**

**Describe HOW your organization addresses its responsibilities to the public, ensures ethical behavior, practices good citizenship, and contributes to the health of its community.**

Within your response, include answers to the following questions:

a. Responsibilities to the Public

(1) HOW do you address the impacts on society of your HEALTH CARE SERVICES and operations? What are your KEY PROCESSES, MEASURES, and GOALS for achieving and surpassing regulatory, legal, and accreditation requirements, as appropriate? What are your KEY PROCESSES, MEASURES, and GOALS for addressing risks associated with your management of HEALTH CARE SERVICES and other organizational operations?

(2) HOW do you anticipate public concerns with current and future services and operations? HOW do you prepare for these concerns in a proactive manner?

b. Ethical Behavior

HOW do you ensure ethical behavior in all STAKEHOLDER transactions and interactions? What are your KEY PROCESSES and MEASURES or INDICATORS for monitoring ethical behavior throughout your organization, with KEY partners and collaborators, and in your GOVERNANCE structure?

c. Support of KEY Communities and Community Health

HOW does your organization actively support and strengthen your KEY communities? HOW do you identify KEY communities and determine areas of emphasis for organizational involvement and support? What are your KEY communities? HOW do your SENIOR LEADERS and your STAFF contribute to improving these communities and to building community health?

**Notes:**

N1. Societal responsibilities in areas critical to your organization also should be addressed in Strategy Development (Item 2.1) and in Process Management (Category 6). Key results, such as results of regulatory and legal compliance (including malpractice) and accreditation, should be reported as Governance and Social Responsibility Results (in Item 7.6).

N2. Public concerns (1.2a[2]) might include patient safety; cost; equitable and timely access to providers; emergence of new health care threats; and the handling of medical waste.

N3. Ethical behavior (1.2b) includes business, professional, health care practice, and patient rights issues. It also includes public accountability and disclosure of information about your organizational health care performance.

N4. Measures or indicators of ethical behavior (1.2b) might include the percentage of independent board

members, measures of relationships with stockholder and nonstockholder constituencies, and results of ethics reviews and audits.

N5. Actions to build community health (1.2c) are population-based services supporting the general health of your community. Such services might include health education programs, immunization programs, unique health services provided at a financial loss, population-screening programs (e.g., hypertension), safety program sponsorship, and indigent care. You should address these results of community health services in Item 7.6.

N6. In addition to actions to build community health, areas of community support appropriate for inclusion in 1.2c might include your efforts to strengthen local community services and education; the environment; and practices of trade, business, or professional associations.

N7. The health and safety of staff are not addressed in Item 1.2; you should address these staff factors in Item 5.3.

For additional description of this Item, see pages 42–43.

# 2 Strategic Planning (85 pts.)

The ***Strategic Planning*** Category examines HOW your organization develops STRATEGIC OBJECTIVES and ACTION PLANS. Also examined are HOW your chosen STRATEGIC OBJECTIVES and ACTION PLANS are deployed and HOW progress is measured.

## 2.1 Strategy Development (40 pts.)

**Approach-Deployment**

**Describe HOW your organization establishes its STRATEGIC OBJECTIVES, including HOW it enhances its PERFORMANCE relative to other organizations providing similar HEALTH CARE SERVICES, overall PERFORMANCE as a health care provider, and future success.**

Within your response, include answers to the following questions:

a. Strategy Development PROCESS

(1) What is your overall strategic planning PROCESS? What are the KEY steps? Who are the KEY participants? What are your short- and longer-term planning time horizons? HOW are these time horizons set? HOW does your strategic planning PROCESS address these time horizons?

(2) HOW do you ensure that strategic planning addresses the KEY factors listed below? HOW do you collect and analyze relevant data and information to address these factors as they relate to your strategic planning:

- your PATIENT, other CUSTOMER, and health care market needs, expectations, and opportunities
- your competitive environment, and/or your collaborative environment to conserve community resources and your capabilities relative to competitors
- technological and other KEY INNOVATIONS or changes that might affect your HEALTH CARE SERVICES and HOW you operate
- your strengths and weaknesses, including STAFF and other resources
- your opportunities to redirect resources to higher priority HEALTH CARE SERVICES or areas
- financial, societal and ethical, regulatory, and other potential risks
- changes in the local, regional, or national economic environment
- factors unique to your organization, including partner and supply chain needs, strengths, and weaknesses

b. STRATEGIC OBJECTIVES

(1) What are your KEY STRATEGIC OBJECTIVES and your timetable for accomplishing them? What are your most important GOALS for these STRATEGIC OBJECTIVES?

(2) HOW do your STRATEGIC OBJECTIVES address the challenges identified in response to P.2 in your Organizational Profile? HOW do you ensure that your STRATEGIC OBJECTIVES balance short- and longer-term challenges and opportunities? HOW do you ensure that your STRATEGIC OBJECTIVES balance the needs of PATIENTS and other KEY CUSTOMERS and STAKEHOLDERS?

**Notes:**

N1. "Strategy development" refers to your organization's approach (formal or informal) to preparing for the future. Strategy development might utilize various types of forecasts, projections, options, scenarios, and/or other approaches to envisioning the future for purposes of decision making and resource allocation.

N2. "Strategy" should be interpreted broadly. Strategy might be built around or lead to any or all of the following: new health care services and/or delivery processes and markets; revenue growth via various approaches, including acquisitions; and new partnerships and alliances. Strategy might be directed toward becoming a center for clinical and service excellence, a preferred provider, a research leader, or an integrated service provider.

N3. Strategies to address key challenges (2.1b[2]) might include access and locations; rapid response; customization; rapid innovation; ISO 9000:2000 registration; Web-based provider, patient, and other customer relationship management; and health care

service quality. Responses to Item 2.1 should focus on your specific challenges—those most important to your organizational success and to strengthening your organization's overall performance as a health care provider.

For additional description of this Item, see pages 43–44.

N4. Item 2.1 addresses your overall organizational strategy, which might include changes in health care services and programs. However, the Item does not address service and program design; you should address these factors in Item 6.1, as appropriate.

## 2.2 Strategy Deployment (45 pts.)

**Approach-Deployment**

**Describe HOW your organization converts its STRATEGIC OBJECTIVES into ACTION PLANS. Summarize your organization's ACTION PLANS and related KEY PERFORMANCE MEASURES or INDICATORS. Project your organization's future PERFORMANCE on these KEY PERFORMANCE MEASURES or INDICATORS.**

Within your response, include answers to the following questions:

a. ACTION PLAN Development and DEPLOYMENT

(1) HOW do you develop and deploy ACTION PLANS to achieve your KEY STRATEGIC OBJECTIVES? HOW do you allocate resources to ensure accomplishment of your ACTION PLANS? HOW do you ensure that the KEY changes resulting from ACTION PLANS can be sustained?

(2) What are your KEY short- and longer-term ACTION PLANS? What are the KEY changes, if any, in your HEALTH CARE SERVICES and programs, your CUSTOMERS and markets (including PATIENT populations), and HOW you will operate?

(3) What are your KEY staffing plans that derive from your short- and longer-term STRATEGIC OBJECTIVES and ACTION PLANS?

(4) What are your KEY PERFORMANCE MEASURES or INDICATORS for tracking progress on your ACTION PLANS? HOW do you ensure that your overall ACTION PLAN measurement system reinforces organizational ALIGNMENT? HOW do you ensure that the measurement system covers all KEY DEPLOYMENT areas and STAKEHOLDERS?

b. PERFORMANCE Projection

For the KEY PERFORMANCE MEASURES or INDICATORS identified in 2.2a(4), what are your PERFORMANCE PROJECTIONS for both your short- and longer-term planning time horizons? HOW does your projected PERFORMANCE compare with competitors' projected PERFORMANCE or other organizations providing similar HEALTH CARE SERVICES? HOW does it compare with KEY BENCHMARKS, GOALS, and past PERFORMANCE, as appropriate?

**Notes:**

N1. Strategy and action plan development and deployment are closely linked to other Items in the Criteria. Examples of key linkages are

- Item 1.1 for how your senior leaders set and communicate directions;
- Category 3 for gathering patient, other customer, and health care market knowledge as input to your strategy and action plans and for deploying action plans;
- Category 4 for measurement, analysis, and knowledge management to support your key information needs, to support your development of strategy, to provide an effective basis for your performance measurements, and to track progress relative to your strategic objectives and action plans;
- Category 5 for your work system needs; staff education, training, and development needs; and related human resource factors resulting from action plans;
- Category 6 for process requirements resulting from your action plans; and
- Item 7.5 for specific accomplishments relative to your organizational strategy and action plans.

N2. Measures and indicators of projected performance (2.2b) might include changes resulting from new ventures; acquisitions or mergers; health care market entry and shifts; and significant anticipated innovations in health care service delivery and technology.

For additional description of this Item, see pages 44–45.

# 3 Focus on Patients, Other Customers, and Markets (85 pts.)

The ***Focus on Patients, Other Customers, and Markets*** Category examines HOW your organization determines requirements, expectations, and preferences of PATIENTS, other CUSTOMERS, and markets. Also examined is HOW your organization builds relationships with PATIENTS and other CUSTOMERS and determines the KEY factors that lead to their acquisition, satisfaction, loyalty, and retention and to HEALTH CARE SERVICE expansion.

## 3.1 Patient, Other Customer, and Health Care Market Knowledge (40 pts.)

**Approach-Deployment**

**Describe HOW your organization determines requirements, expectations, and preferences of PATIENTS, other CUSTOMERS, and markets to ensure the continuing relevance of your HEALTH CARE SERVICES and to develop new HEALTH CARE SERVICE opportunities.**

Within your response, include answers to the following questions:

a. PATIENT/CUSTOMER and Health Care Market Knowledge

(1) HOW do you determine or target PATIENTS, other CUSTOMERS, CUSTOMER groups, and health care market segments? HOW do you include CUSTOMERS of competitors and other potential CUSTOMERS and markets in this determination?

(2) HOW do you listen and learn to determine KEY PATIENT/CUSTOMER requirements and expectations (including HEALTH CARE SERVICE features) and their relative importance to PATIENTS'/CUSTOMERS' health care purchasing decisions? HOW do determination methods vary for different PATIENTS/CUSTOMERS or CUSTOMER groups? HOW do you use relevant information from current and former PATIENTS/CUSTOMERS, including marketing information, PATIENT/CUSTOMER loyalty and retention data, win/loss ANALYSIS, and complaints? HOW do you use this information for PURPOSES of HEALTH CARE SERVICE planning, marketing, PROCESS improvements, and other business development?

(3) HOW do you keep your listening and learning methods current with HEALTH CARE SERVICE needs and directions?

**Notes:**

N1. Patients, as a key customer group, are frequently identified separately in the Criteria. Other customer groups could include patients' families, the community, insurers and other third-party payors, employers, health care providers, patient advocacy groups, Departments of Health, and students. Generic references to customers include patients.

N2. Your responses to this Item should include patients, other customer groups, and market segments identified in P.1b(2).

N3. "Health care service features" (3.1a[2]) refers to all the important characteristics of your health care services that patients and other customers receive. This includes all customers' overall interactions with you and their service experiences. The focus should be on features that affect customer health care-related preference and loyalty and the customers' view of clinical and service quality—for example, those features that differentiate your organization's services from other providers offering similar services. Beyond specific health care provision, those features might include factors such as extended hours, family support services, cost, assistance with billing/paperwork processes, and transportation assistance. Key health care service features and purchasing decisions (3.1a[2]) might take into account how transactions occur and factors such as confidentiality and security.

N4. The determination of health care service features and their relative importance (3.1a[2]) should take into account the potentially differing expectations of patients and other customers.

N5. Listening and learning (3.1a[2]) might include gathering and integrating surveys, focus group findings, Web-based data, and other data and information that bear upon health care purchasing decisions. Keeping your listening and learning methods current with health care service needs and directions (3.1a[3]) also might include use of newer technology, such as Web-based data gathering.

For additional description of this Item, see page 46.

## 3.2 Patient and Other Customer Relationships and Satisfaction (45 pts.)

**Approach-Deployment**

**Describe HOW your organization builds relationships to acquire, satisfy, and retain PATIENTS and other CUSTOMERS; to increase loyalty; and to develop new HEALTH CARE SERVICE opportunities. Describe also HOW your organization determines PATIENT and other CUSTOMER satisfaction.**

Within your response, include answers to the following questions:

a. PATIENT/CUSTOMER Relationship Building

(1) How do you build relationships to acquire PATIENTS and other CUSTOMERS, to meet and exceed their expectations, to increase loyalty and secure their future interactions with your organization, and to gain positive referrals?

(2) What are your KEY access mechanisms for PATIENTS and other CUSTOMERS to seek information, obtain services, and make complaints? How do you determine KEY contact requirements for each mode of PATIENT and other CUSTOMER access? How do you ensure that these contact requirements are deployed to all people and PROCESSES involved in the CUSTOMER response chain?

(3) What is your complaint management PROCESS? How do you ensure that complaints are resolved effectively and promptly? How are complaints aggregated and analyzed for use in improvement throughout your organization and by your partners?

(4) How do you keep your APPROACHES to building relationships and providing PATIENT/CUSTOMER access current with HEALTH CARE SERVICE needs and directions?

b. PATIENT/CUSTOMER Satisfaction Determination

(1) How do you determine PATIENT and other CUSTOMER satisfaction and dissatisfaction? How do these determination methods differ among PATIENT/CUSTOMER groups? How do you ensure that your measurements capture actionable information for use in exceeding your PATIENTS' and other CUSTOMERS' expectations, securing their future interactions with your organization, and gaining positive referrals? How do you use PATIENT and other CUSTOMER satisfaction and dissatisfaction information for improvement?

(2) How do you follow up with PATIENTS and other CUSTOMERS on HEALTH CARE SERVICES and transaction quality to receive prompt and actionable feedback?

(3) How do you obtain and use information on PATIENTS' and other CUSTOMERS' satisfaction relative to satisfaction with your competitors, other organizations providing similar HEALTH CARE SERVICES, and/or BENCHMARKS?

(4) How do you keep your APPROACHES to determining satisfaction current with HEALTH CARE SERVICE needs and directions?

**Notes:**

N1. Customer relationships (3.2a) might include the development of partnerships or alliances with customers.

N2. Determining patient and other customer satisfaction and dissatisfaction (3.2b) might include use of any or all of the following: surveys, formal and informal feedback, customer account histories, complaints, win/loss analysis, and information on timeliness of service delivery. Information might be gathered on the Internet, through personal contact or a third party, or by mail.

For additional description of this Item, see pages 46–47.

N3. Patient and other customer satisfaction measurements might include both a numerical rating scale and descriptors for each unit in the scale. Actionable satisfaction measurements provide useful information about specific service features, delivery, relationships, and transactions that bear upon the customers' future actions—choice of health care provider and positive referral.

N4. Your patient and other customer satisfaction and dissatisfaction results should be reported in Item 7.2.

# 4 Measurement, Analysis, and Knowledge Management (90 pts.)

The ***Measurement, Analysis, and Knowledge Management*** Category examines HOW your organization selects, gathers, analyzes, manages, and improves its data, information, and KNOWLEDGE ASSETS.

## 4.1 Measurement and Analysis of Organizational Performance (45 pts.)

**Approach-Deployment**

**Describe HOW your organization measures, analyzes, aligns, and improves PERFORMANCE data and information as a health care provider at all levels and in all parts of your organization.**

Within your response, include answers to the following questions:

a. PERFORMANCE Measurement

(1) HOW do you select, collect, align, and integrate data and information for tracking daily operations and for tracking overall organizational PERFORMANCE? HOW do you use these data and information to support organizational decision making and INNOVATION as a health care provider?

(2) HOW do you select and ensure the EFFECTIVE use of KEY comparative data and information to support operational and strategic decision making and INNOVATION?

(3) HOW do you keep your PERFORMANCE measurement system current with HEALTH CARE SERVICE needs and directions? HOW do you ensure that your PERFORMANCE measurement system is sensitive to rapid or unexpected organizational or external changes?

b. PERFORMANCE ANALYSIS

(1) What ANALYSES do you perform to support your SENIOR LEADERS' organizational PERFORMANCE review? What ANALYSES do you perform to support your organization's strategic planning?

(2) HOW do you communicate the RESULTS of organizational-level ANALYSES to work group and functional-level operations to enable EFFECTIVE support for their decision making?

**Notes:**

N1. Performance measurement is used in fact-based decision making for setting and aligning organizational directions and resource use at the work unit, key process, departmental, and whole organization levels.

N2. Comparative data and information sources (4.1a[2]) are obtained by benchmarking and by seeking competitive comparisons. "Benchmarking" refers to identifying processes and results that represent best practices and performance for similar activities, inside or outside the health care industry. Competitive comparisons relate your organization's performance to that of competitors and other organizations providing similar health care services. Comparative data might include data from similar organizations and health care industry benchmarks. Such data might be derived from surveys, published and public studies, participation in indicator programs, or other sources. These data may be drawn from local or national sources.

N3. Analysis includes examining trends; organizational, health care industry, and technology projections; and comparisons, cause-effect relationships, and correlations intended to support your performance reviews, help determine root causes, and help set priorities for resource use. Accordingly, analysis draws upon all types of data: patient and other customer-related, health care outcomes, financial and market, operational, and competitive/comparative.

N4. The results of organizational performance analysis should contribute to your senior leaders' organizational performance review in 1.1c and organizational strategic planning in Category 2.

N5. Your organizational performance results should be reported in Items 7.1–7.6.

For additional description of this Item, see pages 47–49.

## 4.2 Information and Knowledge Management (45 pts.)

**Approach-Deployment**

**Describe HOW your organization ensures the quality and availability of needed data and information for STAFF, suppliers and partners, and PATIENTS and other CUSTOMERS. Describe HOW your organization builds and manages its KNOWLEDGE ASSETS.**

Within your response, include answers to the following questions:

a. Data and Information Availability

(1) How do you make needed data and information available? How do you make them accessible to STAFF, suppliers and partners, and PATIENTS and other CUSTOMERS, as appropriate?

(2) How do you ensure that hardware and software are reliable, secure, and user friendly?

(3) How do you keep your data and information availability mechanisms, including your software and hardware systems, current with HEALTH CARE SERVICE needs and directions?

b. Organizational Knowledge

(1) How do you manage organizational knowledge to accomplish

- the collection and transfer of STAFF knowledge
- the transfer of relevant knowledge from PATIENTS and other CUSTOMERS, suppliers, and partners
- the identification and sharing of best practices

(2) How do you ensure the following properties of your data, information, and organizational knowledge:

- integrity
- timeliness
- reliability
- security
- accuracy
- confidentiality

**Notes:**

N1. Data and information availability (4.2a) are of growing importance as the Internet, electronic communication and information transfer, and e-business are used increasingly for provider, provider-to-patient/customer, and business-to-business interactions and as intranets become more important as a major source of organization-wide communications.

N2. Data and information access (4.2a[1]) might be via electronic and other means.

For additional description of this Item, see page 50.

# 5 Staff Focus (85 pts.)

The ***Staff Focus*** Category examines HOW your organization's WORK SYSTEMS and STAFF learning and motivation enable all STAFF to develop and utilize their full potential in ALIGNMENT with your organization's overall objectives and ACTION PLANS. Also examined are your organization's efforts to build and maintain a work environment and STAFF support climate conducive to PERFORMANCE EXCELLENCE and to personal and organizational growth.

## 5.1 Work Systems (35 pts.)

**Approach-Deployment**

**Describe HOW your organization's work and jobs enable all STAFF and the organization to achieve HIGH PERFORMANCE. Describe HOW compensation, career progression, and related workforce practices enable STAFF and the organization to achieve HIGH PERFORMANCE.**

Within your response, include answers to the following questions:

a. Organization and Management of Work

(1) How do you organize and manage work and jobs to promote cooperation, initiative, EMPOWERMENT, INNOVATION, and your organizational culture? How do you organize and manage work and jobs to achieve the agility to keep current with HEALTH CARE SERVICE needs?

(2) How do your WORK SYSTEMS capitalize on the diverse ideas, cultures, and thinking of your STAFF and the communities with which you interact (your STAFF recruitment and your PATIENT/CUSTOMER communities)?

(3) How do you achieve EFFECTIVE communication and skill sharing across health care professions, departments and work units, jobs, and locations?

b. Staff Performance Management System

How does your STAFF PERFORMANCE management system, including feedback to STAFF, support HIGH-PERFORMANCE WORK? How does your STAFF PERFORMANCE management system support a PATIENT/CUSTOMER and HEALTH CARE SERVICE focus? How do your compensation, recognition, and related reward and incentive practices reinforce HIGH-PERFORMANCE WORK and a PATIENT/CUSTOMER and HEALTH CARE SERVICE focus?

c. Recruitment and Career Progression

(1) How do you identify characteristics and skills needed by potential STAFF?

(2) How do you recruit, hire, and retain new STAFF? How do you ensure the STAFF members represent the diverse ideas, cultures, and thinking of your STAFF recruitment community?

(3) How do you accomplish EFFECTIVE succession planning for leadership and management positions, including senior administrative and health care leadership, as appropriate? How do you manage EFFECTIVE career progression for all STAFF throughout the organization?

**Notes:**

N1. "Staff" refers to all people who contribute to the delivery of your organization's services, including paid staff (e.g., permanent, temporary, and part-time personnel, as well as any contract employees supervised by your organization), independent practitioners (e.g., physicians, physician assistants, nurse practitioners, acupuncturists, and nutritionists not paid by the organization), volunteers, and health profession students (e.g., medical, nursing, and ancillary). Staff includes team leaders, supervisors, and managers at all levels. Contract employees supervised by a contractor should be addressed in Category 6.

N2. "Your organization's work" refers to how your staff are organized or organize themselves in formal and informal, temporary, or longer-term units. This might include work teams, process teams, project teams, patient/customer action teams, problem-solving teams, centers of excellence, functional units, remote (e.g., at-home) workers, cross-functional teams, and departments—self-managed or managed by supervisors.

"Jobs" refers to responsibilities, authorities, and tasks of individuals. In some work systems, jobs might be shared by a team.

N3. "Recruitment" refers to how potential staff are hired and brought into the organization. This includes paid staff, privileged staff, and volunteers.

N4. Compensation and recognition (5.1b) include promotions and bonuses that might be based upon

performance, skills acquired, and other factors. Recognition includes monetary and nonmonetary, formal and informal, and individual and group mechanisms. Recognition systems for volunteers and independent practitioners who contribute to the work of the organization should be included, as appropriate.

For additional description of this Item, see pages 50–51.

## 5.2 Staff Learning and Motivation (25 pts.)

**Approach-Deployment**

**Describe HOW your organization's STAFF education, training, and career development support the achievement of your overall objectives and contribute to HIGH PERFORMANCE. Describe HOW your organization's education, training, and career development build STAFF knowledge, skills, and capabilities.**

Within your response, include answers to the following questions:

a. STAFF Education, Training, and Development

(1) HOW do STAFF education and training contribute to the achievement of your ACTION PLANS? HOW do your STAFF education, training, and development address your KEY needs associated with organizational PERFORMANCE measurement, PERFORMANCE improvement, and technological change? HOW does your education and training APPROACH balance short- and longer-term organizational objectives with STAFF needs, including licensure and recredentialing requirements, development, learning, and career progression?

(2) HOW do STAFF education, training, and development address your KEY organizational needs associated with new STAFF orientation, diversity, ethical health care and business practices, and management and leadership development? HOW do STAFF education, training, and development address your KEY organizational needs associated with STAFF, workplace, and environmental safety?

(3) HOW do you seek and use input from STAFF and their supervisors and managers on education and training needs? HOW do you incorporate your organizational learning and KNOWLEDGE ASSETS into your education and training?

(4) HOW do you deliver education and training? HOW do you seek and use input from STAFF and their supervisors and managers on options for the delivery of education and training? HOW do you use both formal and informal delivery APPROACHES, including mentoring and other APPROACHES, as appropriate?

(5) HOW do you reinforce the use of new knowledge and skills on the job?

(6) HOW do you evaluate the effectiveness of education and training, taking into account individual and organizational PERFORMANCE?

b. Motivation and Career Development

HOW do you motivate STAFF to develop and utilize their full potential? HOW does your organization use formal and informal mechanisms to help STAFF attain job- and career-related development and learning objectives? HOW do managers and supervisors help STAFF attain job- and career-related development and learning objectives?

**Note:**

Education and training delivery (5.2a[4]) might occur inside or outside your organization and involve on-the-job, classroom, computer-based, distance learning, and other types of delivery (formal or informal).

For additional description of this Item, see pages 51–52.

## 5.3 Staff Well-Being and Satisfaction (25 pts.)

**Approach-Deployment**

**Describe HOW your organization maintains a work environment and STAFF support climate that contribute to the well-being, satisfaction, and motivation of all STAFF.**

Within your response, include answers to the following questions:

a. Work Environment

(1) HOW do you improve workplace health, safety, security, and ergonomics? HOW do STAFF take part in improving them? What are your PERFORMANCE MEASURES or targets for each of these KEY workplace factors? What are the significant differences in workplace factors and PERFORMANCE MEASURES or targets if different STAFF groups and work units have different work environments?

(2) HOW do you ensure workplace preparedness for emergencies or disasters? HOW do you seek to ensure HEALTH CARE SERVICE and business continuity for the benefit of your PATIENTS, other CUSTOMERS, and STAFF?

b. STAFF Support and Satisfaction

(1) HOW do you determine the KEY factors that affect STAFF well-being, satisfaction, and motivation? HOW are these factors segmented for a diverse workforce and for different categories and types of STAFF?

(2) HOW do you support your STAFF via services, benefits, and policies? HOW are these tailored to the needs of a diverse workforce and different categories and types of STAFF?

(3) What formal and informal assessment methods and MEASURES do you use to determine STAFF well-being, satisfaction, and motivation? HOW do these methods and MEASURES differ across a diverse workforce and different categories and types of STAFF? HOW do you use other INDICATORS, such as STAFF retention, absenteeism, grievances, safety, and PRODUCTIVITY, to assess and improve STAFF well-being, satisfaction, and motivation?

(4) HOW do you relate assessment findings to KEY organizational PERFORMANCE RESULTS to identify priorities for improving the work environment and STAFF support climate?

**Notes:**

N1. Specific factors that might affect your staff's well-being, satisfaction, and motivation (5.3b[1]) include effective staff problem or grievance resolution; safety factors; staff's views of management; staff training, development, and career opportunities; staff preparation for changes in technology or the work organization; the work environment and other work conditions; management's empowerment of staff; information sharing by management; workload; cooperation and teamwork; recognition; services and benefits; communications; job security; compensation; and equal opportunity.

N2. Approaches for staff support (5.3b[2]) might include providing counseling, career development and employability services, recreational or cultural activities, nonwork-related education, day care, job rotation or sharing, special leave for family responsibilities or community service, home safety training, flexible work hours and location, outplacement, and retirement benefits (including extended health care).

N3. Measures and indicators of well-being, satisfaction, and motivation (5.3b[3]) might include data on safety and absenteeism, the overall turnover rate, the turnover rate for patient/customer contact staff, staff members' charitable contributions, grievances, strikes, other job actions, insurance costs, workers' compensation claims, and results of surveys. Survey indicators of satisfaction might include staff knowledge of job roles, staff knowledge of organizational direction, and staff perception of empowerment and information sharing. Your results relative to such measures and indicators should be reported in Item 7.4.

N4. Identifying priorities (5.3b[4]) might draw upon your staff and work system results presented in Item 7.4 and might involve addressing staff problems based on their impact on your organizational performance.

For additional description of this Item, see pages 52–53.

# 6 Process Management (85 pts.)

The ***Process Management*** Category examines the KEY aspects of your organization's PROCESS management, including KEY health care, business, and other support PROCESSES for creating VALUE for PATIENTS, other CUSTOMERS, and the organization. This Category encompasses all KEY PROCESSES and all departments and work units.

## 6.1 Health Care Processes (50 pts.)

**Approach-Deployment**

**Describe HOW your organization identifies and manages its KEY PROCESSES for delivering PATIENT HEALTH CARE SERVICES.**

Within your response, include answers to the following questions:

a. Health Care PROCESSES

(1) HOW does your organization determine its KEY HEALTH CARE SERVICES and service delivery PROCESSES? What are your organization's KEY health care PROCESSES? HOW do these PROCESSES create VALUE for the organization, your PATIENTS and other CUSTOMERS, and your other KEY STAKEHOLDERS? HOW do they contribute to improved HEALTH CARE SERVICE outcomes?

(2) HOW do you determine KEY health care PROCESS requirements, incorporating input from PATIENTS and other CUSTOMERS, suppliers, and partners, as appropriate? What are the KEY requirements for these PROCESSES?

(3) HOW do you design these PROCESSES to meet all the KEY requirements, including PATIENT safety, regulatory, accreditation, and payor requirements? HOW do you incorporate new technology and organizational knowledge into the design of these PROCESSES? HOW do you incorporate improved health care outcomes, CYCLE TIME, PRODUCTIVITY, cost control, and other efficiency and effectiveness factors into the design of these PROCESSES? HOW do you implement these PROCESSES to ensure they meet design requirements?

(4) HOW are PATIENTS' expectations addressed and considered? HOW are HEALTH CARE SERVICE delivery PROCESSES and likely outcomes explained to set realistic PATIENT expectations? HOW are PATIENT decision making and PATIENT preferences factored into the delivery of HEALTH CARE SERVICES?

(5) HOW does your day-to-day operation of your health care PROCESSES ensure meeting KEY PROCESS requirements, including PATIENT safety, regulatory, accreditation, and payor requirements? What are your KEY PERFORMANCE assessments and MEASURES or INDICATORS used for the control and improvement of your health care PROCESSES? HOW are in-process MEASURES used in managing these PROCESSES? HOW is PATIENT and other CUSTOMER, supplier, and partner input used in managing your health care PROCESSES, as appropriate?

(6) HOW do you minimize overall costs associated with inspections, tests, and PROCESS or PERFORMANCE audits, as appropriate? HOW do you prevent errors and rework?

(7) HOW do you improve your health care PROCESSES to achieve better PERFORMANCE, to reduce variability, to improve HEALTH CARE SERVICES and health care outcomes, and to keep the PROCESSES current with HEALTH CARE SERVICE needs and directions? HOW are improvements shared with other organizational units and PROCESSES?

**Notes:**

N1. "Health care processes" refers to patient and community service processes for the purpose of prevention, maintenance, health promotion, screening, diagnosis, treatment/therapy, rehabilitation, recovery, palliative care, or supportive care. This includes services delivered to patients through other providers (e.g., laboratory or radiology studies). Responses to Item 6.1 should be based upon the most critical requirements for successful delivery of your services.

N2. Key processes for the conduct of health care research and/or a teaching mission should be reported in either Item 6.1 or 6.2, as appropriate to your organization's mission.

N3. Process requirements should include all appropriate components of health care service delivery. In a group practice, this might be the making of appointments, presentation, evaluation of risk factors, health education, and appointment closures. Depending upon the health care service, this might include a significant focus on technology and patient-specific considerations.

N4. To achieve better process performance and reduce variability, you might implement approaches such as the PDSA process, six sigma methodology, use of ISO 9000:2000 standards, or other process improvement tools.

N5. To provide as complete and concise a response as possible for your key health care processes, you might want to use a tabular format identifying the key processes and the attributes of each as called for in questions 6.1a(1)–6.1a(7). Depending on the structure of your health care staff, your response to Item 6.1 might deal with some aspects of health care provider services if there is a customer-supplier relationship.

Health care staff should still be addressed in Item 1.1 and Category 5.

N6. The results of improvements in health care outcomes and health care service performance should be reported in Item 7.1. The results of operational improvements in the performance of your key health care service design and delivery processes should be reported in Item 7.5.

For additional description of this Item, see pages 53–54.

## 6.2 Support Processes (35 pts.)

**Approach-Deployment**

**Describe HOW your organization manages its KEY business and other support PROCESSES.**

Within your response, include answers to the following questions:

a. Business and Other Support PROCESSES

(1) HOW does your organization determine its KEY business and other support PROCESSES? What are your KEY PROCESSES for supporting your health care PROCESSES?

(2) HOW do you determine KEY support PROCESS requirements, incorporating input from internal and external CUSTOMERS, and suppliers and partners, as appropriate? What are the KEY requirements for these PROCESSES?

(3) HOW do you design these PROCESSES to meet all the KEY requirements? HOW do you incorporate new technology and organizational knowledge into the design of these PROCESSES? HOW do you incorporate improved CYCLE TIME, PRODUCTIVITY, cost control, and other efficiency and effectiveness factors into the design of the PROCESSES? HOW do you implement these PROCESSES to ensure they meet design requirements?

(4) What are your KEY PERFORMANCE MEASURES OF INDICATORS used for the control and improvement of your support PROCESSES? HOW does your day-to-day operation of KEY support PROCESSES ensure meeting KEY PERFORMANCE requirements? HOW are in-process MEASURES used in managing these PROCESSES? HOW are PATIENT and other CUSTOMER, supplier, and partner input used in managing these PROCESSES, as appropriate?

(5) HOW do you minimize overall costs associated with inspections, tests, and PROCESS OF PERFORMANCE audits, as appropriate? HOW do you prevent errors and rework?

(6) HOW do you improve your support PROCESSES to achieve better PERFORMANCE, to reduce variability, and to keep the PROCESSES current with HEALTH CARE SERVICE needs and directions? HOW are improvements shared with other organizational units and PROCESSES?

**Notes:**

N1. Your key business processes are those non-health care service processes that are considered most important to business growth and success by your organization's senior leaders. These might include processes for innovation, technology acquisition, information and knowledge management, supply chain management, supplier partnering, outsourcing, mergers and acquisitions, project management, and sales and marketing. The key business processes to be included in Item 6.2 are distinctive to your organization and how you operate.

N2. Your other key support processes are those that are considered most important for support of your organization's health care service design and delivery processes, staff, and daily operations. These might include key patient support processes (e.g., housekeeping and medical records) and key administrative support processes (e.g., finance and accounting), facilities management, legal, human resource, and project management.

N3. The results of improvements in your key business and other support processes and their performance results should be reported in Item 7.5.

For additional description of this Item, see pages 54–55.

# 7 Organizational Performance Results (450 pts.)

The ***Organizational Performance Results*** Category examines your organization's performance and improvement in key areas—health care delivery and outcomes, patient and other customer satisfaction, financial and marketplace performance, staff and work system results, operational performance, and governance and social responsibility. Also examined are performance levels relative to those of competitors and other organizations providing similar health care services.

## 7.1 Health Care Results (75 pts.)

**Results**

**Summarize your organization's key health care performance results. Segment your results by customer groups and market segments, as appropriate. Include appropriate comparative data. Indicate those measures that are mandated by regulatory, accreditor, or payor requirements.**

Provide data and information to answer the following questions:

a. Health Care Results
What are your current levels and trends in key measures or indicators of health care outcomes, health care service delivery results, patient safety, and patients' functional status that are important to your patients and other customers? How do these results compare to the performance of your competitors and other organizations providing similar health care services?

**Notes:**

N1. Health care results reported in this Item should include the key health care service features identified as patient and other customer requirements or expectations in P.1b(2), based on information gathered in Items 3.1 and 3.2. The measures or indicators should address factors that affect patient and other customer preference, such as those included in P.1, Note 3, and Item 3.1, Note 3.

N2. Key health care results should be tailored to your organization and might include both mandated and nonmandated results.

For additional description of this Item, see page 55.

## 7.2 Patient- and Other Customer-Focused Results (75 pts.)

**Results**

**Summarize your organization's key patient- and other customer-focused results, including patient/customer satisfaction and patient/customer-perceived value. Segment your results by customer groups and market segments, as appropriate. Include appropriate comparative data.**

Provide data and information to answer the following questions:

a. Patient- and Other Customer-Focused Results
(1) What are your current levels and trends in key measures or indicators of patient and other customer satisfaction and dissatisfaction? How do these compare with satisfaction relative to competitors and other organizations providing similar health care services?

(2) What are your current levels and trends in key measures or indicators of patient- and other customer-perceived value, including patient and other customer loyalty and retention, positive referral, and other aspects of building relationships with patients and other customers, as appropriate?

**Notes:**

N1. Patient and other customer satisfaction and dissatisfaction results reported in this Item should relate to determination methods and data described in Item 3.2.

N2. There may be several different dimensions of patient satisfaction, such as satisfaction with quality of care, satisfaction with provider interaction, satisfaction with the long-term health outcome, and satisfaction with ancillary services. All of these areas are appropriate satisfaction indicators.

N3. Measures and indicators of your patients' and other customers' satisfaction relative to satisfaction with competitors or other organizations providing similar health care services might include objective information and data from your customers and from independent organizations.

For additional description of this Item, see page 56.

## 7.3 Financial and Market Results (75 pts.)

**Results**

**Summarize your organization's KEY financial and health care marketplace PERFORMANCE RESULTS by market segments, as appropriate. Include appropriate comparative data.**

Provide data and information to answer the following questions:

a. Financial and Market RESULTS
   (1) What are your current LEVELS and TRENDS in KEY MEASURES or INDICATORS of financial PERFORMANCE, including aggregate MEASURES of financial return and economic value, as appropriate?
   (2) What are your current LEVELS and TRENDS in KEY MEASURES or INDICATORS of health care marketplace PERFORMANCE, including market share or position, business growth, and new markets entered, as appropriate?

**Note:**

Responses to 7.3a(1) might include aggregate measures such as return on investment (ROI), asset utilization, operating margins, profitability (if relevant), profitability by market or customer segment, liquidity, debt to equity ratio, value added per staff member, bond ratings (if appropriate), and financial activity measures.

For additional description of this Item, see page 56.

## 7.4 Staff and Work System Results (75 pts.)

**Results**

**Summarize your organization's KEY STAFF and WORK SYSTEM RESULTS, including WORK SYSTEM PERFORMANCE and STAFF learning, development, well-being, and satisfaction. Segment your RESULTS to address the diversity of your workforce and the different types and categories of STAFF, as appropriate. Include appropriate comparative data.**

Provide data and information to answer the following questions:

a. STAFF and WORK SYSTEM RESULTS
   (1) What are your current LEVELS and TRENDS in KEY MEASURES or INDICATORS of WORK SYSTEM PERFORMANCE and effectiveness?
   (2) What are your current LEVELS and TRENDS in KEY MEASURES of STAFF learning and development?
   (3) What are your current LEVELS and TRENDS in KEY MEASURES or INDICATORS of STAFF well-being, satisfaction, and dissatisfaction?

**Notes:**

N1. Results reported in this Item should relate to activities described in Category 5. Your results should be responsive to key process needs described in Category 6 and to your organization's action plans and human resource plans described in Item 2.2.

N2. Appropriate measures and indicators of work system performance and effectiveness (7.4a[1]) might include job and job classification simplification, job rotation, work layout improvement, staff retention and internal promotion rates, and changing supervisory ratios.

N3. Appropriate measures and indicators of staff learning and development (7.4a[2]) might include innovation and suggestion rates, courses completed, learning, on-the-job performance improvements, credentialing, and cross-training rates.

N4. For appropriate measures of staff well-being and satisfaction (7.4a[3]), see Item 5.3, Notes.

For additional description of this Item, see pages 56–57.

## 7.5 Organizational Effectiveness Results (75 pts.)

**Results**

**Summarize your organization's KEY operational PERFORMANCE RESULTS that contribute to the achievement of organizational effectiveness. Segment your RESULTS by HEALTH CARE SERVICES and market segments, as appropriate. Include appropriate comparative data.**

Provide data and information to answer the following questions:

a. Organizational Effectiveness RESULTS

(1) What are your current LEVELS and TRENDS in KEY MEASURES or INDICATORS of the operational PERFORMANCE of your KEY health care PROCESSES? Include PRODUCTIVITY, CYCLE TIME, supplier and partner PERFORMANCE, and other appropriate MEASURES of effectiveness and efficiency.

(2) What are your current LEVELS and TRENDS in KEY MEASURES or INDICATORS of the operational PERFORMANCE of your KEY support and business PROCESSES? Include PRODUCTIVITY, CYCLE TIME, supplier and partner PERFORMANCE, and other appropriate MEASURES of effectiveness and efficiency.

(3) What are your RESULTS for KEY MEASURES or INDICATORS of accomplishment of organizational strategy and ACTION PLANS?

**Notes:**

N1. Results reported in Item 7.5 should address your key operational requirements and progress toward accomplishment of your key organizational performance goals as presented in the Organizational Profile and in Items 1.1, 2.2, 6.1, and 6.2. Include results not reported in Items 7.1–7.4.

N2. Results reported in Item 7.5 should provide key information for analysis (Item 4.1) and review of your organizational performance (Item 1.1) and should provide the operational basis for health care results (Item 7.1), patient- and other customer-focused results (Item 7.2), and financial and market results (Item 7.3).

For additional description of this Item, see page 57.

## 7.6 Governance and Social Responsibility Results (75 pts.)

**Results**

**Summarize your organization's KEY GOVERNANCE and social responsibility RESULTS, including evidence of fiscal accountability, ethical behavior, legal compliance, and organizational citizenship. Segment your RESULTS by organizational units, as appropriate. Include appropriate comparative data.**

Provide data and information to answer the following questions:

a. GOVERNANCE and Social Responsibility RESULTS

(1) What are your KEY current findings and TRENDS in KEY MEASURES or INDICATORS of fiscal accountability, both internal and external, as appropriate?

(2) What are your RESULTS for KEY MEASURES or INDICATORS of ethical behavior and of STAKEHOLDER trust in the GOVERNANCE of your organization?

(3) What are your RESULTS for KEY MEASURES or INDICATORS of organizational accreditation, assessment, and regulatory and legal compliance?

(4) What are your RESULTS for KEY MEASURES or INDICATORS of organizational citizenship in support of your KEY communities, including contributions to the health of your community?

**Notes:**

N1. Responses to 7.6a(1) might include financial statement issues and risks, important internal and external auditor recommendations, and management's response to these matters.

N2. For examples of measures of ethical behavior and stakeholder trust (7.6a[2]), see Note 2 to Item 1.2.

N3. Regulatory and legal compliance results (7.6a[3]) should address requirements described in 1.2a. If your organization has received sanctions or adverse actions under law (including malpractice), regulation, accreditation, or contract during the past three years, briefly describe the incident(s) and current status. If settlements have been negotiated in lieu of potential sanctions or adverse actions, give explanations.

N4. Organizational citizenship and community health results (7.6a[4]) should address support for the key communities discussed in 1.2c.

For additional description of this Item, see page 57.

**Comments**

- Results measures reported for work system performance might include improvement in job classification, job rotation, work layout, and working relationships among health care providers, administrators, and support staff. Results reported might include input data, such as extent of training, but the main emphasis should be on data that show effectiveness or outcomes.
- Results reported might include generic or organization-specific factors. Generic factors might include safety, absenteeism, turnover, satisfaction, and complaints (grievances). For some measures, such as absenteeism and turnover, local or regional comparisons might be appropriate.
- Organization-specific factors are those you assess for determining your work system performance and your staff's well-being and satisfaction. These factors might include the extent of training or cross-training or the extent and success of self-direction.

### *7.5 Organizational Effectiveness Results*

**Purpose**

This Item examines your organization's other key operational performance results not reported in Items 7.1–7.4, with the aim of achieving organizational effectiveness and attaining key organizational goals.

**Requirements**

You are asked to provide current levels, trends, and appropriate comparisons for key measures and indicators of operational and strategic performance that lead to your organization's effectiveness and the ongoing achievement of results reported in Items 7.1–7.4.

**Comments**

- This Item encourages your organization to develop and include unique and innovative measures to track health care service development and operational improvement. However, all key areas of health care service delivery and operational performance should be evaluated by measures that are relevant and important to your organization.
- Measures and indicators of operational effectiveness and efficiency might include internal responsiveness indicators such as cycle times and turnaround times; utilization rates; waste reduction such as reducing repeat diagnostic tests; cost reduction; strategic indicators such as innovation rates, time to new health care service introduction, and increased use of e-technology; supply chain indicators such as reductions in inventory, increases in quality and productivity such as six sigma initiative results, improvements in electronic data exchange, and reductions in supply chain management costs; and indicators of strategic goal achievement.

### *7.6 Governance and Social Responsibility Results*

**Purpose**

This Item examines your organization's key results in the area of societal responsibilities, with the aim of maintaining an ethical organization that is a good citizen in its communities.

**Requirements**

You are asked to provide data and information on key measures or indicators of organizational accountability, stakeholder trust, and ethical behavior.

You also are asked to provide data and information on your organization's regulatory, legal, and accreditation compliance and your citizenship and community health activities.

**Comments**

- Independent of an increased focus on issues of governance, ethics, and board and leadership accountability, it is important for organizations to practice and demonstrate high standards of overall conduct. Boards and senior leaders should track relevant performance measures on a regular basis and emphasize this performance in stakeholder communications.
- Results reported should include key accreditation and regulatory review findings, patient safety data, staff licensure and recredentialing determinations, external audits, proficiency testing results, and utilization review results, as appropriate.
- Measures should include environmental and regulatory compliance and noteworthy achievements in these areas, as appropriate. Results also should include indicators of support for key communities and other public purposes, including contributions to improving community health.
- If your organization has received sanctions or adverse actions under law (including malpractice), regulation, accreditation, or contract during the past three years, the incidents and current status should be summarized.

## Scoring System

The scoring of responses to Criteria Items (Items) and Award applicant feedback are based on three evaluation dimensions: (1) Approach, (2) Deployment, and (3) Results. Criteria users need to furnish information relating to these dimensions. Specific factors for these dimensions are described below. Scoring Guidelines are given on page 59.

### Approach

"Approach" refers to how you address the Item requirements—the *method(s)* used. The factors used to evaluate approaches include

- the appropriateness of the methods to the requirements
- the effectiveness of use of the methods and the degree to which the approach
  - is repeatable, integrated, and consistently applied
  - embodies evaluation/improvement/learning cycles
  - is based on reliable information and data
- alignment with your organizational needs
- evidence of beneficial innovation and change

### Deployment

"Deployment" refers to the *extent* to which your approach is applied. The factors used to evaluate deployment include

- use of the approach in addressing Item requirements relevant and important to your organization
- use of the approach by all appropriate work units

### Results

"Results" refers to *outcomes* in achieving the purposes given in Items 7.1–7.6. The factors used to evaluate results include

- your current performance
- your performance relative to appropriate comparisons and/or benchmarks
- rate and breadth of your performance improvements
- linkage of your results measures to important patient/customer, health care, market, process, and action plan performance requirements identified in your Organizational Profile and in Approach-Deployment Items

### Item Classification and Scoring Dimensions

Items are classified according to the kinds of information and/or data you are expected to furnish relative to the three evaluation dimensions given above.

The two types of Items and their designations are

1. Approach-Deployment — **Approach-Deployment**
2. Results — **Results**

Approach and Deployment are linked to emphasize that descriptions of Approach should always indicate the Deployment—consistent with the *specific requirements* of the Item. Although Approach and Deployment dimensions are linked, feedback to Award applicants reflects strengths and/or opportunities for improvement in either or both dimensions.

Results Items call for data showing performance levels, relevant comparative data, and improvement trends for key measures and indicators of organizational performance. Results Items also call for data on breadth of performance improvements, i.e., on how widespread your improvement results are. This is directly related to the deployment dimension; if improvement processes are widely deployed, there should be corresponding results. A score for a Results Item is thus a composite based upon overall performance, taking into account the rate and breadth of improvements and their importance. (See next paragraph.)

### "Importance" as a Scoring Factor

The three evaluation dimensions described previously are critical to evaluation and feedback. However, another critical consideration in evaluation and feedback is the importance of your reported Approach, Deployment, and Results to your key business factors. The areas of greatest importance should be identified in your Organizational Profile and in Items such as 2.1, 2.2, 3.1, 5.1, and 6.1. Your key patient/customer requirements, competitive environment, key strategic objectives, and action plans are particularly important.

### Assignment of Scores to Your Responses

The following guidelines should be observed in assigning scores to your Item responses:

- All Areas to Address should be included in your Item response. Also, responses should reflect what is important to your organization.
- In assigning a score to an Item, first decide which scoring range (e.g., 50 percent to 60 percent) best fits the overall Item response. Overall "best fit" does not require total agreement with each of the statements for that scoring range. Assigning the actual score *within* the range requires evaluating whether the Item response is closer to the statements in the next higher or next lower scoring range.
- An Approach-Deployment Item score of 50 percent represents an approach that meets the overall objectives of the Item and that is deployed to the principal processes and work units covered in the Item. Higher scores reflect maturity (organizational learning), integration, and broader deployment.
- A Results Item score of 50 percent represents a clear indication of improvement trends and/or good levels of performance in the principal results areas covered in the Item. Higher scores reflect better improvement rates and/or levels of performance, better comparative performance, and broader coverage and integration with health care requirements.

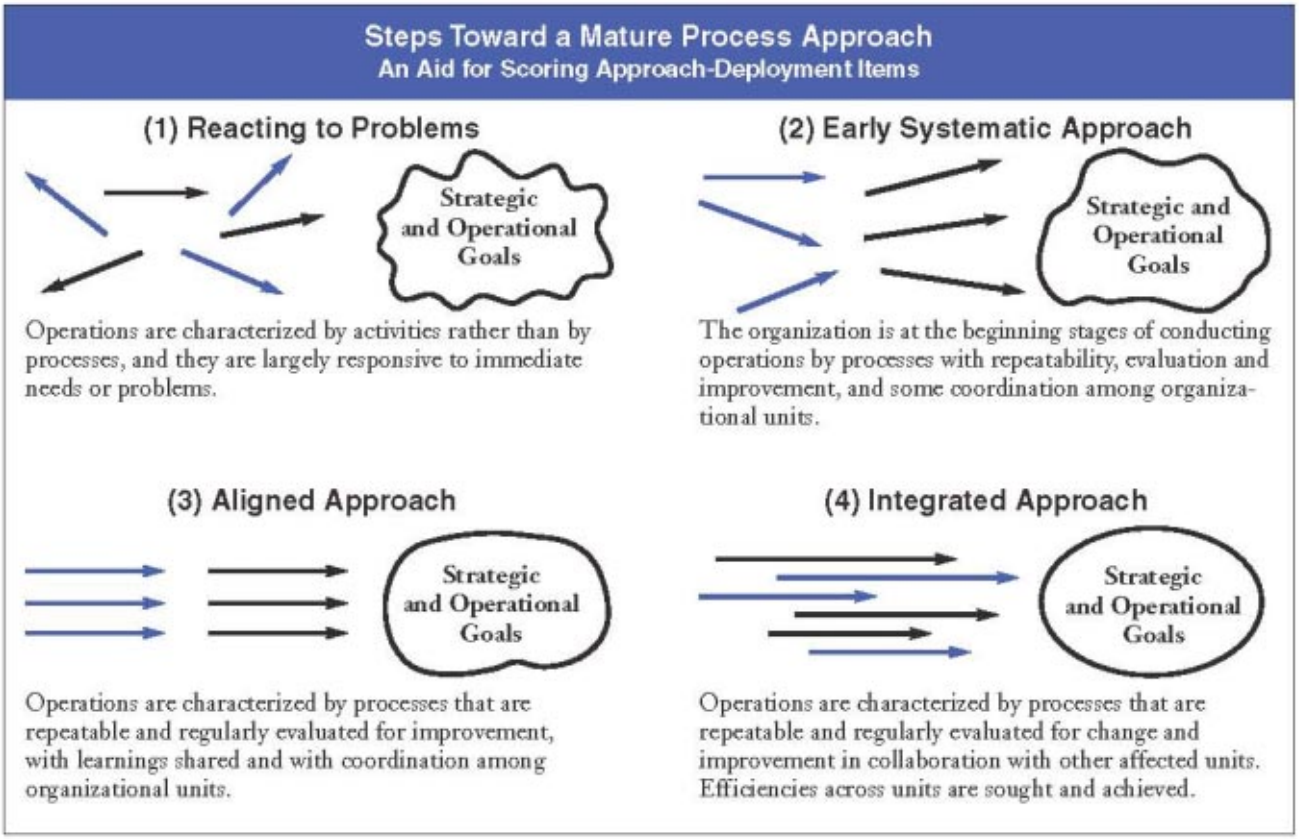
## Scoring Guidelines

**For Use With Categories 1–6**

| SCORE | APPROACH-DEPLOYMENT |
|---|---|
| 0% | ■ No SYSTEMATIC APPROACH is evident; information is ANECDOTAL. |
| 10% to 20% | ■ The beginning of a SYSTEMATIC APPROACH to the BASIC REQUIREMENTS of the Item is evident.<br>■ Major gaps exist in DEPLOYMENT that would inhibit progress in achieving the BASIC REQUIREMENTS of the Item.<br>■ Early stages of a transition from reacting to problems to a general improvement orientation are evident. |
| 30% to 40% | ■ An EFFECTIVE, SYSTEMATIC APPROACH, responsive to the BASIC REQUIREMENTS of the Item, is evident.<br>■ The APPROACH is deployed, although some areas or work units are in early stages of DEPLOYMENT.<br>■ The beginning of a SYSTEMATIC APPROACH to evaluation and improvement of KEY PROCESSES is evident. |
| 50% to 60% | ■ An EFFECTIVE, SYSTEMATIC APPROACH, responsive to the OVERALL REQUIREMENTS of the Item and your KEY organizational requirements, is evident.<br>■ The APPROACH is well deployed, although DEPLOYMENT may vary in some areas or work units.<br>■ A fact-based, SYSTEMATIC evaluation and improvement PROCESS is in place for improving the efficiency and effectiveness of KEY PROCESSES.<br>■ The APPROACH is aligned with your basic organizational needs identified in the other Criteria Categories. |
| 70% to 80% | ■ An EFFECTIVE, SYSTEMATIC APPROACH, responsive to the MULTIPLE REQUIREMENTS of the Item and your current and changing health care needs, is evident.<br>■ The APPROACH is well deployed, with no significant gaps.<br>■ A fact-based, SYSTEMATIC evaluation and improvement PROCESS and organizational learning/sharing are KEY management tools; there is clear evidence of refinement, INNOVATION, and improved INTEGRATION as a result of organizational-level ANALYSIS and sharing.<br>■ The APPROACH is well integrated with your organizational needs identified in the other Criteria Categories. |
| 90% to 100% | ■ An EFFECTIVE, SYSTEMATIC APPROACH, fully responsive to all the requirements of the Item and all your current and changing health care needs, is evident.<br>■ The APPROACH is fully deployed without significant weaknesses or gaps in any areas or work units.<br>■ A very strong, fact-based, SYSTEMATIC evaluation and improvement PROCESS and extensive organizational learning/sharing are KEY management tools; strong refinement, INNOVATION, and INTEGRATION, backed by excellent organizational-level ANALYSIS and sharing, are evident.<br>■ The APPROACH is fully integrated with your organizational needs identified in the other Criteria Categories. |

**For Use With Category 7**

| SCORE | RESULTS |
|---|---|
| 0% | ■ There are no organizational RESULTS or poor RESULTS in areas reported. |
| 10% to 20% | ■ There are some improvements *and/or* early good PERFORMANCE LEVELS in a few areas.<br>■ RESULTS are not reported for many to most areas of importance to your KEY organizational requirements. |
| 30% to 40% | ■ Improvements *and/or* good PERFORMANCE LEVELS are reported in many areas of importance to your KEY organizational requirements.<br>■ Early stages of developing TRENDS and obtaining comparative information are evident.<br>■ RESULTS are reported for many to most areas of importance to your KEY organizational requirements. |
| 50% to 60% | ■ Improvement TRENDS *and/or* good PERFORMANCE LEVELS are reported for most areas of importance to your KEY organizational requirements.<br>■ No pattern of adverse TRENDS and no poor PERFORMANCE LEVELS are evident in areas of importance to your KEY organizational requirements.<br>■ Some TRENDS *and/or* current PERFORMANCE LEVELS—evaluated against relevant comparisons *and/or* BENCHMARKS—show areas of strength *and/or* good to very good relative PERFORMANCE LEVELS.<br>■ Organizational performance RESULTS address most KEY CUSTOMER, market, and PROCESS requirements. |
| 70% to 80% | ■ Current PERFORMANCE is good to excellent in areas of importance to your KEY organizational requirements.<br>■ Most improvement TRENDS *and/or* current PERFORMANCE LEVELS are sustained.<br>■ Many to most TRENDS *and/or* current PERFORMANCE LEVELS—evaluated against relevant comparisons *and/or* BENCHMARKS—show areas of leadership and very good relative PERFORMANCE LEVELS.<br>■ Organizational performance RESULTS address most KEY CUSTOMER, market, PROCESS, and ACTION PLAN requirements. |
| 90% to 100% | ■ Current PERFORMANCE is excellent in most areas of importance to your KEY organizational requirements.<br>■ Excellent improvement TRENDS *and/or* sustained excellent PERFORMANCE LEVELS are reported in most areas.<br>■ Evidence of health care sector and BENCHMARK leadership is demonstrated in many areas.<br>■ Organizational performance RESULTS fully address KEY CUSTOMER, market, PROCESS, and ACTION PLAN requirements. |


Steps Toward a Mature Process Approach
An Aid for Scoring Approach-Deployment Items
(1) Reacting to Problems
Strategic and Operational Goals
Operations are characterized by activities rather than by processes, and they are largely responsive to immediate needs or problems.
(2) Early Systematic Approach
Strategic and Operational Goals
The organization is at the beginning stages of conducting operations by processes with repeatability, evaluation and improvement, and some coordination among organizational units.
(3) Aligned Approach
Strategic and Operational Goals
Operations are characterized by processes that are repeatable and regularly evaluated for improvement, with learnings shared and with coordination among organizational units.
(4) Integrated Approach
Strategic and Operational Goals
Operations are characterized by processes that are repeatable and regularly evaluated for change and improvement in collaboration with other affected units. Efficiencies across units are sought and achieved.

## 2003 Health Care Criteria Response Guidelines

The guidelines given in this section are offered to assist Criteria users in responding most effectively to the requirements of the 19 Criteria Items. Writing an application for the Baldrige Award involves responding to these requirements in 50 or fewer pages.

The guidelines are presented in three parts:

(1) General Guidelines regarding the Criteria booklet, including how the Items are formatted

(2) Guidelines for Responding to Approach-Deployment Items

(3) Guidelines for Responding to Results Items

### General Guidelines

**1. Read the entire Criteria booklet.**

The main sections of the booklet provide an overall orientation to the Criteria, including how responses are to be evaluated for self-assessment or by Award Examiners. You should become thoroughly familiar with the following sections:

- Health Care Criteria for Performance Excellence (pages 14–34)
- Scoring information (pages 58–60)
- Glossary of Key Terms (pages 35–41)
- Category and Item Descriptions (pages 42–57)

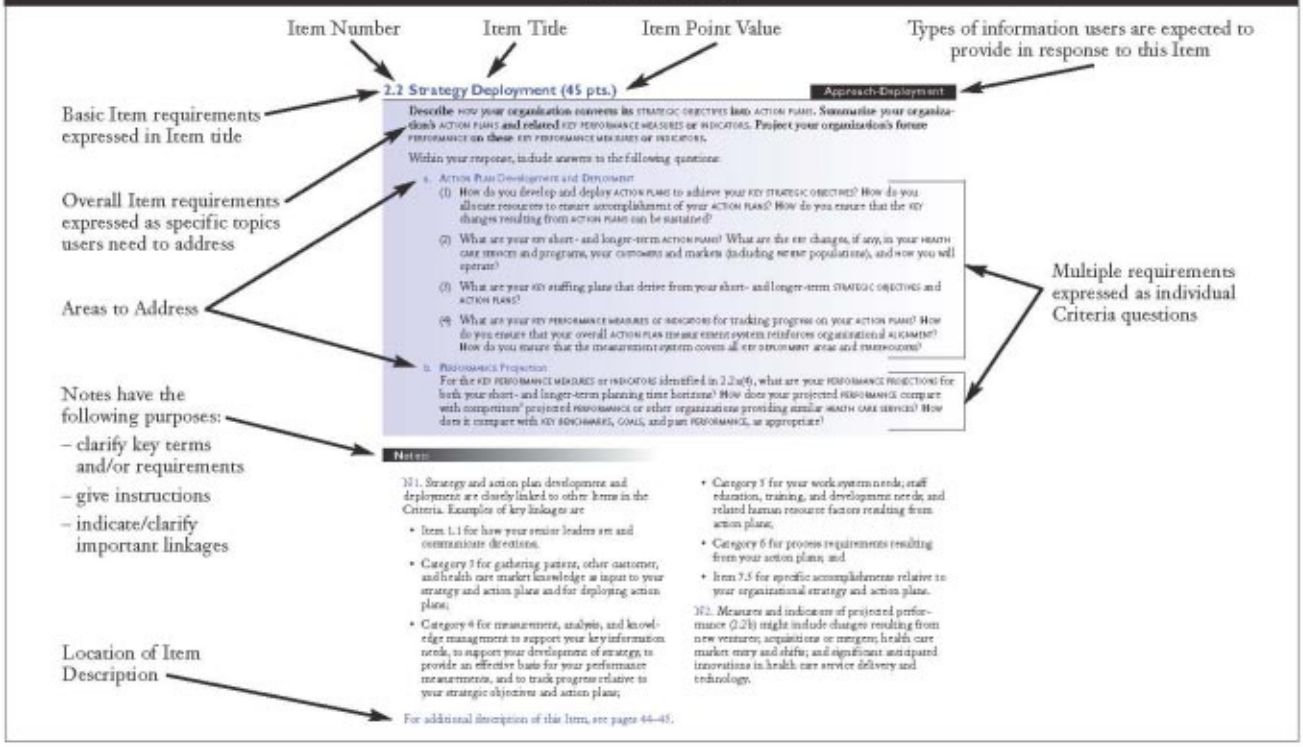
**2. Review the Item format and understand how to respond to the Item requirements.**

The Item format (see figure below) shows the different parts of Items, the role of each part, and where each part is placed. It is especially important to understand the Areas to Address and the Item Notes. Each Item and Area to Address is described in greater detail in a separate section (pages 42–57).

Each Item is classified either **Approach-Deployment** or **Results**, depending on the type of information required. Guidelines for responding to Approach-Deployment Items are given on pages 62–63. Guidelines for responding to Results Items are given on pages 63–64.

Item requirements are presented in question format. Some Areas to Address include multiple questions. Responses to an Item should contain answers to all questions; however, each question need not be answered separately. Responses to multiple questions within a single Area to Address may be grouped, as appropriate to your organization. These multiple questions serve as a guide in understanding the full meaning of the information being requested.

**Item Format**




61

**3. Start by preparing the Organizational Profile.**

The Organizational Profile is the most appropriate starting point for initiating a self-assessment or for writing an application. The Organizational Profile is intended to help everyone—including organizations using the Criteria for self-assessment, application writers, and reviewers—to understand what is most relevant and important to your organization's performance as a health care provider. The questions to address in responding to the Organizational Profile are on pages 14–16.

## Guidelines for Responding to Approach-Deployment Items

Although the Criteria focus on key performance results, these results by themselves offer little *diagnostic* value. For example, if some results are poor or are improving at rates slower than your competitors', it is important to understand *why* this is so and *what* might be done to accelerate improvement.

The purpose of Approach-Deployment Items is to permit diagnosis of your organization's most important processes—the ones that yield fast-paced organizational performance improvement and contribute to key organizational results. Diagnosis and feedback depend heavily on the content and completeness of Approach-Deployment Item responses. For this reason, it is important to respond to these Items by providing your key process information. Guidelines for organizing and reviewing such information follow.

**1. Understand the meaning of "how."**

Approach-Deployment Items include questions that begin with the word "how." *Responses should outline your key process information, such as methods, measures, deployment, and evaluation/improvement/learning factors.* Responses lacking such information, or merely providing an example, are referred to in the Scoring Guidelines as "anecdotal information."

**2. Understand the meaning of "what."**

Two types of questions in Approach-Deployment Items begin with the word "what." The first type of question requests basic information on key processes and how they work. Although it is helpful to include *who* performs the work, merely stating *who* does not permit diagnosis or feedback. The second type of question requests information on *what* your key findings, plans, objectives, goals, or measures are. These latter questions set the context for showing alignment and integration in your performance management system. For example, when you identify key strategic objectives, your action plans, human resource development plans, some of your results measures, and results reported in Category 7 should be expected to relate to the stated strategic objectives.

**3. Write and review response(s) with the following guidelines and comments in mind.**

- Show that processes are *systematic.*

  Approaches that are systematic are repeatable and use data and information so that improvement and learning are possible. In other words, approaches are systematic if they build in the opportunity for evaluation and learning and thereby permit a gain in maturity.

- Show deployment.

  Deployment information should summarize what is done in different parts of your organization. Deployment can be shown compactly by using tables.

- Show focus and consistency.

  There are four important factors to consider regarding focus and consistency: (1) the Organizational Profile should make clear what is important; (2) the Strategic Planning Category, including the strategic objectives and action plans, should highlight areas of greatest focus and describe how deployment is accomplished; (3) descriptions of organizational-level analysis and review (Items 4.1 and 1.1) should show how your organization analyzes and reviews performance information to set priorities; and (4) the Process Management Category should highlight processes that are key to your overall performance. *Showing focus and consistency in the Approach-Deployment Items and tracking corresponding measures in the Results Items should improve organizational performance.*

- Respond fully to Item requirements.

  Missing information will be interpreted as a gap in approach and/or deployment. All Areas to Address should be addressed. Individual questions in an Area to Address may be addressed individually or together.

**4. Cross-reference when appropriate.**

As much as possible, each Item response should be self-contained. However, responses to different Items might be mutually reinforcing. It is then appropriate to refer to the other responses rather than to repeat information. In such cases, key process information should be given in the Item requesting this information. For example, staff education and training should be described in detail in Item 5.2. Discussions about education and training elsewhere in your application would then reference but not repeat details given in your Item 5.2 response.

**5. Use a compact format.**

Applicants should make the best use of the 50 application pages permitted. Applicants are encouraged to use flowcharts, tables, and "bullets" to present information concisely.

6. **Refer to the Scoring Guidelines.**

   Considerations in the evaluation of Item responses include the Criteria Item requirements and the maturity of the approaches, breadth of deployment, alignment and integration with other elements of your performance management system, and strength of the improvement and learning processes relative to the Scoring Guidelines. Therefore, you need to consider both the Criteria and the Scoring Guidelines.

## Guidelines for Responding to Results Items

The Health Care Criteria place the greatest emphasis on results. The following information, guidelines, and example relate to effective and complete reporting of results.

1. **Focus on the most critical organizational performance results.**

   Results reported should cover the most important requirements for your organizational success, highlighted in your Organizational Profile and in the Strategic Planning and Process Management Categories.

2. **Note the meaning of the four key requirements from the Scoring Guidelines for effective reporting of results data:**

   - *trends* to show directions of results and rates of change
   - *performance* levels on a meaningful measurement scale
   - *comparisons* to show how results compare with those of other, appropriately selected organizations
   - *breadth and importance of results* to show that all important results are included and segmented, e.g., by patient/customer, staff, process, and health care service

3. **Include trend data covering actual periods for tracking trends.**

   No minimum period of time is specified for trend data. Trends might span five years or more for some results. For important results, new data should be included even if trends and comparisons are not yet well established.

4. **Use a compact format—graphs and tables.**

   Many results can be reported compactly by using graphs and tables. Graphs and tables should be labeled for easy interpretation. Results over time or compared with others should be "normalized," i.e., presented in a way (such as use of ratios) that takes into account various size factors. For example, reporting safety trends in terms of needle sticks per 100 staff members would be more meaningful than total needle sticks, if the staff size has varied over the time period or if you are comparing your results to organizations differing in size.

5. **Integrate results into the body of the text.**

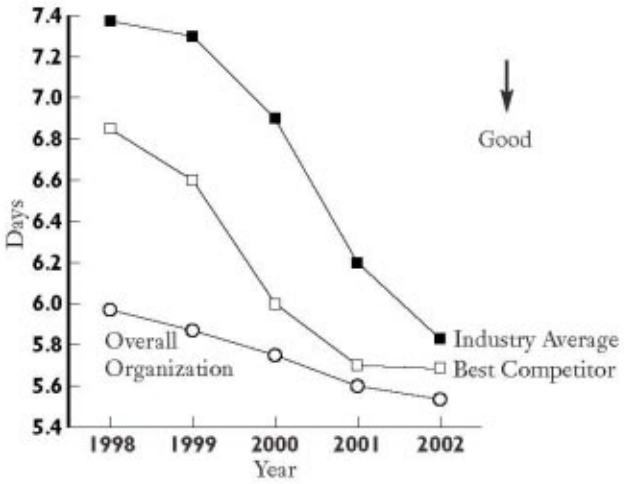
   Discussion of results and the results themselves should be close together in an Award application. *Trends that show a significant positive or negative change should be explained.* Use figure numbers that correspond to Items. For example, the third figure for Item 7.1 would be Figure 7.1-3. (See the example in the figure that follows.)

   The graph on page 64 illustrates data an organization might present as part of a response to Item 7.1, Health Care Results. In the Organizational Profile, the organization has indicated decreasing the average length of stay as a key customer requirement and an indicator of health care service delivery effectiveness.

   Using the graph, the following characteristics of clear and effective data reporting are illustrated:

   - A figure number is provided for reference to the graph in the text.
   - Both axes and units of measure are clearly labeled.
   - Trend lines report data for a key patient/customer requirement—average length of stay.

Figure 7.1-3 Average Length of Stay by Year




- Results are presented for several years.
- Appropriate comparisons are clearly shown.

To help interpret the Scoring Guidelines (page 59), the following comments on the graphed results would be appropriate:

- The current overall organizational performance level is excellent. This conclusion is supported by the comparison with the best competitor and with a health care industry average.
- The organization shows excellent improvement trends.

**6. Refer to the Scoring Guidelines.**

Considerations in the evaluation of Item responses include the Criteria Item requirements and the maturity of the results trends, actual performance levels, relevant comparative data, alignment with important elements of your performance management system, and strength of the improvement process relative to the Scoring Guidelines. Therefore, you need to consider both the Criteria and the Scoring Guidelines.

## ADDITIONAL RESOURCES

Baldrige National Quality Program – main website [Link]
Baldrige Criteria for Healthcare Criteria download page [Link]
NHTSA Guide to Quality Improvement of EMS Systems [Link]
Listing of State Level Quality Programs [Link]

# EMS Literaure Search Update: October-December 2003

There are thousands of medical journals published every month. Trying to stay abreast of the EMS related literature by scanning for pertinent articles can be a huge challenge. The EMS Literature Search Update searches all PubMed indexed journals for recently indexed articles pertinent to EMS – many of which are published outside the realm of the EMS and emergency medicine related journals that most EMS professionals are familiar with.

A search was conducted on December 10, 2003 using the PubMed medical literature search engine website at the National Library of Medicine. The Boolean search query string used for this search was: "*emergency medical services OR ambulance OR emergency medical technician OR paramedic OR medical transportation.*" The search results were then restricted to the 90 day period prior to the search using the "Entrez" section of the database. This returns items that were entered into PubMed in the last 90 days regardless of the date of publication. This search strategy yielded a total of 508 citations. The citations were manually reviewed to exclude those items that did not seem to bear significant relevance to EMS or were too specifically related to hospital issues on the basis of the title and journal in which it was published. This left the 209 citations listed below. Citations are listed in rough order starting from the most recent. To access any of these articles via PubMed, enter the PMID number in to the search box at the PubMed website (www.pubmed.gov), where links to the abstract, source document, source journal and reprint services may be available.

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*Citation:* EMS Literature Search Update: October-December 2003. 2004 Jan-Mar; *EMS Mgmnt J 1(1):117-127*
*Online Access:* http://www.emsmj.com/v1n1/search/default.htm

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