

Using Mini-Cases of Real-World Quick Analyses in Analytical Techniques Courses

Harold Abrams

University of Texas of the Permian Basin

ABSTRACT

Master of Public Administration (MPA) programs usually require students to complete one or two analytical techniques courses. Such courses often do not explore the application of specific techniques in real-world quick analyses conducted in the public sector to address a particular manager's decision problem in a relevant and timely manner (perhaps in only a few days). This article presents mini-cases of actual quick analysis for use in analytical techniques courses. It illustrates how such mini-cases can be used to show students the application and value of specific techniques for conducting practical quick analyses; and it demonstrates the importance of communicating findings from quick analyses in brief, practical ways understandable and useful to busy public sector managers.

KEYWORDS

Policy analysis, quantitative analysis courses, teaching with cases, quick analysis

Analytical techniques courses aim to equip and encourage public managers to make decisions about policies, practices, and procedures based on systematic analysis rather than on anecdotes and hunches alone. However, as noted by Patton and Sawicki (1993) in their *Basic Methods of Policy Analysis and Planning*, systematic analysis may be either quick analysis or researched analysis.

Quick analysis (sometimes called quick and dirty analysis) is frequently done by public agency analysts to promptly address specific decision needs and management questions of particular agency managers. Agency managers are often in effect clients who engage the services of analysts to shed light on the nature of a perceived problem and possibly on the range of potential solutions and their impacts (Behn, 1985; Patton

& Sawicki, 1993, pp. 26–29). To address the client's pressing problems, analysts are often asked to work within the constraints of limited time (perhaps only a few hours or a few days), data availability, and resources (Patton & Sawicki, 1993, pp. 2–6); they must often use methodological or analytical shortcuts (Leman & Nelson, 1981, pp. 103–104); and they frequently must communicate actionable information in brief documents (e.g., memos, summary displays) understandable to busy managers (Cook & Vaupel, 1985, p. 427; Leman & Nelson, 1981, p. 107).

In contrast, *researched analysis* is often done by university researchers over an extended period of time; it tends to employ fewer shortcuts; and it typically is communicated via formal monographs or peer-reviewed journal articles,

which tend to be written more for academics than busy managers (Jaworski, 2011, p. 214). Researched analyses may provide useful information for quick analyses to draw upon; however, researched analyses often do not address specific management questions with sufficient detail, clarity, or relevance (Behn, 1985, pp. 430–431; Jaworski, 2011).

Some Master of Public Administration (MPA) graduates will become analysts and will be asked to conduct quick analyses; many more MPA graduates will not be analysts but will be clients who will need to work with analysts (including shaping and reviewing the work of analysts who conduct quick analyses). As Howlett (2009) found in a survey study of policy analysts working in the Canadian provinces, most “worked on issues and problems that demand immediate attention (i.e., fire-fighting) on either a daily or weekly basis” (pp. 8–9); using basic techniques, analysts seemed to be “working in a client-advice style somewhat removed from the traditional style promoted by textbooks and policy schools” (p. 11). In other words, analysts usually do not have sufficient time or resources to conduct long-term research to address the pressing problems confronted by busy public managers. Thus, quick analysis is common practice in public agencies. This suggests the potential value of using quick analysis mini-cases in analytical techniques courses. However, as Horne (2008) found in a survey of 106 instructors from 90 MPA programs, few such courses illustrate the use of various methods in quick analyses, where the time horizon is short and data are limited.

The idea of using real-life examples in analytical techniques courses seems to be a common suggestion among instructors of such courses in MPA programs (Smith & Martinez-Moyano, 2012). In part, this view is stressed as a way to demonstrate to students the value of analytical techniques for public management.

Patton and Sawicki (1993) provide a set of cases that courses can use to help illustrate the

context of policy analysis. Many of the cases are particularly useful after students have been exposed to courses in economics, statistics and analytical techniques, organizational management, and public budgeting. However, such cases may not be easily usable in more focused analytical techniques courses (e.g., on statistical and research methods). For instance, if the instructor has covered regression analysis, a short case of an actual quick analysis involving regression might illustrate application in a real-world context. If the instructor has covered sampling, validity, and reliability, a short case of an actual quick analysis involving these concepts might be desirable. Conveying the real-world context means illustrating both conducting the technical analysis and communicating the results in a way (e.g., via summary displays, brief face-to-face explanations) that is understandable and useful to the busy manager who has engaged the services of the analyst.

This article presents three mini-cases of actual quick analysis derived from the experiences (1995–2008) of a manager of data analysis for a particular city’s emergency medical service (City EMS); City EMS is the 911 municipal ambulance response provider for that jurisdiction. These mini-cases (each 3–5 pages in length) involve actual instances of quick analysis that can be used in the classroom to convey real-world application of specific analytical techniques, and I also suggest how instructors themselves might develop mini-cases.

ANALYTICAL TECHNIQUES COURSES

MPA programs employ a range of approaches to train students in analytical techniques. According to Aristeguieta and Raffel (2001), MPA programs tend to emphasize one of three approaches:

- (a) management decision-making approach (e.g., policy analysis process, performance measurement, program evaluation, cost-benefit analysis, cost-effectiveness analysis);
- (b) management science approach (e.g., spreadsheet modeling, linear programming, network modeling, regression, queuing); or

- (c) research methods/statistics approach (e.g., hypothesis development and testing, causal designs, literature review, basic descriptive statistics, sampling, regression analysis).

It appears that MPA programs typically require one or two analytical technique courses (Roeder & Whitaker, 1993). It also seems that the research methods/statistics approach is the most frequently used but that some programs use the other approaches (Aristeguieta & Raffel, 2001; Horne, 2008).

This article does not evaluate which approach makes the most sense for training MPA students. Instead, I show that mini-cases involving quick analysis can be productively used in each of the three approaches to illustrate the practical application of various techniques. I have taught in two different programs with two different approaches. At one university, as a part-time visiting assistant professor, I taught a required analytical techniques course in an MPA program that emphasized the management decision-making approach. As a full-time faculty member at another university, I teach a required analytical techniques course in an MPA program that emphasizes the research methods/statistics approach.

MINI-CASE I: A QUESTION ABOUT THE APPROPRIATENESS OF THE TYPE OF UNIT DOING PATIENT TRANSPORT GIVEN THE SERIOUSNESS OF THE CASE

Clients. Medical director and his emergency medicine fellow

Problem. In mid-2005, the City EMS medical director and his emergency medicine fellow suddenly became concerned that Basic Life Support ambulance units (staffed by emergency medical technicians, or EMTs) were “very frequently” transporting certain patients (e.g., with serious cardiac disorders) where more highly trained Advanced Life Support ambulance units (staffed by paramedics) should have been doing the transport. The clients’ perception was fueled by their review of some patient-care reports completed by field personnel. The clients wanted advice on how to reduce the problem.

Assignment. Based on initial discussions with the clients, the manager of data analysis recommended quickly obtaining a more precise measure of the magnitude of the problem; he believed that City EMS could obtain clues about the nature of the problem, its extent, and what might be done to reduce the problem. The manager of data analysis recommended a systematic review of a random sample of cases where transport had been done by Basic Life Support units. It was important to proceed promptly because City EMS transports occurred under the general supervision (and medical license) of the medical director.

Background. In calendar year (CY) 2004, there were approximately 94,000 incidents; 29,000 involved no patient transport, 10,000 involved Advanced Life Support ambulance unit transport, and 55,000 involved Basic Life Support unit transport. This last group was the population of concern. Most Priority 1 incidents (e.g., cardiac disorders, shootings) by protocol required the dispatch of both Advanced Life Support and Basic Life Support ambulance units.

Quick Analysis. To obtain a more precise measure of the magnitude of the perceived problem, the manager of data analysis suggested that the medical director and three other clinical personnel conduct a case review of a random sample of 100 cases drawn from the 55,000 cases involving Basic Life Support unit transport in CY2004. Measures were taken to ensure that the 100-case sample was comparable to the 55,000 cases in terms of the distribution of incident priority level. The medical director, his emergency medicine fellow, the director of the City EMS training academy (a paramedic), and one of the academy training captains (an EMT) reviewed the clinical records and independently assessed whether or not Advanced Life Support unit transport should have occurred in each case in the sample. The 100-case sample fit the limited available time of these extremely busy people, but the manager of data analysis noted in a face-to-face discussion with the medical director that additional cases could be reviewed for a more reliable sample if time permitted. This addressed initial concerns

voiced by the medical director and his emergency medicine fellow about the relatively small sample size.

In about a month, the reviewers developed a file of 100 cases involving Basic Life Support unit transport that contained each reviewer's assessment of whether or not Advanced Life Support units should have done the transport given the condition of the patient. In 77% of the cases, the four reviewers unanimously agreed on whether Advanced Life Support transport should have occurred or was unnecessary.

In the statistical analysis, a case was counted as needing Advanced Life Support unit transport if at least three of the four reviewers believed it necessary. Using this standard, 88 (88%) of the 100 cases transported by Basic Life Support units were found not to have needed Advanced Life Support unit transport. This implied that of an average of 151 Basic Life Support unit transports per day, 133 did not clinically require Advanced Life Support unit transport: $(55,000 \div 365) \times 0.88 = 133$. However, City EMS strives for 100% perfection. So, about 12% of transports done by Basic Life Support units (or 18 transports per day) should have involved Advanced Life Support unit transport. What could be done to head toward 100% perfection?

Review of the 12 flagged cases was instructive:

- As of dispatch, 5 of these cases did not have a call type requiring dispatch of Advanced Life Support or paramedic units i.e., based on information provided by the callers, the City EMS call taker classified the incident as one not requiring paramedic response, so no paramedic unit was sent).
- In 4 of these cases, both Basic Life Support units and Advanced Life Support units were at the scene (paramedics should have followed protocols and transported but did not).
- In 1 case, there was the dispatch of a Basic Life Support unit and no dispatch of an Advanced Life Support unit, even though the call type as of dispatch required the dispatch of the latter such unit.

- As of dispatch, 1 case was classified as a cardiac disorder incident, and both Advanced Life Support and Basic Life Support units were dispatched, but only the latter unit reported arriving at the scene.
- In 1 case, to simplify this summary, another situation was involved that does not neatly fall into the previous categories.

The third and possibly fourth situations above (representing 2 cases total) are consistent with not having an available, nearby Advanced Life Support unit to send to the incident due to shortage in the supply of such units. The first two situations, which account for 9 of the 12 cases flagged, are more consistent with issues in program implementation. In the set of 5 cases, there was a question about whether or not the City EMS dispatch center had followed protocols regarding the assignment of call type and priority for purposes of assigning units. In the set of 4 cases, there was a question about Advanced Life Support unit compliance with City EMS clinical protocols regarding patient transport.

Recommendations. The manager of data analysis provided a two-page summary of this quick study's results and recommended next steps to address the problems found (see the Appendix). He recommended that paramedics be reminded about the protocols for patient transport and that either the medical director's office or the superintendent of dispatch operations review the tapes of the several cases where call type assigned at dispatch did not match the seriousness of what field personnel found at the scene. This latter review might suggest ways to modify call-triaging protocols or might identify a need to reinforce certain existing protocols with the City EMS dispatch center personnel.

Initially, the medical director and his emergency medicine fellow wondered if more cases needed to be reviewed so that the sample size was more "appropriate." The manager of data analysis explained the consequences of delaying action in practical terms understandable to the busy clients. He indicated in face-to-face discussions that the 12% estimate from a random sample

of 100 is “good” within plus or minus 7 percentage points (with 85% confidence); and that this implies that the actual number of problem incidents could well be as low as 7 per day ($[5\% \div 12\%] \times 18$) or as high as 29 per day ($[19\% \div 12\%] \times 18$). Reviewing another 100 cases (for a total sample of 200 cases) would yield an estimate that would be “good” within plus or minus 5 percentage points. However, waiting to take action could well mean that at least 7 cases per day would be transported by Basic Life Support units when Advanced Life Support units should be conducting the transport.

Aftermath. The medical director took decisive action along the lines recommended in the summary provided to him. He issued a memo to all paramedics reminding them about the protocols for transport (including saying that while protocols were usually being followed, sometimes they were not). He also asked the City EMS dispatch center to review the tapes for the several cases where the call type assigned as of dispatch did not match the seriousness of what was found at the scene. The idea was to check the degree of compliance with call-triaging protocols and to provide corrective feedback to dispatch center personnel if necessary.

Comments on Using This Mini-Case. This mini-case essentially involves a program audit that relies on review of a random sample of cases drawn from the relevant population of concern. The instructor might ask students what other situations would benefit such a study (e.g., review of a sample of children in foster care institutions to determine how many should be in less restrictive settings, such as group homes or foster homes, etc.).

This mini-case would be appropriate for a research methods/statistics-oriented course because it deals with issues such as sampling and reliability of measurement. In addition, this mini-case illustrates how an analyst needs to present statistical concepts in brief, practical terms understandable to busy decision makers. There was no detailed explanation about confidence intervals or Type 1 and Type 2 errors. Instead, the manager of data analysis presented

the benefits of delaying action to obtain a larger sample versus the benefits of acting based on the smaller sample already completed.

The instructor might want to ask students what some of the positives of this quick survey study were; he or she might also want to ask students about ways to improve this study. For instance, should more reviewers have been used to cover a larger sample? How would this have complicated the analysis, but what might have been gained? Also, students might be asked about whether City EMS should have done a follow-up review of a new sample of cases to assess the impact of corrective actions taken. If so, what might be an appropriate, feasible research design? For instance, in quick analysis mode, one might aim to examine the percentage of cases appropriately handled before the intervention versus after the intervention (perhaps accounting for a few potentially confounding influences such as the percentage of incidents classified as Priority 1 during the before versus the after time period).

MINI-CASE II: DECLINE IN THE NUMBER OF PATIENT TRANSPORTS BILLED AT CITY EMS

Clients. Chief of department and director of administration

Problem. The number of City EMS patient transports billed suddenly declined. This meant less revenue for agency operations. From fiscal year (FY) 1997 to FY2000, the annual number of patient transports billed increased each year (from 60,259 in FY1997 to 64,736 in FY2000). However, In FY2001, the number of patient transports billed unexpectedly decreased to 63,841.

Assignment. The manager of data analysis was given 2 days to identify why the decline occurred and what might be done about it.

Background. Like most municipal ambulance systems, City EMS relies significantly on revenues from third-party insurance payers (e.g., Medicaid, Medicare, private insurance). City EMS received approximately \$375 per patient

transport billed; and on average, at the time of this case, over 70% of City EMS revenues were generated from billings for transported patients (payers cannot be billed if there is no patient transport; this is true even if an ambulance crew arrives at the scene, assesses the patient, but the patient decides not to be transported).

To simplify a bit, the process leading to a billed patient transport starts with the entering of an incident into the City EMS computerized dispatch system. Then comes the dispatching of one or more ambulances to the scene (only 1% of these incidents get cancelled prior to the dispatch of an ambulance), the arrival of the ambulance(s) at the scene, and patient transport to the hospital (about 65% of all incidents involve patient transport while the remainder do not because the patient refuses transport, or no patient is found at the scene, etc.). Then (at the time of the case) the ambulance crew manually writes a patient-care report that eventually, via daily mail pickup at City EMS stations, makes its way to City EMS headquarters and then the billing department of a major City Hospital (a nonprofit hospital distinct from City EMS). If the paperwork (i.e., patient-care report, or “run sheet”) is not done by the ambulance crew, or is not turned in by the ambulance unit, or does not get entered by the billing department at City Hospital, “paper leakage” occurs and billable patient transports are lost.

One other key facet centers on the number of patients transported. Of all incidents with at least one patient transported, the bulk involve the transport of exactly one patient (e.g., cardiac disorders, severe respiratory distress cases); occasionally, multiple patients are transported (e.g., some motor-vehicle accidents have multiple patients).

Quick Analysis. As a first cut, the manager of data analysis decided to use a simple multiplicative components model, or what is sometimes called the decomposition method (Herendeen, 1998; Li & Baker, 1996). In a nutshell, this involves expressing an outcome of interest as the product of two or more component factors. This approach is an example of what analysts often refer to as a back-of-the-envelope calculation or model (Patton & Sawicki, 1993, p. 154).

In this mini-case, for a fiscal year, the outcome variable of interest was the number of patient transports billed. The choice of component factors is a judgment call. However, as is often so in practice, it was ideal to have at least one component factor that could be affected by agency procedures and policies. Also, especially given the time frame for the analysis, data availability was a consideration. Data on the number of incidents and incident disposition (e.g., whether a patient transport occurred) were readily derivable from the City EMS management information system (MIS) generated from the City EMS computerized dispatch system; however, the City EMS systems (at the time) did not keep track of individual patients and could not produce figures on number of patients transported (the systems could produce figures on whether or not a transport occurred at various incidents). Data on the total number of patient transports billed by month were available from the City Hospital that handled the billing process for City EMS.

Using the background information provided and accounting for data availability, the manager of data analysis formulated the following multiplicative components model, or equation:

$$\text{Number of Patient Transports Billed} = \text{Number of Incidents} \times \frac{\text{Number of Incidents With 1 or More Patients Transported}}{\text{Number of Incidents}} \times \frac{\text{Number of Patient Transports Billed}}{\text{Number of Incidents With 1 or More Patients Transported}}$$

TABLE 1.
Transport Volume and Component Factors by Fiscal Year (1997–2001)

	(A)	=	(B)	×	(C)	×	(D)
	Number of Patient Transports Billed		Number of Incidents		$\frac{\text{Number of Incidents With 1 or More Patients Transported}}{\text{Number of Incidents}}$		$\frac{\text{Number of Patient Transports Billed}}{\text{Number of Incidents With 1 or More Patients Transported}}$
FY97	60,259	=	87,274	×	66.5%	×	1.038
FY98	62,352	=	91,935	×	65.3%	×	1.039
FY99	62,841	=	94,026	×	65.7%	×	1.017
FY00	64,736	=	97,600	×	65.4%	×	1.014
FY01	63,841	=	99,432	×	64.2%	×	1.000

One could collapse the first two component variables into simply the number of incidents with one or more patients transported. However, it is more useful for analysis purposes in this mini-case to maintain these as two distinct component variables. Notice that the units of measurement cancel and the equation is mathematically proper.

The number of patient transports billed came from City Hospital; data on the first two components came from the MIS derived from the City EMS computerized dispatch system; the third component combined data from both sources.

Table 1 presents the multiplicative components model and the data for each of 5 fiscal years. Notice that for each year the product of the three numbers on the right-hand side of the equation equals the number of patient transports billed (with tiny differences due to rounding of the values of the last two component variables). The variable, or component factor, in Column C is the percentage of all incidents that involved the transport of one or more patients; the variable, or component factor, in Column D is the average number of patient transports billed per incident with one or more patients transported. However, it is

important to lay out all factors that are rates with the appropriate numerator and denominator. Why? Because this is the best way to ensure that the units cancel and that the equation is mathematically proper. This is often done in engineering and physical science problems but applies to management analysis applications as well.

Table 1 shows the following about FY1997 through FY2001:

- (a) the number of incidents increased every year, and thus reduced incident load did not explain the decrease in patient transports in FY2001 (see Column B);
- (b) there was some decrease in the propensity to transport (see Column C); and
- (c) there was some decrease in the number billed per incident with one or more patients transported (see Column D).

The second finding above was important to know, but the last finding was the most startling. Why? For FY2001, the number billed per incident with one or more patients transported was exactly 1.000. This figure made no sense be-

cause it implied that every transported incident involved exactly one patient being transported. (When the manager of data analysis examined the figures for each month in FY2001, he found that half of the months had the rate of 0.99; this also made no sense.) Historically, City EMS had averaged about 1.03 patient transports billed per incident with one or more patients transported (see Column D of Table 1). If City EMS had maintained that rate in FY2001, the number of transports billed would have increased by over 1,000 relative to FY2000. In fact, the rates for FY1999 and FY2000 were also suspect, but the rate for FY2001 was blatantly a question.

The above suggested that City EMS was quite possibly facing some paper leakage. At the time, responding EMTs and paramedics completed paper patient-care reports, or run sheets. Billing proceeded from the information provided on those sheets. It appeared that, occasionally, run sheets may have been submitted by field personnel but may not have made it into the billing database, or they may have not been submitted from the field.

Recommendations. In a brief memo, the manager of data analysis presented the above findings (including Table 1) and recommended an audit to verify the extent of paper leakage. He also recommended continued monitoring of the propensity to transport.

Aftermath. City EMS conducted an audit according to guidelines later provided by the manager of data analysis. The audit found that the billing system was in fact missing about 3% of the run sheets (about 150 per month), as suggested by the above quick analysis. This meant that potentially about \$650,000 was lost in revenue for the fiscal year. However, the final amount was less than this. The reason was because during the audit, run sheets found in the City EMS filing cabinet system but not in the City Hospital billing system database were sent to City Hospital for processing.

About half of the apparent leakage was from run sheets not being submitted from the field; and only a handful of individuals from the field

were primarily responsible for this source of paper leakage.

In addition to representing lost revenue, the missing run sheets reflected a shortfall in perfectly meeting City EMS's pre-hospital medical record requirements. While the agency was 98.5% compliant from the field, it wanted 100.0% compliance.

As a result of the above analysis, City EMS instituted new operating procedures to ensure that all run sheets were submitted from the field and that they were incorporated into the billing system. In addition, there was administrative follow-up with the handful of individuals who, according to the audit, were disproportionately responsible for paper leakage from the field. During the second half of FY2002 and for all of FY2003, the ratio of the number of patient transports billed to the number of incidents with 1 or more patients transported increased to over 1.03, and City EMS patient transports billed began to increase once again as expected. A couple of years later, City EMS replaced its paper system and instituted a state-of-the-art paperless patient-care report system; this made field compliance easier and expanded the agency's capability to analyze the characteristics of the population it served.

Comments on Using This Mini-Case. This mini-case can be used to illustrate the practical use of a multiplicative components model for quick analysis of certain problems involving service volume over time.

To acquaint students with basic multiplicative component models, the instructor might assign part of Chapter 2 (pp. 22–38) of Herendeen's *Ecological numeracy* (1998). The book provides a nice introduction to the technique and illustrates its application to ecological topics such as volume of fuel use and level of carbon emissions over time. This extends the range of application beyond service volume alone.

The instructor might then ask students to consider other applications of multiplicative component models to management or policy questions that might be posed by agencies the

students work for or are interested in working for. For instance, if someone works for a public university concerned about enrollment levels, he or she might model the number of first-time freshmen as the product of two or more component factors. If someone works for a human services agency that runs day-treatment programs and is concerned about maintaining or increasing the number of care days provided, he or she might model the number of care days provided as the product of two or more component factors.

Ideally, the instructor might ask students to provide a components model, or equation, with actual figures and to determine how such information might be useful in at least raising questions about operations or policies at their agencies of interest.

Because management science-oriented courses often start with basic spreadsheet modeling, this mini-case may be especially suited for this approach. This mini-case may also be appropriate for courses in the management decision-making vein. Such courses often begin with a policy analysis framework, which includes the notion of problem definition and detailing. Detailing includes gathering and analyzing data to shed light on the nature of a problem and obtain clues about possible solutions; this mini-case does similarly, illustrating the use of a simple multiplicative components model to detail a perceived problem.

MINI-CASE III: CITY EMS RESPONSE TIME AND THE MASSACHUSETTS HEALTH CARE REFORM ACT (ROMNEYCARE)

Clients. Chief of department and his chief of staff

Problem. The initial version of Romneycare in early 2005 (which promoted universal health insurance coverage in Massachusetts prior to Obamacare) included reduced reimbursement for ambulance services. City EMS faced potentially losing over 25% of its annual revenue if the initial proposal remained intact. City EMS needed to present its case against budget cuts before both senior staff in the governor’s office

and the Massachusetts House Ways and Means Committee. The chief of department and his chief of staff thus needed a rigorous set of City EMS response time projections.

Assignment. The chief of department and his chief of staff gave the manager of data analysis 3 days to develop analytically plausible response time projections, along with a summary display, given various cuts in the City EMS annual budget. The data analysis unit was a one-person shop, had no elaborate mathematical model to work with, and was under a tight time constraint.

Background. Because this mini-case involves response time, or how long a patient waits for an ambulance to arrive at the scene, this is a queuing-type problem. To simplify quite a bit, queuing models attempt to relate waiting time prior to being served (e.g., to pay a toll at a set of toll booths at a given location) to factors such as the number of servers available to process service requests (e.g., the number of staffed toll booths), the number of service requests per hour or other unit of time, and typical length of time for a server to handle a service request. Because the manager of data analysis had no model to work with, he decided to develop a very rough model of response time from available City EMS computerized data (drawing on queuing theory in a very simplified way).

Quick Analysis. Loosely drawing on queuing theory, the manager of data analysis developed a model, or equation, that quantified how the amount of change in ambulance unit utilization rate (i.e., unit busyness) affected response time. Unit utilization over a given period of time was calculated as follows:

$$\text{Unit Utilization} = \frac{\text{Number of Ambulance Unit Responses} \times \text{Mean Time/Ambulance Unit Response}}{\text{Number of Ambulance Unit Hours Fielded}}$$

On a given day, if 50 ambulance units were fielded for an average of 8 hours apiece, then 400 unit hours were fielded (reflecting the number of servers). If those 50 ambulance units generated 300 responses (reflecting workload

volume) that on average took 0.70 hour per response to initiate and complete (processing or service time per unit of work volume), then this produced 210 unit hours spent processing a response (e.g., from receiving the job to leaving the hospital if the response involved patient transport). Unit utilization (or unit busyness) in this example was $210 \div 400$, or about 53%. On average, each unit spent about 53% of an 8-hour shift initiating and completing responses to incidents.

Queuing theory predicts that increased unit busyness will tend to increase response time. Unit busyness, in this mini-case, would potentially increase because of the reduced ambulance unit hours (i.e., fewer servers) caused by impending budget cuts. The above formula also suggests that increased workload, or calls for service (i.e., increased number of ambulance unit responses), over a day or other time period will increase unit utilization and thus response time; and increased service time, or time between initiation and completion of responses (i.e., increased time expended per ambulance unit response), will increase unit utilization and thus response time.

The manager of data analysis had access to computerized data files from the City EMS management information system derived in turn from the agency's computerized dispatch system. The incident file recorded data for each incident, such as response time, date and time of incident, call type, priority level of the incident, and other factors. This file made it possible to provide aggregate response-time figures broken out by various time periods, priority level, and so on. From other data files, the manager of data analysis was able to derive number of ambulance unit hours fielded over a given time period and unit busyness (e.g., how many ambulance unit hours were spent responding to and handling incidents).

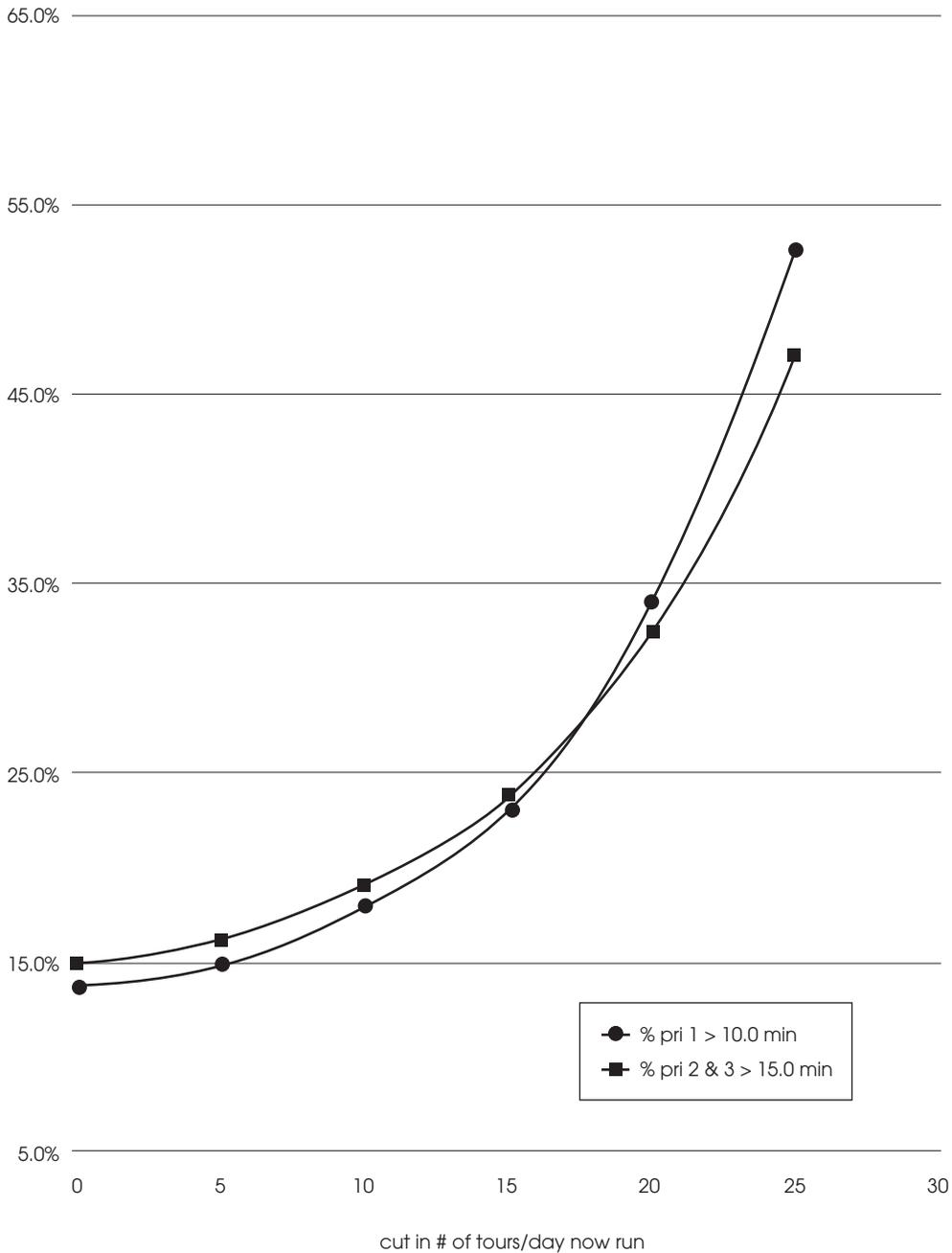
Using Statistical Package for the Social Sciences (SPSS), the manager of data analysis derived a special file consisting of one record for each day in CY2004. For each day, this special file had two measures of response time: the percentage

of Priority 1 incidents (e.g., cardiac arrest, shooting, etc.) with a response time greater than 10 minutes and the percentage of Priority 2 and 3 incidents (e.g., non-life-threatening back injury) with a response time greater than 15 minutes. The manager of data analysis used these cut points because City EMS was especially concerned about the impact of any retrenchment on "outliers," or response times generally considered extreme within the pre-hospital field. For each day, this special file also listed the number of ambulance units run (in unit hours) and how much time (in unit hours) was spent responding to and handling incidents. In the special file, for each day, dividing unit hours spent responding to and handling incidents by the total number of unit hours provided led to the unit utilization rate (the measure of unit busyness).

Unit utilization varied significantly across the days in CY2004 (from a daily low rate of 30% to a high of 70%). The mean daily utilization rate was 52%, with most days scattered between 40% and 60%. Daily response time varied significantly across the days in CY2004. The percentage of Priority 1 incidents with a response time greater than 10 minutes ranged from a low of 0% to a high of 30% (the mean daily figure was 14%). The percentage of Priority 2 and 3 incidents with a response time greater than 15 minutes ranged from a low of 1% to a high of 33% (the mean daily figure was 15%). Some variation is necessary if one is trying to assess the relationship between one variable and another.

Based on queuing theory, one would expect that the relationship between daily response time and daily unit utilization rate would be nonlinear (specifically, exponential). For example, moving from 52% utilization to 55% would increase response time by a bit; moving from 55% to 58% would increase response time somewhat more than a bit; moving from 58% to 61% would yield even more of an increase, and so on. Thus, SPSS and its curve-sketching routine were used to produce equations that related daily response time in an exponential fashion to daily unit utilization.

FIGURE 1.
Projected FY 2006 Outlier Response Time Percentage by # of Tours Cut in 55 Tours per Day
Now Run (Optimistic Estimates)



Note. pri = priority

One equation related the daily percentage of Priority 1 incidents with a response time greater than 10 minutes (the dependent variable) to daily unit utilization (the independent variable); another equation related the daily percentage of Priority 2 and 3 incidents (the dependent variable) to daily unit utilization (the independent variable). Specifically, the analysis found the following:

$$\begin{array}{l} \text{Percentage of} \\ \text{Priority 1 Incidents} \\ \text{With a Response Time} \\ \text{Greater Than 10 Minutes} \end{array} = 2.652e^{2.977 \times \text{unit utilization rate}}$$

$R^2 = .15$ coefficient significant at the .000 level

$$\begin{array}{l} \text{Percentage of} \\ \text{Priority 2 \& 3 Incidents} \\ \text{With a Response Time} \\ \text{Greater Than 15 Minutes} \end{array} = 3.877e^{2.481 \times \text{unit utilization rate}}$$

$R^2 = .19$ coefficient significant at the .000 level

These regression equations proved important for the requested analysis because, for a particular unit utilization level, each provided a predicted response time.

To clearly present this information to government officials, City EMS needed a summary display that depicted the bottom-line response time impact given various ambulance tour-level cutbacks. Figure 1 shows response-time projections given various reductions in the number of “tours” per day (one tour = one ambulance with two EMTs or two paramedics running for 8 hours). Unit utilization levels were projected at each of five different potential tour reduction levels (i.e., for reductions of 5, 10, 15, 20, and 25 tours per day). For each of these five potential reduction levels, the projected unit utilization figures were entered into the regression equations generated to get point estimate projections of response time. For instance, with only 40 tours per day fielded (a reduction of 15 tours per day), a unit utilization rate of 72.7% was estimated. Plugging this into the first equation generated a projected response time of 23.1% of Priority 1 incidents with a response time greater than 10 minutes.¹

The projected values for unit utilization were average daily figures that can vary from day to day and hour to hour; as the average daily utilization nears 100%, the number of days and hours exceeding 100% increases. When utilization exceeds 100% during a given period, waiting time skyrockets (i.e., service demand far exceeds server supply and waiting time explodes or is huge but indeterminate). As the utilization rate approaches 100%, the average number of incidents awaiting service in theory approaches infinity (Stevenson, 1989, pp. 673–674). The City EMS projections model did not account for any of this, suggesting that the projections presented were optimistic (particularly those in the right-hand side of the curves in Figure 1).

The manager of data analysis provided the chief of staff a one-page memo outlining the major steps in the derivation shown in Figure 1. The chief of staff needed this memo in case the government officials reviewing these projections had questions about how they were calculated.

Recommendations. The initial summary memo made no explicit recommendations other than noting that Figure 1 should be used to convey the projected impact of budget cutbacks on response time. Figure 1 also emphasized that the projections were optimistic; response time would probably be worse than shown.

In a separate communication prompted by a question from the chief of department and his chief of staff, the manager of data analysis noted that each 1-point increase in the percentage of Priority 1 incidents with a response time greater than 10 minutes would mean over 250 additional such incidents annually with a response time exceeding this extreme cut point; also, each 1-point increase in the percentage of Priority 2 and 3 incidents with a response time greater than 15 minutes would mean an additional 580 such incidents annually with a response time exceeding this extreme cut point. For instance, a reduction of 15 tours per day (as shown in Figure 1) would mean an increase of about 9% in the Priority 1 incidents with a response time

greater than 10 minutes. This would translate into about 2,250 additional Priority 1 incidents per year with this extreme response time.

Aftermath. Based on comments received from the chief of department and the president of the City EMS union, the above analysis was helpful in the presentations made to government officials, which successfully averted the potential budget cuts.

Comments on Using This Mini-Case. This mini-case illustrates the use of nonlinear regression and, to a degree, queuing theory, which informed the development of the independent variable (actually an index of three variables combined to reflect unit busyness) in the models (equations).

For students with some basic exposure to regression analysis, this mini-case could be used to illustrate the use of nonlinear regression in a real-world situation involving quick analysis done within a tight time frame and with available data. This mini-case also illustrates the importance of having a summary display that succinctly and clearly addresses what is important to the decision makers involved. It was not sufficient to merely produce relevant equations; it was important to present the overall implications of potential cutbacks for system response time in a way that was understandable to nontechnical decision makers.

Students in analytical courses using the research methods/statistics approach who have been exposed to regression analysis might be asked to review the strategy used in this mini-case. What were its positive features? In what ways, if any, might the analysis have been improved? For example, the R^2 values were moderate in size (i.e., as indicated in the regression equations, .15 for one and .19 for the other). R^2 values were provided in the one-page memo to the chief of staff in case anyone asked about them (no one did). Should this have been more explicitly addressed in the final summary display? If so, how (maybe using prediction intervals)? Would this have been confusing to the

decision makers involved? Future research might help improve the predictive power of the models used in this mini-case (e.g., by incorporating variables such as travel distance). However, the analyst must do the best job possible within existing time, resource, and data constraints. Indeed, when students review this mini-case and suggest improvements, they will need to consider these constraints, which analysts typically confront in real-world quick analysis.

Students in analytical courses using the management science approach might be assigned this mini-case because it draws upon queuing theory. If students have not been exposed to regression analysis, the instructor would need to provide some background, perhaps by presenting a hypothetical scattergram of two variables that seem to be related exponentially; the instructor could explain that the computer uses regression to obtain the equation that best fits the data set. The instructor might then have students focus on the concepts of unit utilization and response time. For this group of students, it might then be good to consider in what ways the model in this mini-case is a simplification of the queuing process for this application area; for example, the model does not explicitly consider the spatial dimensions of the process (e.g., day-to-day changes in the distribution of incidents by section of the city). However, pointing out limitations is not sufficient when talking about application in the real world; students need to consider what the analyst in question could have done differently given the time available, data constraints, and intended purposes for the analysis.

USING REAL-WORLD QUICK ANALYSES IN ANALYTICAL TECHNIQUES COURSES

These three mini-cases illustrate the timely and decision-relevant application of particular techniques to specific decision problems confronted by agency managers. Mini-Case I demonstrates the application of concepts such as reliability of measurement and sampling to a program audit and quality-assurance concern. Mini-Case II demonstrates the application of a multiplicative components model (a type of back-of-the-envelope model) to a service volume concern.

Mini-Case III demonstrates the application of regression analysis (informed by queuing theory) to provide response time projections necessary to argue against potential budget cuts. These mini-cases of actual quick analysis convey to students the potential value and use of analytical techniques for addressing real problems faced by public agency managers.

These mini-cases also illustrate the importance of communicating technical results in a way that is understandable and relevant to busy agency managers. In all three mini-cases, the analyst provided actionable information and suggested potential next steps. Moreover, the analyst used a variety of summary devices (e.g., displays and graphs, memos and executive summaries, brief face-to-face discussions) to simply and clearly communicate key findings and implications. For instance, the initial step in Mini-Case III involved generating regression equations to relate daily response time to daily unit busyness. However, simply displaying these equations or plugging in illustrative numerical values would not have completed the task. Instead, the analyst needed to perform other calculations (i.e., to obtain estimates of unit busyness at specific levels of ambulance tour cuts), enter these unit busyness estimates into the regression equations to obtain predicted response times, and plot these predictions in a graphic display. It is the graphic display that addressed exactly what managers and decision makers in this situation wanted to know.

Or consider Mini-Case I, which involved four reviewers assessing a random sample of cases to assess the extent to which Basic Life Support units were transporting cases that should have involved Advanced Life Support unit transport. The summary of this mini-case (see the Appendix) used a question-and-answer format to clearly present the question addressed, the design used to answer the question, the overall findings, and potential next steps. In addition, the analyst in this mini-case met with his “clients” to lay out the implications of taking action using the information on hand versus waiting to take action in order to review a larger sample of cases.

OTHER EXAMPLE PROBLEMS

In addition to the quick analyses in the above mini-cases, the City EMS manager of data analysis found that providing a few basic numbers and displays were helpful to decision makers. These situations might also be developed into mini-cases. For example, the following basic quick analyses of internal agency data addressed specific questions from management in a timely, relevant manner:

- (a) To assist in the design of a city-sponsored pedestrian safety program, the analyst used City EMS data to identify the 50 blocks where City EMS transported the greatest number of pedestrians struck by motor vehicles.
- (b) To ensure equity in the level of response time across the city’s 16 neighborhoods, the analyst reviewed quarterly response time figures by neighborhood and recommended adjustments in ambulance deployment in light of these figures. Then, to assess effectiveness after changes in deployment, the analyst reexamined response times and related figures across the neighborhoods.
- (c) After a basic evaluation review involving survival rate and other data for cardiac arrests, City EMS stopped using a relatively new device (the impedance threshold device) that aimed to enhance the effectiveness of CPR provided by paramedics and EMTs to out-of-hospital cardiac arrest patients. (The apparent lack of measurable survival-rate effectiveness was consistent with field personnel perceptions that the device was difficult to use while performing other required medical procedures.)

CONCLUSION

This article illustrates how mini-cases of actual quick analysis can be used in analytical techniques courses in MPA programs. The mini-cases correspond to the three general approaches used in these courses. The underlying notion is that such mini-cases can convey to students the usefulness of various analytical techniques in addressing real problems faced by public sector managers. Also, mini-cases of actual quick

analysis illustrate that in addition to understanding the nature of analytical techniques, students need to appreciate the importance of communicating findings in brief, practical terms understandable and useful to busy public managers. Instructors can develop mini-cases in several ways. They can use their own experiences as analysts or the experiences of others who are functioning as analysts, and/or they can cull mini-cases from established case programs or from newspaper articles that involve analysis of a particular issue.² This article recommends that instructors consider using mini-cases of actual quick analysis to promote student interest in the application of analytical techniques to public management problems as well as to enhance the relevancy of such courses to real-world analytical efforts conducted in public management settings.

Case Program titled “Conflicting Findings: Evaluating WIC” (Kennedy & Light, 1986). In addition to showing the nature and value of quasi-experimental designs, this mini-case illustrates how analysts conducting quick analysis sometimes draw upon and synthesize researched efforts to complete the assigned task in a timely, relevant manner.

- (d) Review newspaper articles that present a quick analysis of a government proposal to address a given problem. For instance, I have used as a mini-case a *Boston Globe* article titled “Mayor’s Plan on Guns Appears to Miss the Mark” (Naughton & Heinz, 2007). The mini-case illustrates the pitfalls of relying on anecdotes alone without appropriate quick analysis to verify their generalizability and applicability to the problem at hand.

NOTES

- 1 During CY2004, the unit utilization rate was 51.9%. In large part, the projected utilization rates for the five tour reduction levels were extrapolated from this percentage. However, for the no-cut scenario in Figure 1, the analysis used actual CY2004 response-time figures for the projected FY2006 response times (FY2006 runs from July 1, 2005, to June 30, 2006). For the no-cut scenario, the CY2004 response times (measured as a percentage of incidents that had extreme response times) were slightly higher than those that would be obtained from the two regression equations.
- 2 To develop mini-cases of actual quick analyses, an instructor might do the following:
 - (a) Draw on his or her own experiences as an analyst in the public sector.
 - (b) Consider meeting with analysis unit directors who either presently work or previously worked in government;
 - (c) Sift through the material produced in case programs sponsored by public administration programs at institutions such as Harvard and Rutgers. For instance, I have used a mini-case from Harvard’s Kennedy School of Government

REFERENCES

- Aristeguieta, M., & Raffel, J. (2001). Teaching techniques of analysis in the MPA curriculum: Research methods, management science, and “the third path.” *Journal of Public Affairs Education*, 7(3), 161–169.
- Behn, R. (1985). Policy analysts, clients, and social scientists. *Journal of Policy Analysis and Management*, 4(3), 428–432.
- Cook, P., & Vaupel, J. (1985). What policy analysts do: Three research styles. *Journal of Policy Analysis and Management*, 4(3), 427–428.
- Herendeen, R. (1998). *Ecological numeracy*. New York, NY: John Wiley and Sons.
- Horne, C. (2008). Teaching what we know: Describing and challenging the neglect of management science methods in MPA programs. *Journal of Public Affairs Education*, 14(3), 427–438.
- Howlett, M. (2009). Policy advice in multi-level governance systems: Subnational policy analysts and analysis. *International Review of Public Administration*, 13(3), 1–16.
- Jaworski, B. (2011, July). On managerial relevance. *Journal of Marketing*, 75, 211–224.
- Kennedy, D., & Light, R. (1986). *Conflicting findings: Evaluating WIC*. Harvard Kennedy School Case No. C15-86-680.0.

H. Abrams

- Leman, C., & Nelson, R. (1981). Ten commandments for policy economists. *Journal of Policy Analysis and Management*, 1(1), 97–117.
- Li, G., & Baker, S. (1996). Exploring the male-female discrepancy in death rates from bicycling injury: The decomposition method. *Accident Analysis and Prevention*, 28(4), 537–540.
- Naughton, M., & Heinz, H. (2007, April 23). Mayor's plan on guns appears to miss mark. *Boston Globe*, pp. A1, A8.
- Patton, C., & Sawicki, D. (1993). *Basic methods of policy analysis and planning* (2nd ed.). Englewood Cliffs, NJ: Prentice Hall.
- Roeder, P., & Whitaker, G. (1993). Education for the public service: Policy analysis and administration in the MPA core curriculum. *Administration and Society*, 24(4), 512–540.
- Smith, A., & Martinez-Moyano, I. (2012). Techniques in teaching statistics: Linking research production and research use. *Journal of Public Affairs Education*, 18(1), 107–136.
- Stevenson, W. (1989). *Introduction to management science*. Burr Ridge, IL: Irwin Publishing.

ABOUT THE AUTHOR

Harold “Hank” Abrams is associate professor of political science and public administration at the University of Texas of the Permian Basin. Prior to his current position, he managed the analysis units for a variety of public and nonprofit agencies.

APPENDIX

Mini-Case I: Preliminary Findings for Review of 100 Cases Where Basic Life Support (BLS) Alone Transported without Advanced Life Support (ALS) Transport

When BLS transported, how often should ALS have participated in the transport?

ANSWER: Based on a case review of 100 randomly selected incidents from CY2004 where BLS alone transported, we estimate that about 12% of the time ALS should have participated in the transport.

What does this mean in terms of annual number of cases?

ANSWER: In CY2004, there were over 55,000 incidents where BLS alone transported. The above finding of 12% means there were about 6,600 incidents where ALS should have participated in the transport (about 18 times per day on average).

How was the 12% figure derived?

ANSWER: Dr. A (medical director), Dr. B (emergency medicine fellow), Deputy Superintendent C, and Captain D independently assessed the documentation from each of the 100 cases. In 12 cases, at least three of the four people agreed that the patient should have received ALS transport.

How did this percentage vary by shift?

ANSWER: As the following table suggests, the situation is not an issue for the night shift. It is a question for the day and evening shifts.

NIGHT	DAY	EVENING	TOTAL
1/28	7/36	4/36	12/100
(4%)	(19%)	(11%)	(12%)

Notes. Overall *p* value is .15. Comparison between day and night shifts yields a *p* value of .07.

How did this percentage vary by day of the week?

ANSWER: As the following table suggests, the situation is not an issue for Monday through Thursday. It is a question for Friday through Sunday.

MON-THURS	FRI-SUN	TOTAL
3/63	9/37	12/100
(5%)	(24%)	(12%)

Notes. Overall *p*-value is .01. Eight of the 12 cases flagged were in the day and evening shifts Friday–Sunday.

continued on next page

APPENDIX, continued

Mini-Case I: Preliminary Findings for Review of 100 Cases Where Basic Life Support (BLS) Alone Transported without Advanced Life Support (ALS) Transport

What evidence do we have about potentially contributing circumstances?

ANSWER: Out of the 12 cases flagged,

- 5 cases had a non-ALS City EMS call type at dispatch, such as ILL2 or ILL3. (These call types are lower priority—Priority 2 and 3—illnesses and do not by protocol involve the dispatch of ALS units; however, call-type assignment is based on caller information provided prior to dispatch and generally not on the assessment of a medical professional at the scene.)
- 4 cases had both ALS and BLS on-scene.
- 1 case had call type REQE. (This is a call type entered by either the city's police or fire department requesting EMS response; per City EMS protocol, only a BLS unit is dispatched.)
- 1 case had a call type CARDIS where both ALS and BLS were dispatched but only BLS reported being on-scene. (CARDIS means a Priority 1 cardiac disorder call; such calls, per City EMS protocol, have both ALS and BLS units dispatched.)
- 1 case had a call type CARDIS where BLS alone was dispatched and BLS alone arrived on-scene.

The last circumstance and possibly the next to last circumstance may reflect ALS unit availability. This means, however, that 10 of the 12 cases flagged *do not* appear to reflect an ALS unit availability situation.

The first set of 5 cases reflects a question about City EMS triaging accuracy (either the algorithm itself, the call takers, or the inherent limits of triage accuracy); the second set of 4 cases reflects the decision-making process between the ALS and BLS units on-scene.

What are the potential next steps?

ANSWER: For the 5 flagged cases of non-ALS call type, RTQI (the Research, Training, and Quality Improvement division of City EMS) needs to obtain the EMS dispatch center tapes to discern whether the triage algorithm needs to be tweaked and/or educational review of these cases with the call-taking staff needs to be undertaken. For the 4 cases where both ALS and BLS units were on-scene, RTQI needs to pull together the documentation and distill what specific points need to be reinforced with the field units regarding ALS transport policy.

Again, the night shift does not seem to face these situations. The questions raised here primarily lie with the day and evening shifts (particularly Friday–Sunday).