

collapsed to the point where even well-insured patients have little alternative but to seek urgent care in the ED even during office hours.¹⁸

• Hospital ambulance diversion (not accepting ambulance traffic) is at a critical level with some hospitals on diversion 30% to 50% of the time. In the first four months of February 2001, "diversion override" occurred nearly every day in the Phoenix southeast region and for eight days in the entire Phoenix area was saturated.¹⁹ The concept of "ambulance diversion decompression" for EDs is quickly failing.

SUMMARY

As a society, America has failed to recognize the importance of the emergency care safety net and appropriately provide for its survival.²⁰ Ironically, in doing so, we have placed our own survival at risk. As a result, the chances of surviving a heart attack may now depend more on the time of day, day of week, and type of insurance²¹ than almost any other factor.

In our experience, the emergency care safety net is so threatened that the lack of available services is affecting nearly all patients and making EDs intolerable places to work. Emergency nurses, emergency physicians, on-call specialty physicians, and ancillary personnel are seeking alternative employment in unprecedented numbers. Emergency care has become such a financial drain on hospitals and physicians in this ruthless health care market that attempts to avoid this "line of service" have become routine and, increasingly, a matter of financial survival. Traditional "general" hospitals are quickly being replaced by "specialty" hospitals that lack the resources and commitment to emergency services necessary to maintain the health care safety net. Mandating the provision of emergency services through EMTALA without appropriate funding has served only a short-term gain and hastened the demise of the emergency care safety net.

In a free-enterprise health care market, only ensuring the profitability of emergency services and/or returning to government-supported indigent health care will ultimately resolve this crisis. On December 18,

2000, AzCEP called a meeting with Arizona Governor Hull's office and included stakeholders from virtually every aspect of emergency care. We called upon the governor to take leadership to preserve the emergency care safety net and to begin to work on long-term solutions. A full summary of the meeting and other information is available at: www.azcep.org.—TODD B. TAYLOR, MD (tbt@compuserve.com), *Department of Public Affairs, Arizona College of Emergency Physicians, Phoenix, AZ*

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Emergency Department Diversion: Causes and Solutions

Diversion of patients from one "full" emergency department (ED) to another has reached epidemic proportions around the country. It is a nearly daily subject of discussion in the media, attracting the attention of medical caregivers, regulators, and policymakers.¹ Indeed, the problem is very serious. Those patients requiring ambulance admission to an ED are frequently the sickest and cannot tolerate long waiting times, much less outright loss of access. The public's confidence in the integrity of our care system, and their own personal security, is

threatened by an increasingly prevalent impression that in a medical emergency, help might not be available. Yet, despite public concern and media attention, the situation does not seem to be improving. Why?

To answer this question one has to consider the potential operational issues contributing to ED diversion. These can be subdivided into three major categories:

1. problems external to the ED and hospital
2. internal ED operational issues
3. other hospital problems affecting ED function

Problems external to the ED are usually the first to be identified by hospital administrators and ED clinicians. Included in these are increased demand for admission and treatment in the ED (2–3% per year in some areas), natural fluctuations in demand such as the winter flu season, and decreases in ED staffing or the number of staffed hospital beds resulting from the Balanced Budget Act and reduced reimbursement. Frequently, these issues alone become the focus of state and local ED diversion task forces. The universal, and occasionally appropriate, response is a call for increased resources to provide more ED or hospital beds. Without speculating as to the extent to which these issues contribute to ED diversion, experience suggests that simply throwing more money at them is an inadequate solution. We suggest, rather, that energies first be directed toward the identification and solution of operational problems within the ED or hospital.

The ED is only one of many hospital units with internal operational issues leading to increased waste and decreased access. Many problems arise from the fact that the demand for services through the *random* appearance of patients for care must be matched to a *fixed* supply of resources (staff, beds, labs, x-ray, etc). Is this an issue unique to health care delivery? Absolutely not, and there is one particular scientific area of operations research—queuing theory, that has been developed to solve exactly this kind of problem. Indeed, telecommunications, the Internet, and hundreds of other systems all around us have been developed using queuing theory to optimally allocate fixed resources to random demand, including the stresses of periods of peak demand.

How often has queuing theory been used to design and re-engineer our EDs? To our knowledge, never. Health care may take a lesson from other industries. Imagine the chaos if AT&T allocated the number of available telecommunications channels at any moment according to past experience and intuition. How long would it take for you to call home from your office? How long would it take for you to log on to the Internet? Life would quickly become a series of “diversions.”

Why has this methodology not penetrated health care delivery? The short answer is that it was never needed. Until recently, increased resources have been thrown at every new operational issue in order to accommodate peak loads. Unfortunately, in addition to producing massive waste, excess resources may also cause further system dysfunction.² Unless, as ED directors suggest, we are prepared to return to the “good old days” of cost-plus, we must use operational tools, such as queuing theory, to optimally allocate our existing resources. Using these tools, there is the potential to increase access and improve quality while simultaneously reducing waste and cost.²

Yet queuing theory alone will not solve the problem. Emergency department diversion and long patient waiting times commonly result from operational difficulties in other hospital units on which the ED depends. This is the largest and least intuitive area requiring our attention. If an ED director is asked to name the single biggest reason for diversion, the most likely answer is that there are no intensive care unit (ICU) or patient care beds available in the hospital. Thus, obstruction to outflow from the ED rapidly fills it to capacity and new patients must be diverted to other institutions. During periods of diversion, then, the next questions must be: Why are all the beds occupied and who is occupying them? The answers to these questions are multifactorial and have to do with the starting point of hospital occupancy and the timing and number of admissions and discharges.

Occupancy starting point is critical when a hospital regularly begins its day at high census and its patients are unwilling or unable to be discharged early. In this case, even below-normal ED volume cannot be processed and diversion ensues. Timing issues become important when a large number of surgical cases are scheduled and completed early in the day. These patients then compete with ED patients for the same inpatient beds and the operating room (OR), the ED, or both become backed up, causing both surgical delays and emergency diversion. In today’s increasingly busy medical centers, our experience sug-

gests that *within the dynamic relationship of the ED and the rest of the hospital, the single most important factor contributing to ED diversion is the daily variability in the OR elective surgical caseload.* Illumination of this relationship requires us to consider the concept of variability in health care delivery,² particularly in its application to OR scheduling.

The goal of every health care delivery system is to provide the “right care to the right patient at the right time.” This would result in the highest possible quality at the lowest possible cost. In an ideal world, all patients would appear for care in a predictable and smooth pattern. Under this circumstance it would be easy to provide appropriate resources to match the demand pattern and simultaneously achieve the highest quality and maximal efficiency. Unfortunately, we do not live in an ideal world. We must provide quality care in spite of substantial variability in the demand for health care resources. This variability is experienced as the need to care for many disease types of varying severity (clinical variability) that randomly arrive for care (flow variability).² In addition, many health care professionals with variable abilities provide care (professional variability). These “natural” variabilities are an inherent part of health care delivery. They challenge our ability to provide quality care and add expense to the delivery process. The smoother and more homogeneous the demand and delivery are, the lower the cost will be. These natural variabilities, however, cannot be eliminated. Therefore, they must be appropriately managed and paid for. Fortunately, though, for these random variabilities, we have the previously described operations management-based methodology, i.e., queuing theory, that can be used to optimally allocate resources to maximize quality and minimize cost.

Unfortunately, this is not the end of the variability story in health care delivery. There is another type of variability that is impossible for the system to manage. This is “artificial” variability.² It is non-random and at the same time not predictable. The causes are usually hidden and multifactorial. Frequently, they lie within the mundane world of individual provider or patient prefer-

ence, convenience, or routine. This type of variability is especially important in that it not only introduces additional cost but also produces system dysfunction that may ultimately lead to decreased quality. If we are to match decreasing capacity to increasing demand, it must be understood and eliminated.

Perhaps the best example of artificial variability in most hospitals is the day-to-day variation in the number of scheduled elective surgeries. Since elective surgery is not urgent and can be controlled, one would expect a smooth input of cases across the regular working week. In reality, a day-to-day variation of 50% from the average weekday caseload is common, and it is impossible to predict which days of any given week will experience either a peak or valley of demand. As the OR is usually designed and staffed around the average caseload, it cannot easily accommodate unnecessary and unexpected peaks in demand. Valleys lead to waste, as personnel are underutilized, and cannot be sent home without pay. This artificially variable elective caseload not only makes efficient staffing of the ORs impossible, but also imposes a highly variable demand on many related hospital units such as laboratories, recovery rooms, inpatient floors, and ICUs.

Because of today's cost constraints, hospital units are rarely staffed to handle peak patient loads. When peaks do occur, they increasingly result in severe system overload. At best, this creates multiple system queues, delays in service, increases in hospital length of stay, and increased waste. At worst, they lead to staff overload, stress, dissatisfaction, decrease in quality of care, and even, as in the case of ED diversions, outright denial of access to health care.

As noted earlier, a frequently posed solution is to increase the number of hospital beds and operate at an overall lower census. This solution, while potentially reducing the immediate ED crisis, can have only temporary effects. In the long term it can only increase cost while continuing to allow variability in the OR to overload other hospital systems. Eventually, by simply permitting more system variability, it rewards dysfunctional OR scheduling and invites new cycles of bottlenecks, waste, and decreased access.² As a rule, adding resources to accommodate artificial variability is an exercise in codependency to be avoided.

In the face of both increasing ED/OR volume and cost constraints, a busy hospital's only viable alternative is to eliminate as much as possible any artificial variability in its elective surgical schedule. Presently, Massachusetts ED directors report that the primary reason for diversion is the lack of available hospital beds. If for example, two additional beds per day would be sufficient to remedy this deficiency, decreasing elective surgical caseload variability by two to three cases per day could easily provide this. In reality, surgical variability of caseload is much higher than just two to three cases per day in most busy medical centers.

An essential first step in this process is to perform a multicenter study of the effects of artificial variability on critical issues such as ED diversion. This is required to document the problem and to provide sufficient motivation for hospitals to begin the arduous process of smoothing the OR schedule. Since smoothing the elective schedule would necessarily mean rearranging surgeon practice patterns and proactively managing the casemix of

their elective patients, it is unlikely that any hospital will tackle these difficult management issues without clear documentation of potential system benefits. However, if we do not timely and adequately address these issues, we will suffer a continued decline in health care delivery so clearly recently experienced as ED diversion. In the end, *even if all other factors are fixed, if variability is not addressed, ED diversion will continue.* Elimination of variability in the OR elective caseload, and any other elective admission, would not only benefit patients in the ED, but also provide the important "side effects" of increased access to ICUs as well as a significant reduction in hospital waste. Smoothing the elective caseload is not an easy task, but it is an absolutely necessary part of the solution.—EUGENE LITVAK, PHD (litvak@bu.edu), *Boston University School of Management and Harvard School of Public Health, Boston, MA*; MICHAEL C. LONG, MD, *Operating Room Services, Massachusetts General Hospital, Boston, MA*; ABBOT B. COOPER, *Massachusetts General Hospital, Boston, MA*; and MICHAEL L. MCMANUS, MD, *Medical Intensive Care Unit, Boston Children's Hospital, and Pediatric Services South Shore Hospital, Boston, MA*

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