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EMERGENCY DEPARTMENT OVERCROWDING AND AMBULANCE DIVERSION: THE IMPACT AND POTENTIAL SOLUTIONS OF EXTENDED BOARDING OF ADMITTED PATIENTS IN THE EMERGENCY DEPARTMENT

Jonathan S. Olshaker, MD and Niels K. Rathlev, MD

Department of Emergency Medicine, Boston Medical Center and Boston University School of Medicine, Boston, Massachusetts
Reprint Address: Jonathan S. Olshaker, MD, 279 Chapman Street, Canton, MA 02121

□ **Abstract—Emergency Department (ED) crowding and ambulance diversion have been increasingly significant national problems for more than a decade. Surveys of hospital directors have reported overcrowding in almost every state and 91% of hospital ED directors report overcrowding as a problem. The problem has developed because of multiple factors in the past 20 years, including a steady downsizing in hospital capacity, closures of a significant number of EDs, increased ED volume, growing numbers of uninsured, and deceased reimbursement for uncompensated care. Initial position statements from major organizations, including JCAHO and the General Accounting Office, suggested the problem of overcrowding was due to inappropriate use of emergency services by those with no urgent conditions, probably cyclical, and needed no specific policy response. More recently, the same and other organizations have more forcefully highlighted the problem of overcrowding and focused on the inability to transfer emergency patients to inpatient beds as the single most important factor contributing to ED overcrowding. This point has been further solidified by initial overcrowding research. This article will review how overcrowding occurred with a focus on the significance and potential remedies of extended boarding of admitted patients in the Emergency Department. © 2006 Elsevier Inc.**

□ **Keywords— emergency department; overcrowding; ambulance diversion; safety net; uninsured, boarding patients**

OVERCROWDING

The issue of Emergency Department (ED) crowding and ambulance diversion first received national attention with sporadic reports in the late 1980s. It has become an increasingly significant national problem for more than a decade. Surveys of hospital directors have reported overcrowding in almost every state in the U.S. Daily overcrowding has been reported by 10–30% of hospitals surveyed. Over 90% of hospital ED directors reported overcrowding as a problem, resulting in: patients in hallways, full occupancy of ED beds, and long waits occurring several times a week (1). Overcrowding has many other potential detrimental effects including diversion of ambulances, frustration for patients and ED personnel, and most importantly, greater risk for poor outcomes. In some jurisdictions, including the Boston area, an increasing number of diversion requests are being denied. This gives rise to an even more severe problem: ambulances stranded in EDs unable to transfer patients to an already overwhelmed inpatient hospital staff (2).

Initial position statements from major organizations including the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) and the General Accounting Office suggested that the problem of overcrowding was due to inappropriate use of emergency

Administration of Emergency Medicine is coordinated by *Eugene Kercher*, MD, of Kern Medical Center, Bakersfield, California and *Richard F. Salluzzo*, MD, of Conemaugh Meridian Health Group, Johnstown, Pennsylvania

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services by those with no urgent conditions, probably cyclical, and needed no specific policy response.

More recently, the same and other organizations have more forcefully highlighted the problem of overcrowding and focused on the inability to transfer emergency patients to inpatient beds as the single most important factor contributing to ED overcrowding. This point has been further solidified by initial overcrowding research. In this article we will review how overcrowding has occurred with a focus on the significance and potential remedies of extended boarding of admitted patients in the ED.

How Did it Happen?

The 1980s and 1990s saw a steady downsizing in hospital capacity. American Hospital Association data showed 1.36 million hospital beds in 6933 hospitals in 1981, 927,000 staffed beds in 5370 hospitals in 1991, and 829,000 beds in 4950 hospitals in 1999. There were 4547 hospital Emergency Departments in the United States in 1994 and only 4177 remained by 1999 (3).

The most reliable data on ED visits come from the National Hospital Ambulatory Medical Care Survey (NHAMCS), which has been conducted annually since 1992 by the Center for Disease Control's (CDC) National Center for Health Care Statistics (NCHS). For the period from 1992 through 1999, the number of ED visits rose by 14% from 89.9 million annual visits in 1992 to 102.2 million in 1999 (4). More than half of this increase came between 1997 and 1999. The 2002 CDC NCHS Survey documented a continuing increase in the number of hospital ED visits even as other data show a further decline in the actual number of hospital EDs. In 2002 Americans made 110.2 million visits to hospital EDs, a 23% increase over the 90 million visits made in 1992. During the same period of time the number of hospital EDs have decreased about 15% (5). The most common reasons given for an ED visit in the survey were abdominal pain (6.5%), chest pain (5.1%,) and fever (4.8%). Persons aged 75 years and older continued to have the highest rate of ED visits (61.1 per 100 persons). The survey also found that about 60% of EDs were located in metropolitan areas but represented fully 81% of encounters. In addition, 34% of all ED visits required treatment within 15 min, whereas only 10% were classified as non-urgent.

During this time period, a number of laws, programs, and other factors have contributed to increased volume with a simultaneous decrease in reimbursement.

1. The 1986 Emergency Medical Treatment and Labor Act (EMTALA) (6). This law, upheld by the United States Supreme Court, guarantees Emergency Medical care as a civil right extended to all U.S. residents. It requires screening and stabilization for all who seek emergency care, regardless of the ability to pay, and threatens both physicians and hospitals with explicit legal and financial penalties for noncompliance. There were no accompanying requirements for payors, public or private, to support such a mandate. There is no guarantee of payment for hospitals, Emergency Physicians, or on-call specialists who provide these services.
2. The Balanced Budget Act of 1999 cut net Medicare reimbursement.
3. The number of uninsured and underinsured persons in the United States has steadily been increasing during the same time period; in 1990 there were 35.6 million non-elderly uninsured patients, whereas in 1998 43.9 million non-elderly were uninsured (7). The total direct expense for Emergency Physician services to the uninsured is approximately 1 billion dollars annually (8). Total cost to hospitals is much higher. The National Center for Health Care Statistics suggests that 93% of uninsured admissions are linked to an ED visit. The Agency for Healthcare Research Quality (AHRQ) estimates the total cost in 1998 for ED outpatients and hospital inpatient care of the uninsured to be $15–20 billion annually (9).
4. There is limited availability of off-hour services by primary care physicians.
5. Increased use of technology has led to referrals to the ED for abdominal computed tomography (CT) scan, magnetic resonance imaging (MRI), ultrasound, and other new technologies. Even well-insured patients are increasingly using EDs when primary care physicians are unavailable and the urgency and complexity of the problems do not allow for a scheduled, elective evaluation.

In addition, the problem has been worsened by a national work force nursing shortage. In some hospitals the shortage of ED and critical care nurses has reached crisis proportions. Recognition of overcrowding as a significant national problem outside the Emergency Medicine community has occurred in only the last few years.

In 1992, the U.S. Senate Committee on Finance Nationwide Study of Hospital Emergency Departments based upon the General Accounting Office (GAO) Survey of 689 U.S. hospitals was published with the following conclusions:

1. ED visits had increased significantly over the preceding decade.

2. The problem was most prevalent in large urban hospitals and was exacerbated by inappropriate use of emergency services by those with non-urgent conditions (estimated at up to 43% of all visits).
3. Overall, 89% of patients appeared to be receiving timely care and only 7% of patients with urgent conditions experienced significant delays.
4. No national policy interventions were recommended (10).

In November 2000, a Boston Globe article published comments by the U.S. Surgeon General and the President of JCAHO indicating that ambulance diversion may be only a "cyclical phenomenon" that would not require a dedicated policy response (11).

The 2000 Institute of Medicine Report, "Health Care Safety Net. Intact but Endangered," helped bring to national attention the plight of safety net hospitals and providers. It outlined by legal mandate and by explicitly adopted mission that core safety providers maintain an open-door policy offering access to service for patients regardless of the ability to pay and deliver a substantial share of the services to uninsured, Medicaid, and other vulnerable patients. Factors that threaten the survival of the safety net are the growing numbers of uninsured and reduced reimbursement for uncompensated care (12). ED providers were not specifically mentioned but actually are the ultimate safety net for the population described: individuals without insurance or primary care providers and those with Medicaid and special health care needs.

The Institute of Medicine report states that an ideal system should be "Safe, Effective, Patient Centered, Timely, Efficient, and Equitable."

The Joint Commission on Accreditation of Healthcare Organizations (JCAHO) recently has been much more proactive in stressing the existence of and need for interventions for Emergency Department overcrowding. On February 24, 2003, it co-sponsored the National Conference, "The Emergency Department Overcrowding Symposium. Condition Critical. Meeting the Challenge of ED Overcrowding." In addition, JCAHO has now developed new Emergency Department Overcrowding Standards, Rationale, and Elements of Performance that are proposed to appear in the Leadership Chapter of the 2005 Hospital Accreditation Manual (phone communication with JCAHO Standards Section). These new Emergency Department overcrowding standards will stress the need for hospital leadership to engage in the level and scope of planning needed to prevent overcrowding when possible, minimize its impact when it is unavoidable, and improve access to inpatient beds.

The GAO put out a new report in March 2003, with some of its conclusions markedly different from 11 years earlier. "The 2003 Government Accounting Office Report to U.S. Senate; Hospital Emergency Departments, Crowded Conditions vary among Hospitals and Communities. Survey of 2000 hospitals with EDs" found that crowding was most severe in metropolitan areas with large populations, areas with high population growth, and areas with a high percentage of people without health insurance.

The report stated, "While no single factor stands out as the reason why crowding occurs, GAO found the factor most commonly associated with crowding was the inability to transfer emergency patients to inpatient beds once a decision has been made to admit them as hospital patients rather than to treat and release them. Hospitals attempt to match staffed bed with revenue rather than licensed capacity and tend to give priority to scheduled admissions. Of Medicare patients being admitted from the ED, 19/20 of the most common diagnosis-related groups are for medical conditions that are regarded as less profitable than surgical admissions" (13).

The GAO report further goes on to state: "While there are no comprehensive studies on the consequences of crowded conditions, health care researchers and clinicians report that crowding has multiple effects, including prolonged pain and suffering for some patients, long patient waits, increased transport times for ambulance patients, inconvenience and dissatisfaction for the patients and their families, and an increased frustration among medical staff. In addition to delays in treatment, some EDs have reported that patient care has been compromised and patients experienced poor outcomes as a result of crowded conditions in EDs".

The report found three major crowding indicators: Diversion; Boarding; and Leaving before a Medical Evaluation.

Two-thirds of the hospitals in the GAO survey went on diversion at least once during fiscal year 2001. Diversion status was in effect in 2 of every 10 institutions for more than 10% of the time and 1 in 10 were on diversion for more than 20% of the time.

GAO also concluded that senior hospital leadership committees dedicated to solving the problem of ED throughput and output can result in significant improvements.

Potential Solutions

Although national organizations are recognizing that problem of ED overcrowding, research is scarce, particularly on the effects on patient outcomes and potential solutions. Attempts have been made to develop and validate scoring systems for measuring the degree of overcrowding. Such a scoring system would help in standardizing the assessment of ED overcrowding with

the purpose of prompting mobilization of additional resources and determining the need for ambulance diversion. The Emergency Department Work Index (EDWIN) takes into account the number of patients in each triage severity category, the number of physicians on duty, and the number of ED beds that are not occupied by boarders (14). The index correlated well with the physicians' and nurses' perception of overcrowding and diversion in one center but requires evaluation at multiple additional sites. Ambulance diversion and ED throughout time—the time from patient presentation to departure—have been used as surrogate markers of overcrowding in the absence of a widely accepted definition. Neither measure is universally applicable as a marker of overcrowding and should be used with caution when comparing performance between institutions. Diversion is not an option in some EMS systems and throughput time is ED specific and dependent on the complexity of the case mix. In spite of this, the measures have specific value in tracking individual institutional performance over time.

The link between overcrowding and adverse effects on the quality of care has not been clearly established in large-scale trials. The clinical impact of overcrowding must be further defined and measured in order to generate the impetus for further change (15). Bernstein et al found a weak association ($p = 0.03$) between high overcrowding conditions and a composite measure of the number of patients returning to the ED within 72 h, the number of corrections of ED X-ray interpretations, and the number of quality improvement cases (14). In a recent study, the time to thrombolysis for patients with acute myocardial infarction was prolonged by 5.8 min (95% CI 2.7–9.0) during high overcrowding conditions compared with no overcrowding (16). The clinical significance of delaying thrombolysis by 5.8 min is unclear and adverse effects on patient outcomes were not established. The results are nonetheless important because they clearly establish a direct link between overcrowding and delays in critical interventions in a cohort of more than 3000 patients. In another study, Schull et al. showed that an increase in overcrowding in the ED was associated with a substantial increase in the EMS system response and ambulance transport time for patients with chest pain (17).

In 2003, Asplin and colleagues used a consensus of experts to develop an "input," "throughput," and "output" model for ED patient flow (18). They concluded that the most frequently cited reason for ED overcrowding is the inability to move admitted patients from the ED to an inpatient bed. The investigators believe the causes and consequences of ED boarding of inpatients may be the most important areas for immediate research and operational changes to alleviate ED overcrowding and ambulance diversion. Solberg and Asplin published the consensus of a panel of 74 national experts assessing 113 measures of ED and hospital workflow (19). They scored and chose 38 outcomes that may be useful in understanding, monitoring and managing overcrowding. The "output" measures of ED boarding time, boarding burden and hospital occupancy rate carried the highest weight.

Schull et al. similarly concluded that admitted patients are important determinants of ambulance diversion (20). By quantitative analysis, they determined that ambulance diversion increased with the number of patients boarding in the ED and with the boarding time, which is defined as the time from admission order to departure from the ED to a hospital bed. ED throughput time increased 18 min when there was an increase in inpatient occupancy of 10% and was significantly prolonged when occupancy exceeded a threshold of 90%. Medical-surgical inpatient occupancy was one of three variables that were associated with ambulance diversion in a multivariate analysis (21). With respect to diversion, the correlation with the number of ED boarders is substantially higher than the correlation with ED volume—minus boarders—and with the ED throughput time (22). Forster et al. showed a strong association between increased hospital occupancy and ED throughput time for admitted patients (23). These finding emphasize the contribution of the "output" of admitted patients from the ED to overcrowding. Solutions must incorporate strategies to increase inpatient bed capacity either by increasing the number of staffed beds or by improving the efficiency of the admissions and discharge processes.

Increasing Capacity

Based on a retrospective review of ED overcrowding in Rochester, New York, Schneider et al. concluded that rapidly transferring admitted patients from the ED to a hospital bed had the single greatest impact in alleviating the problem (24). They found that additional services for inpatients awaiting beds brought the greatest subjective sense of relief of overcrowding. Their discussion stressed how crucial was the collaboration with the Department of Health Service Management, senior management of the institutions, and payors. "Recognition that the cause and solution to ED overcrowding lay outside the ED was pivotal." A short-stay, undifferentiated inpatient unit was implemented with the purpose of reducing the time from admission decision to departure from the ED. The unit was successful in reducing the throughput time for both admitted and discharged ED patients.

The benefits of a managed acute care unit located remotely from the ED were studied by Kelen et al. (25). The unit consisted of 14 inpatient-based beds that accepted patients requiring extensive evaluation or man-

agement that was likely to exceed 4 h in duration. Admitted ED patients were also sent to the managed acute care unit if an appropriate inpatient bed was not available. Primary ED evaluation was required for approximately 50% of the patients. The investigators found that implementation of the managed care unit had a significant impact in decreasing overcrowding. Over a 6-month period, the monthly hours of ambulance diversion decreased by 40%.

By increasing the number of ICU beds by 43%—from 47 to 67—one institution managed to decrease ambulance diversion hours 66%, from 3.8 h to 1.3 h on average (26). Patients admitted to an ICU spent a mean of 25 min less in the ED, but the throughput time for discharged patients and those admitted to floor and telemetry beds was not decreased.

Admitting patients to hallway bays on the inpatient floors also has been proposed as a solution to the problem of boarding. The Massachusetts Department of Public Health recently endorsed utilization of this method of preventing ED overcrowding and boarding for all hospitals in the state. A transfer-to-ward policy requiring that an admitted patient be transferred within 1 h of bed assignment resulted in a significant decrease in the time from admission decision to departure (27). The strategy remains controversial because it simply transfers the problem of overcrowding from the ED to the hospital ward rather than actually presenting a solution.

Improving Efficiency

Litvak et al. have promulgated the concept of controlling "artificial" variability as a critical management strategy in improving efficiency. The term "artificial" variability refers to the strategy—created by design—of preferentially admitting elective surgical and non-surgical cases on weekdays. This creates an artificial, additional demand for beds on those days. In the sphere of interest, "natural" variability refers to "input," i.e., the arrival of patients via EMS or other means; this process is controlled by patients, primary care and EMS providers rather than by the hospital or ED providers. In an operational analysis of two facilities, Litvak et al. concluded that in institutions where scheduled demand is significant, the correlation between the number of hourly scheduled admissions and diversion was higher than between the number of hourly ED admissions and diversion (22). They also confirmed that the number of scheduled admissions is more variable than the number of ED admissions. A similar pattern has been demonstrated for intensive care services, as diversion from the ICU was better correlated with scheduled demand than with emergency requests for admission (28).

Admitted ED patients compete with elective admissions for critical resources including hospital beds. A change in the paradigm that demands admission of elective cases in a "smooth" or balanced fashion during the course of a 7-day week, would decrease the invariable "bed crunch" that most EDs experience between Mondays and Fridays. A recent study demonstrated an association between the number of daily elective surgical cases performed in the operating room and mean throughput time in the ED (29). In multivariate analysis, the throughput time for each ED patient increased by 15 s per elective surgical case, which at first blush appears insignificant. The mean of 48 elective surgical cases on weekdays were associated with an approximately 5% increase in throughput time for all—admitted and discharged—patients in the ED. Because essentially no cases were performed on weekends, it appears that "smoothing" the surgical schedule to include elective cases on weekends would be beneficial in terms of decreasing throughput time in the ED. This strategy may also reduce the cost of care in the hospital because staffing can be scheduled in a more predictable fashion, rather than emergently staffing for "peaks and valleys" in the flow of post-operative patients.

FUTURE GOALS

The problem of ED crowding has clearly captured the attention of emergency physicians, hospital administration, major health care organizations, and government policymakers. The realization of the major significance of this problem clearly justifies the hope that the present dangerous situation can improve. But the fix is not an easy one and will require sustained, coordinated efforts and resources from all stakeholders.

Future goals are:

1) Future research demonstrating
   a) Adverse effects of overcrowding with particular emphasis on patient outcomes. Current ED workload and crowding invite medical errors, but this needs to be further studied and proven (22).
   b) Measures, programs, or resources needed to improve input, throughput and output.
2) Partnering of Emergency Medicine Organizations, JCAHO and government agencies to bring together all hospital's senior leadership actively involved and dedicated to solving this problem. There is evidence that when senior hospital leadership commits to solve the problems of ED throughput and output, significant system improvements can result (16,23).
3) Partnering and coordinating with community health centers and other outpatient services.

4) Public relations campaigns to bring better public awareness of this problem with emphasis that everyone can be adversely impacted.

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