The Institute for Health, Health Care Policy and Aging Research

Hospital Capacity, Patient Flow, and Emergency Department Use in New Jersey

Derek DeLia, Ph.D.

A Report to the New Jersey Department of Health and Senior Services

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Rutgers Center for State Health Policy

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Executive Summary

In response to concern about growing utilization of hospital emergency departments (ED's) and its implications for hospital surge capacity, the New Jersey Department of Health and Senior Services (NJDHSS) commissioned the study "Emergency Department Utilization and Surge Capacity in New Jersey" to be conducted by the Rutgers Center for State Health Policy (CSHP). This document is the third and final project report. It includes quantitative analysis of recent trends in ED utilization, hospital occupancy, ambulance diversion, and potentially avoidable hospital use in New Jersey (NJ). Using a case study approach, it also provides qualitative analysis of patient flow management and surge capacity planning for hospitals in the state.

After a slight drop in 2004, total ED visits in NJ resumed their previously rising trend in 2005, ending the year with 3.36 million visits statewide (compared to 2.67 million in 1998). ED visits per capita followed a similar pattern and ended 2005 with 385 visits per 1,000 residents (compared to 329 visits per 1,000 residents in 1998). Growth in ED visits is more rapid in regions of the state that have experienced more rapid population growth, especially the Central West. But on a per capita basis, the South and Northeast regions of the state had the highest rates of ED use throughout the study period, 1998-2005.

Part of the rise in ED utilization is attributable to conditions and medical episodes that may have been avoided through better access to primary care. A growing number of inpatient admissions through the ED are for ambulatory care sensitive (ACS) conditions, such as asthma and congestive heart failure. These admissions, which grew from 158,480 in 2003 to 186,284 in

2005, accounted for 31% of all ED admissions in 2005. In 2004, the state began collecting detailed data on ED visits that did not lead to admission. Based on these data, the number of potentially avoidable treat-and-release ED visits grew slightly from 1.15 million in 2004 to 1.24 million in 2005, accounting for 47% and 48% of all treat-and-release ED visits, respectively.

Following the national trend, the hospital sector in NJ experienced declines in capacity (i.e., maintained beds) and inpatient utilization (i.e., inpatient days) from 1998 to 2005. Annual occupancy rates at the state and regional levels fluctuated around 70% during this time. Annual occupancy rates for intensive care and critical care units were higher than overall hospital occupancy during this period but usually remained below 85% leaving at least 15% of capacity available for unexpected patient volume.

However, these annual occupancy figures give a misleading picture of the alignment between the supply and demand for hospital services. Every year, individual hospitals as well as groups of hospitals within the same geographic region experience recurring periods of very high occupancy followed by periods of low occupancy. During peak periods, hospital capacity in NJ appears to be extremely constrained. On 47 days in 2005, more than 95% of all maintained beds in the state were occupied. This number increased from 29 days in 2004 and 11 days in 2003. On these days, there would be almost no immediate surge capacity available to respond to a major emergency such as a natural disaster or terrorist attack without displacing existing patients. On more than ¾ of the days in 2003 through 2005, the state had less than 500 empty staffed beds available per million residents, which is a surge capacity benchmark developed by the federal Health Resources and Services Administration. Failure to meet the benchmark is more common in some parts of the state than others. The Northwest region of NJ stands out as being the most likely to have a limited number of empty beds relative to population.

The likelihood of experiencing high occupancy is quite varied among hospitals in the state. In 2005, for example, 26 facilities spent more than half of the year at or above 95% occupancy of staffed beds. Other facilities experienced very high occupancy much less

frequently if at all. Yet closure of these lower-occupancy facilities could potentially overload remaining hospitals, especially during their peak periods. The majority of informants from case study hospitals (5 out of 7 sites), which are representative of these higher-occupancy facilities, expressed substantial reservations about their ability to treat additional patients from closing hospitals. Since 1995, seventeen general care hospitals have closed in NJ and more closures are currently under consideration. While continued consolidation may be appropriate in some areas, the ability of remaining hospitals to absorb additional volume will eventually diminish as more closures occur.

The frequency of ambulance diversion in NJ underscores the stress on capacity that is often experienced by hospitals in the state. Data from December 2006 and January 2007 reveal that, on average, an ambulance diversion occurs once every hour in NJ. This is similar to an often cited national statistic that there is a hospital on diversion about once every minute in the U.S. Moreover, the reported number of diversions in NJ is likely an undercount, since participation in the state's diversion alert system (used in this report) is not universal. Although ambulances may sometimes override hospitals' diversion requests, these requests provide a clear signal that the hospital staff does not feel completely ready to treat additional patients.

All of the case study participants agreed that better management of patient flow is crucial to avoid ambulance diversion and ED overcrowding more generally. Yet they varied substantially in the scale, scope, and success of their efforts. An important determinant of success in minimizing bottlenecks in the ED (and throughout the hospital) is the extent to which hospitals are able to coordinate across "silos" within the facility. Hospitals that have been successful are able to communicate information rapidly across units and respond quickly when a particular area is reaching capacity. Other hospitals, while attempting to do this, report a greater number of problems in achieving this level of coordination. Some of the more crucial areas of concern include ability to track patients through the entire hospital in real time, coordinating discharge

schedules with the incoming volume of inpatients, and coordinating use of resources between elective surgery and ED patients.

Despite the challenges faced on a daily basis, most case study participants felt that their facilities were reasonably well prepared to respond to a mass casualty disaster or pandemic. All case facilities have disaster management plans that include use of ordinarily non-clinical areas for patient overflow and plans for early discharge of existing patients during a surge. Some of these plans have been tested in exercises or in some cases applied to actual events that have occurred in their areas (e.g., small plane crash, building fire). However, reflecting conditions across the nation, coordination among hospitals that do not belong to a common system appears to be less developed.

Case study hospitals vary in the way they manage potentially avoidable utilization. Some have developed "fast track" systems to separate emergent from other cases in the ED. Two inner city facilities have responded to a large volume of ambulatory care sensitive utilization by developing elaborate case management and chronic disease management systems within the ED itself. While this is a clear departure from the traditional role of the ED, these facilities have decided that community need and patient preference have made this departure necessary. In the words of one participant, these actions represent the "wave of the future" in ED care.

NJ hospitals have also become important providers of care for mental health and substance abuse patients, particularly through the ED. However, case study hospitals have found it much more difficult to provide care for these patients. In contrast to their general acceptance of primary care patients in the ED, study participants expressed concern that their facilities are unable to provide the needed services for these patients. Patients with mental illness are described as being especially difficult to treat in the ED. ED staffing and physical space are not set up to provide mental health services. This sometimes affects the care of other patients as those requiring mental healthcare draw the attention of multiple clinicians and sometimes make other patients feel uncomfortable. Ultimately, a general desire was expressed for health policy

initiatives that would shift these patients out of acute care hospitals and into more appropriate settings.

Like their counterparts nationwide, hospitals in NJ face periodic stress on capacity, which often manifests itself in the form of delayed care in the emergency department (ED). These recurrent strains on capacity, more so than annualized occupancy rates, should be considered in evaluating the adequacy of hospital capacity in a particular community. Stress on hospitals can be understood and managed in terms of factors that affect the flow of patients through the ED. Hospitals have a great deal of ability to improve patient flow through established techniques of operations management.

However, a variety of broader health system issues limits the extent to which hospitals can control their patient flow. Trends in ED use are heavily influenced by the inability of patients to gain access to primary and other specialized care (especially mental health) outside the hospital. Streamlining patient flow through the ED is often hampered by the longstanding disparity in reimbursement for elective surgeries versus other hospital services, which makes it costly to disrupt elective surgery schedules. In the absence of broader health system reform, hospitals will have to find ways to serve an expanding range of patients in a constrained environment. Public policy efforts to assist hospitals in this task would benefit from regular surveillance of hospital patient flow measures and other efficiency indicators.

Hospital Capacity, Patient Flow, and Emergency Department Use in New Jersey

Derek DeLia, Ph.D.

Introduction

Emergency department (ED) utilization has been growing rapidly in the United States, overall and per capita (McCaig and Burt, 2004; Cunningham and May, 2003). Much of this growth is associated with ED visits for conditions that are either non-emergent or treatable in primary care settings (Cunningham and May, 2003). This trend has implications beyond the ED as it signals problems or dissatisfaction with the performance and accessibility of local primary care delivery systems (Billings, Parikh, and Mijanovich, 2000-a).

In 2006, the Institute of Medicine (IOM) released a report describing serious problems confronting hospital ED's across the nation (Institute of Medicine, 2006). These include various signs of overcrowding such as diversion of ambulances to other hospitals, patients "boarding" in the ED until an inpatient bed becomes available, and excessive wait times for care. The regular occurrence of ED overcrowding raises concern about the hospital sector's ability to respond to a mass casualty event such as a terrorist attack or natural disaster. Overcrowded ED's also create an environment where medical errors are more likely and overall quality of care is below its potential (JCAHO, 2004).

In response to concern about potential problems facing ED's in New Jersey (NJ), the New Jersey Department of Health and Senior Services (NJDHSS) commissioned the study "Emergency Department Utilization and Surge Capacity in New Jersey" to be conducted by the Rutgers Center for State Health Policy (CSHP). This document is the third and final project report. The first report documented trends in ED utilization and hospital bed capacity in NJ (DeLia, 2005). It also reviewed the national literature on ED utilization and overcrowding. The

second report analyzed potentially avoidable ambulatory care provided in the ED and potentially avoidable admissions that came through the ED (DeLia, 2006-a).

This report updates analysis from the first two reports and provides additional information about ambulance diversion and the management of patient flow through the ED. The report has four sections. The first provides an updated review of the literature on ED utilization, hospital crowding, and patient flow management. The second section provides analysis of ED utilization, hospital capacity, and ambulance diversion in NJ. The third section summarizes findings from a series of case studies that determined how hospital ED's and Federally Qualified Health Centers (FQHC's) in NJ manage patient flow and coordinate emergency and non-emergency services. The final section provides implications and conclusions.

Literature Review

ED Input, Throughput, and Output

It is now well recognized that the ability to provide service in the ED depends on multiple factors, most of which originate in other parts of the hospital or healthcare sector. To understand how these factors affect ED operations, Asplin et al. (2003) developed a conceptual model that consists of three components: ED input, throughput, and output.

ED input consists of any "condition, event, or system characteristic that contributes to demand for ED services." Input includes demand for emergency care, urgent care, and safety net care. Hospital ED's across the nation have seen an increase in the demand for all three types of care in recent years (McCaig and Nawar, 2006). Much of this demand occurs in rapidly growing metropolitan areas such as Phoenix, AZ and Miami, FL (Bazzoli et al., 2006). The phenomenon of suburban sprawl may exacerbate the effects of population growth on ED crowding. Suburban growth is associated with increasing rates of automobile accidents, but ED and trauma care resources are typically insufficient in these areas and lag behind population growth (Millard,

2007). This places even greater demands on urban ED's and trauma hospitals. In addition, hospital ED's experience an increase in demand when a nearby hospital closes its ED or ceases operations altogether (Sun et al., 2006).

A major contributor to the growth in ED visits overall is use of the ED for non-urgent care. This care is most frequently associated with the uninsured and patients covered by Medicaid who often face barriers to primary care. However, the majority of growth in non-urgent ED visits in recent years has occurred among the privately insured (Cunningham and May, 2003). Although conclusive studies do not exist, this growth is thought to be associated with a number of factors including difficulties in making physician appointments, the desire to receive immediate service without an appointment, and the desire to have tests and other procedures done in a single location.[1] There is also some evidence that physicians will refer patients to the ED in ambiguous cases, after hours, to avoid liability risks, or when they do not have the ability to perform recommended tests in their offices (Berenson et al., 2003; Studdert et al., 2005).

In addition, a large number of people in the U.S. are aging and living longer with complex diseases such as congestive heart failure, obstructive pulmonary disorder, kidney failure, and HIV-AIDS (Derlet and Richards, 2000). These conditions often generate acute episodes that lead to both avoidable and non-avoidable ED visits.

While clinicians and researchers often classify ED use as avoidable or non-emergent, these judgments are generally difficult for patients to make. One study found that 82% of patients with non-urgent conditions believe their situation was urgent (Gill and Riley, 1996). Misinterpretations of urgency can work in the other direction as well. A nationwide survey of ED patients found that 5% of patients who viewed their condition as non-urgent were subsequently hospitalized (Young et al., 1996). Although many patients realize that non-urgent care is available in the ED (Guttman et al., 2003), gray areas in the judgment of urgency remain important factors in the volume and composition of ED input.

ED throughput focuses on the length of time patients spend in the ED. Throughput includes triage, placement, and initial evaluation as well as diagnostic testing and treatments provided in the ED. Throughput is often determined by the cohesiveness of caregiver teams and the efficiency of processes used in the ED. Yet a number of broader factors can also add time to patient stays in the ED. As mentioned above, there is a growing number of individuals with chronic and complex illnesses who often come to the ED for evaluation and treatment. Individuals with multiple illnesses and comorbidities affect ED throughput by increasing the time and number of clinicians required to address medical concerns. As well, ED's with large numbers of non-English speaking patients in their service areas can experience throughput delays due to communication barriers and delays in obtaining language services.

Hospital ED's are treating a rising number of patients with mental health (Larkin et al., 2004) and substance abuse (McDonald et al., 2004) diagnoses. A number of ED physicians have attributed this rise to a decrease in the number of psychiatric beds and decreased funding for mental healthcare (ACEP, 2004). Patients with these diagnoses often require time-intensive treatment that directly affects ED throughput. Moreover, mental health and substance abuse are often listed as secondary diagnoses, which complicate the treatment of other medical conditions.

Growth in the number of "observation stays" in the ED can also affect throughput. A growing number of ED's contain observation areas to evaluate patients who may require inpatient admission but alternatively may be sent home if their condition stabilizes within 24 hours. For example, a patient with a severe episode of asthma may avoid an inpatient admission by remaining in an ED observation unit for 6 to 8 hours before stabilizing and returning home (Derlet and Richards, 2000). These observation stays have become increasingly common for several reasons that are related to reimbursement and technological advances (Coffey et al, 2002). As a result, more resource-intensive care is being provided in the ED. This intensity of care places additional demand on ED resources that make it difficult to provide rapid evaluation and

treatment of other patients. However, observation units also free up resources that would have been used in other hospital areas had the patient been admitted.

In teaching hospitals, ED throughput can be slowed down by the need to train residents in emergency medicine. It has been shown in other contexts that residents often generate inefficiencies by ordering more tests and processing patients more slowly than experienced physicians (Kuttner, 1999; DeLia, Duck, and Cantor, 2003). This may be especially problematic in the ED where the urgency of many conditions and the need to streamline patient flow require rapid decision making. Despite the inefficiencies, training the next generation of physicians remains an important mission of teaching hospitals. As a result, there is a need to balance potentially conflicting goals of training and efficiency in the ED.

ED output refers to the discharge of patients from the ED to the next phase of care as appropriate. Depending on the medical circumstances, the next phase may involve admission to the hospital, transfer to a psychiatric hospital, or release from the ED with a prescription of follow-up care from an ambulatory care provider. The inability of the healthcare system to provide the next phase of care often manifests itself in the form of bottlenecks in the ED and ultimately ED overcrowding.

One of the most commonly cited output bottlenecks facing the ED is the lack of available inpatient beds, especially intensive care unit (ICU) and telemetry beds (Bazzoli et al., 2003; GAO, 2003; Lewin Group, 2002; Derlet et al., 2001; Derlet and Richards, 2000). Lack of needed beds has been traced to hospital downsizing efforts in the 1980's and early 1990's. In an effort to drive out expensive excess capacity, hospitals took beds out of service and closed entire units or facilities. But as occupancy rates exceed 85-90%, the ability of hospitals to match the demand for inpatient care with available beds diminishes rapidly (Forster et al., 2003; Bagust et al, 1999). This mismatch between supply and demand for beds can lead to patient boarding or ambulance diversion.

While bed shortages can be severe, they are not necessarily persistent. Analysis of data from NJ found that hospitals routinely go through periods of extremely high occupancy followed by periods of low occupancy (DeLia, 2006-b). During periods of high occupancy, these hospitals often fail to meet federal benchmarks for the number of empty beds required to respond to a mass casualty emergency. But given the existence of recurring periods of low occupancy, better anticipation and management of variability in the demand for hospital care may play a large role in alleviating ED overcrowding. (This idea is developed further below.) Bottlenecks in the placement of patients into sub-acute facilities may also disrupt the flow of patients through the ED and other hospital units.

Even when beds are available, staffing for those beds is often scarce. Hospitals across the nation have been struggling to fill vacancies in the face of a nationwide shortage of nurses (U.S. Department of Health and Human Services, 2002). Hospitals also struggle to recruit specialist physicians who will work on-call to care for patients in the ED (American College of Emergency Physicians, 2006-a). In the past, specialists would spend time on-call as part of gaining and maintaining their admitting privileges, while also accessing a source of paying patients. But today specialists have other opportunities to work for better pay during more convenient hours in specialty hospitals and outpatient surgery centers. These opportunities make it difficult for hospitals to place too many demands on specialists who often generate substantial revenues through elective surgeries. Since the ED is a high-risk environment, concern about malpractice liability is another factor that dissuades specialists from making themselves available on-call to the ED. Liability issues may be especially salient in NJ, as the American College of Emergency Physicians recently gave the state an F for its malpractice environment in its National Report Card on Emergency Care (ACEP, 2006).

Length of stay in the ED may be increased by the need to arrange follow-up care for patients. Alternatively, ED clinicians may provide additional services with the anticipation that follow-up care will not be available, particularly for the uninsured and other underserved

patients. In some cases, emergency physicians will simply admit patients if appropriate outpatient care cannot be arranged (Asplin et al., 2003). Also, failure to obtain post-ED follow-up care may lead to repeat visits affecting ED input as well as output.

Measurement of ED Overcrowding

Although the problem has been well documented, rigorous measures of ED overcrowding are not fully developed and universally available for research and evaluation. At issue is the reliability of overcrowding measures across facilities and regulatory jurisdictions. For example, ambulance diversion is often taken as a sign of an overcrowded ED. However, hospitals have different criteria for going on divert status. In some parts of the nation, hospitals can divert ambulances simply to avoid additional patients that have been diverted from other hospitals in an apparent gaming of the system (IOM, 2006). The incentives to practice "defensive diversion" are quite strong, as the ED is often a source of uncompensated hospital admissions among the uninsured. Yet in other parts of the nation, such as Fresno County, CA (Anderson, 2003) and Memphis, TN (EMS Insider, 2003), ambulance diversion has been banned entirely. Other crowding indicators such as "excessive waiting times" also suffer from lack of standardization.

To generate consensus and standardization of ED overcrowding measures, Solberg et al. (2003) received funding from the federal Agency for Healthcare Quality and Research (AHRQ) to convene an expert panel who reviewed a list of 113 potential measures. Using the input/throughput/output framework described above, the authors narrowed the original list to 38 measures (15 input, 9 throughput, and 14 output). Some of these measures such as hospital census and occupancy rates can be calculated with existing administrative databases. Many others require much more detailed data about hospital processes. Examples include patient waiting time from registration to provider contact, EMS waiting time at the hospital, and the ED occupancy rate defined as the number of registered ED patients divided by the number of staffed treatment areas at a specific point in time. Since this information is typically contained in

hospitals' internal information systems, it is possible to create a statewide reporting and surveillance database to monitor ED overcrowding. The major challenge of doing so would involve the creation of common measures and definitions and coordination of data reporting across hospitals.

Management of Patient Flow

For some hospitals, the alleviation of overcrowding may involve additional capacity, staffing, or physical space. However, there is a well-developed school of thought, which argues that these extensive and generally costly approaches should not be tried until a hospital has fully evaluated and optimized the flow of patients though the ED and related units. This school emphasizes that adding new capacity to an inefficient system may just create larger facilities that remain overcrowded. This situation occurred at Albert Einstein Medical Center in Philadelphia, PA. After doubling the capacity of its ED, the hospital still diverted ambulances 100 to 150 hours each month due to bottlenecks in other parts of the hospital (Greene, 2007).

Several national organizations have invested substantial resources to promote improvements in hospital patient flow. These include the Joint Commission on Accreditation of Healthcare Organizations (JCAHO), the Institute for Healthcare Initiatives (IHI), the Robert Wood Johnson's Urgent Matters Program, and the American College of emergency Physicians. Some hospitals have worked independently with private consultants to optimize patient flow. These efforts have generated a growing menu of strategies that hospitals may adapt and apply.

Hospitals have few options to affect ED input as this is typically driven by unexpected emergencies and patient access to other sites of care in non-emergencies. Therefore, most patient flow strategies focus on streamlining throughput and output. Although controlled studies are rare, recent reports by the IOM (2006) and JCAHO (2004) document a number of promising avenues that hospitals may pursue.

For example, one innovative throughput strategy is known as zone nursing. Typically, nurses treat ED patients randomly as they arrive. This results in nurses moving to and from different areas with little control over their workflow. Under zone nursing, nurses are assigned to specific areas to minimize the distance and time required to treat multiple patients. The general concept of "zone co-location" is now being tested at Boston Medical Center, which has achieved early success with zone nursing (Wilson and Nguyen, 2004). Other promising throughput strategies include "fast tracking" non-urgent patients to lower levels of care, streamlining ED patient registration, and dedicated support for lab work and clinical consults ordered by ED clinicians.

Many other strategies focus on improving ED output by streamlining patient flow in other units of the hospital. This may be done through coordinated bed management where a "bed czar" or patient flow team constantly monitors the flow of patients through all units of the hospital. These individuals may use a variety of unit assessment tools such as "traffic light systems" to coordinate operations across units. For example, a unit operating at less than or equal to 85% of its capacity would signal green to allow patients to flow in as directed. If occupancy exceeds 85%, the unit will signal yellow, which means it will accept more patients but may soon run out of capacity. A signal of orange would indicate utilization just below capacity. At this stage, the patient flow leader would move to quickly direct more resources (e.g. nurses) to the unit. A signal of red would indicate the unit is operating at full capacity. At this stage, no new patients would be accepted until additional resources are added or existing patients are moved to another area. After implementing this model, Luther Midelfort, a Mayo Health Systems hospital in Eau Claire, WI, saw a steady shifting of unit codes from red to green during a six-month pilot (JCAHO, 2004).

Other output strategies rely on more sophisticated tools from operations research. For example, researchers have highlighted the need to manage variation in the demand for hospital care. This research emphasizes a distinction between "natural" and "artificial" variation (Litvak,

Buerhaus, Davidoff et al., 2005; Litvak, Long, Cooper et al., 2001). Natural variation is the result of random processes that are beyond the hospital's control. Examples include traffic accidents and heart attacks. Although these processes are random, they occur repeatedly and can be forecasted to some degree with statistical models. In contrast, artificial variation is the result of processes that are often overlooked but within the control of the hospital. The most common example is the scheduling of elective surgery. To meet the needs of surgeons, surgeries are often scheduled in heavily loaded "blocks" Monday through Thursday. During these times, elective surgeries compete with the ED for surgical, critical care, and recovery resources. This competition can lead to a cycle of ambulance diversion and cancelled surgeries as the supply of these resources are outstripped by demand. In the case of naturally varying patient demand, tools from mathematical queuing theory can be used to forecast and prevent these bottlenecks from occurring. However, since the scheduling of surgeries is not truly random (i.e., artificial), these tools do not apply.

Instead some hospitals have tried to minimize the artificial variability in their patient loads by smoothing out their elective surgery schedules. This involves a reduction in scheduled surgeries Monday through Thursday and an increase Friday through Sunday. This approach was illustrated by a demonstration at Boston Medical Center, which took place between April 1 and September 30, 2004 (Urgent Matters, 2004). During the same months in 2003, BMC performed 157 emergency surgeries and 334 elective surgeries were cancelled or delayed due to the unexpected demand for emergency surgeries. Based on this prior experience, the demonstration team calculated that it could almost always meet the demand for emergency surgery without disrupting previously scheduled ones by keeping one operating room in reserve for emergencies.

The results of the demonstration were viewed as highly successful. From April 1 to September 30 of 2004, 159 emergency surgeries were performed at BMC (compared to 157 during the same period in 2003) and only 2 elective surgeries were disrupted (compared to 334 during the same period in 2003).

This approach required a great deal of cooperation from surgeons who were asked to dramatically change their usual method of scheduling surgeries. Under the usual method, which is common for many hospitals, surgeons would "own" blocks of time in an operating room each week and would schedule patients into these blocks as needed. Under the new method, surgeons worked with a group of schedulers who would coordinate when and in which room elective surgeries would take place on an as-needed basis. It remains to be seen whether other facilities would be able coordinate its surgeons and hospital staff to achieve similar results.

A variety of less sophisticated strategies are also promising for reducing ED output bottlenecks. These include the following:

- Minimize discharge waiting times by rescheduling physicians' discharge rounds when occupancy rates increase,
- Use housekeeping SWAT teams to clean and prepare beds as soon as patients are discharged instead of cleaning all empty beds in an entire unit on a pre-set schedule,
- Use discharge lounges where patients can complete paperwork, receive follow-up instructions, and wait for transportation without occupying an inpatient bed.

Despite their potential, methods to improve patient flow are not universally implemented by hospitals. This may be expected as many methods are fairly new and have not been demonstrated on a large scale. However, other factors may stand in the way of patient flow improvement even as best practices are disseminated. While patient flow management is essentially a hospital-wide enterprise, the consequences of suboptimal flow tend to be concentrated in the ED, and therefore, hidden from other parts of the hospital. As a result, decision makers in other areas may not perceive patient flow as an urgent problem. Also, hospital reimbursement may create incentives that work against efforts to optimize patient flow and minimize ED overcrowding (IOM, 2006).

Scheduled surgeries are typically the most profitable services provided by hospitals (Ginsburg and Grossman, 2005). In contrast, admissions through the ED often involve uninsured

patients or patients in need of less profitable services (e.g., treatment for pneumonia). Patient flow improvement measures that disrupt elective surgery schedules may induce surgeons and their patients to take their business elsewhere. Similarly, unclogging the ED may open more avenues for money-losing cases to enter the hospital.

The IOM recently called on the JCAHO to strengthen existing standards to "sharply reduce and ultimately eliminate ED crowding, (patient) boarding, and (ambulance) diversion (IOM, 2006)." Nevertheless, recommendations like these have faced strong opposition and remain controversial. At one time the JCAHO considered an accreditation standard that would have banned the practice of patient boarding in the ED. It also drafted requirements for better coordination with Emergency Medical Services (EMS) and other agencies to minimize ambulance diversion. While these initiatives were supported by emergency physicians, they were not strongly endorsed by hospital executives and associations (Morissey, 2004). In the end, JCAHO revised its directives to emphasize patient flow through the entire hospital while removing specific directives about ED overcrowding.

As mentioned above, some jurisdictions have acted independently to ban ambulance diversion on their own. Others have developed their own systems to better coordinate EMS response when hospitals are on diversion and have set uniform standards for when diversion is appropriate. In NJ, hospitals can voluntarily participate in a statewide ambulance diversion alert system. Data from that system is analyzed in the next section of the report.

Hospital Surge Capacity

The prevalence of hospital overcrowding raises concern about the capacity of hospitals to treat a sudden surge of patients that may arise from a disaster or pandemic. An entire planning and research apparatus has been created to address these issues, which has accelerated its work since the terrorist attacks of September 11, 2001. Recent evaluations have suggested that hospitals are better prepared to respond to disasters since 9/11 but still remain below the level

that is required (IOM, 2006; Schur et al., 2004). While it is beyond the scope of this report to fully survey the disaster planning literature, it is useful to review the findings on hospital surge capacity in light of the conditions currently affecting ED utilization and patient flow on a daily basis.

An important aspect of surge capacity is the availability of beds to treat a sudden surge of patients. As a planning benchmark, the Health Services and Resources Administration (HRSA) has set a surge capacity standard of 500 beds immediately available for every million people living in an area (AHRQ, 2004). In NJ, the number of empty staffed beds often fails to meet this standard, while the standard typically is met in terms of licensed beds (DeLia, 2006-b). There has been no national study of this issue.

Given the difficulties involved maintaining large amounts of excess capacity, a major patient surge will require hospitals to expand well beyond their normal capacity by creating additional patient treatment areas. This may involve placing beds or stretchers into cafeterias and conference rooms or the use of specialized tents and mobile facilities that can be placed near the hospital building. Although most hospitals have plans in place to ramp up surge capacity in this way, a survey of hospitals in 2003 found that 39% had no developed plans to do so (Niska and Burt, 2005). The IOM report also raised specific concerns about limitations in the availability of negative pressure rooms to prevent the spread of airborne pathogens as well as shortages of equipment such as mechanical ventilators and decontamination showers.[2]

During a major disaster, hospitals may create surge capacity by rearranging existing patterns of care. The quickest and easiest way of doing this would involve postponing elective procedures and redirecting patients seeking non-urgent care. A more difficult, but potentially important, action involves altering the standards of care that patients receive. Under ordinary circumstances, hospitals give priority to the most critical patients first. But when responding to a disaster, hospitals may need to change priorities. After convening a panel of experts in healthcare, medicine, emergency management, and bioethics, the AHRQ issued a

recommendation that healthcare providers responding to a mass casualty event should focus on the goal of maximizing the number of lives saved (AHRQ, 2005). The recommendation explicitly recognizes that this will prevent healthcare providers from "doing everything possible to save a life" as they economize scarce resources during a surge. The agency recommends further that public and private planners develop triage systems and legal frameworks to implement this recommendation as part of disaster planning activities.

The AHRQ has also sponsored research to eventually assist hospitals in the process of "reverse triage" during a mass casualty event. This research is designed to guide hospitals that need to discharge patients early in an effort to create surge capacity for incoming patients (Kelen, Kraus, McCarthy et al., 2006). Preliminary analysis has identified five patient disposition categories ranked by risk of adverse medical consequences resulting from early discharge. These categories can be used to compare the risks associated with early discharge to the risks associated with inadequate capacity to treat a surge of patients.

Data Analysis

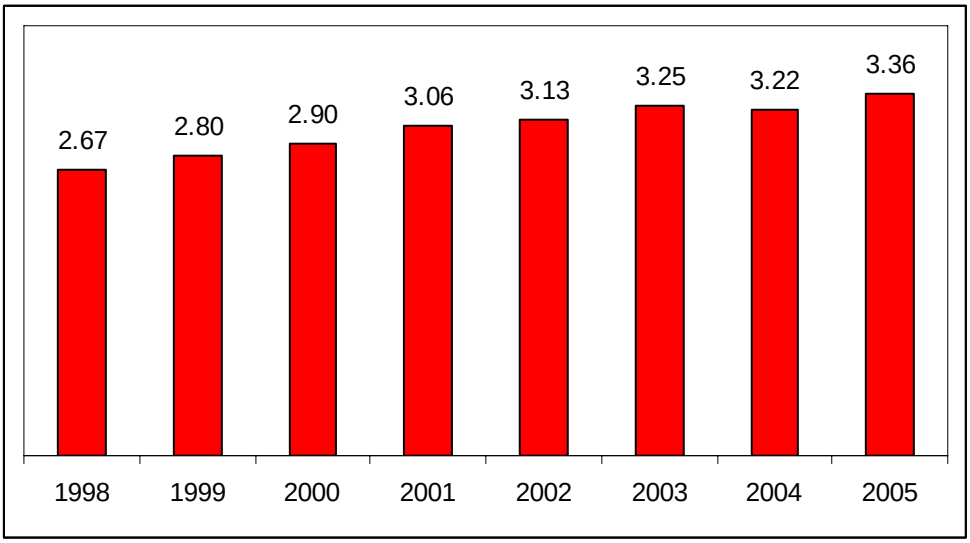
This section of the report provides updated analysis of ED utilization and inpatient surge capacity in New Jersey. First annual trends in hospital utilization, occupancy, and potentially avoidable ED use are analyzed. Then daily variation in hospital occupancy rates and surge capacity is analyzed. Data are obtained from Uniform Billing (UB-92) records and Acute Care Hospital (ACH) Cost Reports from 1998 to 2005. Due to limitations in data availability, analysis of patients who were treated and released from the ED is restricted to 2004 and 2005 and analysis of daily variation is retricted to the years 2003 through 2005. For certain analyses (noted below), data are obtained from Quarterly Hospital Utilization (B-2) Reports and the U.S. Census Bureau. Since trends from 1998-2003 were analyzed in the first project report, this report emphasizes changes since 2003.

This section concludes with a brief analysis of recent ambulance diversion activity in NJ in December 2006 and January 2007. As noted above, ambulance diversion is not a pure measure of hospital overcrowding since the criteria for diversion varies across hospitals. Nevertheless, ambulance diversion remains an important indicator of hospitals' ability to manage their patient flow and a clear barrier to healthcare access. Data on ambulance diversion is obtained from the Jemstat system, which the NJ Office of Emergency Medical Services (EMS) makes available to hospitals and the EMS community to share real time information about diversion activity. Although participation in Jemstat is not universal, the data provide a snapshot of the frequency of ambulance diversion among Jemstat participants and a sampling of reasons for its occurrence.

Annual trends

After rising steadily from 1998 to 2003, total ED visits in NJ fell slightly in 2004 (Figure 1). In 2005, these visits rebounded to 3.36 million representing the highest annual volume of ED visits for the study period.

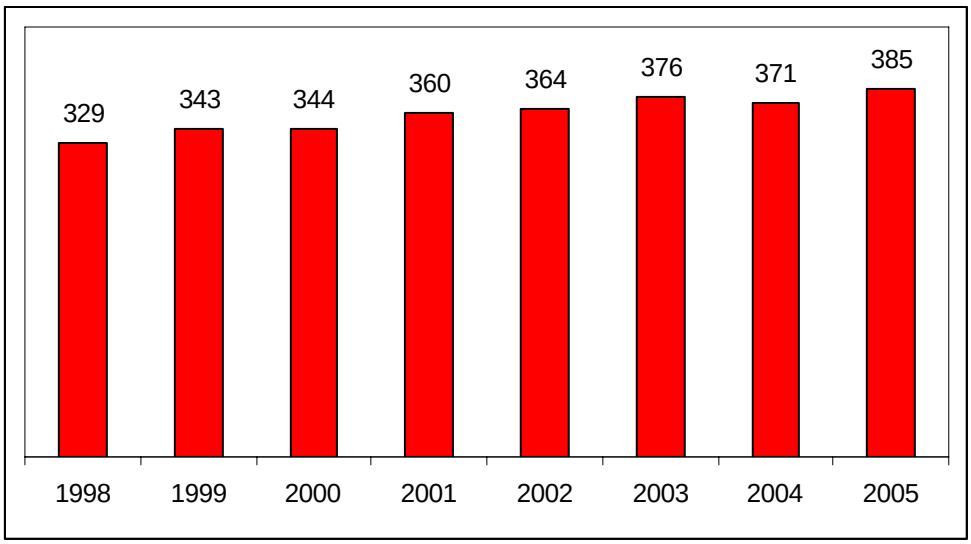
Figure 1: Total ED Visits in NJ (in millions), 1998-2005



Source: Acute Care Hospital (ACH) Annual Cost Report

From 2003 to 2005, the NJ population grew by 1% but total ED visits grew by 3%. As a result, ED visits per 1,000 population reached its highest level of the study period in 2005 despite a drop in 2004 (Figure 2).

Figure 2: ED Visits per 1,000 Residents in NJ, 1998-2005



Sources: Acute Care Hospital (ACH) Annual Cost Report, U.S. Census Bureau

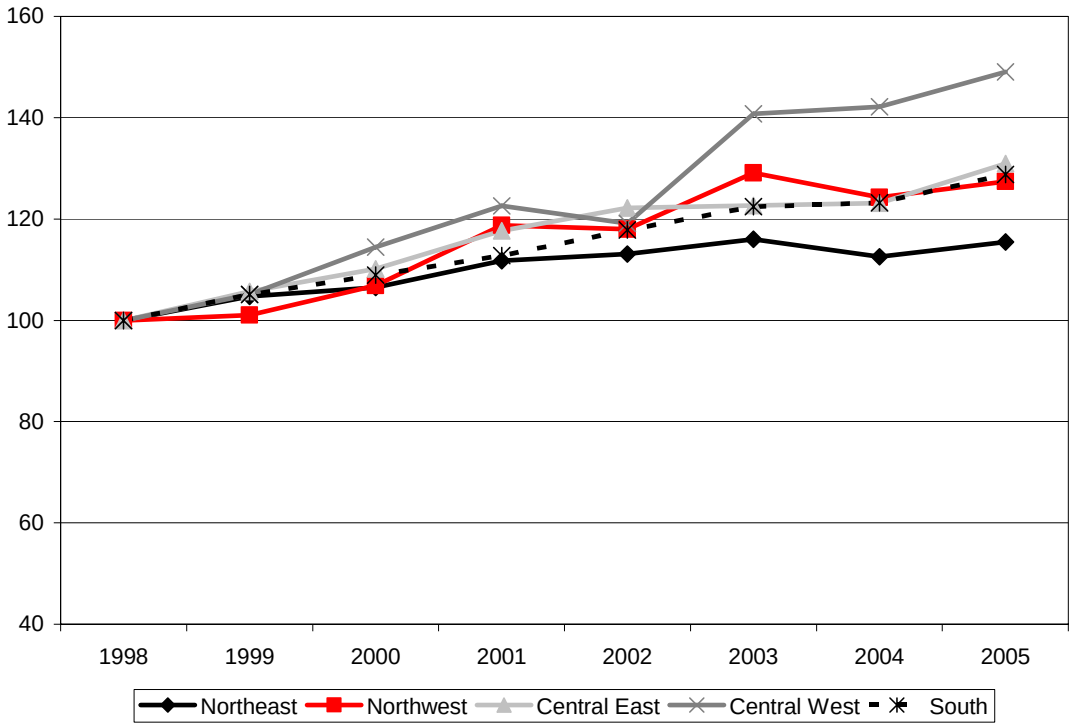
Growth in ED visits varies by region of the state. As in previous reports, regions are defined according to the state's Hospital Emergency Response and Medical Information System (HERMIS). Specifically, the state is divided into five non-overlapping regions as follows:

1. Northeast: Bergen, Passaic, Essex, and Hudson Counties
2. Northwest: Sussex, Warren, and Morris Counties
3. Central East: Middlesex, Union, Monmouth, and Ocean Counties
4. Central West: Mercer, Hunterdon, and Somerset Counties
5. South: Burlington, Camden, Gloucester, Salem, Cumberland, Atlantic, and Cape May Counties

Since the total number of ED visits also varies by region, Figure 3 shows the percentage change in these visits since 1998. The level of visits is set at 100 for each region in 1998 and the

data points for the remaining years show the percentage change relative to that base year. Although the Northeast accounts for the largest share of ED visits (33% in 2005), it experienced the slowest growth among the HERMIS regions in recent years and even declined slightly in 2004 (Figure 3). In contrast, ED visits in the Central West region grew rapidly in 2003 and continued growing through 2005. As a result, this region's share of statewide ED visits grew from 7.1% in 1998 to 8.4% in 2005. ED visits in other regions grew at roughly the same pace as the state overall.

Figure 3: Percentage Change in ED Visits by Region of NJ, 1998-2005



Sources: Acute Care Hospital (ACH) Annual Cost Report, U.S. Census Bureau

ED visits patterns are driven partly by differences in population growth across the HERMIS regions (Table 1). With some exceptions, most regions grew at a slow and steady pace during the study period. Growth in the Northeast, which is the most heavily populated region,

flattened out after 2002. The Central West, which led the state in ED visit growth, also led in total population growth. This region's population grew at rate of approximately 1.5% per year compared to 1.1% for the state overall.

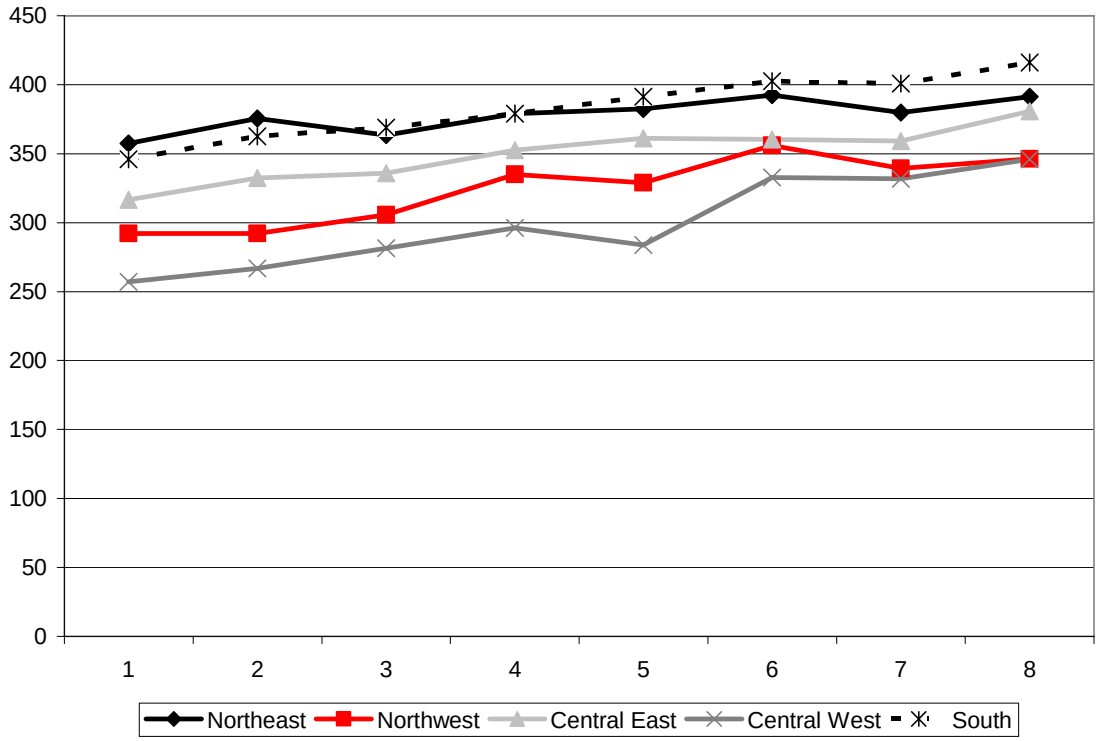
Table 1: New Jersey Population in Millions, 1998-2005

	1998	1999	2000	2001	2002	2003	2004	2005
New Jersey	8.12	8.14	8.41	8.51	8.59	8.64	8.70	8.72
Northeast	2.65	2.64	2.78	2.79	2.80	2.80	2.81	2.80
Northwest	0.70	0.71	0.72	0.73	0.73	0.74	0.75	0.75
Central East	2.31	2.33	2.40	2.44	2.47	2.49	2.51	2.52
Central West	0.74	0.75	0.77	0.78	0.80	0.80	0.81	0.82
South	1.71	1.72	1.75	1.77	1.79	1.80	1.82	1.84

Source: U.S. Census Bureau

Population-based rates of ED use also vary by region (Figure 4). Throughout the study period, the Northeast and the South had the highest rates of ED use per 1,000 residents. The Central West and Northwest had the lowest. Regions with smaller rates of use had faster growth in these rates so that by 2005, the difference in per capita ED use between the highest and lowest regions became smaller. In addition, the trend in per capita ED use has been moving slowly upward for all regions.

Figure 4: ED Visits per 1,000 Residents by Region of NJ, 1998-2005



Sources: Acute Care Hospital (ACH) Annual Cost Report, U.S. Census Bureau

The composition of ED visits varies between those that led to inpatient admission and those where patients were treated and released the same day (Table 2). Almost half of all treat-and-release ED visits were attributable to privately insured patients followed by self-pay/uninsured who account for almost one-fourth of these visits. In contrast, almost half of all admissions through the ED are attributable to Medicare patients followed by the privately insured who account for approximately one-third of these admissions. These percentages are similar to those reported for prior years (DeLia, 2006-a).

Medicaid utilization appears fairly low in these data. This may reflect miscoding in the UB data as Medicaid managed care patients are often coded as being enrolled in a private HMO. Although the UB system added fields for Medicare and Medicaid HMO's in 2003, the fields appear to be underutilized. Therefore, Medicaid (and to a lesser extent Medicare) utilization is probably understated and private insurance overstated in these data.

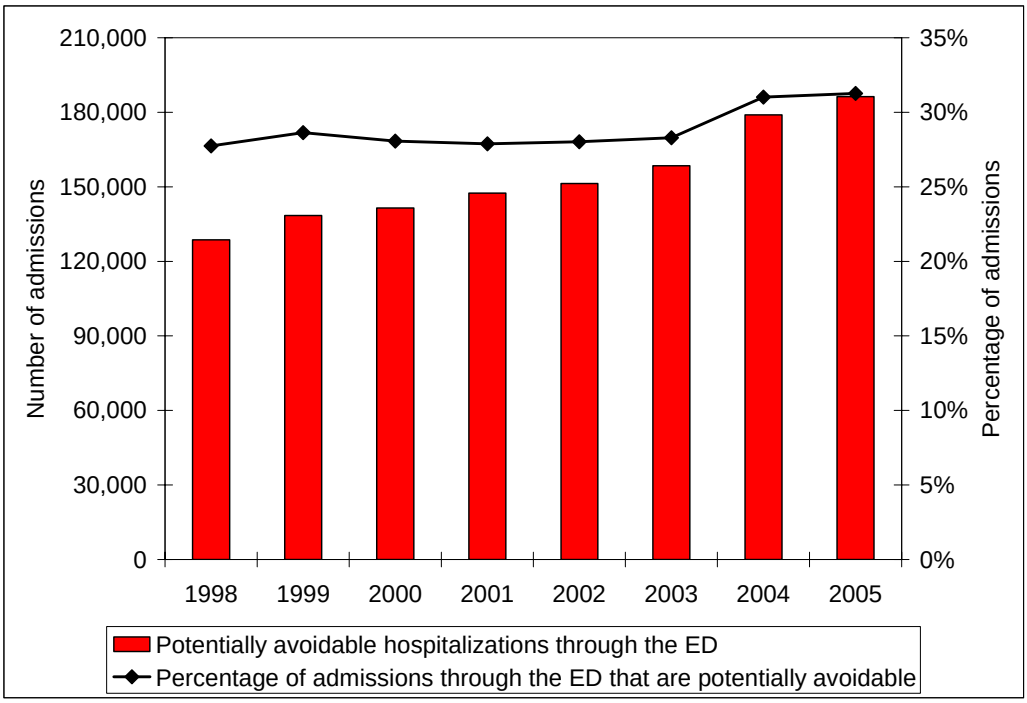
Table 2: ED Volume in NJ by Expected Payer, 2005

	Treat-and-release ED visits		Inpatient admissions through the ED	
	Total	Potentially avoidable	Total	Potentially avoidable
Total volume	2,591,647	1,246,740	595,716	186,284
Percentage of volume by expected payer				
Private insurance [a]	49%	50%	32%	27%
Medicaid [b]	9%	11%	6%	6%
Medicare [b]	12%	11%	48%	57%
Uninsured/self-pay	23%	25%	11%	9%
Other [c]	7%	4%	3%	1%

Source: NJ Uniform Billing (UB-92) Records
[a] Private insurance includes HMO's, commercial indemnity plans, and Blue Cross Blue Shield Plans.
[b] Patients in Medicaid and Medicare HMO's may be classified as private insurance.
[c] Other insurance is a residual category that includes most frequently worker's Compensation and No Fault Insurance as well as government programs such as CHAMPUS and Veteran's Administration Health Coverage.

A growing number of inpatient admissions through the ED are potentially avoidable (Figure 5). Potentially avoidable admissions are measured as admissions for ambulatory care sensitive (ACS) conditions (Billings et al., 1993; DeLia, 2004). These admissions are typically avoidable when patients have access to timely and effective primary care (e.g., asthma, congestive heart failure). From 1998 through 2003, ACS admissions as a percentage of total ED admissions remained approximately constant at about 28%. This percentage rose to 31% in 2004 and remained at that level in 2005.

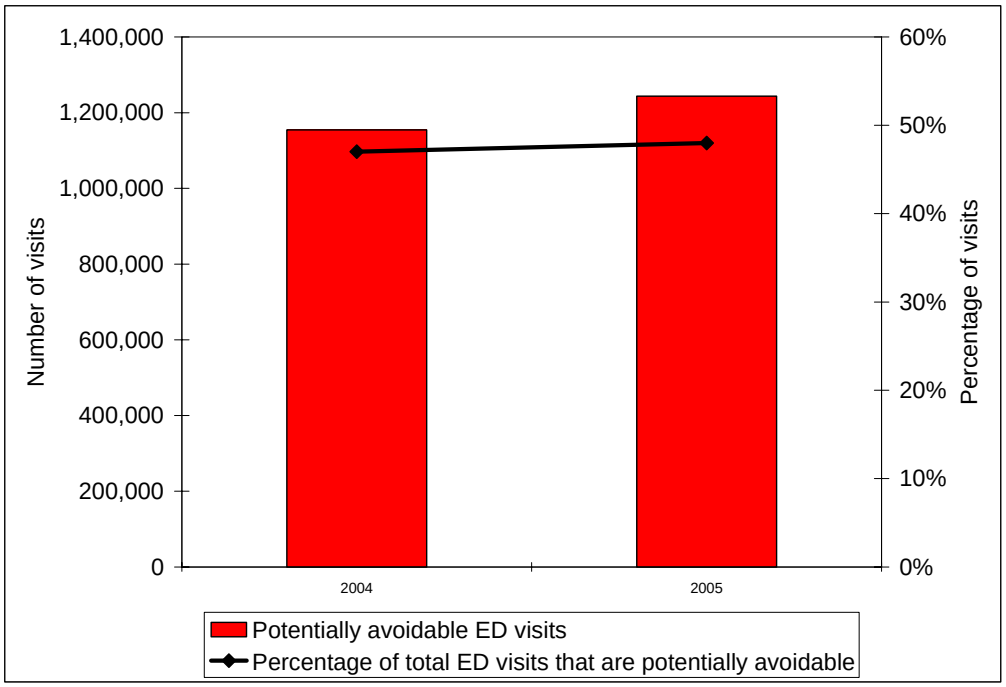
Figure 5: Potentially Avoidable Hospital Admissions through the ED in NJ, 1998-2005



Source: NJ Uniform Billing (UB-92) Records

A large volume of patients treated and released from the ED also present with conditions that are either avoidable or treatable outside of the ED (Figure 6). These conditions are defined as those falling into one of the following three categories as defined by Billings, Parikh, and Mijanovich (2000-b): non-emergent, emergent/primary care treatable, or emergent ED care needed but preventable/avoidable.[3] Although the volume of potentially avoidable treat-and-release ED visits grew from 2004 to 2005, they have remained almost constant as a percentage of total treat-and-release ED volume. Specifically, just under half of all treat-and-release patients come to the ED with conditions that are amenable to primary care.

Figure 6: Potentially Avoidable Treat and Release ED Visits in NJ, 2004-2005

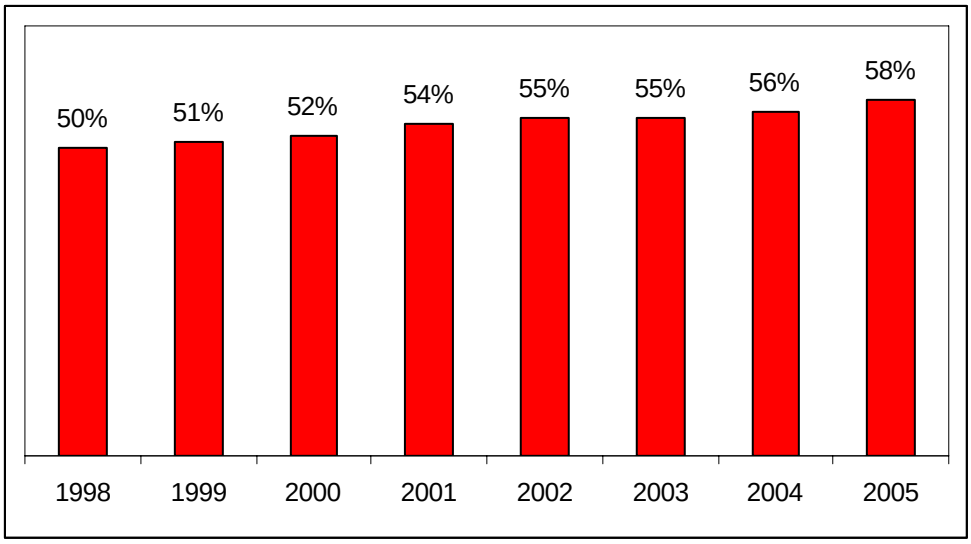


Source: NJ Uniform Billing (UB-92) Records

The composition of potentially avoidable ED visits and admissions is similar to that for total volume. One exception is that Medicare patients account for a larger percentage of ACS admissions through the ED than total ED admissions.

In recent years, the ED has grown in importance as a source of inpatient admissions for NJ hospitals. In 1998, 50% of all inpatient admissions in NJ originated in the ED (Figure 5). By 2003, this percentage had increased to 55%. This increase continued in the following two years so that by 2005, 58% of all admissions came via the ED.

Figure 5: Percentage of Total Inpatient Admissions Originating in the ED in NJ, 1998-2005



Source: NJ Uniform Billing (UB-92) Records

As described above, the availability of inpatient beds has been identified as one of the drivers of ED overcrowding. Prior research has shown that maintained beds rather than licensed beds are much more important as a limiting factor in providing capacity for inpatient care (DeLia, 2005; DeLia, 2006-b). Therefore, capacity analysis in this section stresses the use of maintained instead of licensed beds.

Table 3 shows annual changes in inpatient utilization, capacity, and occupancy by region of NJ from 1998 to 2005. With a few exceptions, the Table generally shows a contraction in capacity (i.e., maintained beds) and use of inpatient care (i.e. patient days). This contraction reflects a combination of factors including reductions in length-of-stay, shifting of inpatient procedures to an outpatient basis, hospital closures, and downsizing in remaining hospitals. During the study period, 13 hospitals closed in NJ (Accenture, 2006). Closures occurred most often in the Northeast (6) followed by the South (4) and the Central East (3). No other regions experienced a hospital closure from 1998 to 2005. Interestingly, the Central West, which did not experience any closures during this time, experienced the greatest reduction in maintained beds (i.e., a decrease of 15%).

Table 3: Total Inpatient Utilization, Capacity, and Occupancy by Region, 1998-2005

	1998	1999	2000	2001	2002	2003	2004	2005
New Jersey								
Days[a]	6,398,999	6,382,716	6,288,356	6,413,688	6,361,131	6,427,167	6,265,448	6,239,658
Beds[b]	26,153	25,533	24,603	24,588	24,289	24,095	23,789	23,570
OR[c]	67%	68%	70%	71%	72%	73%	72%	73%
Northeast								
Days[a]	2,694,189	2,686,887	2,633,881	2,595,205	2,616,546	2,629,053	2,529,547	2,468,893
Beds[b]	10,653	10,547	10,137	10,017	10,004	9,877	9,402	9,181
OR[c]	69%	70%	71%	71%	72%	73%	74%	74%
Northwest								
Days[a]	493,871	480,278	464,616	480,183	484,540	497,357	498,811	498,995
Beds[b]	2,038	1,966	1,911	1,973	1,866	1,893	1,930	1,969
OR[c]	66%	67%	67%	67%	71%	72%	71%	69%
Central East								
Days[a]	1,690,002	1,709,691	1,743,015	1,748,286	1,759,934	1,758,656	1,709,242	1,706,130
Beds[b]	6,773	6,557	6,498	6,247	6,402	6,310	6,390	6,291
OR[c]	68%	71%	73%	77%	75%	76%	73%	74%
Central West								
Days[a]	427,740	422,436	385,187	392,006	405,678	420,465	416,793	422,018
Beds[b]	1,964	1,931	1,647	1,660	1,724	1,667	1,669	1,670
OR[c]	60%	60%	64%	65%	64%	69%	68%	69%
South								
Days[a]	1,093,197	1,083,424	1,061,657	1,198,008	1,094,433	1,121,636	1,111,055	1,143,622
Beds[b]	4,725	4,532	4,410	4,691	4,293	4,348	4,398	4,459
OR[c]	63%	65%	66%	70%	70%	71%	69%	70%

Source: Acute Care Hospital (ACH) Annual Cost Report
[a]Total inpatient days
[b]Total maintained beds
[c]Occupancy rate = Days/(365 x beds)

Maintained bed occupancy rates generally rose from 1998 to 2005 reflecting the longer term trend among hospitals nationwide to operate with less excess capacity (Bazzoli et al., 2003). Nevertheless, no region in the state experienced an annual occupancy rate above 75%. As noted above, occupancy above 85% may raise concern about capacity constraints. Occupancy of 75% is well under this benchmark.

Patient days and maintained beds in the intensive care unit (ICU) and critical care unit (CCU) exhibit more fluctuation than total days and maintained beds (Table 4). ICU/CCU occupancy rates are often higher than occupancy rates overall. But with only a few exceptions, these occupancy rates remained below 85% across the state for most years of the study.

Table 4: Intensive Care Unit (ICU)/Critical Care Unit (CCU) Utilization, Capacity, and Occupancy by Region, 1998-2005

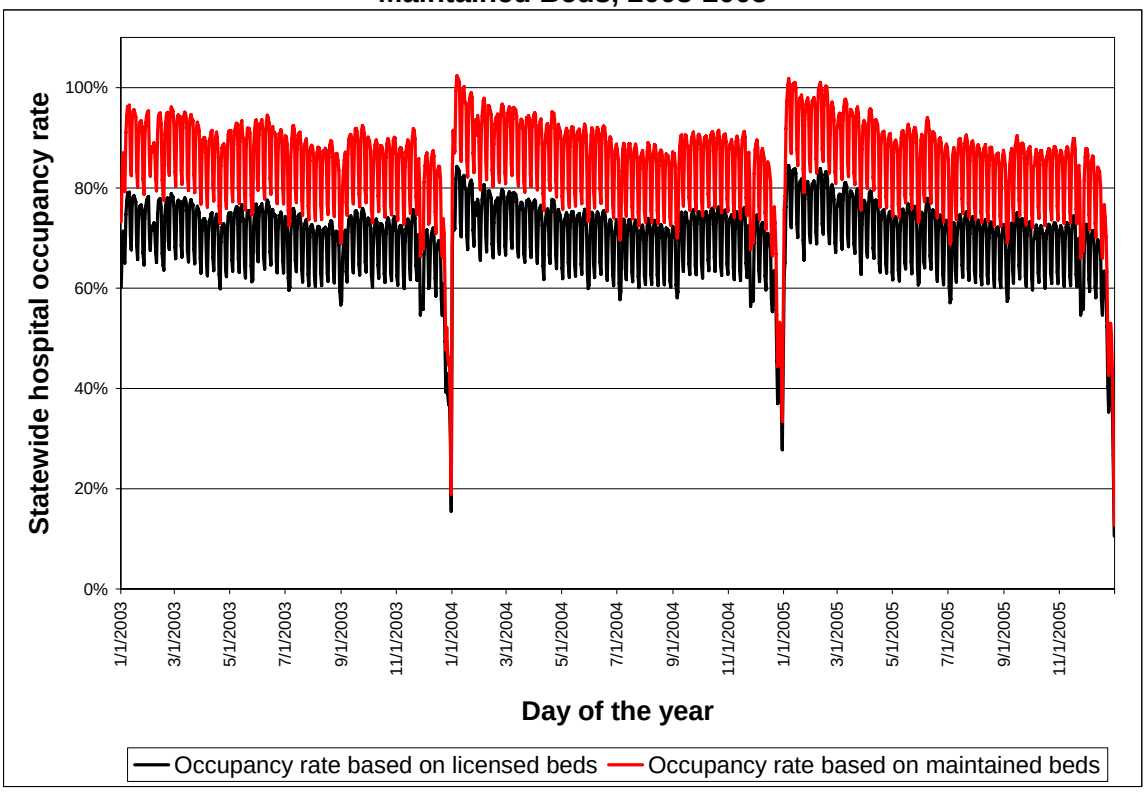
	1998	1999	2000	2001	2002	2003	2004	2005
New Jersey								
Days[a]	531,799	541,838	532,579	537,260	532,105	527,852	522,366	515,387
Beds[b]	1,961	1,922	1,853	1,865	1,855	1,870	1,848	1,888
OR[c]	74%	77%	79%	79%	79%	77%	77%	75%
Northeast								
Days[a]	213,578	221,827	225,914	217,775	213,685	214,844	203,757	201,583
Beds[b]	783	788	788	784	795	802	737	756
OR[c]	75%	77%	79%	76%	74%	73%	76%	73%
Northwest								
Days[a]	38,058	39,348	24,758	24,302	30,277	23,970	31,526	24,461
Beds[b]	133	132	94	95	93	96	127	106
OR[c]	78%	82%	72%	70%	89%	68%	68%	63%
Central East								
Days[a]	149,166	150,731	150,199	145,140	145,110	144,333	144,877	141,295
Beds[b]	555	527	507	482	489	500	493	511
OR[c]	74%	78%	81%	82%	81%	79%	81%	76%
Central West								
Days[a]	33,711	36,815	36,338	37,141	36,951	37,911	37,365	36,957
Beds[b]	136	134	132	128	132	132	134	134
OR[c]	68%	75%	75%	79%	77%	79%	76%	76%
South								
Days[a]	97,286	93,117	95,370	112,902	106,082	106,794	104,841	111,091
Beds[b]	354	341	332	376	346	340	357	381
OR[c]	75%	75%	79%	82%	84%	86%	80%	80%

Source: Acute Care Hospital (ACH) Annual Cost Report
[a]Total inpatient days
[b]Total maintained beds
[c]Occupancy rate = Days/(365 x beds)

Daily Variation in Hospital Utilization

The analysis above suggests that a fair amount of hospital surge capacity exists across all regions of NJ. However, that analysis is based on annual occupancy rates that do not reflect day-to-day variation in hospital use. Figure 6 shows statewide occupancy rates for all NJ hospitals combined for each day of the year from 2003 to 2005. The numerator in the occupancy rate is the number of inpatients occupying a bed on each day. Separate calculations are done with maintained beds and licensed bed in the denominator. Although daily inpatient use can be measured using UB-92 data, bed supply data are available on a quarterly basis only in Hospital Utilization (B-2) Reports. Therefore, the corresponding quarterly number is used to approximate the daily number of beds. While this adds some error to the occupancy measures, the error is likely to be small since hospital beds usually do not vary substantially within quarters, especially relative to inpatient census.

Figure 6: Daily Variation in Statewide Hospital Occupancy Rates: Licensed Versus Maintained Beds, 2003-2005



Sources: NJ Uniform Billing (UB-92) records and Quarterly Hospital Utilization (B-2) Reports

Figure 6 shows wide variation in day-to-day occupancy rates. When measured in terms of licensed beds, occupancy rates fluctuate mostly between 60% and 80%. At the end of the year, occupancy rates fall precipitously as many fewer elective procedures are scheduled during this time. Daily occupancy rates measured with maintained beds tell a different story. These occupancy rates are concentrated between 80% and 100%. In many cases, maintained bed occupancy exceeds 90% and on some days the number of inpatients exceeds the number of maintained beds statewide (i.e., occupancy exceeds 100%). It is not clear from these data what happens to patients when occupancy exceeds 100%. These data may reflect boarding of patients waiting for a bed. Alternatively, they may reflect the transition of patients in and out of the same bed on the same day. For example, one patient may be discharged in the morning and another patient admitted to the same bed in the afternoon. In this case, the data used in this analysis would count two patients in the same bed on the same day. In either case, statewide occupancy above 100% indicates very crowded conditions in the hospital sector.

Table 5 shows in more detail how often maintained beds are at high occupancy NJ and in the five HERMIS regions. All parts of the state spent a substantial part of each year with very limited excess capacity in terms of maintained beds. Although the percentage of days at very high occupancy fluctuated from year to year, no region showed a steady pattern of increasing or decreasing time at high occupancy. However, the Northwest stands out for spending the most time of the year at very high occupancy levels, while the Central West rarely exceeds the 85% benchmark.

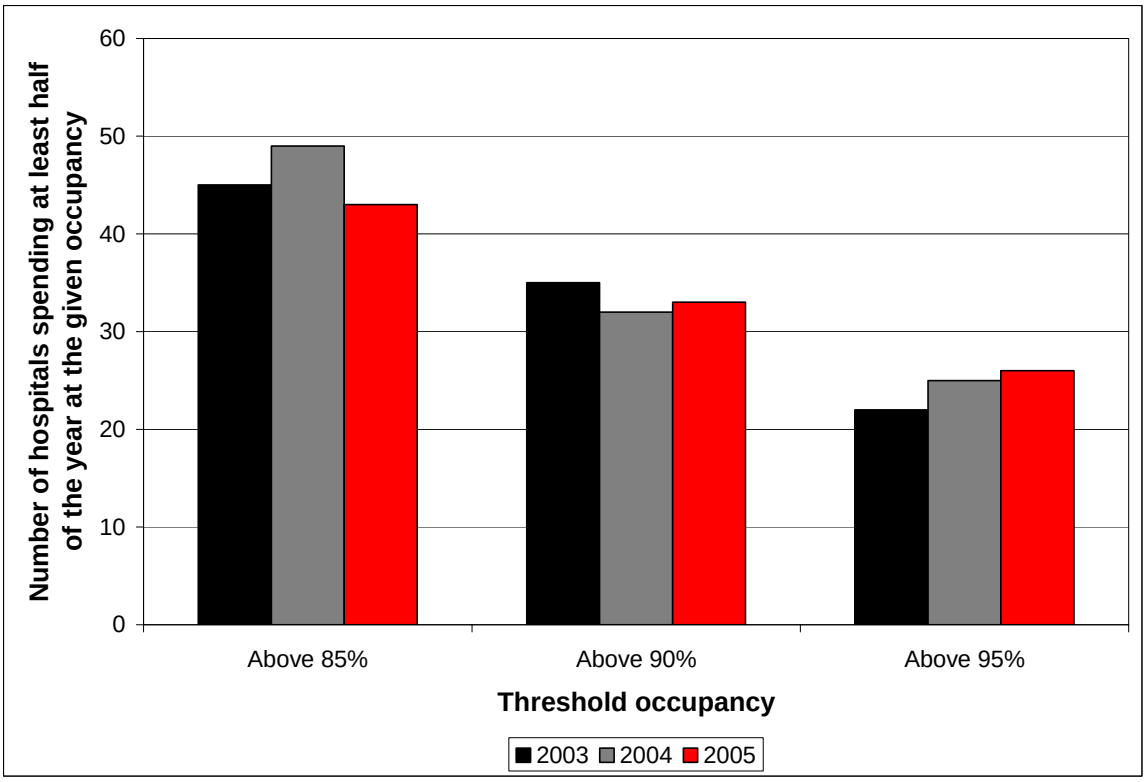
Table 5: Daily Variation in Hospital Occupancy Rates[a] by Region, 2003-2005

	2003	2004	2005
New Jersey			
Average daily occupancy rate	85%	86%	85%
Percentage of days with occupancy rate ≥ 0.85	62%	65%	62%
Percentage of days with occupancy rate ≥ 0.90	32%	37%	28%
Percentage of days with occupancy rate ≥ 0.95	3%	8%	13%
Northeast			
Average daily occupancy rate	85%	87%	87%
Percentage of days with occupancy rate ≥ 0.85	62%	69%	67%
Percentage of days with occupancy rate ≥ 0.90	39%	46%	41%
Percentage of days with occupancy rate ≥ 0.95	11%	19%	19%
Northwest			
Average daily occupancy rate	92%	90%	89%
Percentage of days with occupancy rate ≥ 0.85	77%	74%	71%
Percentage of days with occupancy rate ≥ 0.90	66%	58%	52%
Percentage of days with occupancy rate ≥ 0.95	47%	32%	25%
Central East			
Average daily occupancy rate	86%	86%	85%
Percentage of days with occupancy rate ≥ 0.85	66%	67%	64%
Percentage of days with occupancy rate ≥ 0.90	39%	33%	29%
Percentage of days with occupancy rate ≥ 0.95	8%	12%	10%
Central West			
Average daily occupancy rate	73%	73%	72%
Percentage of days with occupancy rate ≥ 0.85	1%	2%	5%
Percentage of days with occupancy rate ≥ 0.90	0%	0%	1%
Percentage of days with occupancy rate ≥ 0.95	0%	0%	0%
South			
Average daily occupancy rate	84%	86%	85%
Percentage of days with occupancy rate ≥ 0.85	59%	65%	65%
Percentage of days with occupancy rate ≥ 0.90	28%	39%	32%
Percentage of days with occupancy rate ≥ 0.95	2%	6%	10%

Sources: NJ Uniform Billing (UB-92) Records, Quarterly Hospital Utilization Report (B-2)
[a]Occupancy rates based on maintained beds.

Capacity constraints also vary by individual hospital. From 2003 to 2005, more than 40 hospitals spent at least half of the year with maintained bed occupancy above 85% (Figure 7). Particularly striking is the growth in the number of hospitals with maintained bed occupancy above 95% for at least half of the year from 22 facilities in 2003 to 26 in 2005.

Figure 7: Number of NJ Hospitals at High Occupancy[a], 2003-2005



Sources: NJ Uniform Billing (UB-92) Records, Quarterly Hospital Utilization Report (B-2)
[a]Occupancy rates based on maintained beds.

To guide state and local authorities in their emergency planning activities, the federal Health Resources and Service Administration (HRSA) created a benchmark level of empty beds that should be available to treat casualties from a major disaster or epidemic (Agency for Healthcare Policy and Research, 2004). Specifically, the HRSA benchmark states that 500 empty beds should be available per million people living in the affected area. Table 6 shows that the number of maintained beds in NJ frequently falls below this benchmark.

Table 6: Empty Beds per Day by Region, 2003-2005

	Licensed beds			Maintained beds		
	2003	**2004**	**2005**	**2003**	**2004**	**2005**
NJ						
Average number of empty beds per day	904	841	842	371	341	357
Percentage of days that number of empty beds < 500 per million residents	0%	1%	4%	75%	78%	75%
Northeast						
Average number of empty beds per day	1,269	1072	1085	425	350	360
Percentage of days that number of empty beds < 500 per million residents	0%	0%	0%	68%	76%	74%
Northwest						
Average number of empty beds per day	381	460	477	154	189	220
Percentage of days that number of empty beds < 500 per million residents	78%	67%	64%	98%	95%	92%
Central East						
Average number of empty beds per day	692	729	726	323	320	339
Percentage of days that number of empty beds < 500 per million residents	10%	7%	13%	84%	81%	78%
Central West						
Average number of empty beds per day	866	839	860	563	568	587
Percentage of days that number of empty beds < 500 per million residents	0%	0%	1%	44%	42%	35%
South						
Average number of empty	862	796	774	360	316	333

beds per day						
Percentage of days that number of empty beds < 500 per million residents	0%	1%	8%	78%	80%	78%

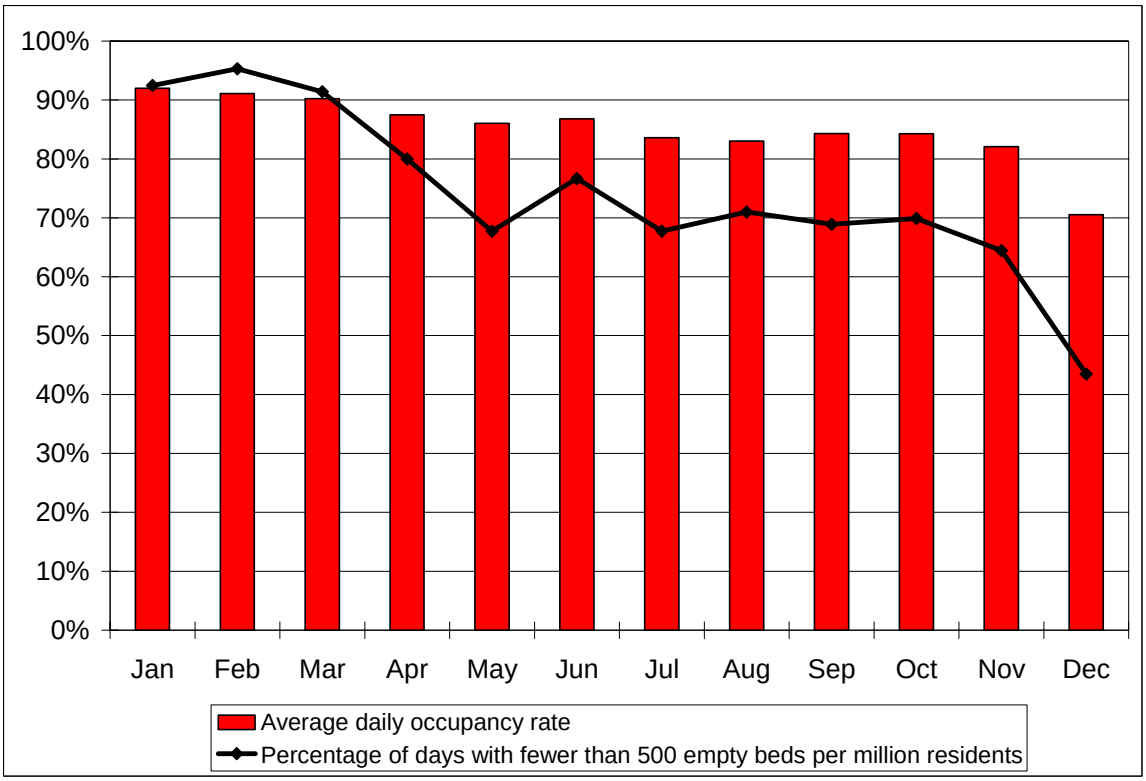
Sources: NJ Uniform Billing (UB-92) Records, Quarterly Hospital Utilization Report (B-2)

In the Northwest, the number of empty maintained beds almost never meets the HRSA standard (although the percentage of days below the standard has declined from 2003 to 2005). In the Central West, the HRSA standard is met more often but is still not met at least one-third of the time. This is somewhat surprising given the relatively low occupancy of maintained beds in this region (Table 5). However, as shown in Table 1, the population of the Central West has grown faster than in any other region of the state. Since hospital capacity grows much slower than population, this region often finds itself below the HRSA benchmark even though its hospitals are not always full.

In contrast to the case for maintained beds, the HRSA standard is almost always met for licensed beds (Table 6). The Northwest stands out as an important exception. The Central East also shows some time when the supply of empty licensed beds is below the benchmark. In addition, signs of stress on the supply of licensed beds also began to appear in the South in 2005.

Strain on hospital capacity is more likely to occur during certain months of the year. On average, maintained bed occupancy rates are at their highest from January through March and at their lowest in December (Figure 8). The percentage of days where the number of empty maintained beds falls below the HRSA benchmark follows the same pattern as occupancy rates.

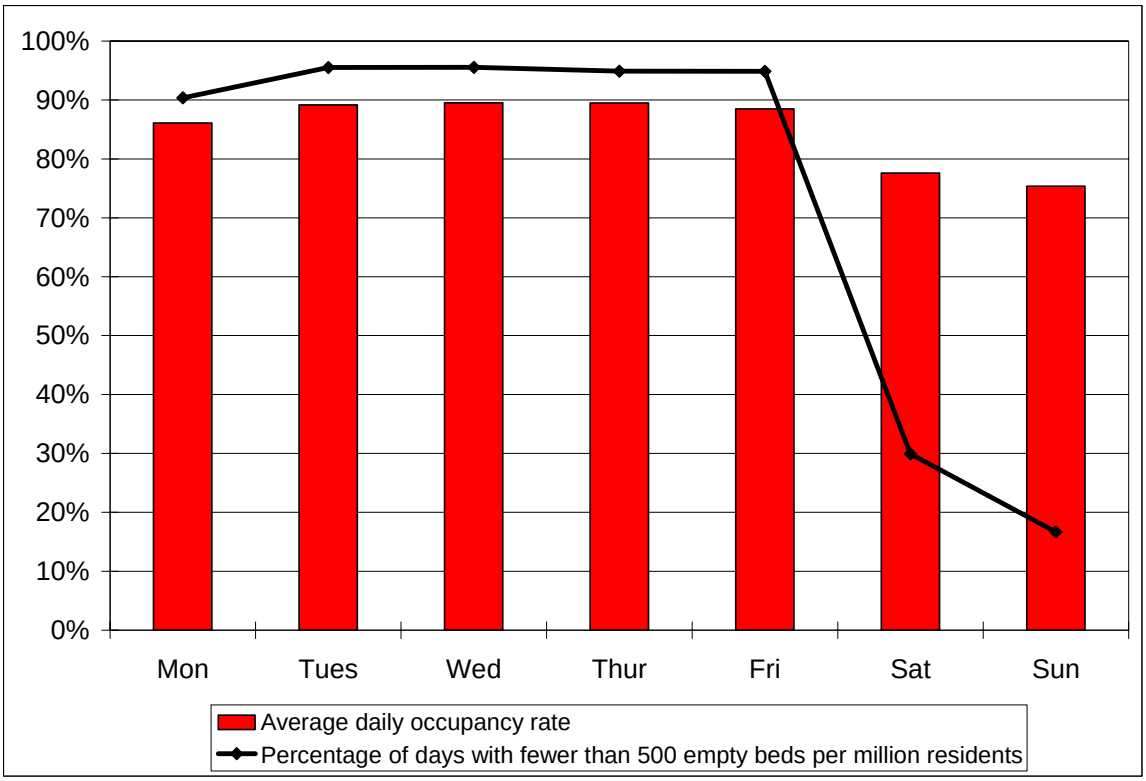
Figure 8: Variation in Statewide Hospital Occupancy and Empty Beds by Month, 2003-2005 Combined[a]



Sources: NJ Uniform Billing (UB-92) Records, Quarterly Hospital Utilization Report (B-2)
[a]Occupancy rates and empty bed counts are based on maintained beds.

Day of the week is also an important predictor of strained capacity. On average, hospitals are nearly 90% full from Tuesdays through Fridays and then they rapidly empty on Saturdays and Sundays (Figure 9). On Mondays, volume increases substantially and rises again in the Tuesday through Friday period. The percentage of time with limited surge capacity (i.e., below the HRSA benchmark) follows the same pattern as occupancy rates.

Figure 9: Variation in Statewide Hospital Occupancy and Empty Beds by Day of the Week, 2003-2005 Combined[a]



Sources: NJ Uniform Billing (UB-92) Records, Quarterly Hospital Utilization Report (B-2)
[a]Occupancy rates and empty bed counts are based on maintained beds.

Ambulance diversion

In December 2006, 762 total episodes of ambulance diversion were reported by 36 hospitals in NJ's Jemstat system (Table 7). This total amounts to approximately 24 episodes per day or one per hour across the state. Since participation in Jemstat is not universal, this finding may understate the extent of diversion activity in the state. Diversion episodes increased to more than 1,000 the following January, apparently reflecting the much higher volume that hospitals tend to see at the beginning of the year.

Table 7: Frequency of Ambulance Diversion in NJ, December 2006 & January 2007[a]

	December 2006	January 2007
Number of hospitals with at least one diversion	36	38
Number of diversion episodes	762	1,062
Full/total diversion episodes	104	250
ED diversion episodes	415	543
Critical care diversion episodes	218	199
Number of diversion episodes per day	24.6	34.3
Monday	29.3	41.4
Tuesday	31.0	51.8
Wednesday	40.3	37.4
Thursday	31.8	42.8
Friday	21.4	27.8
Saturday	12.6	13.5
Sunday	12.6	18.3
Number of diversion episodes per hour	1.0	1.4
12:00AM-7:59AM	0.8	1.1
8:00AM-4:59PM	1.0	1.4
5:00PM-11:59PM	1.3	1.8

Source: Jemstat.org Status Alert

[a]Not all NJ hospitals participate in the Jemstat reporting system. Therefore, numbers in the table may under-represent total ambulance diversion activity in NJ.

Jemstat records the service limitations that hospitals report on their diversion alerts. More than half of all diversion episodes in both months involved diversion from the ED. More than 40% involved critical care or were classified as full/total divert. Compared to December 2006, a greater percentage of diversions were classified as full/total in January 2007 (14% in December versus 24% in January). The remaining episodes include diversions for psychiatric services, special services, or CT scans as well as temporary diversions for emergency exercises.

In some cases, hospitals issued several diversion notices in the same day or even within the same hour. Although hospitals may report a return to normal conditions after going on diversion, the Jemstat system assumes that hospitals return to normal after four hours. If this is not the case, the hospital will issue another diversion notice. In addition, some facilities will issues diversion notices for various services within the course of a few hours or even minutes. For example, ED diversion may be followed by diversion of critical care services, followed in turn by full/total hospital diversion. (In this report, each of these diversions would be counted separately in the total number of diversion episodes.)

Ambulance diversions are most common Mondays through Thursdays. After falling on Fridays, they reached their lowest levels on Saturdays and Sundays. This pattern is similar to that demonstrated for inpatient occupancy in the analysis above.

Diversion activity varies somewhat by time of day. Diversions are most likely to occur during the evening hours (5PM to midnight) followed by daytime hours (8AM to 5PM). Diversion activity slows down during the overnight hours (midnight to 8AM). Nevertheless, ambulance diversion still occurred almost once per hour in December and more than once per hour in January even during the overnight period.

Case Studies

Design and site selection

This section summarizes findings from the case study analysis. The goal of the analysis is to understand sources of stress on hospital ED's, how hospitals manage patient flow through the ED and other units, potential barriers to implementing best practices, how hospitals coordinate care with federally qualified health centers (FQHC's), and implications for surge capacity. The case studies consist of telephone interviews lasting approximately 30 minutes with key

informants from hospitals in NJ. Informants include ED directors, nurse managers, and patient flow managers. A copy of the interview protocol is found in the Appendix.[4]

Hospitals were chosen based on occupancy and frequency of ambulance diversion. The original design envisioned matched pairs of hospitals that are similar in occupancy and other characteristics but with one member of the pair experiencing frequent ambulance diversion and the other experiencing little or no diversion. Scheduling difficulties precluded the implementation of this highly structured selection process. Instead interviews were conducted with seven hospitals from different regions of NJ that vary in their overall diversion activity but are not considered matched pairs. Frequency of diversion is based on data from the Jemstat system analyzed above and from direct questioning of interviewees. Six of the seven case hospitals participate in Jemstat. Those that indicated during the interview that they were on diversion frequently reported more than 50 diversion episodes per month in December 2006 and January 2007. Those that indicated during the interview that they were on diversion rarely reported 0 to 16 diversion episodes per month. The one hospital that does not participate in Jemstat reported in the interview that it had not diverted an ambulance in over two years. By this classification, three case hospitals are frequently on diversion and four are rarely or never on diversion.

Compared to the universe of all hospitals in the state, case study hospitals are larger operate at higher occupancy, and are more likely to be members of the Council of Teaching Hospitals (COTH). Case hospitals cover a range of areas across NJ but do not fully represent all areas as defined by HERMIS regions. In particular, the Central West is not represented and the Northwest is overrepresented in the case study sample. The implications of the sample characteristics for drawing final conclusions will be outlined in the discussion section.

Table 8: Characteristics of Case Study Hospitals in 2005

Characteristic	Case hospitals	All NJ hospitals
Average number of maintained beds	462	287
Average occupancy rate	75%	70%
Days above 95% occupancy	173	113
Membership in COTH	43%	15%
HERMIS region		
Northeast	29%	34%
Northwest	29%	10%
Central East	14%	23%
Central West	0%	9%
South	29%	24%

Sources: Acute Care Hospital (ACH) Annual Cost Report, NJ Uniform Billing (UB-92) Records

Overcrowding and patient flow

Not surprisingly, all three of the hospitals that are frequently on ambulance diversion report ED overcrowding on a regular basis. One informant summarized the issue stating that "overcrowding is always a challenge." Among the four hospitals that do not divert frequently, two indicated that the ED is never overcrowded, one said it happens sometimes, and one said it occurs frequently. The classification of one hospital ED as routinely overcrowded but not routinely on diversion appears to be driven by a recent policy change at the facility. The new policy explicitly discourages diversion and requires more quantifiable criteria for doing so (e.g., time between decision to admit and actual admission routinely exceeding 30 minutes and growing). Although the ED is still overcrowded, the hospital has been able to cope with the situation without resorting to frequent diversion episodes as it had in the past.

There was virtually no overlap in the indicators that hospitals used to define and measure overcrowded conditions. One had specific criteria involving cycle times for beds and laboratory tests. Another hospital defines ED overcrowding as a situation where at least 6 patients are

waiting for admission or at least 12 patients are waiting for care. Others simply stated that they were overcrowded and followed up with numerous examples of how difficult it is to see patients in a timely manner or move them on to the next stage of care (as described below).

The lack of common definitions for ED overcrowding led to a lack of common thresholds for ambulance diversion, particularly among the three case hospitals that divert frequently. In all three cases, diversion is based on a combination of volume, occupancy, and/or patient acuity. Only one of the three had a specific measure that triggered the diversion decision (available beds relative to patients waiting for admission).

Two informants provided additional detail about circumstances where ambulances override diversion requests. These circumstances often involve life threatening cases (e.g. cardiac arrest) or cases where the patient's physician has admitting privileges at only one hospital in the area. Moreover, since there are many separate ambulance providers in NJ, a hospital's diversion alert does not always reach all ambulance drivers. Despite these caveats, ambulance diversion is still relied upon to manage the flow of patients through the ED. One informant observed, "Sometimes it's psychological for the staff. Diversion seems to slow things down."

Additional problems are created when several area hospitals are on diversion simultaneously. When this happens, hospitals must revert to taking all patients who come by ambulance. As one informant described it, "We kind of laugh when we are on divert. When we are on divert, so is everybody else. It really becomes a moot point. Patients are coming regardless." These diversion overrides are described as a source of substantial frustration for caregivers in the ED.

All of the hospital informants appeared to agree that better management of patient flow is crucial to avoid ED overcrowding. Yet they varied substantially in the scale, scope, and success of their efforts.

The three facilities that experienced little or no overcrowding described detailed patient flow management systems that run through the entire hospital. For example, two of these hospitals use traffic light systems similar to those described in the literature review above. When the volume in inpatient units or ancillary service areas (e.g., labs) reaches a certain level, automatic warnings are generated that indicate a need for backup resources. When this occurs, more resources (e.g., nurses) are brought to the area or alternatively, patients are diverted to another area that can provide the needed service (e.g., a lab on another floor). This system is also used by one of the hospitals to determine when patient volume is high enough to justify ambulance diversion, which occurs only rarely at this facility. The third hospital in this set emphasized the measurement of cycle times through various stages of the care process (e.g., the time interval between the request and receipt of lab results). In the informant's words, "We analyze everything that moves in the ED." These measures allow managers in the ED and other departments to move quickly when cycle times begin to slow down. The informant offered a view of the big picture saying, "We drive the entire hospital through the ED … The ED runs the flow of the facility."

The four hospitals with overcrowded ED's have also made attempts to improve patient flow. While some of their attempts were believed to be successful, the procedures that were implemented were generally not as comprehensive or far reaching as the ones used by the other three hospitals described above. Some of the approaches that helped reduce, if not eliminate, ED overcrowding include the following:

- Use of hospitalists to expedite the movement of patients into different levels of care
- Creation of a back-up team of on-call nurses to fill in when scheduled nurses call out
- Bed huddles to assess conditions in the ED and other units on a daily basis.

One informant also described some success with a procedure where patients who used to be boarded in the ED are sent up to the units immediately. Having a patient board in the unit

hallway creates a visible incentive to speed up the admission process. However, this informant added that the procedure cannot be done if the floors themselves are overwhelmed.

Two hospitals with overcrowded ED's described how recent expansions of capacity did not alleviate overcrowding. "They heard it was new and they showed up", was the assessment of one ED manager who observed an increase in volume that came with the added capacity. Another commented that the expanded capacity had no effect on ambulance diversion hours adding that, "It's not volume. It's process." Yet, like several others, this individual described a number of difficulties involved with getting other parts of the hospital to coordinate their operations with the needs of the ED. In stark contrast to the above case where the ED "drives the hospital", another informant described the position of the ED as follows, "The ED serves as a buffer for everything that's going on in the hospital, inpatient beds and stuff like that. The ED is the sponge for all the areas of overflow."

Almost all of the interviewees discussed difficulties they faced with timely discharge of patients. In many facilities, ED volume increases after 11AM. Ideally, patients ready to end their inpatient stay would be discharged by then, making room for admissions through the ED. However, admitting physicians are often not available to give their final signoff until later in the day. Instead, these physicians often spend their mornings holding office hours or performing surgeries. As a result, discharge orders are written at different times of the day depending on the physician's schedule. Coordination problems increase when patients need to consult with more than one physician before discharge. Some informants also described difficulties involved with getting family members to pick up discharged patients in the morning. Due to work and other responsibilities, family members are often not available until the evening hours.

Informants described different methods to improve the timeliness of discharges. One facility with only limited episodes of overcrowding emphasizes the need for timely discharge to physicians and patients' families as part of the formal admission process. This method was viewed as helpful, if not definitive, in improving timely discharge. Another informant in an

overcrowded ED found it much more difficult to achieve this type of coordination. In this hospital, an attempt was made to ask admitting physicians to expedite their discharges when the ED became overcrowded via notes in the physicians' lounge. Since the ED was routinely overcrowded, the requests were very common and ultimately "annoying" to the physicians. As a result, this method was viewed as unsuccessful. The informant added, "Our hands are tied. I can't make a physician do it (discharge quickly). We can only suggest that they do."

Another facility considered the creation of a discharge lounge to hold patients before they are released from the hospital but ultimately decided against it. The informant reasoned that with declining length of stay, patients are discharged sicker than they used to be and would not be comfortable in a temporary holding area. As a result, this arrangement would be very costly in terms of reducing patient satisfaction.

The types of patients seen by hospitals also play a role in ED overcrowding. Several informants emphasized strongly the difficulties created by a growing number of psychiatric patients coming to the ED. These difficulties were described by facilities in wealthy suburban areas as well as those in economically struggling inner cities. Psychiatric patients were described as creating ED stress along a number of dimensions. The care of psych patients is resource-intensive as they require close and continuous supervision. They often spend substantial time in the ED as providers search for psychiatric beds in the hospital or elsewhere in the community to place them. Moreover, psychiatric patients often "act out" and create distractions to other patients and clinicians in the ED. A common theme across many interviews was the desire for relief from the growing volume of psychiatric patients by expanding mental healthcare capacity or through some other policy intervention. One informant described the situation dramatically stating, "We could provide better patient care if we were not babysitting the criminally insane."

Informants described similar problems created by intoxicated patients who are brought to the ED and must be held there until they are sober. In some cases, intoxicated individuals

make repeat visits to the ED. Although these patients are offered substance abuse counseling and related services, these services are commonly turned down.

Informants were asked about the issue of physicians referring patients directly to the ED as discussed in the literature review above. Most said the practice was common. The most cited reasons for doing so included convenience, the ability to obtain quick results, and the need to perform tests that could not be done in the physician's office. None of the informants believed that physician referral to the ED was related to insurance status. One informant suggested that physicians may get around cumbersome pre-approval processes of health plans by sending patients to the ED instead of making arrangements for imaging and other diagnostic services. In addition, two informants indicated that physicians no longer admit patients directly to units. Instead, patients will be sent directly to the ED and admitted from there based on availability of beds.

Informants at teaching facilities discussed the role of residents in the ED. Most agreed that residents can slow down patient flow. However, these facilities believe they are able to adjust for this with appropriate staffing and supervision by attending physicians. One informant discussed cases where they will temporarily disrupt teaching activity to deal with overcrowded conditions. According to another informant, residents eventually move from becoming a drag on patient flow to becoming "flow enhancers" as they gain more experience.

Queuing and smoothing

Informants were asked about the implementation of queuing theory and the smoothing of elective surgery schedules as described in the literature review above. Although the general concepts are viewed favorably, a number of practical barriers to implementing them are common. One informant believed that "too much modeling does not give bang for the buck", adding that formal operations research is often complicated and requires training. Only one informant described efforts to explicitly smooth the elective surgery schedule as a way of

improving patient flow through the ED. The results of the effort are believed to have been positive. This informant observed that "Surgeons are beginning to appreciate the problem (of bottlenecks in the ED)." However, like most other interviewees, this informant was also aware of a "fine line" for how much hospitals could ask their surgeons to accommodate the needs of other hospital units, as surgeons bring the most lucrative cases into the hospital. Although the benefits of smoothing would be greatest when applied to high-volume surgeons, this informant pointed out that the loss of profitable business would also be highest if these surgeons were to be alienated and move their patients to another facility. Another informant echoed this concern by describing how the rearrangement of surgery schedules, while useful to the ED, would involve "deep financial costs to the hospital."

Primary care and chronic disease management

According to all hospital informants, patients commonly use the ED for non-emergent and primary care related services. However, there was a clear split between hospitals in wealthy and poor areas over the effects this had on their operations and the need for specific efforts to address the problem. In wealthier areas, use of the ED for non-emergencies is generally viewed as random and episodic. Although some patients seek care for chronic diseases, most informants in these areas did not describe theses cases as particularly burdensome to their operations. Although uninsured and indigent cases are not common in these areas, one informant described situations where insured patients, particularly the elderly, come to the ED after other outpatient treatments failed to resolve their problems. These include individuals with chronic conditions as well as patients who received antibiotics or other treatments that proved to be ineffective.

Hospitals in low-income areas have a very different experience. These facilities described a large volume of cases that come to the ED with late stage illnesses such as cancer and kidney failure or come repeatedly for chronic conditions such as asthma, diabetes, and congestive heart failure. Because the volume of these cases is so large and the problems are so severe, these

facilities have embarked on efforts to improve primary care in the ED with emphasis on the management of chronic diseases. One informant described this undertaking as the "wave of the future" for hospital ED's.

In one facility, an ED case management system has been developed and implemented to provide comprehensive treatment and coordination of services to patients, especially those with overlapping medical, psychiatric, and financial problems. The idea was initially resisted by the hospital, since the ED is traditionally a place where patients are stabilized and moved on to the next level of care. However, once implemented, the program was viewed as giving the most "bang for the buck" in terms serving patients and reducing the number of repeat visits to the ED. In one example, a diabetic patient, often in ketoacidosis, had been coming to the ED 70 times per year. After entering the ED's case management program, the patient comes to the ED only once or twice per year.

Informants were asked about the coordination of primary care services with nearby FQHC's. Although some suggested that it would be useful to do so, none had any particular arrangements in place. More often, these hospitals had their own clinics or other providers that they referred to when needed.

Anticipated response to hospital closure

As part of the interview, hospital informants were asked how well they would be able to handle increased volume from a hospital closure, particularly in the ED. Five of the seven informants expressed strong reservations or outright alarm at this prospect. According to one informant, the hospital is "at a tipping point right now. If that (nearby closure) were to happen, it would have draconian effects in this environment." Interestingly, this particular informant had spoken confidently about the hospital's ability to mange its current patient flow and its avoidance of hospital diversion. However, this hospital also operates at very high occupancy (above 90%) throughout most of the year suggesting that it would be difficult to add more volume

without new capacity. Another informant from a hospital that is frequently overcrowded and frequently on diversion went so far as to question the wisdom of previous closures. The informant linked prior closures to a recent influx of ED patients remarking that, "It makes you wonder if that was the right choice." An informant in an ED that is currently not overcrowded and not frequently on diversion expressed a similar reservation. This informant suggested that the new volume would be "hard to handle" and expressed concern about the number of other hospitals that are currently on diversion.

Two informants felt fairly comfortable with the prospect of nearby hospital closures. Both described ongoing plans that anticipate and seek out a growing volume of patients coming to their hospital. One believed that talk of a potential closure in the area was already sending new patients to their facility, as patients and physicians begin preparing for what might come. Another had a fairly recent experience with a nearby closure. Although volume at the facility did increase in response, it did not cause a huge spike in the number of patients seeking care. However, this hospital already describes its ED as overcrowded and diverts ambulances frequently. This raises the question of how well it could meet additional patient care demands, if another closure took place.

Surge capacity

All case hospitals have plans in place to deal with a surge of patients in a large-scale emergency. They described a variety of drills and tabletop exercises that have been done to prepare for specific emergencies (e.g., train crashes, avian flu, bubonic plague). These hospitals also have plans in place to create overflow areas within the facility – e.g., cafeterias, tents, conference rooms. Some hospitals have already implemented their plans in real emergencies such as a recent building fire and an airplane crash.

Hospital informants also spoke of plans to create surge capacity via early discharge or transfer of patients. None of the facilities have a formal reverse triage system in place for

emergencies. Instead most would look to admitting physicians to judge which patients could be discharged early. If these physicians are not available, a designated physician would be charged with making decisions to empty out beds if needed. One informant expressed concern about the availability of transport services to move these patients out of the hospital, since ambulances would likely be busy bringing casualties into the hospital. In addition, concerns were raised about the ability to discharge patients early after health system changes have already reduced patient lengths of stay and patients still receive fairly intensive services on the last day of their stay.

Hospitals that are part of systems have plans in place to transfer patients within the system to make room for critically injured patients. However, coordination among hospitals that do not belong to a common system appears to be less developed. Moreover, although they were open to working with FQHC's and other non-hospital providers during a mass casualty event, none of the case hospitals had specific plans to do so. One informant described the need for broader legal and operational frameworks to be created before other facilities could be more integrated into disaster planning. This informant also added that fear of potential lawsuits would limit plans to "think outside the box" in response to extreme emergencies.

Discussion

Hospital occupancy and capacity

The analysis above highlights a number of issues that are critical for assessing the amount and distribution of hospital capacity in NJ. The importance and timeliness of this topic is underscored by the creation of the Commission on Rationalizing Healthcare Resources by Governor Corzine. Although the Commission's mandate is fairly broad, hospital capacity will be a major focus.

It has been argued here and elsewhere (DeLia, 2006-b) that annual bed and utilization statistics give a misleading picture of the alignment between supply and demand for hospital services. Every year, individual hospitals, as well as groups of hospitals within the same geographic region, experience recurring periods of very high occupancy followed by periods of low occupancy. This makes average annual statistics inappropriate for an assessment of community need for hospital beds. In addition, staffing shortages also play an important role in constraining the supply of hospital care, as hospitals often have a large number of beds that are licensed but not necessarily staffed. Concern over the supply of hospital staff, particularly nurses, was also raised by case study participants.

During peak periods, hospital capacity in the state appears to be extremely constrained. On 47 days in 2005, more than 95% of all staffed beds in NJ were occupied. This number increased from 29 days in 2004 and 11 days in 2003. On these days, there would be almost no immediate surge capacity available to respond to a major emergency such as a natural disaster or terrorist attack without displacing existing patients. On more than ¾ of the days in 2003 through 2005, the state had less than 500 empty staffed beds available per million residents, which is a surge capacity benchmark developed by the federal Health Resources and Services Administration (AHRQ, 2004). Some regions, particularly the Northwest part of the state, fail to meet this threshold more often than others.

The surge capacity benchmark chosen by HRSA was derived mostly by intuitive judgments rather than an empirically derived number. Nevertheless, it is clear that hospital capacity in NJ goes through periods of high stress, which is increasing in frequency. Although the state's population is not growing as rapidly as in other parts of the nation, population growth does occur at a pace of more than 85,000 people per year. Population growth combined with population aging suggests that the demand for hospital care in the future will not simply fall off even as many services move to ambulatory surgery centers and other outpatient settings.

It is interesting to note that even annualized statistics do not support the claim that NJ hospitals have unusually low occupancy rates. According to data from the American Hospital Association, the overall occupancy rate in NJ is 73% compared to 65% nationwide (Accenture, 2006). Nevertheless, the likelihood of experiencing high occupancy is quite varied among hospitals in the state. In 2005, for example, 26 facilities spent more than half of the year (i.e., more than 182 days) at or above 95% occupancy of staffed beds. Other facilities experienced very high occupancy much less frequently if at all.

Hospitals that operate at low occupancy are often targeted as candidates for potential closure. Yet closure of these low-occupancy facilities could potentially overload remaining hospitals, especially during their peak periods. In NJ, seventeen general care hospitals have closed since 1995 (Accenture, 2006) and more closures are currently under consideration. While continued consolidation may be appropriate in some areas, the ability of remaining hospitals to absorb additional volume will eventually diminish as more closures occur.

Research on hospital closures in California demonstrated this possibility and concluded that the ability of nearby hospitals to treat the patients of formerly closed hospitals diminished as more closures occurred (Sun et al., 2006). In addition, interviewees at many of the case study hospitals in NJ revealed substantial reservations about their ability to treat additional patients from closing hospitals. One interviewee went so far as the question the wisdom previous closures in the area. It is important to note that the case study hospitals are generally larger, operating at higher occupancy, and more likely to be major teaching hospitals than hospitals statewide. Hospitals with these characteristics are less likely to face the prospect of closure themselves. However, they would be expected to treat additional patients from facilities that did close. Their ability to do so is an important consideration when evaluating the costs and benefits of any specific proposal for hospital closure.

The frequency of ambulance diversion in NJ underscores the stress on capacity that is often experienced by hospitals in the state. Data from late 2006 and early 2007 reveal that, on

average, an ambulance diversion occurs once every hour in NJ. This is similar to an often cited national statistic that there is a hospital on diversion about once every minute in the U.S. (Burt et al., 2006). Moreover, the reported number of diversions in NJ may represent an undercount, since participation in the state's diversion alert system (used in this report) is not universal.

Nevertheless, the implications of ambulance diversion on patient access to care are not totally clear. For patients in truly critical condition, ambulances will override diversion requests as needed. Also, when several nearby hospitals go on diversion at the same time, it becomes impossible for ambulances to honor the requests and so hospitals on diversion continue to receive patients. As a result, the effect of multiple and simultaneous diversions in an area is difficult to assess. The IOM report raised concern about hospitals going on diversion strategically to avoid taking patients, particularly unprofitable ones, from other diverting facilities. Alternatively, hospitals with some available capacity may see it quickly disappear as other facilities go on diversion, a situation that was emphasized by some case study participants. As a result, even though a diversion override will get the patient into the hospital, the attempt at diversion may be a signal of difficulties patients will face in obtaining the full range of required treatment in a timely way.

Hospital surge capacity

The recurring stress on hospital capacity in NJ has direct implications for disaster surge capacity. However, case study participants provided a more nuanced view of their ability to respond to a mass casualty event. Along some dimensions, participating hospitals appear to be better prepared than hospitals nationwide as assessed by the IOM. But along others, hospitals appear to struggle with the same issues raised in the IOM report.

All participants described the existence of detailed disaster planning protocols, which are routinely rehearsed and sometimes tested in real emergencies that have come up such as a building fire and a small airplane crash. They also elaborated on their plans to use tents,

cafeterias, and overflow areas to create surge capacity. Along these dimensions, case hospitals appear to be better prepared than indicated for hospitals nationally in the IOM report. Case hospitals also have systems in place to create surge capacity through early discharge or transfer of existing patients. These typically consist of a chain of command for ordering early discharge based on individual judgment rather than formal clinical guidelines.

Some participants spoke about drills and other coordination activities with law enforcement and other agencies that would be called upon to respond to a large emergency. Still, other described areas where coordination is less developed. For example, hospitals in the same system appear to be seamlessly coordinated for all emergencies. In contrast, very little joint planning has occurred among hospitals not formally linked by system affiliation. Although many participants had a positive view of enhanced disaster response coordination with FQHC's, most said they had no systems in place to pursue it. During the course of the project, attempts were made to obtain the perspectives of FQHC's on these issues. However, a variety of scheduling problems made it impossible to obtain a set of FQHC participants that could be included in the study.

Coordination of emergency medical services (EMS) is also problematic in the view of some hospital informants. This problem was raised as part of broader discussions of ambulance diversion under usual circumstances but came up again in discussion of disaster management. A major issue is the lack of coordination among different ambulance services that are run privately or on a volunteer basis. One participant expressed a specific EMS concern related to early discharge of patients that might be required during an emergency. Specifically, ambulances may be so overwhelmed in their efforts to bring casualties to the hospital that there would be no capacity to bring early discharge/transfer patients to other facilities. Many of these concerns echo concerns that were raised on a national scale by the IOM report.

All of these assessments should be viewed in light of some caveats about the case study hospitals. As mentioned above, case facilities are generally larger, operate at higher occupancy,

and are more likely to be major teaching hospitals than the statewide average. They are also more likely to be located in the Northwestern region of the state and less likely to be in the Central East compared to the geographic distribution statewide.

Hospital efficiency and patient flow

Periodic stresses on hospital capacity in NJ might be alleviated with improvements in the operating efficiency of hospitals. As described in the literature review, a number of national organizations have worked with hospitals to develop methods for achieving this goal. The case study analysis above reveals that hospitals in NJ are engaged in a number of these efforts, albeit with varying levels of commitment and success. An important determinant of success in minimizing bottlenecks in the ED is the extent to which hospitals are able to coordinate across "silos" within the hospital. Hospitals that have been successful are able to communicate information rapidly across units and respond quickly when a particular area is reaching capacity. Other hospitals, while attempting to do this, report a greater number of problems in achieving this level of coordination.

A common problem is the inability to discharge patients from inpatient beds in a timely way, which creates bottlenecks for ED patients who are waiting for admission. In general, admitting physicians have little incentive to rearrange their practice schedules to avoid these bottlenecks, since their practices are not affected by patient flow through the ED. Hospitals that emphasize timely discharge as part of a hospital-wide admission policy generally have more success at moving patients quickly from the ED to the inpatient floors. In contrast, hospitals that make intermittent requests for quicker discharges from individual physicians continue to struggle with patients boarding in the ED.

A similar problem concerns the coordination of elective surgery schedules with the flow of patients through the ED into surgical and intensive care areas. Although case study participants saw value in this coordination, many described institutional barriers to achieving it.

Consistent with prior research (IOM, 2006; Ginsburg and Grossman, 2005), participants emphasized the financial costs to the hospital of creating too many disruptions to the existing flow of elective surgeries, which are important sources of revenue.

Hospitals have a clear interest in improving their own patient flow. But as shown above, the incentives to pursue these interests may be blunted by divergent priorities across hospital units and broader health system issues that reinforce the divergence. Given the implications for patient access to care and emergency response, this situation is of public as well as private concern. However, public policy responses are limited by a lack of standardized data on patient flow performance and how policy initiatives can improve or impede that performance.

Measurement of patient flow performance is an emerging field of research. This research builds and elaborates on ED overcrowding measures described in the literature review above as well as other unpublished work conducted within the hospital sector. In 2006, leaders in the field convened a summit on ED performance measures focusing specifically on patient flow (Welch et al., 2006). The summit concluded with a set of recommendations for specific performance measures and definitions of hospital peer groups for making comparisons. This initiative is currently being pilot tested by an ED collaborate group in Maryland.

The expanding scope of care in the ED

Both quantitative and qualitative analyses document a wide range of services provided in the ED. As documented in the second project report (DeLia, 2006-a), a large number of patients come to the ED for primary care or for conditions that primary care might have prevented. These include, for example, acute episodes of asthma and congestive heart failure as well as ED visits for follow-up care and treatment of non-emergent infections. This report finds that this potentially avoidable use of the ED has grown slightly in recent years. Ambulatory care sensitive (ACS) admissions through the ED grew from 158,480 in 2003 to 186,284 in 2005 and accounted for 31% of all ED admissions in 2005. The number of potentially avoidable treat-and-release ED

visits grew slightly from 1.15 million in 2004 to 1.24 million in 2005, accounting for 47% and 48% of all treat-and-release ED visits, respectively.

Case study hospitals all reported experience with potentially avoidable ED use but varied substantially in the volume of such use as well as their attitudes and responses toward it. Two participants in hospitals with low to average volumes of potentially avoidable use gave very different perspectives on the matter. The first described the process as being expected and routine noting that "we don't debate that with the patients … we thank them for coming and provide care." In contrast, when asked to discuss public policy ideas applicable to the ED, the second felt that non-emergent use of the ED could be avoided with better education of patients and even physicians who often directly refer patients to the ED.

Most case study hospitals have "fast track" or similar systems in place to treat non-emergent cases and routinely refer patients to their outpatient clinics for non-emergent care. However, two hospitals operating in inner cities find themselves in need of a much more elaborate response to primary care-related use of the ED. Faced with a large and growing volume of chronic and late-stage illness, these facilities have begun to develop systems of case management and disease management within the ED itself.

These systems represent a radical shift away from the traditional role of the ED, which emphasizes rapid diagnosis and stabilization of patients with the goal of curing them or moving them to the next level of care. However, changing conditions of chronic disease prevalence, access to primary care, and regulatory requirements for ED care have steadily eroded this traditional role in many hospitals. As a result, an expanded role for the ED may be the best response to these changes in many service areas (Siegel, 2004).

Hospital ED's, nationally and in NJ, have also become important providers of care for mental health and substance abuse patients (IOM, 2006; DeLia, 2006-a). However, case study participants were much less willing to accept this role for the ED than they were in terms of primary care. To the contrary, most described difficulties they face in providing appropriate care

and finding placement for individuals, particularly the mentally ill, who could not be well cared for in their facilities. These patients are also considered very distracting to other patients and the staff trying to care for them. Ultimately, a general desire was expressed for health policy initiatives that would shift these patients out of acute care hospitals and into more appropriate settings such as psychiatric hospitals or ambulatory mental health clinics.

Conclusion

Like their counterparts nationwide, hospitals in NJ face periodic stress on capacity, which often manifests itself in the form of delayed care in the emergency department (ED). These recurrent strains on capacity, more so than annualized occupancy rates, should be considered in evaluating the adequacy of hospital capacity in a particular community. Stress on hospitals can be understood and managed in terms of factors that affect ED input (i.e., the number of patients coming to the ED for care), throughput (i.e., the movement of patients through the ED), and output (i.e., the availability of resources in the next level of care). Though performance is uneven, hospitals have a great deal of ability to affect ED throughput and output through patient flow management techniques.

However, a variety of broader health system issues limits the extent to which hospitals can control their ED input and some aspects of ED output. Trends in ED input are heavily influenced by the inability of patients to gain access to primary and other specialized care (especially mental health) outside the hospital. Streamlining ED output is often hampered by the longstanding disparity in reimbursement for elective surgeries versus other hospital services, which makes it costly to disrupt elective surgery schedules. In the absence of broader health system reform, hospitals will have to find ways to serve an expanding range of patients in a constrained environment. Public policy efforts to assist hospitals in this task would benefit from regular surveillance of hospital patient flow measures and other efficiency indicators.

Appendix

Questions for Case Study Participants

Thank you for agreeing to participate in the study. This interview is expected to take approximately 30 minutes to complete.

1. What is your current position/title and what are your current responsibilities?

2. Does your ED experience overcrowding on a regular basis?
    a. How do you measure overcrowding?
       Probe: Patient flow dashboard system
    b. How often has the ED been overcrowded in the past 3 months? By what measures?
    c. How often has your ED diverted ambulances in the past 3 months?
    d. Do you participate in the state's JEMSTAT system to monitor ambulance diversions?

3. Can you identify predictable periods of peak and off-peak demand for various services in the ED?
    a. Do you forecast demand and use the results for planning?

4. What do you see as the greatest challenges to meeting the ongoing demand for ED care? Probe: bed capacity, staffing, equipment

5. What are the major barriers to efficient patient flow through the ED?
    Probe: available beds, staffing, on-call specialists, coordination across hospital units, discharge to sub-acute care

    a. Outpatient surgeries and observation stays in the ED require hospital resources but are not counted in inpatient occupancy statistics. How do these services affect capacity management and patient flow?

6. If a nearby hospital closed, how difficult would it be to serve patients from the closed facility, particularly in the ED?

7. Are there any approaches to alleviate ED overcrowding that you have tried and found particularly successful or unsuccessful?

Probe: redesigning elective surgery schedule, patient flow procedures in other units, hospitalist/nurse bed expediter.

a. Has your hospital reviewed or implemented flow management strategies suggested by JCAHO, Institute for Healthcare Improvement, or the Urgent Matters Program?

8. What percentage of patients coming to the ED come for primary care or conditions that primary care may have prevented?

a. How does it affect ED operations when patients use the ED for primary care? Probe: impact on patient flow

9. Do you have a "fast track" to see patients that are more appropriate for primary care than ED care?

a. What percent of visits are "fast track"?

b. Is there different staffing for "fast track" (not ED trained)

10. Are there special problems related to uninsured or immigrant patients that affect ED operations?

Probe: Financial stress, Casemix, social/language problems

11. Do private physicians send patients to the ED for evaluation rather than seeing the patients themselves?

a. Are patients sent from private offices "boarded" in the ED?

12. Do you have a large number of repeat ED users?

a. Do they create special challenges?

b. Do you have specific procedures to identify and direct the care of these patients?

13. Do you have arrangements with local FQHC's or primary care centers to provide follow-up care after an ED episode?

Probe: Shared clinical data, shared appointment system

14. Do you have physician training programs?

a. Do these programs improve or impede ED efficiency?

Probe: time to initial evaluation, time to complete evaluation, number of tests ordered, re-evaluation of patient by attending physicians

15. In the event of a major disaster, what kinds of immediate actions would be most important to make significant additions to surge capacity?

Probe: cancel surgeries, early discharge/transfer (criteria), use of non-clinical space for overflow

16. Have you found it necessary to take any of these or similar actions in the past year?

17. How difficult would it be to staff licensed beds that are currently not staffed?

a. Have any of these beds been permanently taken out of service?

18. In the event of a disaster, is there a specific role that could be played by FQHC's or primary care centers to support your hospital's emergency response?

Probe: Screening/triage, shared staff, receive patient overflow, create temporary inpatient unit

19. Do you find that most disaster planning activities enhance or detract from other non-disaster related patient care activities?

20. What sorts of public policy initiatives would you consider most important to support or improve hospital emergency care?

Thank you again for your participation.

Endnotes

1. Some analysts have commented that so-called "prudent layperson" mandates may also have contributed to the rising trend in ED utilization (Burt and McCaig, 2001; JCAHO, 2005). These mandates require insurers to provide reimbursement for ED visits that are made by policyholders who "reasonably believe" that they have an emergent medical problem. However, a recent study has cast doubt on the power of prudent layperson laws to affect ED volume (Hsia, Chan, and Baker, 2006).

2. In the event of a disaster, hospitals may also receive assistance from federal emergency medical assets such as the Federal Medical station and other mobile medical units maintained by the federal government.

3. These conditions are defined more specifically as follows: 1) Non-emergent – The patient's initial complaint, presenting symptoms, vital signs, medical history, and age indicated that immediate medical care was not required within 12 hours. 2) Emergent/Primary Care Treatable – Based on information in the record, treatment was required within 12 hours, but care could have been provided effectively and safely in a primary care setting. The complaint did not require continuous observation, and no procedures were performed or resources used that are not available in a primary care setting (e.g., CAT scan or certain lab tests). 3) Emergent, ED Care Needed , Preventable/Avoidable – Emergency department care was required based on the complaint or procedures performed/resources used, but the emergent nature of the condition was potentially preventable/avoidable if timely and effective ambulatory care had been received during the episode of illness (e.g., flare-ups of asthma, diabetes, congestive heart failure, etc.).

4. Study protocols were approved by Rutgers University Institutional Review Board for research with human subjects on February 7, 2007.

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