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Emergency Department Utilization and Surge Capacity in New Jersey, 1998–2003

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Executive Summary

Emergency department (ED) overcrowding is a nationwide problem with numerous consequences. Overcrowding can reduce healthcare quality by increasing the potential for medical errors, prolonging pain and suffering, and reducing patient satisfaction with services. In some cases, emergency patients are "boarded" in the ED until inpatient beds become available and ambulances are diverted to other hospitals causing significant delays in treatment when there may be little time to spare. Concern about ED capacity is heightened by the threat of bioterrorism and other mass casualty events, which require hospitals to maintain adequate reserves of surge capacity.

A number of factors make New Jersey a possible target for bioterrorist attacks, and therefore, require the state to make a concerted effort to ensure an adequate level of surge capacity in its hospital sector. These features include the state's unusually high population density, extensive public transit networks, and close ties to the economy of New York City.

NJ is also home to 1.2 million uninsured residents who often rely on hospital ED's as their provider of last resort. This creates an additional reason to examine the capacity and functioning of hospital ED's in the state.

In response to these issues, the New Jersey Department of Health and Senior Services (NJDHSS) commissioned a study by the Rutgers Center for State Health Policy (CSHP) to analyze "Emergency Department Utilization and Surge Capacity in New Jersey." Under the study agreement, the CSHP will produce three analytic reports over three years. This document, which is the first of these reports, reviews the literature on ED overcrowding and presents analysis of ED utilization and hospital inpatient capacity in NJ from 1998-2003. The analysis is based on hospital cost reports and other utilization reports that hospitals file with the state. While these data are the best sources of information currently available, they do contain limitations, which are discussed in the body of the report. Therefore, the findings in this report may be considered preliminary until more detailed data become available. Specifically, the second project report will contain more detailed information about all ED patients (admitted and non-admitted), which is currently being collected in the state's revised Uniform Billing (UB) records.

During the 1990's, hospital capacity for both emergency and non-emergency care declined throughout the United States. Much of this decline may be attributed to changes in healthcare financing and organization that emphasized ambulatory care and lower level post-acute care over often more costly inpatient hospital services. During this time thousands of beds were taken out of service in response to diminishing demand for hospital admissions, patient days, and ED services. By the late 1990's, however, ED utilization began a period of rapid increase that continues today. This increase in ED utilization combined with reductions in inpatient capacity has created conditions of ED overcrowding and ambulance diversion throughout the United States. Nationally, these conditions are exacerbated by an inadequate number of specialty physicians on call in the ED and an insufficient supply of emergency nurses. Although NJ requires hospitals to have a physician on call for all services offered, data collected by the American College of Emergency Physicians suggests that hospitals in NJ are finding it difficult to comply with these regulations.

While the uninsured often rely on the ED for primary care treatable illnesses, uninsured utilization is not considered a primary cause of ED overcrowding and ambulance diversion. Instead most of the nationwide increase in ED utilization is tied to greater utilization by privately insured patients.

Despite these trends, some have warned that the solution to ED overcrowding involves more than just expanding facilities or hiring additional staff. At issue is the need for hospitals to use existing resources more efficiently before investing in new ones. For example, a growing number of hospitals in the U.S. have focused on streamlining the flow of patients through different units of the hospital. Hospitals that are successful at improving patient flow can relieve stress on their ED's by making it easier to transfer patients from the ED to inpatient beds in other units.

Trends in NJ are similar to those at the national level in showing a rapid increase in ED utilization from 1998-2003. ED visits leading to inpatient admission grew at the same rate as ED visits overall leaving the percentage of ED visits leading to inpatient admission constant at 19%. Nevertheless, the ED has increased its importance as a source of admissions for NJ hospitals. Specifically, the percentage of total inpatient admissions that originated in the ED increased from 50% in 1998 to 55% in 2003. As a result, a greater proportion of hospital admissions involve an element of unpredictability, which can increase the difficulty of capacity management. Although the NJ population has grown during this time, ED utilization has grown faster. The

number of ED visits per 1,000 population increased from 329 in 1998 to 376 in 2003 – a rate of growth that exceeds the national average.

According to statewide hospital cost reports, almost half of the growth in NJ's non-admitted ED volume is attributed to Medicaid patients. In a subsequent report, this finding will be compared to patient-level data from the new Uniform Billing (UB) records that will include non-admitted ED patients. According to inpatient UB data, more than half of the growth in admitted ED volume is driven by Medicare patients. Both of these findings stand in contrast with the national trend where the growth in ED volume is driven primarily by privately insured patients. It is important to note, however, that the annual cost report data for NJ includes a special designation for Medicare and Medicaid HMO's that is not present in NJ UB and national datasets. As a result, some ED patients covered by Medicare or Medicaid may be classified as privately insured in UB and national data.

ED visits grew most rapidly in the North-West and Central-West regions of NJ. Although the Northeastern corridor near New York City accounts for the largest number of ED visits, this region experienced much smaller growth in ED volume compared to other parts of the state.

From 1998 through 2003, NJ also experienced a decline in inpatient capacity measured by the supply of licensed and maintained beds. This led to rising trends in the number of ED visits per bed, occupancy rates for general acute care beds, and occupancy rates for intensive and critical care beds. Despite these trends, most hospitals appear to maintain adequate inpatient capacity to deal with an unexpected surge in patient volume. Moreover, a small number of facilities appears to be operating with significant excess capacity.

Nevertheless, some important exceptions are noted in the analysis. Specifically, the report identifies seven hospitals that have operated at consistently high occupancy rates throughout the study period. On the surface, it appears that these hospitals would have to divert patients if faced with a large and unexpected demand for emergency care. Alternatively, these hospitals might be able to rearrange their patient load to make room for emergency patients should the need arise.

Of greater concern, a larger number of hospitals across NJ experience short periods of extremely high occupancy even though their aggregate annual and quarterly statistics show a good deal of available capacity. For emergency planning purposes, measures of daily occupancy may be more appropriate markers of surge capacity. Because same-day surgery (SDS) procedures utilize perioperative staff and other resources, measures of daily occupancy might also include an allowance for SDS. When such an allowance is made, a greater number of hospitals in NJ appear to experience short periods of extremely high occupancy.

This report also finds that a significant share of hospital admissions through the ED are for ambulatory care sensitive (ACS) conditions, which are often preventable if patients receive primary care services at an earlier stage of illness (e.g., asthma, ear infection). Specifically, in 2003 23% of ED admissions among non-elderly adults (ages 18-64) were for ACS conditions, while 43% of ED admissions among children were for these conditions. Using a slightly modified approach for ACS admissions among the elderly (ages 65 and above), this report also found that 32% of all admissions through the ED among elderly patients were for ACS conditions.

Thus far, rising ED utilization has not led to a widespread shortage of ED surge capacity in NJ. However, for limited periods of time, surge capacity does appear to be constrained for some hospitals in the state. Moreover, if recent trends persist, limitations in surge capacity may become more common in the near future. As described in this report, episodes of ED overcrowding often can be prevented or alleviated by private activities of individual hospitals. Nevertheless, the effectiveness of these activities remain a public concern as hospital ED's continue to play a vital role in public health and emergency response. These issues will be monitored further as more detailed ED utilization data from NJ hospitals become available.

Emergency Department Utilization and Surge Capacity in New Jersey, 1998–2003

Derek DeLia, Ph.D.

Introduction

Emergency department (ED) overcrowding is a nationwide problem with numerous consequences. Overcrowding can reduce healthcare quality by increasing the potential for medical errors, prolonging pain and suffering, and reducing patient satisfaction with services (Derlet and Richards, 2000). In some cases, ED patients who have been screened and stabilized are "boarded" in the ED as they wait for several hours or even days for inpatient beds to become available. This further delays care and prevents ED staff from attending to newly arriving patients. In its most extreme form, ED overcrowding leads to ambulance diversion. In these instances, patients in need of critical care must be taken to the next available hospital causing significant delays in treatment when there is little time to spare. Stress on ED's is also affected by the large portion of patients who come to the ED for conditions that are largely non-emergent, treatable in other settings, or preventable with access to primary care (McCaig and Burt, 2004; Billings et al., 2000-a; Billings et al., 2000-b).

In addition, hospital ED's must operate within the rules of the Emergency Medical Treatment and Active Labor Act (EMTALA). This federal law mandates that any hospital ED receiving payments from the Medicare program provide screening and stabilization to all patients regardless of ability to pay. Since most hospitals depend heavily on Medicare revenue, the EMTALA has effectively made hospital ED's the "safety net for the safety net" as poor and uninsured patients come to the ED when services are unavailable elsewhere.

In New Jersey, state law requires hospitals to meet a stricter standard with regard to safety net services. Specifically, all acute care hospitals must maintain an ED and must provide all necessary services within their capability – not just screening and stabilization – to patients coming to the hospital for care.

These requirements combined with the steady demand for uncompensated care have led to a common belief that ED's are financial liabilities to hospitals nationwide (Perotin, 2004; Conolly, 2004; Austin, 2003). When faced with significant financial pressure, hospitals may feel the need to curtail or eliminate ED services leaving local communities without a nearby source of

emergency care. However, a recent study of hospitals in California questions this belief and argues that ED's actually generate significant revenue for most hospitals (Melnick et al., 2004). Specifically, ED's serve as a source of inpatient admissions and other services used by insured patients. Melnick et al. found that these additional services more than offset the costs of uncompensated ED care for most hospitals in their study. Moreover, a number of hospitals, in NJ and throughout the United States, have recently expanded rather than curtailed their ED capacity.

Regardless of their revenue implications, hospital ED's are required for immediate response to terrorist attacks and other disasters involving mass casualties. To adequately respond to such emergencies, hospital ED's must have enough surge capacity on hand to treat large numbers of patients who need immediate care. However, as described below, the trend in ED capacity over the past decade has been one of decline as the total number of hospitals operating ED's in the United States fell significantly during the 1990's.

This particular trend has not been experienced in NJ, as every general hospital in the state is required to maintain an ED. Nevertheless, hospitals in NJ have experienced ED overcrowding and increased demand for uncompensated care similar to those experienced by hospitals nationwide (McKean-Kelly, 2004). Analysis of ED surge capacity in NJ is especially important as a number of features make the state a prime target for bioterrorist attacks including its population density, extensive public transit networks, and close ties to the economy of New York City. In addition, NJ is home to 1.2 million uninsured residents who often rely on hospital ED's as their provider of last resort (DeLia et al., 2004). This feature adds to the need for a thorough examination of the capacity and functioning of hospital ED's in NJ.

In response to these issues, the New Jersey Department of Health and Senior Services (NJDHSS) has commissioned a study by the Rutgers Center for State Health Policy (CSHP) to analyze "Emergency Department Utilization and Surge Capacity in New Jersey". Under the study agreement, the CSHP will produce three analytic reports over three years. This document, which is the first of these reports, reviews the literature on ED overcrowding and presents analysis of ED utilization and hospital inpatient capacity in NJ from 1998-2003. The report ends with a discussion of study implications.

Literature Review

National Trends in ED Utilization

During the 1990's ED utilization increased rapidly in the United States. Specifically, the number of ED visits increased by 23% from 89.8 million in 1992 to 110.2 million in 2002 (McCaig and Burt, 2004). ED use has risen most rapidly in areas of the nation with rapid population growth (Bazzoli, 2003). However, the growth in ED volume has outpaced growth in population, as ED visits per 1,000 persons increased from 357 in 1992 to 389 in 2002 (McCaig and Burt, 2004).

Contrary to popular belief, the recent increase in ED visits is not driven by greater utilization among uninsured and Medicaid patients. Rather growth in ED volume is driven primarily by increased utilization by privately insured populations. From the period 1996-97 to 2000-01, ED visits among the privately insured increased by 24% compared to 16% for ED visits overall (Cunningham and May, 2003). Rising ED use among the privately insured coincides with a general increase in all ambulatory care utilization among privately covered patients.

Although conclusive research does not yet exist, rising ED use among the privately insured is potentially linked to a variety of causes. In the late 1990's managed care took on a less stringent form with fewer formal restrictions on ED use. The emergence of prudent lay person standards for ED use, passed by several state governments in the late 1990's, are also believed to be a contributing factor to increases in ED volume. Longer waits for appointments at physicians' offices are also cited as a cause for increased utilization of the ED.

ED volume among the uninsured also increased from 1996-97 to 2000-01 but at a much slower pace than it did among the privately insured. During this time, ED visits among self-pay/free care patients (a proxy for the uninsured) increased by 10% compared to 24% for the privately insured.

ED visits by Medicaid patients did not increase from 1996-97 to 2000-01. Cunningham and May suggest that this may be explained by the continued use of tightly managed HMO plans in the Medicaid program during this period of time.

A large proportion of ED visits are for conditions that are either "non-emergent" or "emergent but primary care treatable". A non-emergent condition (e.g., normal delivery or HIV/AIDS treatment) is defined as one where the patient's initial complaint, presenting symptoms, vital signs, medical history, and age indicate that immediate care is not required within twelve hours (NYU, 2004). An emergent but primary care treatable condition (e.g., emergency CAT scan) is defined as one where treatment is required within twelve hours but care could be provided effectively and safely in a primary care setting. In addition, the patient's

complaint does not require continuous observation and all procedures performed or resources used are available in a primary care setting (NYU, 2004).

Using data from New York City in 1998, Billings et al. (2000) found that nearly 75% of non-admitted ED patients received treatment for non-emergent or primary care treatable conditions. Patients most likely to use the ED for these conditions included blacks, Hispanics, and individuals covered by Medicaid.

Earlier work by Cunningham et al. (1995) found that very young children were more likely than older children or adults to use the ED for non-urgent care. The authors suggest that this may be because parents of young children go straight to the ED when they are unable to reach the child's primary care provider, especially outside of regular office hours. It has not been examined whether the high use of the ED for non-emergent and primary care treatable conditions among Medicaid patients is driven by the large number of young children covered by Medicaid or aspects of the program itself.

An important finding of this study is that uninsured patients had rates of non-emergent/primary care treatable ED use similar to those of commercially insured patients. Although the uninsured rely heavily on the ED for a variety of medical needs, out-of-pocket costs are likely a deterrent to extensive ED utilization by the uninsured.

Billings et al. also found that rates of non-emergent/primary care treatable ED use was lowest among the elderly. The study authors attribute this finding to the nearly universal coverage offered to the elderly under Medicare and the greater likelihood among the elderly of having a usual primary care physician.

Much of the nationwide increase in ED visits is attributable to non-emergent or primary care treatable utilization. Using a classification system that differs somewhat from that used by Billings et al. (2000), the Center for Studying Health System Change attributed all of the increase in ED visits between 1996-97 and 2000-01 to conditions that were neither "emergent" nor "urgent" (Cunningham and May, 2003).[1]

A recent study by Zuckerman and Shen (2004) describes the characteristics of frequent ED users. Using data from the 1997 and 1999 National Survey of America's Families, they classify non-elderly adults as non-ED users (those with no ED visits in the prior year), occasional users (1-2 visits), and frequent users (3 or more visits). They found a number of factors associated with heavy ED use including insurance coverage, self-reported health status, and use of ambulatory care in other settings. Specifically, the uninsured and privately insured individuals were equally likely to be heavy ED users, while individuals covered by Medicaid or other state programs were

twice as likely as the privately insured to be heavy ED users. This finding is consistent with the one obtained by Billings et al. using hospital ED records.

The study by Zuckerman and Shen also found that individuals in fair or poor health were more than 3.5 times more likely than others to be heavy ED users. As well, individuals with three or more visits to a physician outside of the ED were more than five times as likely to be heavy ED users. The authors conclude that heavy users of the ED likely represent a high need population who use a large volume of medical care overall and who depend heavily on state-sponsored health insurance.[2]

ED Overcrowding

Despite the increase in ED utilization, the number of hospitals operating ED's in the U.S. declined by 15% from 1992-2002 (McCaig and Burt, 2004). Much of this decline may be attributed to financial pressure stemming from competitive pricing by managed care organizations and reductions in hospital reimbursement under the Medicare and Medicaid programs. As a result, a growing number of ED visits are concentrated in a smaller number of ED's, which are taking on a heavier patient load.

According to a survey commissioned by the American Hospital Association in 2002, almost 2/3 of ED's nationwide believe they are operating at or above capacity (Lewin, 2002). The perception of ED overload is even more common among urban, and large hospitals (i.e., hospitals with more than 300 beds). The prevalence of ED overload is positively associated with the complexity of care available at ED's. Specifically, 87% of Level I trauma centers and 79% of Level II trauma centers report patient loads at or above capacity. In addition, 1/3 of all hospitals experienced some time on ambulance diversion status in November of 2001.

The U.S. General Accounting Office (GAO) recently published a report examining the status of hospital ED's in Metropolitan Statistical Areas (MSA's) according to three measures – 1) the number of hours a hospital is on ambulance diversion status, 2) the proportion of patients and length of time that patients board in the ED, and 3) the proportion of patients who leave the ED before receiving a medical evaluation (U.S. General Accounting Office, 2003).

The report found that in 2001, 67% of hospital ED's reported being on diversion status for some time during that year. In addition, ten percent of hospital ED's reported being on diversion status for more than 20% of the year, which amounts to five hours per day on average.
It is important to note that ambulance diversion, while often cited as a measure of ED overcrowding is not as straightforward as it may seem. In its report on overcrowding, the GAO provides a very careful and somewhat nuanced definition of ambulance diversion:

> "Under certain circumstances where a hospital lacks staffing or facilities to accept additional emergency patients, the hospital may place itself on 'diversionary status' and direct en route ambulances to divert to another hospital. In general, hospitals ask EMS providers to divert ambulances to other medical facilities because their emergency department staff are occupied and unable to promptly care for new arrivals or specific services within the hospitals, such as the intensive care units, are filled and unable to accommodate the specialized needs of new ambulance arrivals. While on diversion, hospitals must still treat any patients who arrive by ambulance, and in some cases, local community protocols allow ambulances to go to a hospital that is on diversion when the patient asks to go to that hospital or if the patient needs immediate medical treatment. In addition, even while on diversion, the emergency department is still required to screen and treat nonambulance patients—those patients who walk in or otherwise arrive at the hospital—and these patients make up the vast majority of visits to the emergency department." (GAO, 2003, page 7)

As this definition suggests, different hospitals can have very different criteria for going on diversion status with varying consequences for patient care and access. Also regulatory standards that permit hospitals to divert patients vary across jurisdictions. For example, in Fresno County, California ambulance diversions have been banned altogether (Anderson, 2003). In San Diego County, standardized (and voluntary) criteria have been established by the San Diego County Medical Society to determine when diversion is appropriate (Vilke et al., 2004).

The 2003 GAO report also documents a significant amount of patient boarding in the ED. Approximately 90% of hospitals surveyed reported some degree of patient boarding in the ED (for two hours or more) during 2001. Patient boarding typically lasted for two to eight hours for most hospitals though 20% reported an average boarding time above eight hours.

Finally, approximately 1.4% of ED patients left the ED after triage but before medical evaluation. Seven percent of hospitals reported that 5% or more of their triaged patients left the ED without being seen. Overall the GAO report found that ED overcrowding according to all three indicators was most pronounced among MSA's with larger populations, rapid population growth, and high percentages of residents without health insurance.

Inpatient Capacity

A growing body of research shows that ED overcrowding is most often caused by problems occurring in other areas of the hospital (Derlet and Richards, 2000; Livak et al., 2001). One of the most commonly cited causes of ED overcrowding is insufficient inpatient capacity. Ironically, this problem may have been caused by earlier healthcare reform efforts that sought to address problems of excessive inpatient capacity.

As healthcare costs skyrocketed during the 1970's and 80's, attention began to focus on the costs of maintaining idle capacity in the hospital sector. While empty beds provide the benefit of surge capacity in times of emergency, they also entail significant costs in terms of capital investment and staffing, which are allocated to patient care charges in various parts of the hospital. Gaynor and Anderson (1995) estimate the average cost of an empty bed at $58,040 (updated to 2002 purchasing power). Their estimated cost of an empty bed is higher for hospitals with below average occupancy rates. Excess inpatient capacity also raises concern about Roemer's Law, which states that an excessive supply of hospital beds creates pressure to fill those beds with patients who would otherwise receive treatment in less expensive settings (Roemer, 1961).

The Medicare Prospective Payment System and private managed care were both designed in part to create disincentives for excessive investment in hospital inpatient capacity. In response, a significant number of hospital beds were taken out of the healthcare system through hospital closures, mergers, and downsizing efforts. The total numbers of beds fell from 992,000 in 1980 to 825,000 in 2000 (American Hospital Association, 2004).[3]

Although they were designed to reduce hospital costs and improve efficiency, these efforts may have left some communities with insufficient surge capacity to respond to large-scale emergencies. Hospitals and other stakeholders (e.g., health plans, state governments) often describe a link between ED overcrowding and insufficient inpatient beds (Bazzoli, 2003). Hospitals feeling the greatest constraints on their ED capacity are those in large MSA's, which experienced the largest capacity reductions from 1996-2001 (Bazzoli, 2003).

Shortages of certain types of beds are thought to be particularly important contributors to ED overcrowding. Intensive care unit (ICU) and critical care unit (CCU) beds stand out as most important in the ability of ED's to take on additional emergency patients. Some hospitals also express concern about the availability of telemetry, pediatric, cardiac, and psychiatric beds.

Two recent reports have also cited limited availability of post-acute care beds as a contributing factor to ED overcrowding (McManus, 2001; Shactman and Altman, 2002). Payment cuts to post-acute care providers under the Balance Budget Act (BBA) of 1997 led to the closure of many home health agencies, skilled nursing facilities, and nursing homes in the late 1990's. Those that remain in operation have tended to keep occupancy rates high in an effort to minimize costs. As a result, hospital inpatients that could be discharged to alternate forms of care spend additional time in acute care beds.

Hospital Occupancy

For two decades reductions in demand for inpatient care led to reductions in hospital occupancy rates from 75% nationwide in 1980 to 64% in 2000 (American Hospital Association, 2004). Hospitals with the lowest occupancy rates have faced the greatest pressure to offer discounts to private health plans. In response to falling revenues, these hospitals took beds out of service or shut down completely. Since the late 1990's, however, the combination of reduced capacity and reduced stringency of managed care has led to an increase in occupancy rates among existing hospitals that did not close. By 2002, the nationwide occupancy rate increased to 66% (American Hospital Association, 2004). More importantly, in some markets, hospitals report occupancy rates of 80% to 95% (Bazzoli et al., 2003), which leaves little capacity to deal large scale emergencies.

Although some hospitals have fairly low occupancy rates within a given reporting period (typically one year), they may face significant variation in occupancy within the reporting period. For example, a hospital may have an occupancy rate of 70% for the year but go through some periods when occupancy is very high (e.g., greater than 90%) and other periods when occupancy is very low (e.g., less than 60%). This variation in inpatient utilization makes it difficult to maintain surge capacity, since that would require frequent adjustments in the number of beds and providers to staff them. Hospitals facing the greatest variation in daily occupancy confront the greatest challenge in maintaining adequate surge capacity while keeping costs down.

Little if any published research analyzes daily variation in surge capacity in American hospitals. However, a study done in the context of the British National Health Service provides a useful benchmark (Bagust, Place, and Posnett, 1999). According to the authors' calculations, as the average hospital occupancy approaches 85%, the risk of needing to turn away emergency patients and the number of days this is likely to occur increase significantly. If average occupancy exceeds 90%, the "system is regularly subject to bed crises".

Official data on hospital occupancy are likely to understate available capacity for two reasons (Shactman and Altman, 2002). First, care provided on an outpatient basis can divert resources that may be used for inpatient and emergency care. For example, same-day surgeries require the use of operating rooms, Post Anesthesia Care Units (PACU's), surgeons, perioperative staff, and potentially observation beds. Nevertheless, as long as patients are discharged in less than 24 hours, utilization like this is not counted in hospital occupancy statistics. Second, pressure from third party payers to reduce inpatient lengths of stay have changed the way elective surgeries are scheduled. Instead of admitting patients in the evening before a scheduled surgery, patients are admitted early in the morning that same day. This often

creates congestion as patients who are scheduled for discharge remain until 12 o'clock noon or later. This form of congestion is generally not captured in official census statistics, which are designed to measure the number of filled beds as of midnight each day.

A report on ED overcrowding in Massachusetts illustrates the problem of "midnight bias" in measuring occupancy rates (McManus, 2001). In one region of that state, the hospital occupancy rate measured as of midnight each day in early February 2001 was recorded as 77%. However, if the same measurements were taken at 12 o'clock noon on each day, the occupancy rate would have been recorded as 96.2%. The choice of when to measure inpatient census – 12 midnight versus 12 noon – would change the assessment of surge capacity from fairly adequate to virtually none.

Occupancy rates often are measured as patient days relative to licensed beds. However, when beds are taken out of service it is not clear how quickly they can be made available for emergencies or other uses. In some cases, licensed beds may be taken out of service completely. Therefore, it is useful to consider utilization relative to staffed, or maintained, beds in measuring occupancy.

Personnel Shortages

The discussion of bed supply and occupancy rates suggests that ED overcrowding might be relieved by expanding inpatient capacity. However, even if more beds were available, hospitals would face challenges in staffing those beds and maintaining an adequate supply of on-call physicians. Discussions of a nationwide nursing shortage have appeared in both the peer reviewed literature and the general media. Inadequate supply of inpatient nurses can directly affect the number of staffed beds available to admit emergency patients. A study by the Lewin Group found that hospitals experiencing the greatest time on ambulance diversion status also reported the highest rate of vacant positions for registered nurses (Lewin, 2002).

In addition, several reports have described a growing shortage of specialist physicians willing to work on-call for hospital ED's. On-call work has become increasingly unattractive to specialists as on-call time is often uncompensated and specialists have more attractive options working in private practice and in specialty hospitals dealing with well insured patients during normal business hours. Physician specialists in neurosurgery, neurology, and cardio/thoracic surgery have been cited by hospitals as the most difficult ED coverage slots to fill (Lewin, 2002). Shortages of lab, radiology, and other clinical personnel are also cited by hospitals as a strain on ED service capabilities.

Since the time of the Lewin study regulatory changes at the federal level may have made it more difficult for hospitals to maintain on-call specialty coverage. In November of 2003, the

Center for Medicare and Medicaid Services (CMS) enacted modifications to the EMTALA. Specifically, hospitals are still required to maintain a list of on-call physicians, but now these physicians may place themselves on call at more than one hospital simultaneously and they may limit the amount of time they spend on call. On-call physicians may also schedule elective surgeries and other procedures during their on-call times.

Between April and August of 2004, the American College of Emergency Physicians (ACEP, 2004) conducted a nationwide survey of hospital ED directors to assess the ability of hospitals to maintain on-call specialty coverage after the CMS modifications to EMTALA. They found that 2/3 of the ED's reported having problems maintaining adequate on-call specialty coverage with a slightly higher percentage in the Northeast and Southern regions of the United States.

In NJ, state regulation requires hospitals to have physicians on call for all services offered. Nevertheless, 65% of the 29 NJ hospitals included in the ACEP survey reported difficulty in getting specialty coverage for their ED's (Stewart, 2004). In some cases, a hospital may be unable to provide a specialty service on site but it can provide the service by transferring the patient to another facility owned by the same hospital network (Stewart, 2004).

Clinical Content of ED Services

ED overcrowding is also related to changes in the clinical content of ED services including a greater prevalence of chronic illness, increased patient complexity, and changes in the practice of emergency medicine. An editorial published in the *Annals of Emergency Medicine* emphasizes the importance of medical advances, which have increased the longevity of individuals with chronic illnesses (Derlet and Richards, 2000). Such individuals add to the demand for ED care when faced with unpredictable medical episodes. The concomitant rise in comorbidities among ED patients makes diagnosis and treatment more difficult and time consuming leading to greater stress on ED resources. The growing number of non-English speaking patients further exacerbates these problems. A recent study found that many hospital administrators share the view that increased medical complexity is a contributing factor to ED overcrowding (Bazzioli, 2003).

Derlet and Richards (2000) also argue that many patients who used to require overnight admissions are now being treated on an outpatient basis within the ED. For example, asthmatic patients who would have been discharged from the ED into an inpatient bed now undergo 6 to 8 hours of intensive treatment and observation in the ED and are sent home. This kind of change in medical practice further strains ED resources.

Changes in hospital admission standards, originally introduced by managed care plans, have given rise to observation stays, which add to the workload of ED personnel (McManus, 2001). Specifically, more tests are done before admission and patients must wait in the ED until the results are obtained. It is not clear whether the retreat from tightly managed health plans has changed this situation.

Diagnostic testing in the ED is also affected by provisions in the EMTALA, which prohibit hospitals from skimping on care, particularly for patients with limited means to pay. Operationally, this means that ED's are required to do a battery of tests and observational procedures that are generally not done in other settings. In some cases, this is clearly appropriate as seemingly minor conditions can be signs of more serious problems. However, in other cases these precautions are taken primarily for legal rather than medical reasons.

Finally, a growing number of patients have been coming to the ED for non-urgent medical conditions. These patients do not crowd out more urgent cases, since urgent patients automatically receive higher priority. However, large volumes of non-urgent cases can add to stress on ED personnel and further strain ED resources in times of peak demand for emergency services.

Patient Throughput

In spite of capacity problems there is an emerging consensus in the literature that simply expanding capacity (along with needed staffing) is not the solution to overcrowding and may ultimately do more harm than good as more fundamental problems are ignored. At issue is the efficient management of hospital resources. Although specific solutions will vary by hospital, the literature has identified a number of key areas that should be a concern for hospital managers. The first involves freeing up inpatient beds more quickly. A number of methods have been suggested to reduce ED overcrowding by freeing up inpatient beds more quickly (Bazzoli et al., 2003). These include

- Integrated patient tracking systems to provide real time information on discharges throughout the hospital
- Earlier scheduling of physician rounds to promote earlier discharge of patients.
- Discharge lounges where discharged patients can wait for relatives to take them home.

The reengineering of non-medical hospital functions can also reduce ED overcrowding. For example, consultants at Cap Gemini Ernst & Young suggest the creation of maintenance "SWAT teams" to clean beds as they open anywhere in the hospital (Haugh, 2003).

Other approaches focus on moving patients more rapidly through the ED into appropriate units of care. Some hospitals now use fast-track ED programs to direct patients immediately to the appropriate unit of care – e.g., mental health, primary care clinic (Haugh, 2003). Hospitalists and expediter nurses can also be instrumental in moving patients quickly through the ED and other related units of the hospital (Frank, 2001).

Elective surgeries in the operating room have been cited as a source of "artificial variability" in patient flow that contributes to ED overcrowding (Litvak and Long, 2000). Although elective surgeries are scheduled in advance, they are not counted as part of a hospital's inpatient census until the surgery takes place. At that time, the bed used for that surgery cannot be used for an unanticipated emergency even if the surgery was elective in nature. The scheduling of elective surgeries is random in the sense that it depends on the scheduling needs of the surgeon and surgical support staff. This "artificial variability" complicates hospital planning for the "natural variability" in inpatient admissions that are caused by unpredictable emergencies. The result can be ED overcrowding and patient boarding because emergencies occur at a time when several beds are occupied by patients receiving elective surgery. In response to this problem, Litvak et al. (2001) advocate an approach to scheduling elective surgeries that minimizes peaks and valleys in the flow of elective surgeries. Reduction in this artificial variability, it is argued, makes it easier to manage the truly random variability in emergency admissions.

This approach is illustrated by a recent demonstration at the Boston Medical Center (BMC), 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.

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.

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). It remains to be seen whether other facilities would be able coordinate its surgeons and hospital staff to achieve similar results.

Recent Trends in NJ

This section of the report provides analysis of ED utilization and hospital inpatient capacity in New Jersey. Data on ED utilization and inpatient capacity come from the New Jersey Quarterly Hospital Utilization Report (B-2) and the New Jersey Annual Acute Care Hospital (ACH) Cost Report submitted by hospitals to the New Jersey Department of Health and Senior Services from 1998-2003. Detailed information about hospital admissions through the ED comes from uniform billing (UB-92) data from 1998-2003. This report also utilizes NJ population data obtained from the U.S. Bureau of the Census.

Table 1 shows the number of hospitals appearing in each database in each year of the study. These numbers vary due to a number of factors including closures, changes in the way related facilities file their reports (jointly or individually), and missing data.

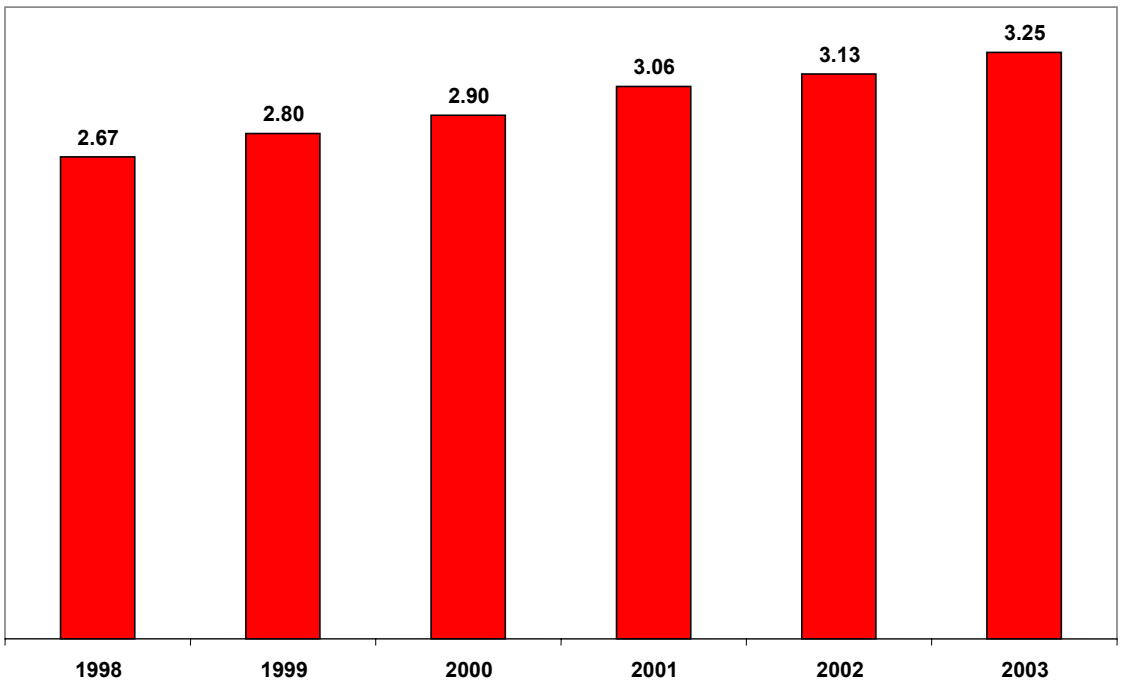
Table 1: Number of Facilities by Data Source and Year

Data Source	1998	1999	2000	2001	2002	2003
Acute Care Hospital (ACH) Cost Report	83	81	79	79	86	85
Quarterly Utilization (B-2) Report	94	94	92	91	90	85
Discharge/same Day Surgery File (UB-92)	92	92	91	90	87	88

ED Utilization

ED visits in NJ have grown significantly in recent years. Specifically, total ED visits in state grew from 2.67 million in 1998 to 3.25 million in 2003 – an increase of 21.8% over five years (Chart 1). Throughout this period, the percentage of ED visits that resulted in an inpatient admission remained constant at approximately 19% (according to ACH Cost Reports). Nevertheless, the role of the ED in generating inpatient admissions expanded from 1998-2003. According to UB-92 data, the percentage of total admissions originating in the ED grew steadily from 50% in 1998 to 55% in 2002 and remained at that level in 2003 (Chart 2).

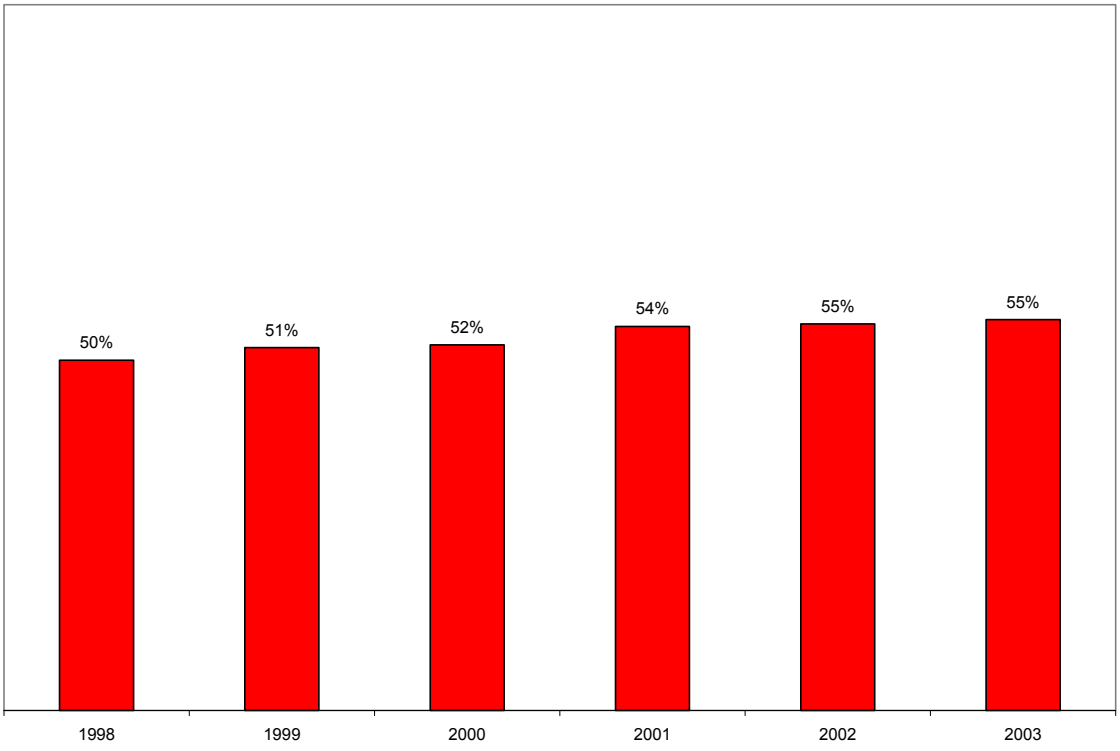
Chart 1: ED Visits in NJ (in Millions) 1998-2003



Source: New Jersey Annual Acute Care Hospital (ACH) Cost Report

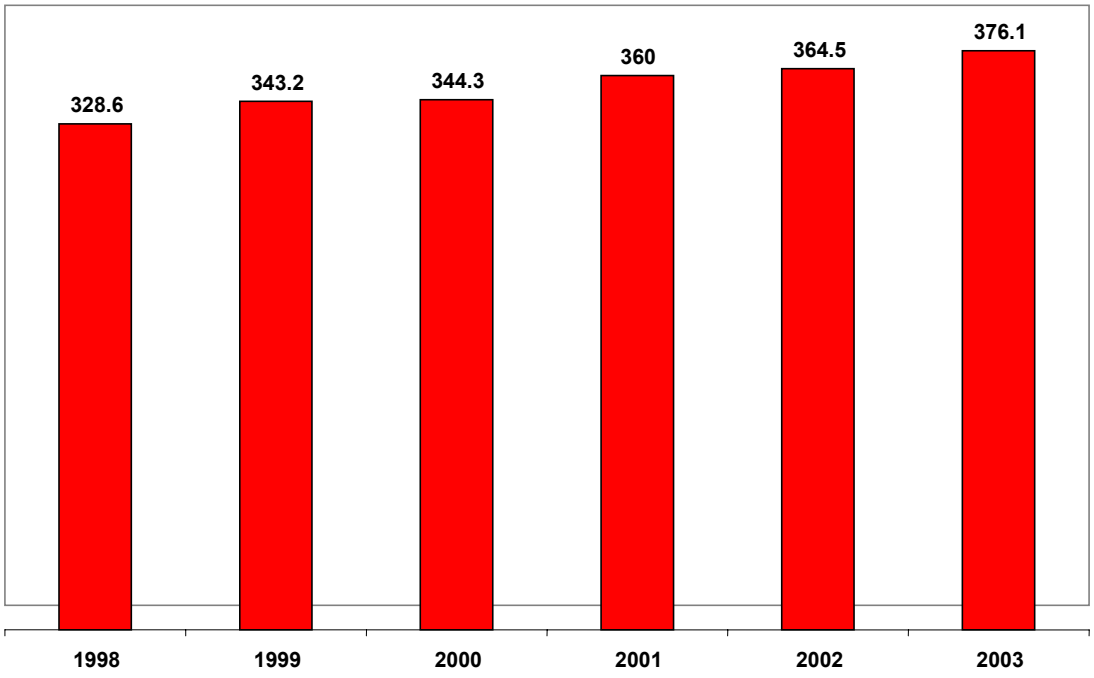
Although New Jersey's population has grown during this period, population growth does not fully account for the growth in ED visits. Total ED visits per 1,000 population grew from 328.6 in 1998 to 376.1 in 2003 (Chart 3). The rate of growth in per capita ED visits appears to be higher for NJ than for the U.S. overall. Analysis by McCaig and Burt (2004) shows that ED visits per 1,000 population nationwide grew by 9% from 1992 to 2002. NJ data going back to 1992 were not available for this study. Nevertheless, available data show that ED visits per 1,000 population in NJ grew by 11% over a much shorter time period from 1998 to 2002.

Chart 2: Percentage of Total Admissions in NJ Originating from the ED, 1998-2002



Source: New Jersey Hospital Uniform Billing (UB) Data

Chart 3: ED Visits per 1,000 Population in NJ, 1998-2003



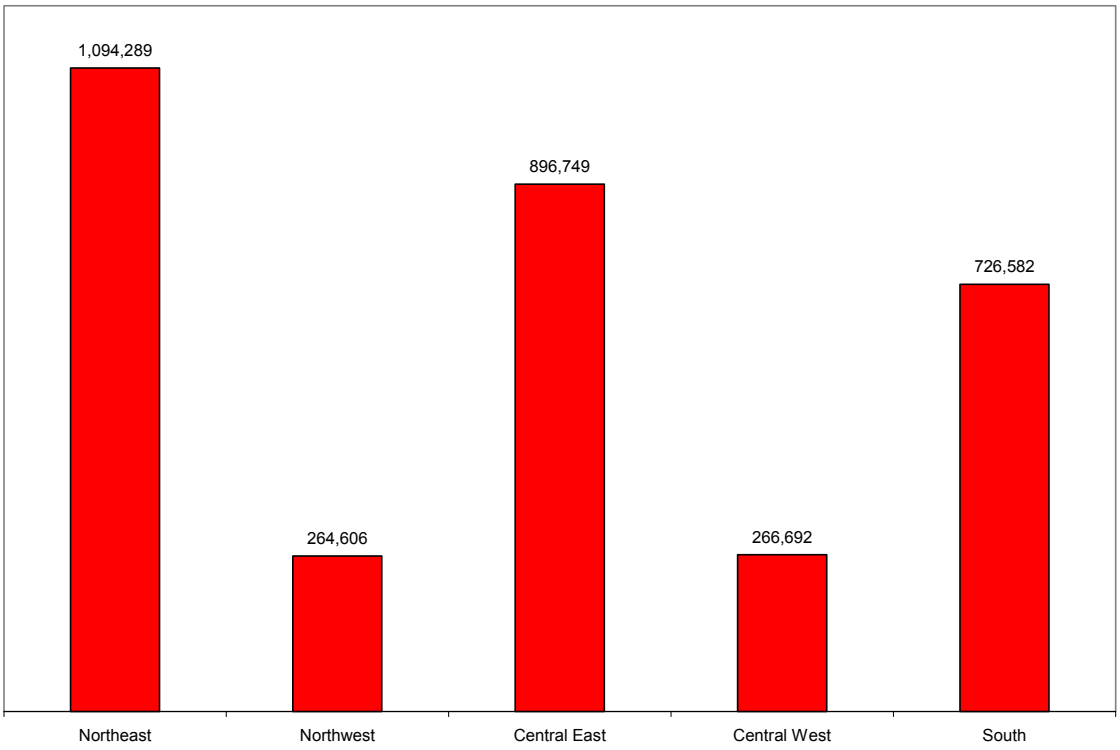
Sources: New Jersey Annual Acute Care Hospital (ACH) Cost Report, U.S. Census Bureau

The total number and growth in ED visits varied significantly by region of NJ from 1998-2003. For analytic purposes, NJ 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

These regions are the same as those used by the state's Hospital Emergency Response Medical Information System (HERMIS). In this analysis, counties refer to the location of hospitals where ED services are delivered rather than the residence of patients receiving ED care.

Chart 4: ED Visits by Region of NJ, 2003

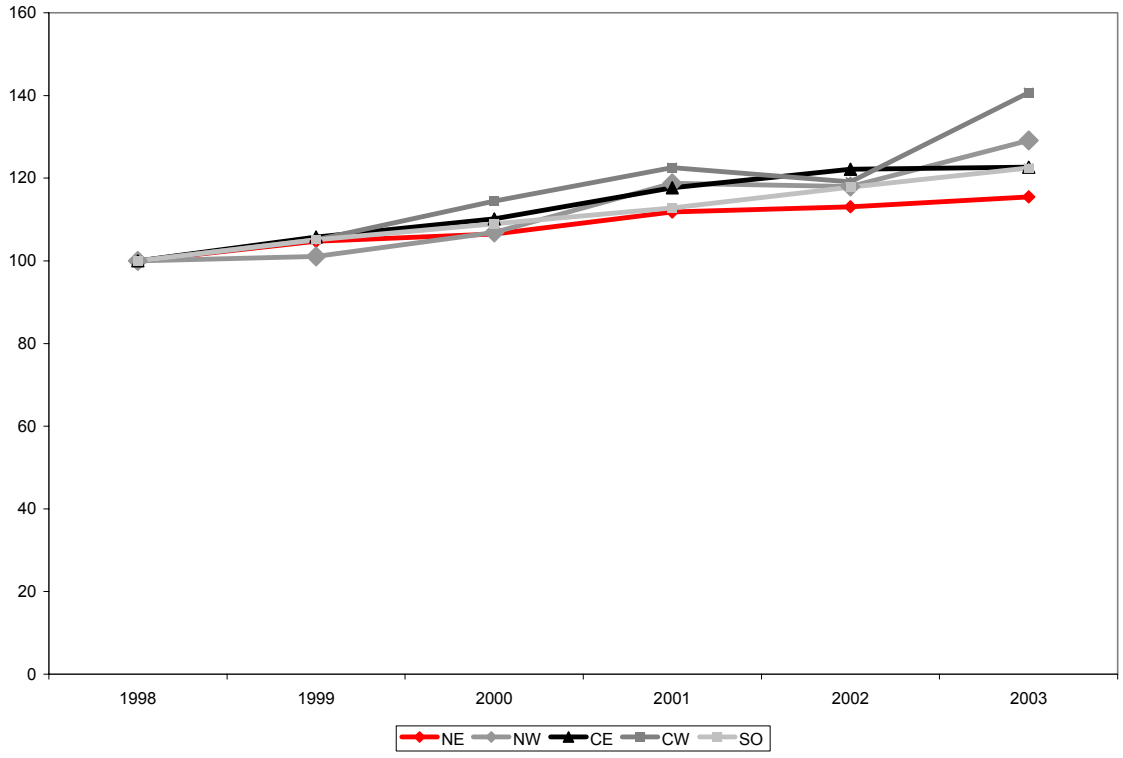


Source: New Jersey Annual Acute Care Hospital (ACH) Cost Report

In 2003, the greatest volume of ED visits were provided in the Northeastern region, as this is the most extensively populated part of NJ (Chart 4). In the same year, a significant number of ED visits was also provided in the Central East, which is followed by the South in terms of overall ED volume. Much fewer ED visits were provided in the relatively sparsely populated North West and Central West regions.

Chart 5 shows year-to-year changes in ED volume by region. Since the total volume of ED visits varies across regions, ED volumes are standardized as follows. For each region, the total volume of ED visits is set at 100 in 1998, which is viewed as a base year. ED volume for subsequent years is measured relative to the base for each region – i.e., a value of 110 is interpreted as 10% higher than the base volume. Chart 5 shows that the Central West region experienced the fastest growth in ED volume (41%) from 1998-2003 followed by the Northwest (29%). ED volume grew least rapidly in the Northeast (15%).

Chart 5: Annual Change in ED Visits Compared to Base Year by Region of NJ, 1998-2003

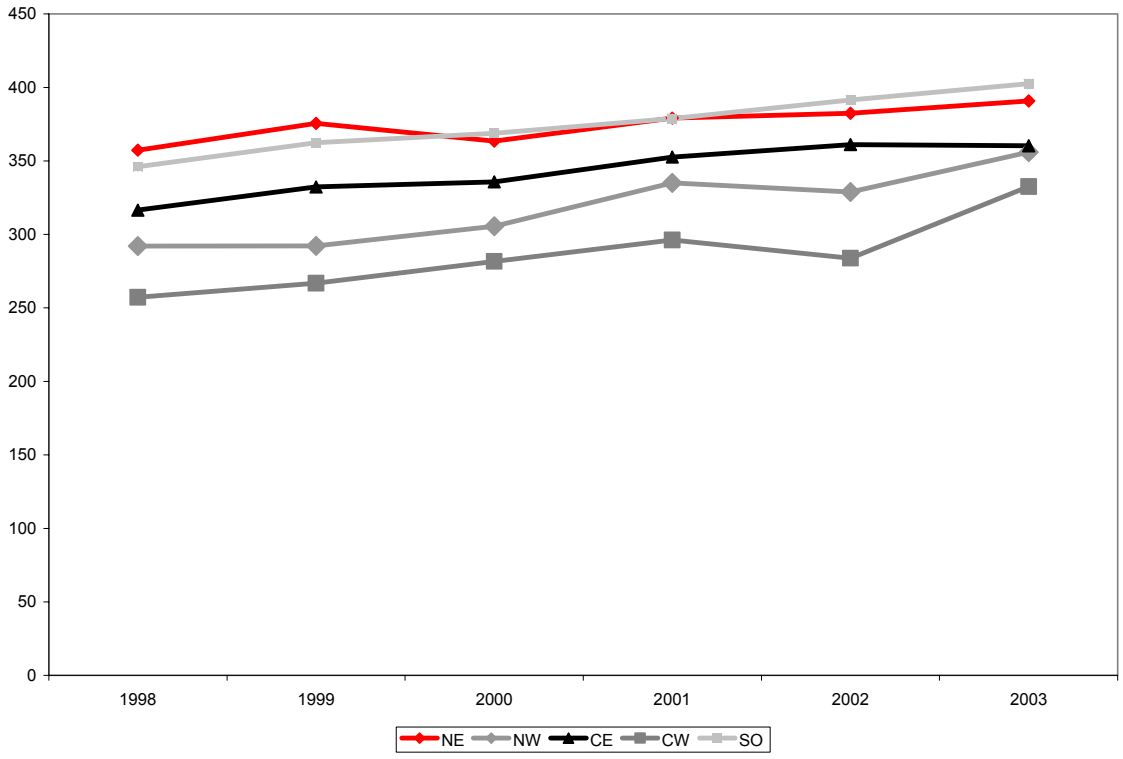


Source: New Jersey Annual Acute Care Hospital (ACH) Cost Report

Regional differences in the growth of ED volume do not appear to be driven by differences in population growth. From 1998-2003, the rate of population growth varied from 5% in the South to 9% in the Central West compared to a much broader range of 15% to 41% in the rate of ED volume growth. As a result, the regions with the greatest ED visit growth experienced the fastest growth in ED visits per 1,000 population – i.e., 29% in the Central West and 22% in the Northwest.

Chart 6 also reveals large differences in the level of ED visits per 1,000 population. While the Central West experienced the most rapid growth in this measure, it consistently ranked the lowest in terms of the total number of ED visits per capita. In other words, the trend line for the Central West in Chart 6 is always below the trend line for other regions. The Northwest is similar to the Central West in that it experienced rapid growth in ED visits per 1,000 population but remains at a low level compared to other regions of the state. The most striking trend, perhaps, occurred in the Southern region. In this region, ED visits per 1,000 population grew continuously throughout the study period and eventually overtook the Northeast as the highest ranking region in terms of per capita ED use.

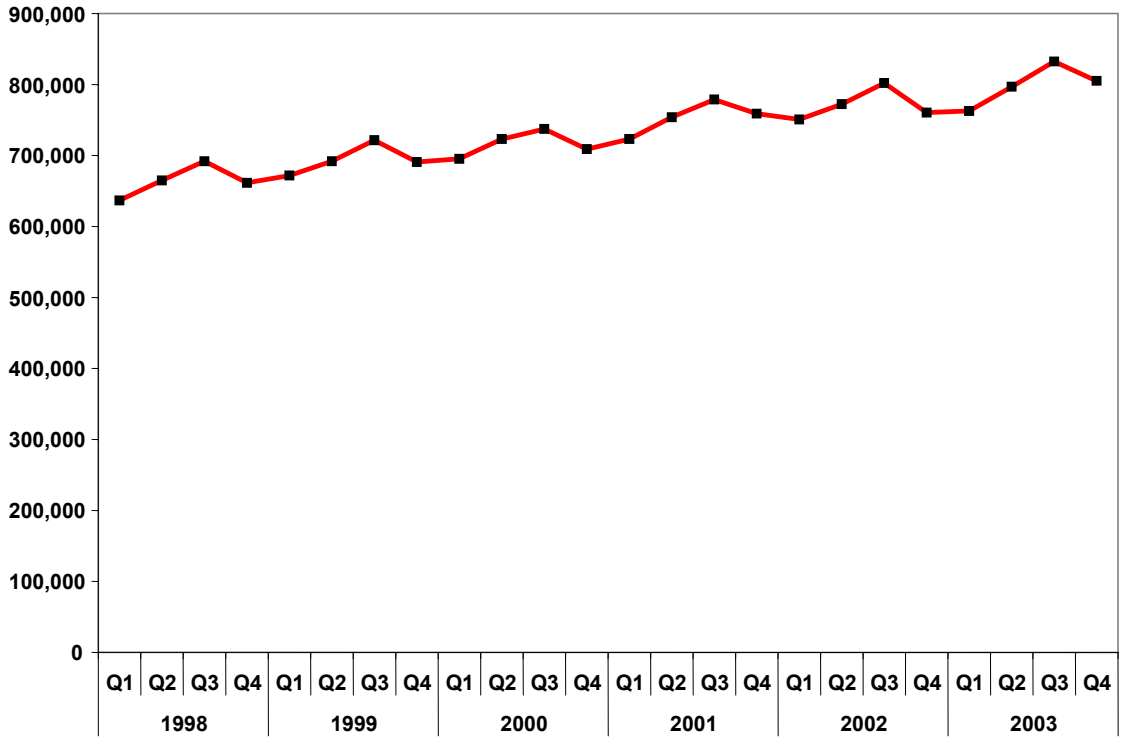
Chart 6: ED Visits per 1,000 Population by Region of NJ 1998-2003



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

Because it is available on a quarterly basis, data from the B-2 utilization report enable a more detailed examination of recent trends in ED volume. Chart 7 shows quarterly variation in ED visits in NJ from the first quarter of 1998 through the fourth quarter of 2003. Although the trend is steadily upward, ED utilization tends to drop in the fourth quarter of every year. In all six years from 1998-2003, ED visits reach their highest levels during the third quarter.

Chart 7: ED Visits in NJ by Quarter, 1998-2003



Source: New Jersey Quarterly Hospital Utilization Report

Changes in ED utilization vary by source of payment. Table 2 shows which payers accounted for the increase in outpatient ED volume from 2000-2003. These data reflect ED visits net of admissions as ED admission data are not available by payer in the annual cost report.[4] Also, reporting of outpatient ED data by payer did not begin until the year 2000. Almost half (45%) of the increase in outpatient ED volume from 2000-2003 is accounted for by Medicaid (including Medicaid managed care). As a result, Medicaid increased its statewide share of outpatient ED volume from 14% to 17% during this period. In contrast, outpatient ED volume among Medicare (including Medicare managed care) patients declined by approximately 12,000

visits from 2000-2003. This decline led to a slight reduction in Medicare's share of total outpatient ED visits from 16% to 14%. The share of ED visits accounted for by other payers remained essentially constant from 2000 to 2003. In particular, self pay patients, including uninsured individuals, consistently accounted for a little over 1/5 of all outpatient ED volume.

Table 2: Change and Share of Outpatient ED Visits by Payer, 2000-2003

	Increase in Volume of ED Visits, 2000-2003	Percent of Total Increase	Share of ED Visits	
			2000	2003
Statewide	272,981	100%	100%	100%
Medicaid	122,551	45%	14%	17%
Medicare	-12,447	-5%	16%	14%
HMO/Commercial/BCBS	102,181	37%	43%	42%
Self-pay	45,544	17%	23%	22%
Other	15,152	6%	4%	4%

Source: New Jersey Annual Acute Care Hospital (ACH) Cost Report
Outpatient ED visits refer to ED visits that did not lead to inpatient admission.

Data on hospital admissions through the ED is available by payer from the UB-92 records. Unfortunately, these data are not directly comparable to the annual cost report data for two reasons. First, the total number of statewide ED admissions recorded in the UB data are 10%-13% less than what is reported in the annual cost reports. Second, it is not clear whether all Medicaid HMO admissions are recorded as Medicaid or as (private) HMO in the UB payer field. Because it is based on billing records, the UB data probably give a more accurate account of total volume. However, the identification of Medicaid utilization requires analysis of ACH Cost Report data due to the difficulty in identifying Medicaid HMO's in the UB records.

Using the two data sources, a few broad trends can be compared between purely outpatient ED visits and ED visits that led to inpatient admission – hereafter referred to as inpatient ED volume. First, both data sources show a 21% increase in inpatient ED volume from 1998-2003. Second, admissions through the ED grew at a roughly similar rate for all payers as the relative shares of total ED visits remained stable throughout the period. One exception is Medicare, which increased its share of ED admissions from 46% in 1998 to 48% in 2003. Moreover,

since Medicare accounts for almost half of all ED admissions, Medicare also accounted for 56% of the total increase in inpatient ED volume from 1998-2003.

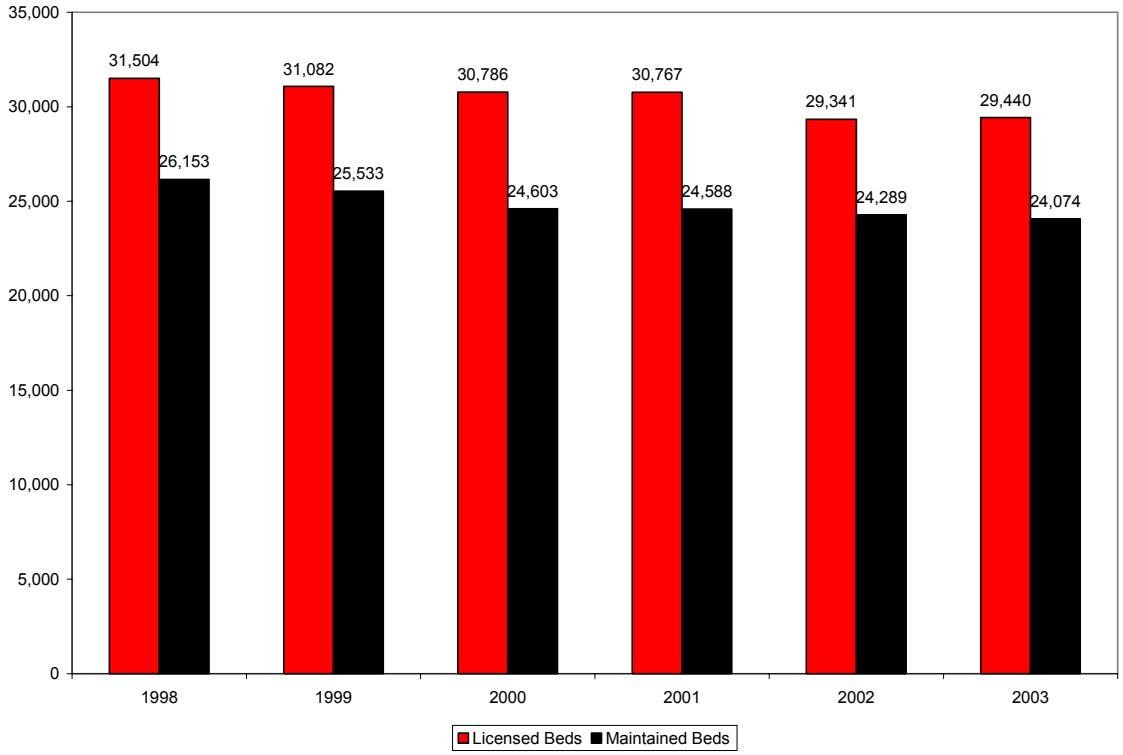
Admitted ED volume for Medicaid patients appears to be sensitive to the way Medicaid managed care patients are classified in the UB data. Admissions through the ED for patients classified as Medicaid declined significantly from 1998-2003. However, ED admissions rose for patients in HMO's that serve large segments of the Medicaid managed care population (e.g., Amerigroup, Horizon/Mercy). If these admissions are counted as Medicaid, then the admitted ED volume for Medicaid grows at a rate that is similar to other payers.

Altogether, trends in ED volume by payer appear to be different in NJ compared to the national trend where most of the growth occurs in the privately insured population. However, as described in the discussion section, this comparison is a tentative one due to differences in the way payer data are collected at the national level.

Inpatient Capacity

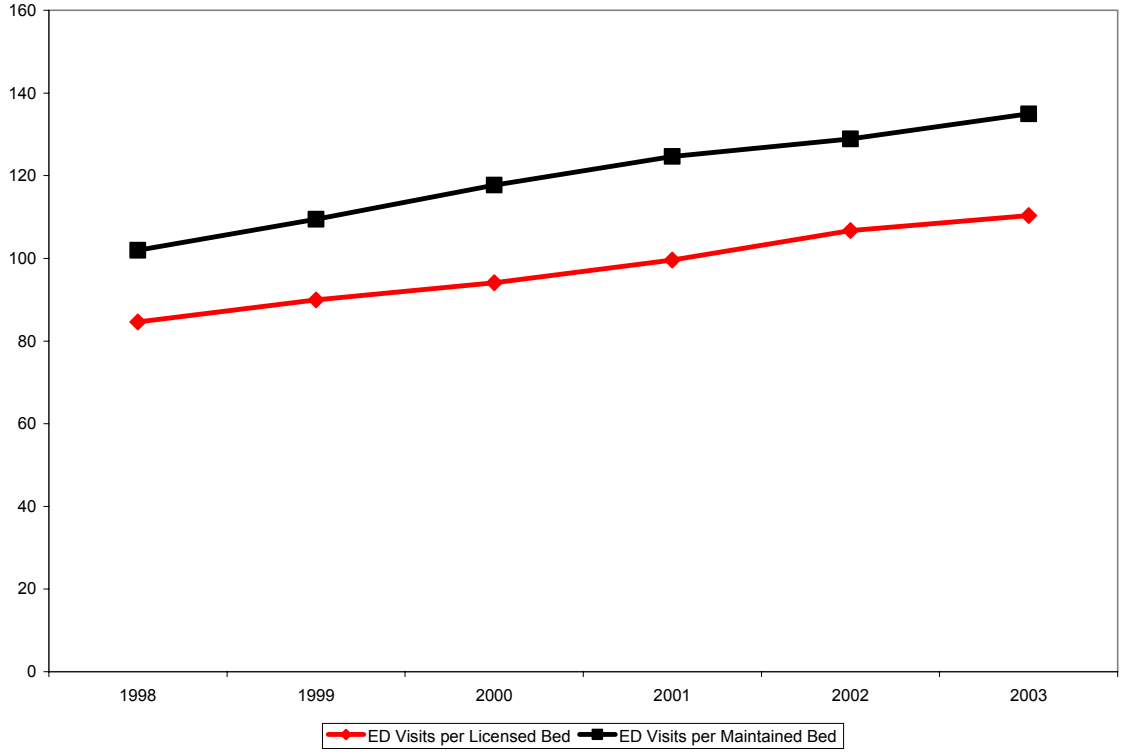
Inpatient capacity at NJ hospitals has declined steadily in recent years. Total maintained beds fell from 26,153 in 1998 to 24,074 in 2003 (Chart 8). A broader measure of capacity focuses on licensed beds. In some cases, licensed beds can be brought into service with additional staffing, although licensed may also be taken out of service permanently. Taken together, maintained and licensed beds may be viewed as lower and upper limits on inpatient capacity. The total number of licensed beds in NJ fell from 31,504 in 1998 to 29,440 in 2003 (Chart 8). This decline in capacity combined with the increase in ED volume has led to a significant increase in ED visits per bed – 30% for maintained beds and 32% for licensed beds (Chart 9).

Chart 8: Total Licensed and Maintained Beds in NJ, 1998-2003



Source: New Jersey Annual Acute Care Hospital (ACH) Cost Report

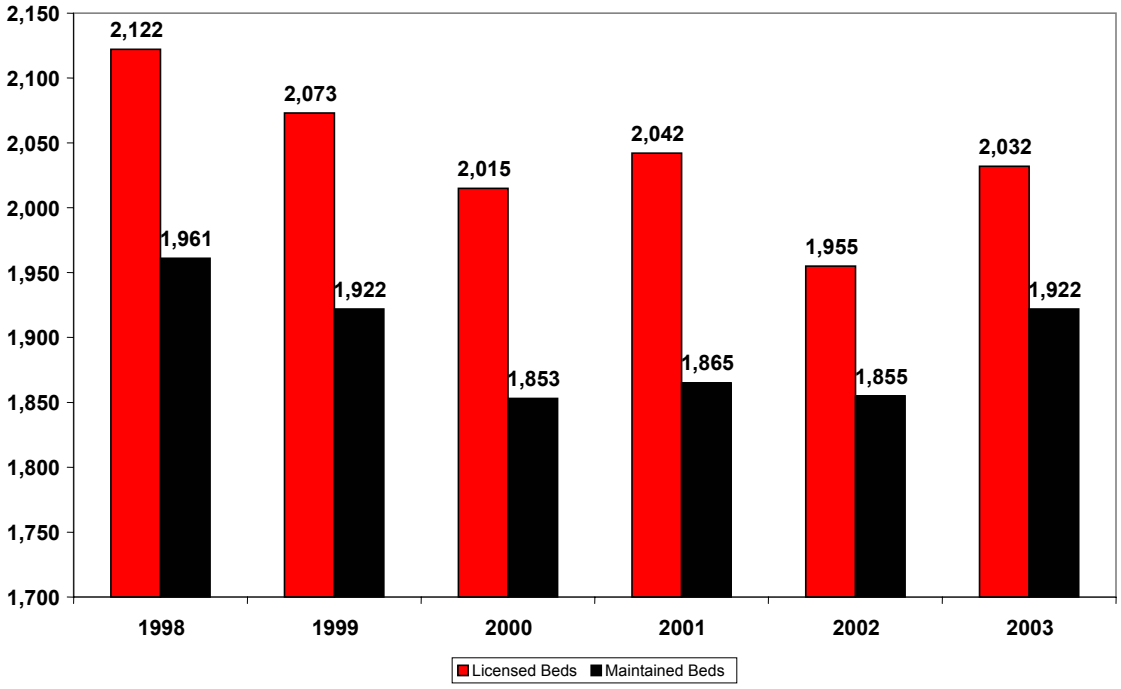
Chart 9: ED Visits per Bed in NJ, 1998-2003



Source: New Jersey Annual Acute Care Hospital (ACH) Cost Report

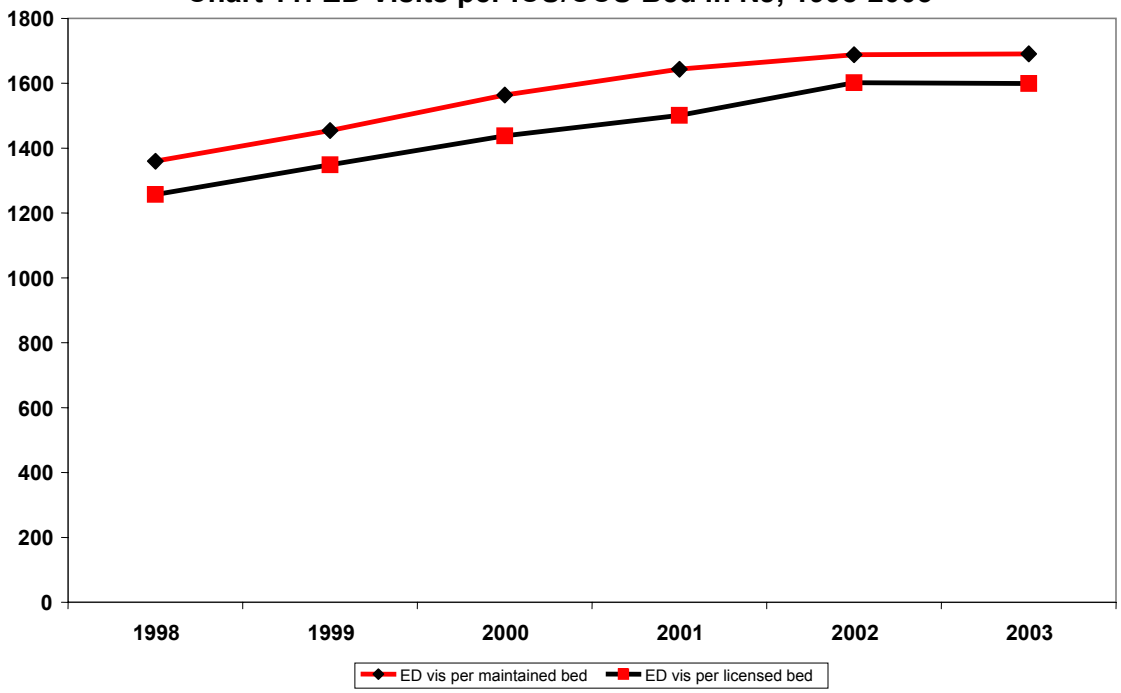
A frequently cited source of ED overcrowding is insufficient supply of beds in the critical care unit (CCU) or intensive care unit (ICU) of the hospital. The total number of both maintained and licensed ICU/CCU beds fell from 1998-2000 and then fluctuated from 2000-2003 (Chart 10). In 2003 ICU/CCU bed capacity according to both measures was lower in 2003 than it was in 1998. This led to an increase in ED visits per ICU/CCU bed from 1998-2002, which leveled off in 2003 (Chart 11).

Chart 10: Licensed and Maintained ICU/CCU Beds in NJ 1998-2003



Source: New Jersey Annual Acute Care Hospital (ACH) Cost Report

Chart 11: ED Visits per ICU/CCU Bed in NJ, 1998-2003



Source: New Jersey Annual Acute Care Hospital (ACH) Cost Report

Occupancy Rates

Hospital occupancy rates provide a direct measure of hospital surge capacity in the face of a mass casualty event. Hospitals that are nearly full (i.e., near 100% occupancy) are extremely limited in their ability to provide emergency care to critically ill or injured patients. Table 3 shows the inpatient occupancy rate for NJ overall and for the five regions of the state from 1998-2003. The statewide occupancy rate is defined as statewide inpatient days divided by statewide inpatient beds times 365. This number measures the utilization of inpatient capacity for the entire hospital sector in NJ. It can be interpreted as a weighted average of all hospitals' occupancy rates where hospitals with more beds are given greater weight in the calculation. Regional occupancy rates are calculated similarly. Separate calculations are performed for maintained and licensed hospital beds.

With maintained beds in the denominator, the statewide inpatient occupancy rate increased from 67% in 1998 to 73% in 2003. In other words, 33% of inpatient capacity statewide would have been available for large-scale emergencies in 1998, while only 27% would have been available in 2003. As expected, the occupancy rate based on licensed beds shows more unused capacity. This occupancy rate has also trended upward suggesting a decline in reserve capacity over time.

The practical difference between these two measures of capacity-in-use hinges on how quickly a licensed bed can be converted to a maintained bed. Since the speed of conversion is likely to vary by type of bed and type of illness treated, the two occupancy measures might be regarded as upper and lower bounds for unavailable inpatient capacity. Despite their rising trend, neither measure of inpatient occupancy indicates an excessively low level of surge capacity – i.e., between 27% and 40% in 2003.

The rising trend in occupancy rates is consistent across all five regions of NJ. For most of the study period, higher occupancy rates have been found in the Northeast and Central East regions. However, by 2003 occupancy rates (using either measure of beds) in the South and Northwest have approached or even surpassed occupancy rates in the other two regions.

Table 3: Occupancy Rates Statewide and by Region

	1998	1999	2000	2001	2002	2003
Occupancy Rate Based on Maintained Beds						
New Jersey	67%	68%	70%	71%	72%	73%
Northeast	69%	70%	71%	71%	72%	73%
Northwest	66%	67%	67%	67%	71%	72%
Central East	68%	71%	73%	77%	75%	77%
Central West	60%	60%	64%	65%	64%	69%
South	63%	65%	66%	70%	70%	70%
Occupancy Rate Based on Licensed Beds						
New Jersey	56%	56%	56%	57%	59%	60%
Northeast	57%	58%	57%	57%	58%	59%
Northwest	57%	54%	53%	56%	64%	65%
Central East	58%	58%	61%	61%	64%	63%
Central West	52%	54%	50%	56%	55%	56%
South	50%	51%	50%	54%	55%	57%

Source: New Jersey Annual Acute Care Hospital (ACH) Cost Report

Throughout the state, occupancy rates for ICU/CCU beds are higher than overall occupancy rates indicating less surge capacity for ICU and CCU patients than for inpatients overall (Table 4). ICU/CCU occupancy rates grew from 74% in 1998 to 79% in 2000 and then fell back to 77% in 2003.

Table 4: ICU/CCU Occupancy Rates by Region

	1998	1999	2000	2001	2002	2003
Occupancy Rate Based on Maintained Beds						
New Jersey	74%	77%	79%	79%	79%	77%
Northeast	75%	77%	79%	76%	74%	75%
Northwest	78%	82%	72%	70%	89%	66%
Central East	74%	78%	81%	82%	81%	80%
Central West	68%	75%	75%	79%	77%	79%
South	75%	75%	79%	82%	84%	84%
Occupancy Rate Based on Licensed Beds						
New Jersey	69%	72%	72%	72%	75%	73%
Northeast	68%	70%	72%	69%	70%	71%
Northwest	74%	76%	65%	63%	86%	66%
Central East	68%	74%	74%	72%	74%	72%
Central West	68%	75%	74%	79%	73%	75%
South	69%	70%	71%	77%	84%	82%

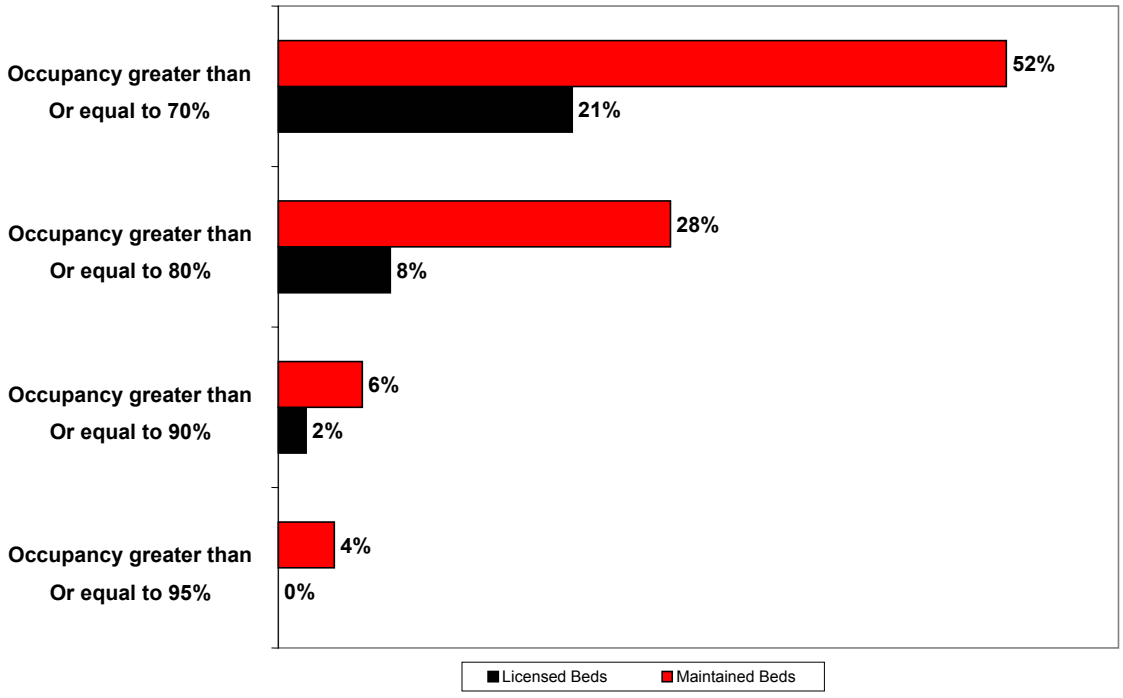
Source: New Jersey Annual Acute Care Hospital (ACH) Cost Report

In regional analysis, ICU/CCU occupancy rates behaved fairly erratically with each region experiencing years of rising and falling occupancy. As a result, the ranking of regions by ICU/CCU occupancy rates (using either measure of bed capacity) changed frequently from 1998-2003.

The trend in overall occupancy rates does not fully reveal the extent to which surge capacity may be severely limited in some hospitals. As shown in Chart 12, some NJ hospitals experienced extremely high occupancy rates in 2003. With maintained beds in the denominator, about half of all hospitals experienced occupancy rates at 70% or higher. More importantly, more than one quarter of NJ hospitals had occupancy rates exceeding 80% with some exceeding 90% and a small percentage exceeding 95%. These percentages fall dramatically, however, when

occupancy rates are calculated using licensed beds instead of maintained beds. By this occupancy measure, only one-fifth of hospitals have occupancy rates of 70% or higher with none experiencing occupancy at 95% or more.

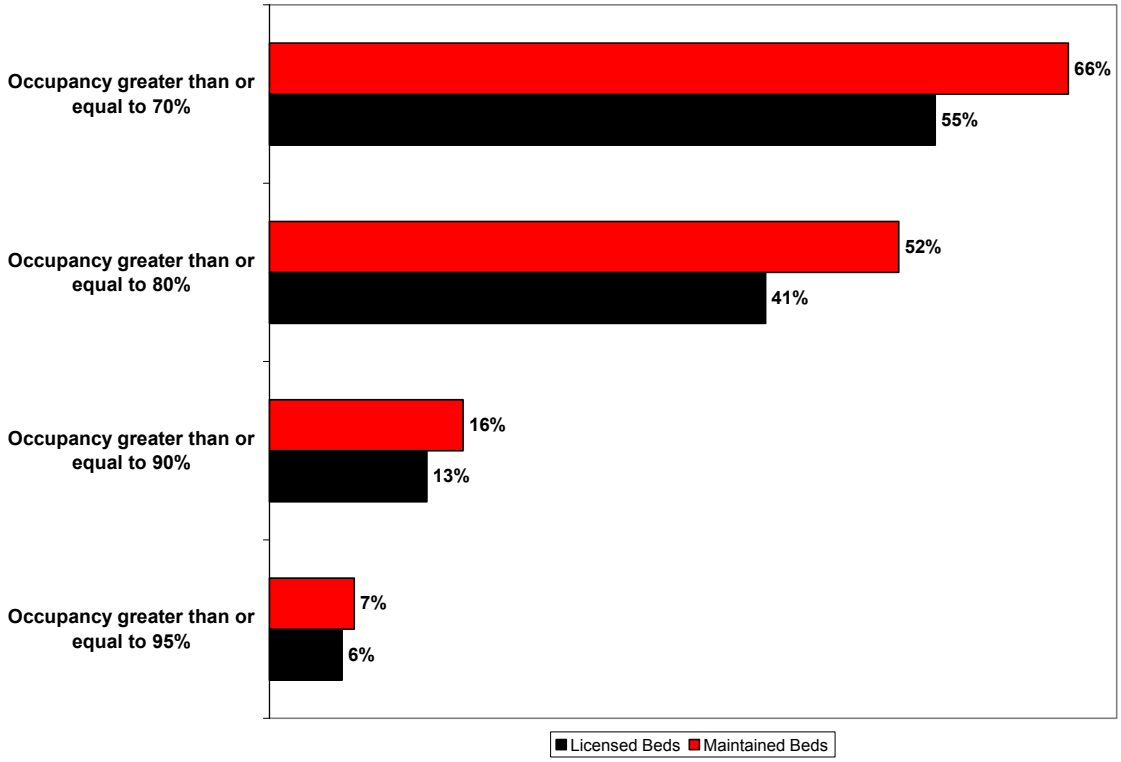
Chart 12: Percentage of Hospitals Exceeding Various Occupancy Thresholds for General Acute Care Beds, 2003



Source: New Jersey Annual Acute Care Hospital (ACH) Cost Report

Extreme occupancy rates are more common for ICU/CCU beds than for beds in general (Chart 13). With maintained ICU/CCU beds in the denominator, just under two-thirds of all NJ hospitals experienced ICU/CCU occupancy rates at 70% or higher in 2003. One-half of all NJ hospitals experienced ICU/CCU occupancy rates at 80% or higher. Moreover, fairly large percentages of hospitals experienced extreme occupancy rates – i.e., 16% at 90% or more and 7% at 95% or more. Calculations with licensed ICU/CCU beds in the denominator lead to lower percentages of hospitals falling into each of these categories, but the reductions are not as large as they are in the case of overall occupancy rates. Specifically, half of all hospitals still experience occupancy greater than or equal to 70% of licensed ICU/CCU beds with 6% equaling or exceeding 95% ICU/CCU occupancy.

Chart 13: Percentage of Hospitals Exceeding Various Occupancy Thresholds for ICU/CCU Beds, 2003



Source: New Jersey Annual Acute Care Hospital (ACH) Cost Report

Before ascribing policy significance to the presence of hospitals with very high occupancy rates, it is important to understand whether these hospitals have experienced this level of occupancy for a prolonged period of time. One unusual year of high occupancy may not require a major policy or managerial response. Indeed, if times of high occupancy are truly transitory, then the bottleneck on inpatient capacity would likely have abated before any response could be implemented. On the other hand, if some hospitals have experienced high occupancy for several years in a row, then this would be an indication that a strong public policy or resource management initiative is needed.

To explore the issue of persistence of high occupancy rates, hospitals were divided into five groups – those in the top 20% according to occupancy rate, those in the next 20%, and so on. This ranking was done based on data for 1998 only. Table 5 shows the average occupancy rate over time for hospitals in each group. Because the ranking is based on data from 1998 only, hospitals remain in the same group for each year of the study. If the phenomenon of high occupancy is transitory for most hospitals, then one would expect the average occupancy rate for the top 20% to converge fairly quickly to the overall average over time. Similarly, the average

occupancy rate for hospitals in the bottom 20% might converge upward to the overall average if extremely low occupancy were a transitory phenomenon also.[5]

The data in Table 5 suggest that most hospitals maintain a fairly steady occupancy level over time. In other words, hospitals with the highest occupancy rates in 1998 were likely to have the highest occupancy rates throughout the five subsequent years. Hospitals in other quintiles (i.e., groups of 20%) did not appear to change their relative rank over time either.[6] These include hospitals in the bottom 20% that have experienced very low occupancy rates for all six years of the study.

Table 5: Average Occupancy Rate by Quintile in 1998

Quintile	1998	1999	2000	2001	2002	2003
Highest 20%	81%	79%	80%	80%	81%	82%
Second highest 20%	72%	72%	70%	71%	70%	71%
Third highest 20%	65%	65%	66%	69%	71%	74%
Fourth highest 20%	59%	61%	65%	64%	67%	68%
Bottom 20%	50%	53%	55%	57%	57%	59%

Source: New Jersey Annual Acute Care Hospital (ACH) Cost Report

A similar analysis shows that ICU/CCU occupancy rates are a little less stable over time compared to overall occupancy rates (Table 6). Hospitals in the top 20% in 1998 experience an immediate decline in the average ICU/CCU occupancy rate, which is sustained for the remaining years of the study. Also, the rank order of average occupancy rates switches across groups in later years of the study. For example, in 2001 the group labeled "Third highest 20%" has a higher average occupancy rate than the group labeled "Second highest 20%". Also the group of hospitals ranked in the bottom 20% in 1998 experienced higher average occupancy in the remaining years of the study.[7] Nevertheless, hospitals ranked in the top 20% in 1998 still have the highest average ICU/CCU occupancy rate in every year from 1998-2003.

Table 6: Average ICU/CCU occupancy rate by quintile in 1998

Quintile	1998	1999	2000	2001	2002	2003
Highest 20%	90%	86%	87%	85%	86%	86%
Second Highest 20%	81%	81%	80%	77%	73%	74%
Third Highest 20%	74%	76%	77%	79%	80%	82%
Fourth Highest 20%	67%	70%	72%	73%	73%	75%
Bottom 20%	55%	63%	64%	67%	66%	63%

Source: New Jersey Annual Acute Care Hospital (ACH) Cost Report

Given the persistence of high occupancy for at least some hospitals, it is useful to understand which hospitals consistently have high occupancy rates and what, if any, characteristics they have in common. For this purpose, a separate classification is done for hospitals that have at least 85% occupancy, either overall or for ICU/CCU beds, for every year of the study.

Only three hospitals met this criterion for overall occupancy. In some years, calculated occupancy among these three facilities approached or equaled 100%. Specifically, these hospitals are:

- Hackensack University Medical Center
- Robert Wood Johnson University Hospital
- Raritan Bay Medical Center-Old Bridge

Before 2002, Raritan Bay Medical Center-Old Bridge reported data jointly with Raritan Bay Medical Center-Perth Amboy. In the two years with individual cost report filings (2002-2003), Raritan Bay Medical Center-Old Bridge had occupancy rates that exceeded 95%.

An important feature shared by all three of these facilities is that they are all located in some of the more heavily populated areas of the state – a feature that has two implications. First, a catastrophic event in any of these areas may create a large number of casualties, and therefore, a large immediate demand for emergency resources. Second, each of these facilities is located near other hospitals that may be able to absorb diverted patients in the case of a large-scale emergency. For the purposes of emergency response planning, these implications work in

opposite directions. Therefore, a more detailed area-level analysis is required to fully understand whether these hospitals are operating with insufficient surge capacity.

There were seven hospitals that met the 85% criterion for ICU/CCU beds with many approaching or equaling 100% in reported ICU/CCU occupancy. These hospitals are [8]

1. Burdette Tomlin Memorial Hospital
2. Christ Hospital
3. Robert Wood Johnson University Hospital
4. Raritan Bay Medical Center – Old Bridge
5. Virtua/West Jersey-Marlton
6. Kennedy Hospital/University Medical Center-Washington [9]

Hospitals with consistently high ICU/CCU occupancy rates are spread across three regions of the state. Specifically, three of these hospitals (numbers 1, 6, and 7 above) are located in the Southern region, while two are located in the Northeast (numbers 2 and 4 above) and two are located in the Central East (numbers 3 and 5 above). These hospitals also vary according to their proximity to other hospitals and population density of their local market areas. For example, Burdette Tomlin Memorial Hospital is located in Cape May Courthouse, which is a fairly isolated part of NJ with no other hospitals close by. In contrast, Christ Hospital is located in Jersey City, which is densely populated, with several other hospitals nearby.

As described in the literature review, hospital occupancy statistics that are reported annually or even quarterly can hide much of the stress on inpatient capacity that stems from daily volatility in the inpatient census. To better understand how daily volatility may affect inpatient surge capacity, the variation in daily census was calculated for each hospital in NJ for 2003 using UB-92 data. The calculation of a daily occupancy rate requires bed supply data on a daily basis. Since these data are not available, daily occupancy rates are calculated by dividing the daily census for each hospital by the corresponding number of beds for the relevant quarter as reported in the B-2 file (e.g., the occupancy rate for July 23 is calculated as inpatients on that day divided by beds in the third quarter). Since this analysis is illustrative in nature and the calculations involved are resource intensive, only data for the third quarter of 2003 is analyzed. Licensed beds are more prevalent than maintained beds, and therefore, will give smaller values for daily occupancy. To be conservative, licensed beds are used for this calculation.

The analysis of daily occupancy excludes newborns, since women admitted for maternity are recorded separately. The inclusion of newborns would overstate the daily use of hospital beds, since newborns are assigned to their own hospital bassinets.

The literature reviewed above suggests that same-day surgeries (SDS's) use a significant amount of hospital resources, particularly surgical beds, that is not captured in inpatient occupancy statistics. To explore this issue, a separate calculation is done using all inpatient (excluding newborns) and SDS patients in the numerator of the occupancy rate. Occupancy rates that include SDS's may be viewed as an upper bound of each hospital's used capacity, as SDS's and inpatient surgery utilize some overlapping resources. Similarly, occupancy rates that do not include SDS's may be viewed as a lower bound, since this overlap is not accounted for.

Finally, the analysis of daily occupancy is restricted to 78 hospitals that report UB-92 and B-2 in a compatible way. If a hospital includes two or more facilities in a single B-2 report, then it is not possible to link bed data from this report to the patient data in the UB file. Therefore, facilities that did not allow a direct link were excluded from this analysis.

Table 7 provides statistics on daily occupancy rates compared to summary measures available in the B-2 file. The mean quarterly occupancy rate is calculated by taking the average across hospitals of the occupancy rate for the third quarter of 2003 (from the B-2 report). The mean daily occupancy rate is calculated by first taking the average daily occupancy rate for each hospital over 92 days in the third quarter of 2003 and then taking the average of this number across all hospitals in the analysis. The maximum and minimum daily occupancy rate report the highest and lowest occupancy rate calculated by any hospital on any day in the third quarter of 2003.

Table 7: Summary Statistics for Daily and Quarterly Occupancy Rates Statewide and by Region, Third Quarter of 2003

Region	Number of Hospitals	Mean Quarterly Occupancy Rate	Mean Daily Occupancy Rate	Minimum Daily Occupancy Rate	Maximum Daily Occupancy Rate
Including Inpatient Care Only					
NJ	78	56%	68%	8%	153%
Northeast	30	54%	63%	17%	110%
Northwest	6	54%	73%	8%	153%
Central East	17	63%	76%	34%	138%
Central West	7	57%	66%	37%	124%
South	18	55%	68%	28%	115%
Including Inpatient Care and Outpatient Surgery					
NJ	78	63%	71%	8%	158%
Northeast	30	58%	65%	18%	117%
Northwest	6	61%	76%	8%	158%
Central East	17	68%	78%	34%	145%
Central West	7	63%	70%	37%	133%
South	18	65%	71%	28%	122%

Sources: New Jersey Quarterly Hospital Utilization Report (B-2), New Jersey Hospital Uniform Billing (UB) Data

The statewide mean occupancy rate for the third quarter of 2003 (56%) is lower than the average daily occupancy rate for that same quarter (68%). Similar findings are obtained for each of the five regions of NJ with and without the inclusion of outpatient surgery as a source of occupancy. As expected, occupancy rates that include outpatient surgery are higher than standard occupancy rates. Nevertheless, with an average daily value of 71%, even these "inflated" measures of occupancy do not appear excessively high for "the average hospital on an average day".

Looking beyond averages, however, the data suggest that for some hospitals on at least some days, occupancy can be extremely high – at times exceeding 100%. Occupancy above 100% may occur when one patient is discharged and another one is admitted to the same bed later in the day. The analysis above would count both patients as occupying the same bed, while occupancy rates based on a midnight census would include only one.

Table 8 focuses on hospitals that experience extremely high occupancy defined as an occupancy rate equal to or above 95%. Using the standard measure of occupancy, 22% of hospitals analyzed experienced this level of occupancy on at least one day in the third quarter of 2003. This percentage varies by region with 13% of hospitals in the Northeast experiencing at least one day of very high occupancy compared to 33% in the Northwest, 35% in the Central East, 14% in the Central West, and 22% on the South. These percentages increase when outpatient surgery volume is added to the daily occupancy statistics – 35% statewide, 27% in the Northeast, 50% in the Northwest, 47% in the Central East, 29% in the Central West, and 33% in the South.

Table 8: Summary Statistics for Hospitals with Occupancy Rates Greater than or Equal to 95%, Third Quarter of 2003

Region	Number of Hospitals	Number of Hospitals Experiencing One or More Days with Occupancy Greater Than or Equal to 95%	Percentage of Days with Occupancy Greater than or Equal to 95% Among Hospitals Included in Column 3		
Including Inpatient Care Only			Mean	Min	Max
NJ	78	17	42%	1%	100%
Northeast	30	4	22%	1%	65%
Northwest	6	2	83%	66%	100%
Central East	17	6	49%	1%	99%
Central West	7	1	64%	64%	64%
South	18	4	27%	4%	59%
Including Inpatient Care and Outpatient Surgery					
NJ	78	27	33%	1%	100%
Northeast	30	8	16%	1%	73%
Northwest	6	3	58%	3%	100%
Central East	17	8	46%	2%	99%
Central West	7	2	36%	2%	70%
South	18	6	27%	1%	71%

Sources: New Jersey Quarterly Hospital Utilization Report (B-2), New Jersey Hospital Uniform Billing (UB) Data

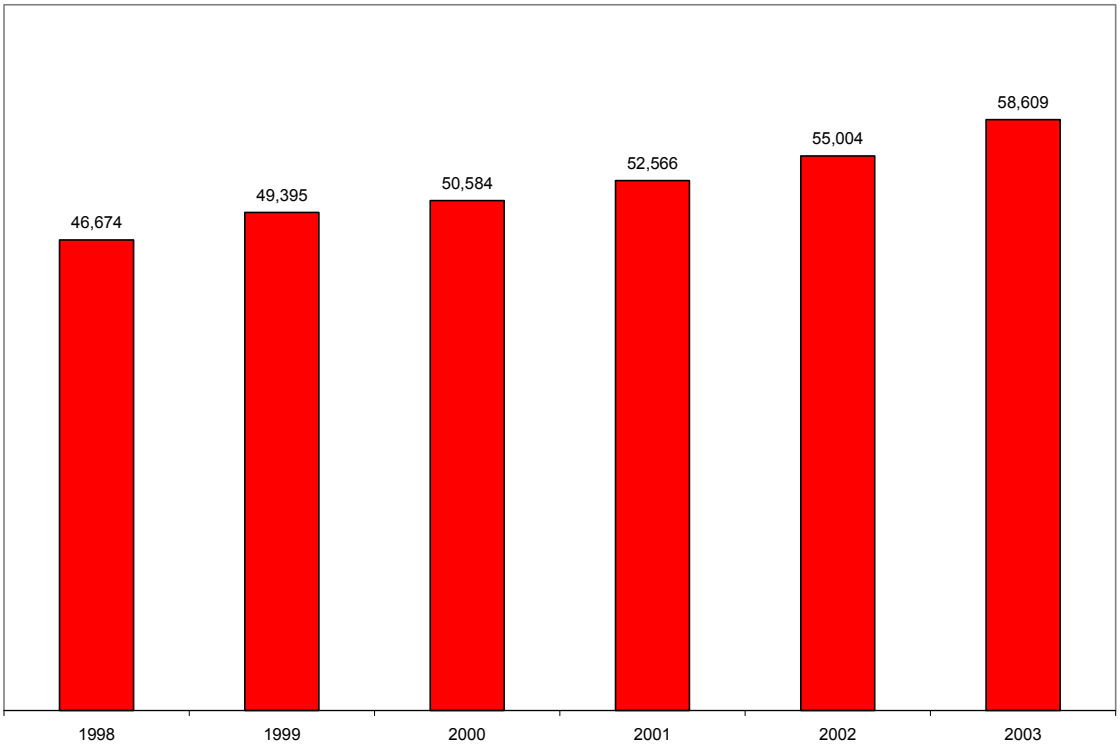
Table 8 also shows that the frequency of high occupancy varies considerably among those facilities that experience at least one day at 95% occupancy or greater. For example, statewide the average hospital in this subset spent 42% of the days in the third quarter of 2003 at this very high level of occupancy. However, at the individual hospital level, the percentage of days at high occupancy ranged from 1% for one hospital to 100% for another. Similar variation exists within regions and for occupancy rates calculated with outpatient surgery in addition to inpatient admissions.

Preventable Hospital Admissions Through the ED

The remaining analysis focuses on ambulatory care sensitive (ACS) admissions through the ED. ACS admissions are admissions to the hospital for conditions that are usually preventable when individuals have access to timely and effective primary care (e.g., asthma, bladder infections).[10] Since these conditions are generally treatable at an earlier stage in other settings, they represent a source of stress on the ED and other hospital resources that might be avoided if medical care services were organized differently.

In 2003, ACS admissions accounted for 24% of all hospital admissions through the ED for non-elderly adults (ages 18-64).[11] The total number of ACS admissions through the ED for this population grew by 25.6% from 46,674 in 1998 to 58,609 in 2003 (Chart 14).

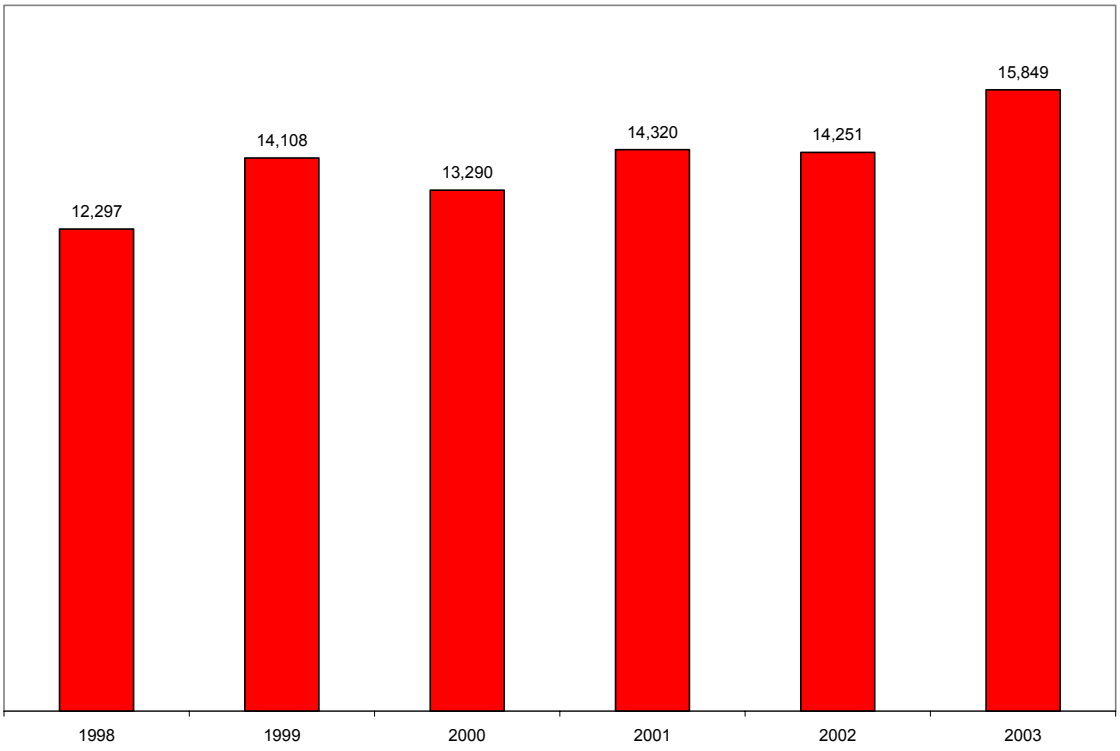
Chart 14: Total number of ED Admissions for ACS Conditions among Non-Elderly Adults (Ages18-64) in NJ, 1998-2003



Source: New Jersey Hospital Uniform Billing (UB) Data

ACS admissions make up a much larger percentage (45% in 2003) of hospital admissions through the ED among children (ages 0-17). Among children, the total number of ACS admissions through the ED grew by 28.9% from 12,297 in 1998 to 15,849 in 2002 (Chart 15).

Chart 15: Total Number of ED Admissions for ACS Conditions among Children (ages 0-17) in NJ, 1998-2003

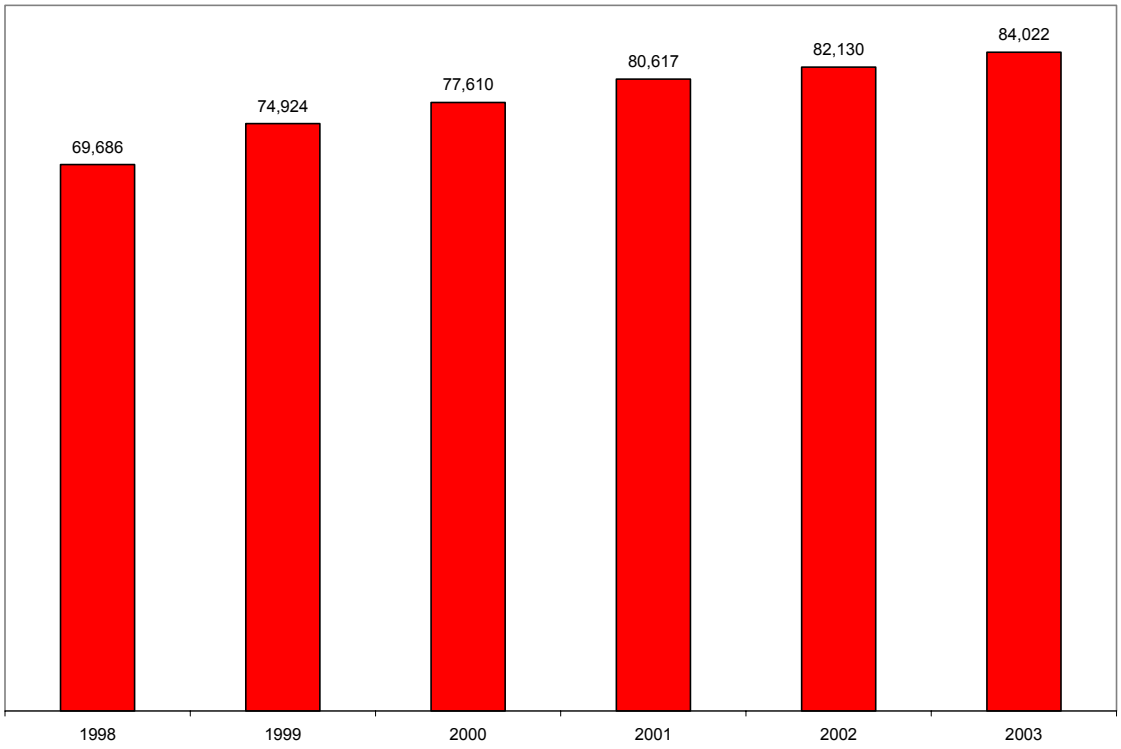


Source: New Jersey Hospital Uniform Billing (UB) Data

Analysis of ACS admissions through the ED for elderly (ages 65 and over) adults has been performed also. However, this analysis must be interpreted with some caution. ACS admissions were developed primarily to monitor hospitalizations among the non-elderly population. Since some diseases present differently in the elderly, the algorithm used to classify ACS admissions must be modified for this population. Following Blustein, Hanson, and Shea (1998), this report excludes pneumonia from ACS admissions for the elderly.

These modified ACS admissions made up 32% of hospital admissions through the ED among elderly patients. The total number of these admissions grew by 21% from 69,686 in 1998 to 84,022 in 2003.

Chart 16: Total Number of ED Admissions for ACS Conditions among Elderly Adults (ages 65 and over) in NJ, 1998-2003



Source: New Jersey Hospital Uniform Billing (UB) Data
For elderly adults, ACS admissions exclude pneumonia.

The percentage of admissions through the ED that are attributable to ACS conditions varies somewhat by hospital characteristics. Most notably, ACS conditions make up a significantly higher percentage of ED admissions in hospitals with high concentrations of Medicaid and uninsured/self-pay patients – i.e., 18% for these hospitals versus 12% for other hospitals (Table 9). A list of facilities with high concentrations of Medicaid and uninsured/self-pay patients appears in Appendix A.

Table 9: ACS Admissions through the ED by Characteristics of Hospitals and Hospital Markets, 2003

	Number of Hospitals	Total ACS Admissions Through the ED	Percentage of Admissions Through the ED for ACS Conditions
Statewide	86	74,458	16%
Hospital Characteristics			
High Medicaid & uninsured/self-pay	30	30,071	18%
Low to moderate Medicaid & uninsured/self-pay	54	44,384	12%
Teaching	12	20,242	15%
Non-Teaching	72	54,213	13%
Beds			
1 Tercile	29	34,313	13%
2 Tercile	28	20,741	13%
3 Tercile	29	14,201	14%
Market Characteristics			
Market Concentration			
1 Tercile	28	24,415	12%
2 Tercile	30	25,297	13%
3 Tercile	28	24,746	16%
Median Income			
1 Tercile	28	24,580	12%
2 Tercile	28	19,587	13%
3 Tercile	30	30,291	17%
Total Population			
1 Tercile	29	32,896	14%
2 Tercile	28	18,478	13%
3 Tercile	29	23,084	14%

Continued on next page

Table 9 Continued

	Number of Hospitals	Total ACS Admissions Through the ED	Percentage of Admissions Through the ED for ACS Conditions
Percentage Black			
1 Tercile	26	22,304	16%
2 Tercile	28	24,203	15%
3 Tercile	32	27,951	12%
Percentage Hispanic			
1 Tercile	29	27,616	15%
2 Tercile	30	24,352	14%
3 Tercile	27	22,490	12%
Immigrant Percentage			
1 Tercile	28	28,078	15%
2 Tercile	29	23,578	14%
3 Tercile	29	22,802	12%

Sources: New Jersey Hospital Uniform Billing (UB) Data; Claritas, Inc.; New Jersey Birth Records

See text for variable definitions.

In this table, hospitals are ranked by terciles of continuous variables – e.g., the first tercile includes the largest 1/3 of hospitals according to the number of beds, the second tercile includes the middle 1/3, and the third tercile includes the bottom 1/3. Tercile rankings for other variables are analogous.

ED admissions in teaching hospitals are only slightly more likely to involve ACS conditions than ED admissions in other hospitals (Table 9). In this report, teaching hospitals are defined as those listed on the Association of American Medical Colleges' website (http://www.aamc.org/members/listings/thgeomonm.htm). A list of facilities classified as teaching hospitals appears in Appendix B.

The difference in percentage of ED admissions attributable to ACS conditions is driven by the safety net status of several teaching hospitals. Among hospitals classified as teaching but not safety net, the percentage of ED admissions attributable to ACS conditions is 13%. This is almost the same as the corresponding percentage for hospitals classified as non-teaching/non-safety net (12%). The percentage of ED admissions attributable to ACS conditions is higher for safety net hospitals regardless of their teaching status – i.e., 17% for safety net/non-teaching hospitals and 19% for safety net/teaching hospitals.

Among non-safety net hospitals, those designated as teaching are no different from non-teaching hospitals according to this measure (i.e., 12% each). However, among safety net hospitals, those designated as teaching have a higher percentage of ED admissions attributable to ACS conditions than non-teaching safety net hospitals (20% versus 16%).

The percentage of ED admissions attributable to ACS conditions does not vary significantly by hospital size (Table 9). For this analysis, hospitals were divided into three groups based on the total number of maintained beds – largest 1/3, middle 1/3, and smallest 1/3. In each group, ACS conditions account for 13-14% of all ED admissions.

ACS admissions as a percentage of all ED admissions vary by the characteristics of markets in which hospitals operate. For each hospital, a core market area is defined as the set of patient zip codes accounting for 90% of its inpatient and same-day surgery volume. Market characteristics are derived from zip code level data that is aggregated to the market level for each hospital.

Hospitals operating in the least concentrated markets tend to have a higher percentage of ED admissions that are attributable to patients with ACS conditions (Table 9).[12] These hospitals are generally located in urban areas with several other facilities nearby.

Hospitals that serve markets where family income is comparatively low tend to have higher concentrations of ACS conditions among patients admitted through the ED. This is shown in Table 9 where hospitals are classified according to the median family income of residents living in each hospital's market area. Hospitals in the top and middle 1/3 according to this classification are similar in the percentage of ED admissions for ACS conditions (12-13%). However, hospitals serving markets in the lowest 1/3 of the income distribution have a somewhat higher percentage of ED admissions for ACS conditions (17%).

The percentage of ED admitted patients with ACS conditions does not vary with the total number of people living in a hospital's core market area (Table 9). However, this percentage does vary with the racial/ethnic composition of the local population (Table 9). Specifically, hospitals that serve markets with higher concentrations of African American and Hispanic residents tend to have higher concentrations of ACS conditions among patients admitted through the ED.

Hospitals that serve markets with higher concentrations of immigrant residents also appear to have slightly higher concentrations of ACS conditions among patients admitted through the ED (Table 9). Because data on immigrant populations is unavailable at the zip code level, it is approximated using available data on immigrant births. Specifically, hospital markets are classified according to the percentage of births in the relevant zip codes to foreign born women.

Discussion

In the late 1980's ED overcrowding became a serious concern among emergency medical professionals. A report by the General Accounting Office concluded that much of the increase in ED utilization during that time was attributable to a rapidly growing number of uninsured individuals who relied on the ED for a variety of healthcare services (U.S. General Accounting Office, 2003). ED utilization leveled off in the mid-1990's partly due to the growth of managed care, which required preauthorization for ED use and de-emphasized hospital care in general. By the end of the 90's, growth in the uninsured population had slowed down and uninsured rates for children actually fell with the emergence of the State Children's Health Insurance Program.

By the year 2000, however, ED use was growing quickly once again. In 2001, ambulance diversions had become increasingly frequent across the nation. The causes for the surge in ED use and ED overcrowding at the present time appear to be very different from the ones that led to overcrowding in the 1980's. As described above, the causes this time are closely tied to supply side issues such as bed capacity, labor force shortages, and the management of patient flow throughout the hospital. Moreover, recent increases in the demand for ED care are driven more by increased utilization among privately insured, rather than uninsured, patients.

ED Utilization in New Jersey

While insufficient ED capacity is a nationwide concern, a recent study noted that Northern NJ has a particularly acute and growing ED overcrowding problem that stands out in comparison to other urban areas (Bazzoli, 2003). That study based its conclusions on findings from interviews with stakeholders in twelve metropolitan statistical areas in 2002 and 2003. The analysis in this report gives a quantitative assessment of ED utilization throughout NJ over a longer time period from 1998 through 2003.

During this time, ED utilization increased rapidly, at an average rate of 4.4% per year. Although New Jersey's population grew during this time, the number of ED visits grew faster. As a result, ED visits per capita also increased rapidly at a pace (3% per year) that is faster than the national average. ED volume has grown most rapidly in the Central-West and Northwest regions of the state. In addition, ED visits statewide have consistently grown most rapidly in the third quarter of every year from 1998 to 2003.

Throughout the study period, ED visits leading to inpatient admission grew at the same rate as ambulatory ED visits, keeping the percentage of total ED visits leading to admission constant at 19%. However, the pattern of ED growth by payer is different for outpatient and inpatient ED volume. According to annual hospital cost report data, almost half of the growth in

ambulatory ED visits from 2000-2003 is driven by Medicaid patients and almost 2/5 is driven by the privately insured (data by payer from 1998-1999 are not available). Self-pay/uninsured patients, who maintained a 20% share of ambulatory ED visits throughout the study period, account for only 17% of the increase in outpatient ED volume in NJ. Ambulatory ED visits among Medicare patients in NJ declined during this period.

These findings contrast with national data, which show that most of the increase in ED volume is driven by privately insured patients (Cunningham and May, 2003). However, payer categories in the national data are less refined than those that appear in the New Jersey Acute Care Hospital (ACH) Cost Report and so comparisons to NJ data must be done in light of some caveats. At issue is the treatment of Medicare and Medicaid beneficiaries who are enrolled in HMO's. The ACH Cost Report contains specific fields for Medicare and Medicaid HMO's. The data used by Cunningham and May is derived from the National Hospital Ambulatory Medical Care Survey (NHAMCS), which is conducted annually by the federal government. The NHAMCS has separate categories for private insurance, Medicare, and Medicaid/SCHIP but none specifically for Medicare or Medicaid HMO's. As a result, Medicare and Medicaid patients enrolled in privately managed HMO's may be misclassified as privately insured. The second report of this project will include more detailed analysis of ED visits that do not lead to admission using new data fields available in hospitals' Uniform Billing records.

In contrast, ED visits leading to admission grew at roughly the same pace for most payers in NJ from 1998-2003. An important exception is Medicare, which grew slightly faster than average. Because of this as well as its large share of ED admissions in 1998, Medicare patients account for 56% of the growth in ED admission volume during the study period. Like the NHAMCS data, the Uniform Billing (UB) data used to analyze admitted ED volume in NJ does not differentiate between HMO's that cover private patients and those that cover Medicare or Medicaid patients.

The ED has become somewhat more important as a source of inpatient admissions among NJ hospitals. In 1998, 50% of all inpatient admissions originated in the ED. By, 2003 this number reached 55%. This trend has implications for resource planning and surge capacity management, as admissions through the ED are inherently less predictable than elective and non-emergent inpatient admissions.

Surge Capacity in NJ

The increase in ED utilization occurred as the number of licensed and maintained hospital beds in NJ either decreased or remained the same. This led to a rapid rise in the number of ED visits per bed. Because of their crucial role in providing emergency treatment, it is

important to focus specifically on the supply of beds for Intensive Care Units (ICU's) and Critical Care Units (CCU's). The analysis in this report showed that ICU/CCU beds declined in NJ from 1998 to 2001 and then began to rise or fluctuate slightly thereafter. Nevertheless, the total number of ICU/CCU beds in 2003 remained smaller than in 1998. Overall this led to a rising trend in ED visits per ICU/CCU bed from 1998-2002. This trend then leveled off in 2003 in contrast to the experience of ED visits per general acute care bed, which rose continuously throughout the study period.

This report also examined hospital occupancy rates, both overall and for ICU/CCU beds, as measures of emergency surge capacity. Occupancy rates for both types of beds have risen continuously in NJ from 1998-2003 suggesting a decline in surge capacity over time. Occupancy rates for ICU/CCU beds have been consistently higher than for general acute care beds overall. Nevertheless, statewide data do not reveal a significant shortage of reserve capacity overall. In 2003, the statewide occupancy rate, based on maintained beds, was 73% for acute care and 77% for ICU/CCU care suggesting reserve capacities of 27% and 23%, respectively. Measured surge capacities are higher when based on licensed beds.

Statewide trends in occupancy hide significant variation among individual facilities. In any given year of the study, some facilities had very low occupancy (e.g., less than 50%), while others had very high occupancy (e.g., above 95%). In other words, some facilities operate with a good deal of excess capacity, while some have very little capacity to spare. In addition, there are a small number of hospitals located in various parts of the state that have experienced consistently high occupancy rates throughout the study period. This limited group of facilities appears to be most at risk for lacking surge capacity during a mass casualty event.

Analysis of daily inpatient utilization revealed a much larger number of hospitals that appear to go through brief periods of very high occupancy that are not reflected in annual or even quarterly occupancy statistics. For example, among 78 hospitals analyzed in the third quarter of 2003, 22% experienced at least one day with occupancy at 95% or higher. Hospitals in the Central East and Northwest regions of the state were the most likely to experience at least one day at this very high occupancy level. Some hospitals experienced extremely high occupancy for all or most days of the quarter.

The analysis of daily occupancy rates also considered the impact of same-day surgeries (SDS's) on hospital surge capacity. SDS's are performed using beds that are set aside primarily for outpatient procedures. However, SDS's can affect hospital surge capacity by placing demands on perioperative staff and by using beds in Postanesthesia Care Units (PACU's) that may be shared with admitted surgery patients.

To gain perspective on the relationship between hospital surge capacity and hospital-based SDS, a supplemental analysis of daily hospital utilization included SDS performed by hospitals in the numerator of the occupancy rate. Since the denominator in this case does not include beds used primarily for SDS, the calculated ratio cannot be interpreted as a real occupancy rate. Instead this ratio might be viewed as an upper bound on unavailable surge capacity compared to a lower bound that considers inpatient care alone. According to this broadly defined measure of surge capacity, 35% of the 78 hospitals analyzed in the third quarter of 2003 experienced at least one day with extremely high occupancy.

The analysis of daily occupancy rates is complicated by the lack of data on daily bed capacity. The capacity measure used above is the number of licensed beds reported by hospitals for the third quarter of 2003. There are two reasons why occupancy rates calculated this way provide a conservative (i.e., downward) estimate of used capacity. First, the total number of maintained (i.e., staffed) beds available for patient care is generally less than the total number of licensed beds. Second, even though maintained beds may be added and removed to match patient demand within a given quarter, the number of licensed beds is not as flexible. In theory, staff may be found to bring licensed beds into service. In practice, many hospitals would find it difficult to bring in the required staff quickly. Moreover, hospitals may remove licensed beds from service completely to make room for other uses (e.g., office space, gift shop). Since these changes are not always reported to the regulatory authorities, some facilities will have an overcount of their licensed beds. Altogether, the use of licensed beds instead of maintained beds in the denominator has a downward effect on the calculated occupancy rate. Therefore, the actual amount of daily surge capacity may be somewhat less than the amount described in the analysis above.

When ED surge capacity is severely constrained, it is important to determine whether certain patients already admitted to the hospital could be discharged early or transferred to another hospital in the case of an unexpected mass casualty event. Work on this topic is currently being conducted by researchers at Johns Hopkins University under a grant from the Agency for Healthcare Research and Quality (2003). The goal of that study is to develop criteria that hospital administrators can use to identify patients that might be discharged early to make room for critically injured patients. Depending on data requirements, the results of that study might be used to inform surge capacity planning before a catastrophic event occurs.

From a broader perspective, resources available in other healthcare facilities such as imaging centers, nursing homes, and community health centers may also be needed in response to a mass casualty event. Facilities that perform ambulatory surgery – whether licensed facilities

or one-room operating rooms in a physician practice – may also contribute to surge capacity in an emergency.

Optimizing ED and Other Hospital Resources

This report finds that a limited number of hospitals in the state have experienced continuous or recurring periods of very high occupancy. These facilities face pressure to minimize the amount of disruption that very high occupancy can bring to patient care. As described above, one of the most commonly cited causes of ED overcrowding is a lack of available inpatient beds, which can lead to boarding of patients in the ED. This point is underscored by the analysis of daily occupancy appearing in this report, which shows that the potential for ED overcrowding may be significantly understated by annual or quarterly occupancy statistics.

While some high-occupancy facilities may consider expanding capacity, this approach can be very costly and is probably not the most efficient option in most cases. This caution is especially relevant if periods of high demand are transitory. As an alternative to major capacity investments, the literature reviewed above identifies several actions that high-occupancy hospitals can take to optimize existing hospital resources. These actions often focus on increasing the speed of patient flow from one hospital department to another with an eye toward minimizing ED overcrowding. If inpatient beds are freed up more rapidly, there will be less pressure to board patients in the ED until a bed becomes available.

The impetus to improve patient flow has grown recently through the inclusion of patient flow criteria as part of the new hospital accreditation standards released by the Joint Commission on Accreditation of Healthcare Organizations (JCAHO). The new standards require hospital leaders to "develop and implement plans to identify and mitigate impediments to efficient patient flow throughout the hospital" (JCAHO, 2005). The connection between patient flow and ED overcrowding is cited by the accreditation manual as a primary reason for the new standard.

While process improvements are likely to be of great help in reducing ED overcrowding, the national literature also identifies personnel shortages as an important source of stress on hospital ED's. In some ways, this reflects the broader problem of a national nursing shortage. In other ways, personnel issues are inherent to staffing in the ED specifically. The literature reviewed above notes a shortage of specialist physicians on-call in the ED, especially in the areas of neurosurgery, neurology, and cardio/thoracic surgery. Although NJ requires hospitals to have physicians on call for all services performed on site, recent research suggests that hospitals in

the state may find it increasingly difficult to comply with these regulations (American College of Emergency Physicians, 2004; Stewart, 2004).

Non-Emergent and Preventable Admissions through the ED

National data show a rapidly rising trend in the use of the ED for primary care treatable and non-emergent medical problems. While non-emergent patients can be asked to wait longer when emergent cases arrive, these patients do add stress to hospital ED's by placing demands on ED personnel and other resources. Moreover, in New Jersey, hospitals are required by law to see ED patients within four hours of arrival. Equally important, use of the ED for non-emergent and primary care treatable conditions runs counter to established standards of high quality medical care. Specifically, patients are generally best served when they receive care from the same provider who can coordinate care across multiple episodes. Patterns of ED utilization for non-emergent and primary care treatable conditions in NJ are not well known. These data have recently become available and will be presented in the next report under the current agreement with the NJDHSS.

This report does provide analysis of ambulatory care sensitive (ACS) hospital admissions through the ED. While these admissions are often emergent, they are typically preventable when patients receive timely and effective primary care at an earlier stage of illness. The analysis above shows that these admissions have risen steadily from 1998 to 2003. By 2003, 23% of all admissions through the ED among non-elderly adults (ages 18-64) were for ACS conditions, while 43% of ED admissions among children were for these conditions. Using a slightly modified approach for ACS admissions among the elderly (ages 65 and above), this report also found that 32% of all admissions through the ED among elderly patients were for ACS conditions. Not surprisingly, these admissions are most likely to occur at hospitals with high concentrations of Medicaid and uninsured/self-pay patients. Also, prior research has shown that heavy users of the ED tend to be individuals with chronic illnesses and people with Medicaid coverage who use large volumes of all types of service (Zuckerman and Shen, 2004).

These findings suggest that stress on hospital ED's might be reduced with greater use of primary care services and disease management programs to treat illnesses at earlier stages. It remains unclear, however, how best to identify and treat individuals most at risk for an ACS admission.

The national literature documents a significant amount of growth in ED utilization among the privately insured for non-emergent medical problems. One report suggests that so-called "prudent layperson standards" may be a factor that encourages the use of the ED for non-emergent conditions (Cunningham and May, 2003). Although these standards were intended to

preserve access to the ED for emergent and potentially emergent conditions, they may have had the unintended consequence of allowing patients to consider the ED as a first rather than last resort for dealing with a variety of medical problems. This problem is exacerbated when patients are unable to get timely appointments to their primary care doctor. Moreover, in cases where doctors are paid on a capitated basis, there may be little incentive for physicians to squeeze patients into a tight appointment schedule – a situation that creates further demand for services in the ED that might be provided in other settings. It is currently unknown whether these issues are contributing factors to ED utilization in NJ.

Study Limitations

This report used data from Acute Care Hospital (ACH) Cost Reports as well as inpatient and same-day surgery Uniform Billing (UB) records to describe patterns of emergency department (ED) utilization and surge capacity. While these data are the best sources currently available, they contain their own strengths and weaknesses that should be kept in mind. The ACH Cost Reports have the advantage of specific payer fields that account for Medicare and Medicaid HMO's. They also provide data on ED patients who are not admitted as inpatients. However, the cost reports are generally audited in a targeted fashion only and ED data in the reports are not part of the targeted audit. Additionally, the ACH Cost Reports do not contain patient-level information. The UB data is collected at the patient level but does not include a separate payer field for Medicare and Medicaid HMO patients. The UB data also does not include information about non-admitted ED patients. Some of these problems will be addressed in the second report for this project when non-admitted ED utilization becomes available in the UB records.

Conclusion

This report finds that from 1998 to 2003, New Jersey experienced rapidly rising emergency department (ED) utilization combined with a reduction in the supply of inpatient beds. Most of the growth ED visits leading to inpatient admission is attributable to Medicare patient. Most of the growth in non-admitted ED volume is attributable to Medicaid patients.

While these developments did not lead to a widespread shortage in ED surge capacity, some hospitals appeared to be operating near or beyond peak capacity for short periods of time. A continuation of these trends might lead to more significant shortages of surge capacity in the future. Moreover, the ED is becoming more important as a source of inpatient admissions, which

adds a greater element of unpredictability to the total demand for hospital care. As described in this report, episodes of ED overcrowding can be alleviated or prevented altogether by private activities of individual hospitals. Nevertheless, the effectiveness of these activities remain a public concern as hospital ED's continue to play a vital role in public health and emergency response.

Endnotes

[1] The study authors note two important caveats about their data. First, approximately ¼ of ED visits could not be classified by their algorithm. Second, unclassifiable visits grew from 1996-97 to 2000-01.

[2] The authors acknowledge that there may be some reverse causality in this relationship – i.e., heavy users of the ED may be referred for additional ambulatory care visits in other settings.

[3] These data refer to beds in non-federal short term and other special hospitals.

[4] According to staff from the Hospital Financial Reporting and Support Division of the NJDHSS, the ACH Cost Report is sufficiently accurate for broad comparisons of volume by payer but not for highly detailed payment analysis. In forthcoming analysis, ED volume of non-admitted patients by payer will be calculated using UB and ACH Cost Reports.

[5] This analysis is restricted to 72 (71 for ICU/CCU beds) hospitals that consistently report occupancy rate data for every year of the study. Hospitals that closed, merged, or changed the way they submit cost reports are excluded.

[6] Additional analysis showed that the relative ranking of hospitals by occupancy rate does become less stable as time passes. For example, the simple correlation between the occupancy rate in 1998 and 1999 is 0.78. However, the simple correlation between the occupancy rate in 1998 and 2003 is only 0.58.

[7] Simple correlations for ICU/CCU occupancy rates are generally smaller and diminish faster than they do for overall occupancy rates. For example, the simple correlation between the ICU/CCU occupancy rate for 1998 and 1999 is 0.64. The simple correlation between the ICU/CCU occupancy rate for 1998 and 2003 is 0.46 and reaches a minimum of 0.38 for 1998 and 2002.

[8] The Hospital Center at Orange, which closed in 2004, also met these criteria in the years it was open.

[9] The last three hospitals on this list did not file individual cost reports until 2002.

[10] In this report, ACS admissions are defined using the methods described in Billings et al. (1993) and DeLia (2003).

[11] ACS admissions are not calculated for elderly patients, since ACS conditions are not well-defined for this population.

[12] Market concentration is measured using the Hirschman-Herfindahl Index (HHI), which is defined as the sum of the squares of the market share of each hospital that serves the market area. The HHI ranges from 0 to 1 with a value of 0 corresponding to a largely dispersed or competitive market and a value of 1.0 corresponding to a highly concentrated or monopoly market. The classification of hospitals in Table 9 is based on HHI values corresponding to the top, middle, and bottom thirds of the distribution of HHI values.

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Appendix A: Facilities with High Concentrations of Vulnerable Patients

In this report, hospitals with high concentrations of vulnerable patients are defined by the percentage of total gross charges that are attributable to Medicaid, uninsured, and self-pay patients as reported in the annual Acute Care Hospital (ACH) Cost Report for 2003. Following the approach used by Burt and Arispe (2004) at the Centers for Disease Control, hospitals in the top one-third according to this percentage are considered high Medicaid and uninsured/self-pay hospitals. It is well known that most payers do not pay according to gross charges, which are generally set much higher than actual prices. However, charges are generally consistent within each hospital, and therefore, charge ratios give a useful approximation of each hospital's payer mix. The classification used here is broader than that used by the state to classify facilities as safety net hospitals (i.e., those ranked in the top 10 according to charity care delivery). Facilities classified as serving high concentrations of vulnerable patients are listed below.

1. Newark Beth Israel Medical Center
2. Palisades Medical Center of New York
3. St. Mary's Hospital (Passaic)
4. Cooper Hospital/University Medical Center
5. Christ Hospital
6. Cathedral, St. James Hospital
7. St. Joseph's Hospital & Medical Center
8. Beth Israel Hospital (Passaic)
9. St. Francis Medical Center (Trenton)
10. Barnert Hospital
11. South Jersey Healthcare System
12. Raritan Bay Medical Center
13. Bon Secours-St. Mary Hospital (Hoboken)
14. Capital Health System at Mercer
15. Bergen Regional Medical Center
16. Muhlenberg Regional Medical Center
17. St. Elizabeth/Trinitas
18. Jersey City Medical Center
19. East Orange General Hospital
20. Kennedy Hospitals/University Medical Center
21. Capital Health System at Fuld
22. Columbus Hospital
23. Cathedral, St. Michael's Medical Center
24. Greenville Hospital
25. University Hospital/UMDNJ
26. Raritan Bay Medical Center, Perth Amboy
27. Atlantic City Medical Center-City Division
28. Kennedy Hospitals/ University Medical Center-Cherry Hill

Appendix B: Facilities Classified as Teaching Hospitals

In this report, teaching hospitals are defined as those listed on the Association of American Medical Colleges' website (http://www.aamc.org/members/listings/thgeomonm.htm). Facilities classified as teaching hospitals are listed below.

1. Cooper Hospital/University Medical Center
2. Hackensack University Medical Center
3. Saint Barnabus Medical Center
4. Monmouth Medical Center
5. Morristown Memorial Hospital, Jersey Shore Medical Center
6. Robert Wood Johnson University Hospital-New Brunswick
7. Saint Peter's University Hospital
8. Newark Beth Israel Medical Center
9. University of Medicine and Dentistry of New Jersey-University Hospital
10. St. Joseph's Hospital and Medical Center
11. University Medical Center at Princeton