Decreased Length of Stay and Cumulative Hospitalized Days Despite Increased Patient Admissions and Readmissions in an Area of Urban Poverty

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BACKGROUND: Length of stay at US acute care hospitals has been steadily decreasing since 1960, and there is ongoing concern that increasing financial pressures on hospitals with high proportions of Medicaid patients may be causing unduly short lengths of stay.

OBJECTIVE: To study temporal trends in hospital utilization on internal medicine services at Temple University Hospital, which has the highest percentage of Medicaid and uninsured patients in the state of Pennsylvania.

DESIGN: Examination of temporal changes in hospital practice over three time periods spanning 13 years.

MEASUREMENTS: Numbers of discharges, 1- and 12-month re-admission rates, and lengths of stay. US census data from 1990 to 2000 were examined for the eight major zip codes in which hospitalized patients live.

MAIN RESULTS: The number of internal medicine admissions increased from 1991 (117/month) to 2004 (455/month); $p < 0.0001$. Mean length of stay for the index admission decreased from 8.7 to 4.9 days; $p < 0.001$. The percentage of patients readmitted within 12 months of the discharge date of the index admission increased from 42.3% to 49.5%; $p = 0.045$. Mean cumulative length of stay over 12 months, including readmissions, decreased significantly (15.8 to 12.5 days; $p = 0.031$). Compared to all US hospitals, our hospital had a greater increase in admissions and a greater decrease in length of stay. During this time period, in surrounding zip codes, there were decreases in total population and total number of persons living in poverty, but also multiple closures of area hospitals that served poor patients.

CONCLUSION: During the 13-year study period, despite increased readmission rates, the overall number of hospitalized days per year on the internal medicine inpatient service decreased. As local hospitals serving this inner city low income area have closed, our hospital had atypically high increases in numbers of admissions and decreases in length of stay. This raises questions

about current adequacy of hospital care in inner city areas of poverty.

KEY WORDS: hospital length of stay; health care costs; poverty.

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BACKGROUND

Length of stay at US acute care hospitals has been steadily decreasing since 1960¹ for a variety of reasons, which include changes in medical technology and customary medical practice, and financial pressures including salary demands and changes in hospital reimbursement²⁻⁴. Over the past 20 years, there has been a paradigm shift in strategy regarding patients requiring hospitalization⁴. In the past, patients would remain hospitalized until the majority of their medical issues were diagnosed and treated to resolution. In contrast, there is presently an emphasis on stabilizing the patient, minimizing the duration of hospitalization, and postponing complete diagnosis and treatment for the outpatient setting⁵. Such a strategy leading to the early discharge of incompletely treated patients could eventually lead to more frequent readmissions and might have paradoxical effects of not only decreasing the quality of patient care, but also driving up health care costs secondary to expensive readmissions of incompletely healed patients. A recent study by Jencks, Williams, and Coleman found that 19.6% of hospitalized Medicare patients were rehospitalized within 30 days, and 56.1% were rehospitalized within 1 year. They estimated that the yearly cost to Medicare of unplanned rehospitalizations was 17.4 billion dollars⁶.

As length of stay has been decreasing nationally, there has been limited study about the possible relationships among poverty, length of stay, and health care quality. In data published by the National Center for Health Statistics for the years 1997-2002⁷, the lengths of stay of poor, near poor, and non poor have all been decreasing, but poor patients had the longest length of stay for all years listed. A recent study by Andrulis and Duchon examined hospital capacity and utilization in the 100 largest US cities between 1996 and 2002⁸. Urban hospital resources available in cities with high poverty

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levels were not less than those in other cities. However, while these two studies suggest that poor patients do not have unusually short lengths of stay and do not suffer from a lack of health care resources, their data analyses do not take into account the effect of severity of illness on length of stay or the possible uneven distribution of resources to poor patients in cities that have adequate total resources.

Temple University Hospital is an urban teaching hospital that has the highest percentage of Medicaid and uninsured patients in the state of Pennsylvania. Our impression has been that the number of hospital admissions to the medical service has been increasing, length of stay has been dropping substantially, and readmissions to the hospital have been frequent. We examined admission volume, length of stay, readmission rates, and hospitalization days per patient per year for patients hospitalized on the Internal Medicine Service at Temple University Hospital at three points in time over a 13-year period. We attempted to relate temporal changes in these rates with changes in local population size and poverty rates. From these data, we formed hypotheses about hospital utilization in inner cities with areas of intensive poverty.

METHODS

Temple University Hospital is a 575-bed inner city tertiary care teaching hospital in Philadelphia, Pennsylvania. Hospital discharge data were obtained for patients hospitalized on the inpatient services of the Department of Internal Medicine for three different time periods spanning 13 years: May 1 through June 30, 1991; May 1 through June 30, 1998; and May 1 through June 30, 2004. We chose three time points (end and mid points) rather than studying all 13 years in order to enhance the clarity of the comparisons. Further, because of the number of patients admitted each year, we expected a good study power to detect linear trends (for a total sample size of 1,500, the power to detect a linear correlation of continuous variables, when 1% of the variability is explained by the model, is 98%; the power to detect a linear trend in proportions when rates change by 5% from one time period to the next is at least 90%; statistical methods listed below).

Discharge data were collected for all patients discharged from a general internal medicine or an internal medicine subspecialty service during these time periods. During the study periods, the first admission for each patient was defined as the "index admission." Information was obtained from a computerized inpatient database maintained by the medical records department and from a data base maintained by the finance department. Discharge data obtained included: date of admission, date of discharge (or death), gender, age, zip code of residence, payer for hospital services, and primary discharge diagnosis. Discharge diagnoses were later stratified into the major organ system or disease category responsible for the illness, e.g., cardiac disease, gastrointestinal disease, and infectious disease. All inpatient admissions that occurred within 12 months after the discharge date from the index admission were reviewed; extracted discharge data were identical to those collected for the initial admission. Readmissions were included only for patients originally admitted

during the 2-month study periods. Times to readmission from the index discharge date, the number of readmissions within 12 months, and total days in the hospital within 12 months of the index admission date were calculated. During the months under study, patients admitted to the hospital resided in 107 zip codes. Eight zip codes (19121, 19122, 19130, 19132, 19133, 19140, 19141, and 19144) were each the zip code of residence for at least 20 patients; these accounted for 74% of admitted patients in the study. In order to examine demographic temporal trends in these geographic areas, US census data were examined from 1990 and 2000 for these zip codes (<http://factfinder.census.gov/>).

An Excel spreadsheet (Microsoft Corporation, Redmond, WA) was used for data manipulation. Numbers of admissions for each 61-day study period were compared using a Poisson rare events probability calculation (Epi 6, CDC, Atlanta, GA). For dichotomous variables, tests for linear trends in proportions were performed using an extended Mantel-Haenszel chi-square test (Epi 6, CDC, Atlanta, GA). For continuous variables, tests for linear trends were performed using a least squares linear regression for the variable of interest versus time (SYSTAT 11.0, SYSTAT Software Inc., San Jose, CA). A statistically significant trend occurred when the coefficient for the variable of interest was significantly different from 0. Values for individual time periods were compared, pairwise, to one another using one-way analysis of variance with *p* values corrected for multiple comparisons. Power calculations for linear regression were done using an Internet-based program⁹. Power calculations for tests for linear trends in proportions were done using extrapolations from Table 1 in reference 10¹⁰.

RESULTS

During the three time periods studied, there was a progressive increase in the number of admissions during the 2 study months. In 1991 there were 234 people discharged between May 1 and June 30 compared to 371 discharges in 1998 and 909 discharges in 2004 ($p < 0.0001$ for all pairwise comparisons) (Fig. 1A).

On the Internal Medicine Service of Temple University Hospital, the average age of admitted patients increased significantly over the 13 years encompassed by this study: from 53.7 years in 1991 to 55.1 years in 1998 and 59.8 years in 2004 ($p < 0.001$). The mean length of stay decreased significantly between 1991 and 1998, from 8.7 days to 4.5 days ($p < 0.001$). In 2004, the mean length of stay was 4.9 days, which was not significantly different from 1998 (Fig. 1B). The rate of death prior to discharge differed in the 3 study years: it was 4.2% in 1991 and 4.6% in 1998. In 2004 only 1% died, and 1.3% were discharged to hospice (this did not occur in the other years). While these rates differed, the number of patients involved was small; when these patients were excluded, analysis of length of stay remained unaltered (data not shown).

The percent of patients readmitted within 12 months of the discharge date of the index admission increased significantly over 13 years. The 12-month readmission rate was 42.3% in 1991, 46.6% in 1998, and 49.5% in 2004 ($p = 0.045$) (Fig. 1C).

Readmission diagnoses were the same as for the index admission 49.5%, 37.6%, and 40.0% of the time in 1991, 1998, and 2004, respectively ($p=NS$). The mean length of stay for the first readmission (among patients who were readmitted within 1 year of the index admission) decreased sequentially from 8.3 days in 1991, to 7.2 days in 1998, and to 5.8 days in 2004 ($p=0.017$) (Fig. 1B). The “early readmission” rates defined as the proportion of patients readmitted within 30 days of discharge from their index admission were also examined. Unlike the total rates of readmission within 1 year, rates of

early readmission did not change significantly over time (although there was a trend toward greater numbers of early readmissions). The early readmission rate was 16% in 1991, 17% in 1998, and 21% in 2004, ($p=0.08$) (Fig. 1C).

Over the study period, the mean number of admissions *per patient* within 12 months of the index admission increased significantly. The average number of admissions per patient was 1.9 in 1991, 2.2 in 1998, and 2.4 in 2004 ($p=0.008$). Of interest, the average number of days between the index admission and the first readmission was not significantly

Figure 1. Hospital discharges, lengths of stay, and hospital readmission data for patients hospitalized on an internal medicine service during 2-month time periods in 1991, 1998, and 2004. Error bars display standard errors of the mean.

different among the three study periods: 90.2, 91.1, and 88.4 days in 1991, 1998, and 2004, respectively ($P>0.05$) (Fig. 1D). Also, the average length of stay for the index admission did not differ between patients who were readmitted within 12 months (5.4 days) and those who were not (5.4 days). Patients who were readmitted to the hospital within the 12 months of their index admission tended to be slightly older (mean age 58.6 years) than patients without readmissions (mean age 56.8 years), $p=0.045$. No differences in gender were found between patients with and without readmissions.

Progressing from 1991 to 2004, despite the increasing 12-month readmission rates and mean number of admissions per patient per year, there was a significant overall decrease in the cumulative number of hospitalized days over 12 months for patients admitted to the internal medicine service. The average number of hospital days per patient over 12 months decreased from 15.8 days in 1991, to 12.5 days in 1998, and remained at 12.5 days in 2004 ($p=0.031$, for initial rate compared to the later two rates) (Fig. 1D). This was a reflection of reduced lengths of stay in the later time periods during both index and subsequent hospital admissions.

Hospital discharges, readmissions within 12 months of the index admission, and length of stay were also analyzed for several disease categories including cardiac, pulmonary, gastrointestinal, and infectious diseases over the 13-year study period. For each of the disease categories, the number of hospital admissions increased dramatically between 1991 and 2004, and lengths of stay decreased (Table 1). Changes in length of stay differed according to the insurer of (payer for) patients. We grouped payers into three groups: Medicare (647 patients), Medicaid (610 patients), and private insurance (265 patients). Patients with no pre-existing coverage for medical services were classified by the hospital as "Medicaid Pending" and were included in the Medicaid group. There was a significant decrease in mean length of stay among Medicare patients (9.4 days in 1991, 5.8 in 1998, and 5.5 in 2004; $p<0.001$) and among Medicaid patients (11.2 days in 1991, 4.4 in 1998, and 4.9 in 2004; $p<0.001$). Privately insured patients had comparatively short lengths of stay during each of the study years, and there was no significant decrease over time (4.3 days in 1991, 3.4 in 1998, and 4.2 in 2004; $p=0.95$).

While the number of internal medicine admissions to Temple Hospital was increasing substantially, census data for the eight zip codes contributing the greatest number of internal medicine patients showed a decreasing population, an absolute decrease in numbers of persons 65 years and older, and fewer persons living below the poverty level. Between 1990 and 2000, the population for these eight zip codes decreased from 319,175 to 285,981. The number of

persons ≥ 65 years of age decreased from 37,725 to 33,135 (the percent of the total population remained constant at 12% in both years). The number of persons living below the federal poverty level decreased from 111,705 to 98,216 (the percent of total population was constant at 36% in both years).

DISCUSSION

At Temple University Hospital, between 1991 and 2004, there was a dramatic increase in the number of admissions to the internal medicine service despite a shrinking population in the zip codes in which hospitalized patients lived. The total number of hospital beds at Temple Hospital over this time was roughly constant at 575. At the same time, there was a similarly dramatic decrease in the mean duration of hospitalization on the medical service and a significant, but more modest increase in rates of hospital re-admission. Despite more re-hospitalizations, there was still a major decrease in the total number of days spent in the hospital per year for individual patients. Therefore, it is clear that a decrease in length of stay over this 13-year study period did not result in a rise in re-admissions sufficient to override the effect of the shortened length of stay for the initial admission.

In order to understand the relationship among admission volume, length of stay, and readmission rates at Temple University Hospital, it is helpful to review hospital utilization data for the entire US during the same time period. The Organization for Economic Cooperation and Development¹ is an international group that maintains health data for multiple countries including longitudinal data about health care utilization. Its latest data include numbers of acute care hospital admissions and admission rates per 100,000 population for the years 1990 to 2004, as well as numbers of beds per 100,000 population, and mean length of stay at acute care hospitals between 1960 and 2005.

Beginning in 1984, the numbers of beds per 100,000 population shrank substantially. In 1960, there were 3.5 beds per 100,000; in 1983, 4.4; and in 2005, 2.7. Between 1990 and 2004, the number of hospital admissions per 100,000 population initially decreased by about 8% (1990 to 2000), but then increased almost to initial levels by 2004. The most dramatic change in utilization of hospital services in the US between 1960 and 2005 was in mean duration of hospital stay. In 1960, it was 20.5 days; in 2005, it was 6.5 days.

Comparing national trends to our own during the 13 years encompassed by our study, national hospital admissions

Table 1. Number of Admissions and Mean Length of Stay for Index Admission, Stratified by Year and Diagnostic Category

Diagnostic category	Number of admissions			p value ^a	Mean length of stay: Index admission			
	1991	1998	2004		1991	1998	2004	p value ^b
Cardiac	41	123	241	<0.0001	6.6	4.1	3.8	0.002
Pulmonary	35	38	122	<0.0001	12.5	3.6	4.7	0.012
Gastrointestinal	17	45	105	<0.0001	7.2	3.8	4.7	NS
Infection	58	69	174	<0.0001	7.4	6.7	6.1	NS
Other	99	170	437	<0.0001	9.0	4.7	4.7	<0.001

^aFor comparison of 2004 and 1991 values

^bTest for linear trend over three successive time periods

increased by 12%, while Temple University Hospital medical admissions increased by 74%, national mean length of stay decreased by 28%, and Temple Hospital's by 43%. In the final year of our study, the mean length of stay was 4.9 days, which is significantly lower than the national average of 6.5 days. Nationally, bed capacity decreased by 17%, while Temple University Hospital's did not change. Based on 10-year census data, the national population increased by 13.2%, but the population in the eight zip codes contributing the most patients to Temple University Hospital decreased by 10.4%. While medical service admissions, of course, may not be completely reflective of total hospital admissions, these data nonetheless suggest that, unlike the country as a whole, our fairly large inner city hospital was faced with a substantial increasing number of patients requiring admission and coped by substantially decreasing length of stay.

In north Philadelphia during the 1990s and early 2000s, one major teaching hospital (Medical College of Pennsylvania) and two smaller hospitals (Parkview Hospital and City Avenue Hospital) within 2 miles of Temple Hospital were forced to close for financial reasons¹¹. (Neither Parkview nor City Line Hospitals were in the eight zipcodes supplying the greatest number of patients to Temple Hospital, but each was in an immediately adjacent zip code and easily accessible to Temple patients.) These hospital closings may well be the main explanation for our observed findings of increased numbers of patients and diminished length of stay. Research on closure of US hospitals suggests that areas with a large number of Medicaid recipients are at the highest risk for hospital failure^{8,12}. For this reason, trends in numbers of medical admissions and length of stay at Temple University Hospital may be typical of inner city urban teaching hospitals in the US.

It is interesting that hospital length of stay decreased dramatically for Medicare and Medicaid patients, but not for privately insured patients (whose length of stay was short from the very beginning). This could reflect a more "tight" control over length of stay by private insurers during the entire study period. However, many of Temple's privately insured patients reside in more affluent areas of the city and are admitted for specialty care; such admissions may differ from admissions of Medicare and Medicaid patients in many respects.

What is the relationship between length of stay and outcome among patients with the same diagnosis and severity of illness? It is important to note that in the US, during any time period examined, there has always been a significant disparity between geographic regions in length of stay irrespective of diagnosis⁴. Chassin from the US Congress Office of Technology Assessment described several studies that evaluated outcomes in several US regions with varying length of stay for the same diagnosis⁴. These studies examined patients with myocardial infarction, cholecystectomy, and cataract surgery, and also 603,000 inpatients with a wide variety of diagnoses. In these studies, after adjusting for demographic and prognostic factors, there was no relationship between length of stay and outcome. A number of studies have examined outcomes for patients with the same principal diagnosis in a single location based upon length of stay. Results have been mixed. In a study of outcomes for patients with admissions for congestive heart failure, patients with longer length of stay had superior outcomes². A study of outcome after CABG showed there was no relation between "early discharge" (<15th percentile in length of stay) and adverse outcomes. A large Canadian study

of patients with four diagnoses found no relationship between length of stay and number of physician visits after hospital discharge¹³. Thus, there is no compelling reason to believe that the dramatic shortening of length of stay at Temple University Hospital would necessarily be associated with a suboptimal quality of care.

Published studies also do not demonstrate a convincing connection between short length of stay, per se, and hospital readmission. Readmission within 12 months of hospital discharge seems, in multiple studies, to be highly correlated with underlying characteristics of patients rather than inadequate care during the index hospitalization. This has been seen in studies of the National Health Service in England¹⁴, geriatric patients^{15,16}, chronic obstructive lung disease¹⁷⁻¹⁹, stroke²⁰, and heart failure²¹. Readmission within 1 month might be more indicative of inadequate care during the index admission than readmission within 12 months. Nonetheless, studies have shown both increased 30-day readmissions with shorter initial length of stay in psychiatric patients²² and also increased 30-day readmissions with *longer* initial length of stay in general medical patients^{4,23}, geriatric patients¹⁵, and surgical patients²⁴. Clearly length of stay is associated not only with patterns of medical practice, but also with severity of illness, so that observational studies have, at best, a limited ability to delineate the relationships between short length of stay, 30-day readmission rates, and quality of health care.

CONCLUSION

At our hospital, dramatic increases in numbers of admissions were associated with dramatic decreases in length of stay. This pattern of hospital utilization was likely the result of multiple hospital closures in the indigent community that surrounds the hospital. This experience may very well reflect that of multiple poor urban areas that depend on Medicaid for much of their medical reimbursement. Studies of adverse health outcomes that appear to correlate with premature hospital discharge are important and would advance our knowledge about the full effects of the sizable decrease in length of stay that may occur in areas of poverty.

Conflicts of Interest: None disclosed

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