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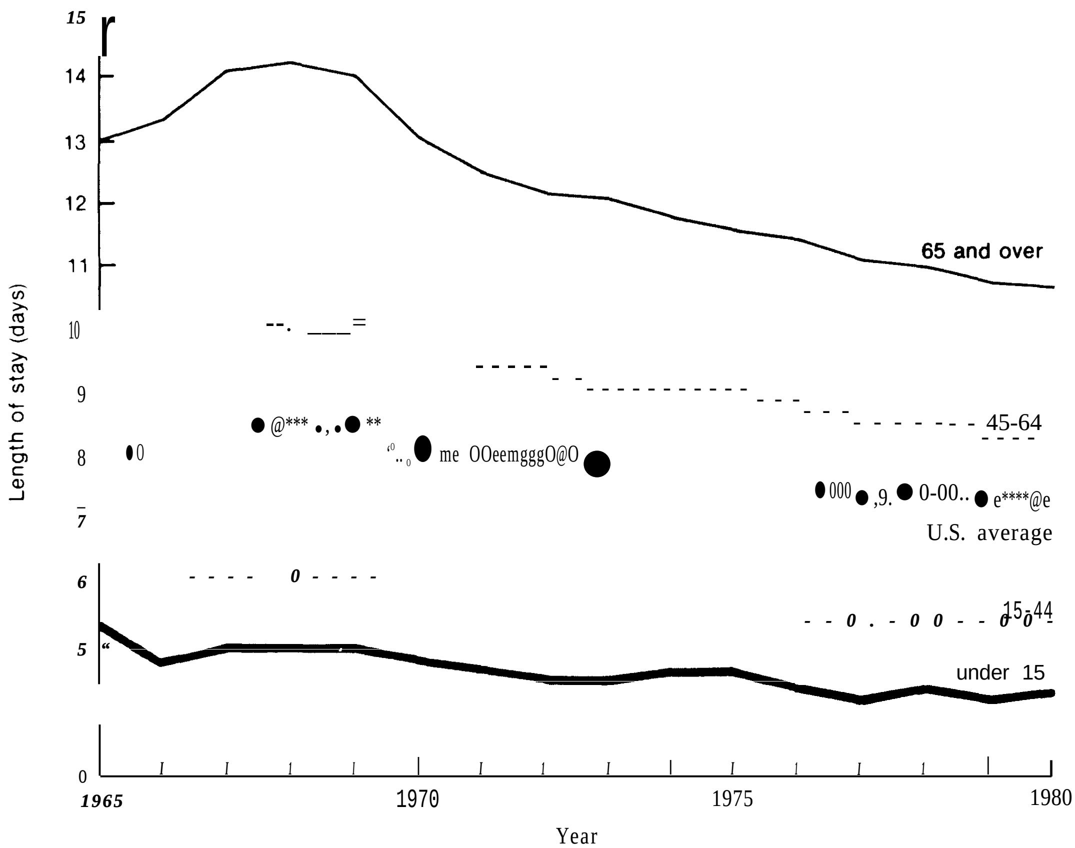
# Variations in Hospital Length of Stay

# 2.
# Variations in Hospital Length of Stay

In general, average length of stay (LOS) in short-term, non-Federal hospitals has been falling since 1968 in the United States, Figure 1 shows the trends in LOS since 1965, the year in which the Medicare and Medicaid laws were passed, for the United States as a whole and for each of four age groups. The increase in LOS that followed the enactment of the Federal health insurance legislation and continued through 1968 in both the U.S. average and the elderly is the only dramatic departure from an otherwise virtually unbroken decreasing trend. The early years of the Medicare program also witnessed a rapid rise in the proportion of hospitalized patients that were elderly, While this proportion has risen continuously from 16 percent in 1965 to 26 percent in 1980, fully 40 percent of the increase took place between 1965 and 1968 (130). Since 1968 all age groups have shown decreasing lengths of stay; the elderly have decreased by 25 percent, the older adult group by 18 percent, the young adult group by 15 percent, children by 12 percent, and the combined U.S. average by 14 percent.

Given this pervasive downward trend in LOS, the stability of the geographic differences in LOS over time is remarkable. In 1980, the average LOS in the Northeast was 39 percent higher than in

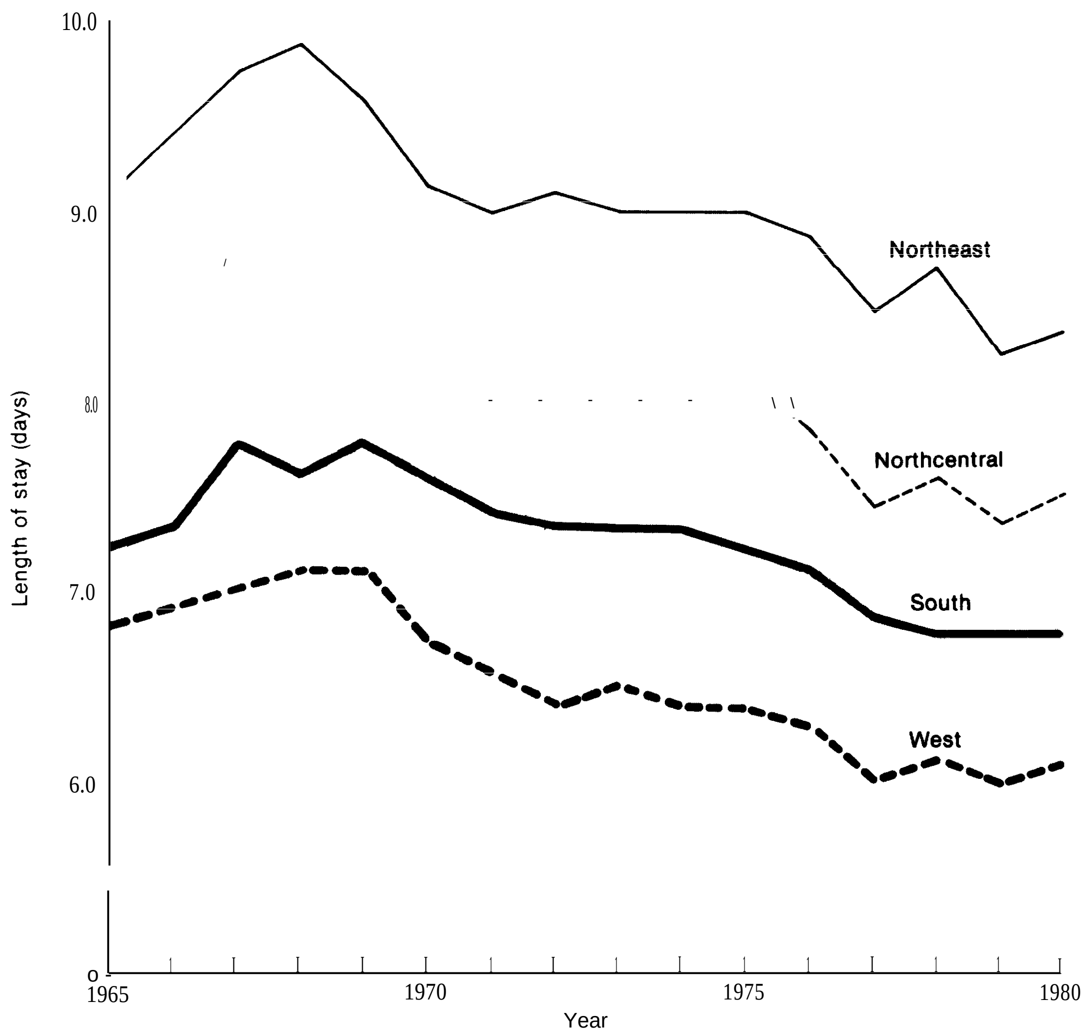
**Figure 1.—Age-Specific Trends in Hospital Length of Stay**




SOURCE *Vital and Health Statistics*, series 13, Nos 2, 10, 14, 17, 19, 23, 26, 31, 41, 46, 55, 60, 64 (Washington, D C National Center for Health Statistics 1967-82) the West, the NorthCentral was 23 percent higher, and the South 11 percent higher. Figure 2 shows how consistent these regional differences have been since 1965. Since the peak year of 1968, both the Northeast and the West have decreased in LOS by 14 percent, the Northcentral has fallen by 15 percent and the South by 12 percent.

An analysis of data collected by the Professional Standards Review Organization (PSRO) program reveals the same concentration of high LOS areas in the Northeast and low LOS areas in the West (74). Of the ten PSROs with the highest overall Medicare LOS in **1979,** five were in New York, three in New Jersey, and one each in Illinois and Ohio. Of the ten with the lowest Medicare LOS, six were in California, one each in Oregon, Idaho, Washington, and Montana. PSRO Medicaid data from the same year are similar. Of the ten PSROs with the highest Medicaid LOS, two each were in Pennsylvania and North Carolina, and one each was in New York, New Jersey, Maryland, Virginia, Indiana, and Florida. Of the ten PSROs with the lowest Medicaid LOS, seven were in California, and one each in Idaho, Oregon, and Louisiana.

**Figure 2.— Regional Differences in Hospital Length of Stay: Trends Over Time**




SOURCE: *Vital and Health Statistics*, series 13, Nos 2, 10, 14, 17, 19,23, 26,31, 41,46, 55,60,64 (Washington, D. C.' National Center for Health Statistics, 1967-82)

Although this case study is concerned solely with LOS, it is relevant to ask the question: does this geographic pattern of low lengths of stay in the West mean that the West uses fewer hospital services per capita? The most commonly employed measure of hospital service use is total days of care per 1,000 population. This figure is the product of the average LOS and the admission rate per 1,000 in the region.

Table 1 shows data on admission and days of care rates per **1,000** population by region for 1980. The data show clearly that the West not only has the lowest LOS of any region but also the lowest admission rate. These two factors combine to give the West the lowest rate of use of total hospital days of any of the census regions. Some of the other regions do change their relative positions in the ranking of admission rates and days of care from where they stand with respect to LOS. For example, the Northeast has an admission rate that is slightly below the U.S. average, whereas the Northcentral has the highest admission rate. These factors contribute to the ranking of the Northcentral region as the one with the highest rate of use of hospital days of care. From another viewpoint, however, the data on total days of care are similar to those on LOS. The two regions with below average LOS (West and South) are the two regions with below average overall hospital use, as reflected in total days of care per 1,000. The Northeast and Northcentral regions, the areas with above average LOS, are the two regions with above average overall hospital use.

**Table 1.–Admission and Days of Care Per 1,000 Population by Census Region in 1980**

| Region[a] | Admission rate (per 1,000 population) | Total days of hospital care (per 1,000 population) |
|---|---|---|
| Northeast ., . . . . . . . . . . . . | 162 | 1,387 |
| Northcentral. . . . . . . . . . . . | 187 | 1,412 |
| South . . . . . . . . . . . . . . . . | 175 | 1,191 |
| West . . . . . . . . . . . . . . . . . . | 144 | 873 |
| United States average . . . | 170 | 1,231 |

[a]Northeast . Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania
Northcentral = Michigan, Ohio, Illinois, Indiana, Wisconsin, Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas
South = Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida, Kentucky, Tennessee, Alabama, Mississippi, Arkansas, Louisiana, Texas, Oklahoma
West = Montana Idaho, Wyoming Colorado, New Mexico, Arizona, Utah, Nevada, Washington, Oregon, California, Hawaii, Alaska

SOURCE *Vital and Health Statistics*, series 13, No 64, DHHS publication No (PHS) 82.1725 (Washington, D C National Center for Health Statistics, 1982)

In attempting to explain regional LOS differences, the first possibility that arises is that the demographic composition of the populations in the four census regions may be sufficiently different to account for all or part of the LOS differences. Of all the demographic variables, age has the strongest relationship to LOS. Figure 1 shows how rapidly LOS rises as a function of age, with the elderly spending 2.4 times as long in the hospital per stay in 1980 as those under age 15. In contrast, the average LOS for men in 1980 was 7.7 days, and for women it was **7’. o** days. For whites the average LOS in 1980 was 7.3 days, the same as the U.S. average, and for all other races it was 7..5 days (129). Thus, it is conceivable that significant differences in age and sex (if not race) distributions could explain at least some of these geographic LOS variations.

Table 2 shows the 1980 age and sex distributions of hospitalized patients in each of the four census regions. On inspection, regional differences in these distributions appear to be minor. This observation proves to be correct. Table 3 shows the results of age and sex adjusting the regional figures for average LOS, using the direct standardization method. This method uses the entire U.S. population of hospitalized patients as the standard. The age- and sex-specific lengths of stay for each population subgroup of each region are then multiplied by the proportion that each subgroup represents in the standard population. These products are summed *over* all the age and sex subgroups to arrive at a figure that adjusts LOS for age and sex differences. Clearly, the effect of the age and sex adjustment is minimal. The West’s LOS remained the same, the Northcentral and the South increased by 0.1 days, and the Northeast decreased by 0.1 days. Thus, while there are slight differences among the regions in the demographic characteristics of their hospitalized patients, these differences play a minimal role in explaining overall LOS variations. Gornick (60, 61,62) came to the same conclusion after a similar analysis of data pertaining to the Medicare population alone.

The lack of explanatory power of demographic characteristics has also remained constant over

**Table 2.—Age and Sex Distributions of Hospitalized Patients by Census Region in 1980**

| Region | Percent male | Age group (percent of region's hospital patients) | | | |
|---|---|---|---|---|---|
| | | Under 15 | 15-44 | 45-64 | 65 and over |
| Northeast | 41.2 | 8.9 | 39.5 | 24.0 | 27.7 |
| Northcentral | 40.0 | 10.2 | 41.0 | 22.9 | 25.9 |
| South | 38.9 | 10.7 | 41.7 | 22.2 | 25.4 |
| West | 40.9 | 7.9 | 43.4 | 23.0 | 25.8 |
| United States average | 40.0 | 9.7 | 41.3 | 22.9 | 26.1 |

SOURCE *Vital and Health Statistics*, series 13, No 64, DHHS publication No (PHS) 82.1725 (Washington, D C National Center for Health Statistics. 1932)

**Table 3.–Age and Sex Adjusted Length of Stay by Region in 1980**

| Region | Unadjusted LOS (days) | Adjusted LOS (days) |
|---|---|---|
| Northeast | 8.5 | 8.4 |
| Northcentral | 7.5 | 7.6 |
| South | 6.8 | 6.9 |
| West | 6.1 | 6.1 |
| United States average | 7.3 | — |

SOURCE Calculated from data In *Vital and Health Statistics*, series 13, No 64, DHHS publication No. (PHS) 82.1725 (Washington, D.C National Center for Health Statistics, 1982).

time. If one examines age-specific lengths of stay for the four age groups displayed in figure 1 for the 15 years between 1966 and 1980 for each of the four census regions, one finds that the Northeast had the highest LOS for every age group in every year save one. * Thus, in 59 of 60 possible comparisons the Northeast showed the highest LOS. The same analysis reveals the West to exhibit the lowest LOS in 59 of 60 possible comparisons.

The possibility that case mix** differences among regions might account for some of the LOS variations is a much more difficult proposition to evaluate. Table 4 displays LOS data from the National Center for Health Statistics' (NCHS) 1980 Hospital Discharge Survey that are diagnosis specific for the 18 major diagnostic categories of the International Classification of Diseases: 9th Edition. Once again the data provide evidence of high LOS in the Northeast and low LOS in the West. In **13** of 18 categories, the Northeast is highest in LOS, and in 15 of 18 the West is lowest. It is also true, however, that the Northeast has slightly more patients in high LOS diagnostic categories than the other census regions. Table 5 gives the distribution of cases among the 18 diagnostic categories for the United States and the four census regions. In each of the three diagnostic categories with the highest average U.S. LOS (mental disorders, neoplasms, and diseases of the circulatory system), the Northeast has a greater proportion of cases than the average U.S. population. What effect do these case mix differences have on the difference between the Northeast and the West in LOS? Table 6 presents the results of a direct standardization of LOS by region using the U.S. distribution of cases as the reference population. The case mix differences described above have only a small impact, reducing the average LOS for the Northeast by **0.2** days.

Other data confirm this finding and extend it specifically to the Medicare and Medicaid populations. Gornick (61) found that for the Medicare population LOS for many specific conditions was highest in the Northeast and lowest in the West. She also found that adjusting New York's average Medicare LOS for California's case mix resulted in only a 0.1 day reduction in New York's LOS. Table 7 presents data from the PSRO program on Medicaid LOS for the 15 most common Diagnosis Related Groups in 1980. The same regional trends appear. In all 15 instances a western region exhibited the lowest LOS, while in 12 of 15 cases a northeastern region demonstrated the highest. Again, it appears that for every population examined, the Northeast has the highest LOS and the West the lowest for virtually all diagnoses.

* In 1978, the Northcentral region registered a LOS that was 0.1 days higher than the Northeast for patients 15 to 44 years of age.

** Case mix has been defined in various ways. In this case study, it refers to the relative frequency of various types of patients, reflecting different needs for hospital resources. There are many ways of measuring case mix, some based on patients' diagnoses or the severity of their illnesses, some on the utilization of services, and some on the characteristics of the hospital or area in which it is located.

**Table 4.— Diagnosis-Specific Length of Stay by Region: 1980**

| Condition | Us. | LOS in days NE | NC | s | w |
|---|---|---|---|---|---|
| 1. Mental disorders | 11.6 | 11.6 | 13.4 | 9.8 | 10,7 |
| 2. Neoplasms. | 10.5 | 12.0 | 10.7 | 10.1 | 8.5 |
| 3. Circulatory disorders | 10.0 | 12.4 | 10.2 | 9.2 | 8.1 |
| 4. Endocrine, nutritional, metabolic, and immunity disorders. | 9.6 | 11.8 | 9.7 | 8.9 | 7.7 |
| 5. Perinatal disorders | 8.7 | 8.1 | 9.5 | 9.0 | 7.3 |
| 6. Musculoskeletal diseases | 8.3 | 9.8 | 8.9 | 8.1 | 6.5 |
| 7. Skin diseases | 8.0 | 9.5 | 7.8 | 7.4 | 7.8 |
| 8. Injury and poisoning | 7.7 | 9.5 | 7.8 | 7.3 | 6.6 |
| 9. Hematologic disorders | 7.2 | 8.8 | 6.9 | 6.8 | 6.0 |
| 10. Gastrointestinal diseases | 7.0 | 7.9 | 7,2 | 6,6 | 6.2 |
| 11. Infectious and parasitic diseases | 6.9 | 7.7 | 7,3 | 6.6 | 6.1 |
| 12. Congenital anomalies | 6.6 | 6.8 | 7.5 | 6.0 | 5.9 |
| 13, Respiratory diseases | 6.3 | 7.6 | 5.9 | 6.3 | 5.4 |
| 14. Genitourinary disorders | 5.6 | 5.7 | 5.8 | 5.6 | 5.0 |
| 15. Diseases of the nervous system | 5.4 | 6.3 | 5.5 | 5.4 | 4.5 |
| 16. Symptoms, signs, and ill-defined conditions | 4.5 | 5.0 | 4.6 | 4.6 | 3.7 |
| 17. Supplementary classification (850/o newborn deliveries) | 3.7 | 4.3 | 4.1 | 3.4 | 3.0 |
| 18. Complications of pregnancy and childbirth | 2.5 | 2.2 | 2.6 | 2.7 | 2.3 |
| All conditions | 7.3 | 8.5 | 7.5 | 6.8 | 6.1 |

Key NE = Northeast, NC = Northcentral, S = South, W = West

SOURCE *Vital and Health Statistics*, series 13, No 64 DHHS publication No (PHS) 82-1725 (Washington. DC National Center for Health Statistics, 1982)

**Table5.— Distribution of Cases by Diagnosis by Region: 1980**

| Condition | U.S. | Region (percent of cases) NE | NC | s | w |
|---|---|---|---|---|---|
| 1. Mental disorders | 4.5 | 6.3 | 4,9 | 3.3 | 3.9 |
| 2. Neoplasm | 6.5 | 8.0 | 6.6 | 5.5 | 6,7 |
| 3. Circulatory disorders | 13.6 | 14.5 | 13.1 | 13.6 | 13,2 |
| 4. Endocrine, nutritional, metabolic, and immunity disorders | 3.0 | 3.0 | 3.1 | 3.1 | 2.7 |
| 5. Perinatal disorders | 0.2 | 0.2 | 0.3 | 0.2 | 0.3 |
| 6. Musculoskeletal diseases | 5.9 | 4.6 | 6.6 | 5.7 | 7.0 |
| 7. Skin diseases | 1.6 | 1.7 | 1.6 | 1.6 | 1.4 |
| 8. Injury and poisoning | 9.5 | 8.4 | 9.3 | 9.3 | 11.8 |
| 9. Hematologic disorders | 0.9 | 1.0 | 0.9 | 0.9 | 0.7 |
| 10. Gastrointestinal diseases | 12.3 | 12.1 | 12.1 | 13.4 | 10.5 |
| 11. Infectious and parasitic diseases | 1.7 | 1.7 | 1.6 | 1.9 | 1.6 |
| 12. Congenital anomalies | 0.9 | 0.9 | 1.0 | 0.8 | 0.9 |
| 13, Respiratory diseases | 9.1 | 8.1 | 9.2 | 10.1 | 8.2 |
| 14. Genitourinary disorders | 9.5 | 9.4 | 9.2 | 10.4 | 8.3 |
| 15. Diseases of the nervous system | 4.7 | 4,4 | 54 | 4.0 | 5.1 |
| 16. Symptoms, signs, and ill-defined conditions. | 1.7 | 1.3 | 1.7 | 2,0 | 1.6 |
| 17. Supplementary classification (850/o newborn deliveries) | 11.7 | 10.9 | 11.0 | 11.8 | 13,5 |
| 18. Complications of pregnancy and childbirth | 2.7 | 3.4 | 2.5 | 2.4 | 2.6 |
| All conditions | 100.0 | 99.9 | 100.1 | 100.0 | 100.0 |

Key NE = Northeast, NC = Northcentral, S = South, W = West

SOURCE *Vital and Health Statistics*, series 13, No 64, DHHS publication No (PHS) 82-1725 (Washington, D.C.:National Center for Health Statistics, 1982)

Blumberg (20)recently looked at this question from a different perspective. He studied whether the low LOS and hospital use rate in the West might be a reflection of a lower prevalence of morbidity in the population. He compared the NCHS Health Interview Survey measure of ''restricted activity days" with LOS and admission rate data from the NCHS Hospital Discharge Survey. Restricted activity days are defined as days during which activity is decreased from usual because of an illness or injury that has been present for at least 3 months. He found that people in the West actually reported the highest rates of restricted activity days of any region, 37 percent higher than

**Table 6.—Case-mix Adjusted Length of Stay by Region: 1980**

| Region | Unadjusted LOS (days) | Adjusted LOS (days) |
|---|---|---|
| Northeast | 8.5 | 8.3 |
| Northcentral | 7.5 | 7.5 |
| South | 6.8 | 6.9 |
| West | 6.1 | 6.1 |
| United States average | 7.3 | — |

SOURCE Calculated from data In *Vital and Health Statistics*, series 13, No 64, DHHS publication No (PHS) 82-1 725 (Washington, DC. National Center for Health Statistics, 1982)

those in the lowest region, the Northcentral. After standardizing LOS by these morbidity measures, he found that western lengths of stay were lower than expected while those in the Northeast and Northcentral were higher than expected. Thus, adjusting for differences in population morbidity actually widened regional LOS differences. While one may argue that the measure of morbidity used was insensitive or subject to biased reporting because of regional population differences in interpretation, the study does establish that regional differences in this particular morbidity measure do not account for regional LOS variations.

Two recent PSRO studies have examined the relationship between case mix or severity of illness and LOS. In both of them, an eastern PSRO and a western PSRO paired themselves and carefully scrutinized data from medical records for two specific kinds of patients in an effort to explain the differences between them in LOS. In one study, the Utah PSRO (UPSRO) and the Central Massachusetts PSRO (CMPSRO) analyzed LOS for their patients with myocardial infarction (MI) and cholecystectomy. Table **8** presents LOS data for these two PSROs and these two conditions. The data demonstrate the typical pattern of lower western LOS for each diagnosis and each insurance subgroup.

In the MI study (24), patients were included only if they had had a documented MI and were Federal beneficiaries (Medicare and Medicaid patients). Patients from small hospitals (less than 1,500 discharges per year) were excluded. All of the patients were classified into severity of illness categories to distinguish those with uncomplicated MIs, those with MIs with congestive heart failure, and those with cardiogenic shock. There were no differences between the two patient populations in proportion of patients in each severity class or in class-specific mortality rates. However, LOS for each severity class was longer in the CMPSRO populations.

This study has some important limitations, including the fact that the UPSRO study population represented patients from 3 months in 1979,

**Table 7.–Highest and Lowest DHHS Regions for Medicaid Length of Stay in 1980 by Diagnosis Related Group (DRG)**

| Description and number of DRG | Number of cases | Highest region | LOS (days) | Lowest region | LOS (days) |
|---|---|---|---|---|---|
| 1. Normal Mature Newborn (318) | 357,633 | II[a] | 5.2 | Ix | 3.3 |
| 2. Normal Delivery (278) | 208,641 | v | 3.3 | Ix | 2.2 |
| 3. Complicated Delivery (281) | 159,092 | v | 3.8 | Ix | 2.8 |
| 4. Functional Intestinal Disorder (206) | 58,990 | II | 5.5 | x | 3.6 |
| 5. Schizophrenia (89) | 44,206 | II | 20.5 | Ix | 11.5 |
| 6. Seizures, syncope, chest pain, or epistaxis with secondary diagnosis (323) | 30,236 | II | 7.3 | x | 4.0 |
| 7. Electrolyte disorder (333) | 27,016 | II | 9.2 | x | 5.2 |
| 8. Urinary symptoms (328) | 20,860 | II | 7.2 | x | 4.3 |
| 9. Fracture with major operation, including hip arthroplasty (348) | 16,792 | II | 18.9 | Ix | 12.0 |
| 10. Diabetes (75) | 15,276 | II | 12.0 | x | 6.8 |
| 11. Congestive heart failure (132) | 15,996 | II | 11.6 | x | 6.7 |
| 12. Ischemic heart disease without operation (124) | 12,095 | II | 8.5 | x | 4.8 |
| 13. Acute Myocardial Infarction (121) | 11,578 | II | 14.4 | x | 9.8 |
| 14. Pneumonia over age 30 (167) | 11,066 | II | 12.0 | x | 7.8 |
| 15. Emphysema without operation (176) | 10,941 | III | 14.4 | x | 6.9 |

[a]Region II - New York, New Jersey, Region III - Pennsylvania, Delaware, West Virginia, Virginia, District of Columbia, Maryland; Region V = Illinois, Indiana, Ohio, Wisconsin, Michigan, Minnesota; Region IX = California, Nevada, Arizona, Hawaii; Region X - Washington, Oregon, Idaho, Alaska,

SOURCE *PSRO Data Report/rig and Analysis System* (Baltimore, Md.: Health Standards and Quality Bureau, 1982).

**Table 8.—1978 Length of Stay Data for Utah and Central Massachusetts PSROs by Source of Payment**

| Condition and payment source | LOS in days UPSRO | CMPSRO |
|---|---|---|
| Myocardial infarction: | | |
| Medicare . . . . . . . . . . . . . . . | 12.9 | 15.7 |
| Medicaid . . . . . . . . . . . . . . . . . | 11.2 | 14.7 |
| Cholecystectomy: | | |
| Preoperative: | | |
| Medicare ... . . . . . . . . . . . . . . | 2.5 | 4.2 |
| Medicaid ... . . . . . . . . . . . . . . | 1.7 | 3.1 |
| Total stay: | | |
| Medicare ... . . . . . . . . . . . | 10,8 | 15.2 |
| Medicaid . . . . . . . . . . . . . . . . . . | 8.0 | 10.5 |

SOURCE *PHDDS Report Series*, "1978 Medicare/Medicaid Spilt Report" (Bait!. more, Md Health Standards and Quality Bureau, 1 980)

whereas the CMPSRO population was a sample of 1978 patients. In addition, patients were included in the study based in part on electrocardiogram readings performed by different physicians who did not employ uniform criteria. Despite these limitations, however, the study is significant as one of the very few that have attempted to discover what clinical factors underlie regional LOS differences.

In the cholecystectomy study **(25),** data were collected prospectively in both PSROs from February to June 1980. As in the MI study, patients were classified into disease stages according to previously developed severity of illness criteria. Three categories of patients were identified: those without gallstones (Stage I), those with stones (Stage II), and those with severe conditions such as cholangitis, perforated gallbladder, or emphysema (Stage III). There were more patients in the most *severe* class in the CMPSRO population (22 v. 14 percent), fewer patients in Stage I (6 v. 11 percent), and about the same proportion in Stage ll **(72 v. 75** percent). LOS data were given only for Stage ll patients, where LOS was 3.1 days longer for CMPSRO patients.

Four other interesting conclusions emerged from this study. First, patients initially admitted to the medical service in central Massachusetts had a far longer LOS than those admitted first to the surgical service (18.2 v. 10.4 days). The medical patients in Utah also had a longer LOS, but the difference was far less (11.2 v. 8.9 days). In both cases, 70 percent or more of this difference occurred before the operation. Thus, internists in central Massachusetts took almost 4 days longer than their Utah counterparts to make the diagnosis of cholelithiasis and arrange for surgery. Second, there were no differences in the incidence of postoperative morbidity, rate of common duct exploration, or the performance of additional procedures between the two PSROs. All of these factors increased LOS in both populations, but their relative rate of occurrence was the same.

Third, while there was no difference between the two groups in the day that patients first resumed oral feeding, there was a significant difference in the day of first ambulation. In Utah, 80 percent of patients were ambulatory the day after surgery, while only 35 percent of the central Massachusetts patients were so treated. This difference in medical practice may have contributed to the 1.6 day longer postoperative LOS in central Massachusetts. Finally, the study analyzed the difference in distribution of its patients according to the anesthesia risk code assigned by the individual patients' anesthesiologists. This measure may be viewed as an independent severity of illness classification. In this analysis, the Utah patient population had a slightly greater anesthesia risk than the CMPSRO population. This finding indicates that within the Stage 11 severity class, CMPSRO's greater LOS cannot be attributed to greater severity of illness. Thus, this study is consistent with the MI study in suggesting that severity of illness differences do not explain higher eastern lengths of stay. It is also significant in that it suggests some differences in medical and surgical practice that may contribute to these LOS differences.

A similar set of studies was carried out by two PSROs in the Baltimore area (BPSRO) and the Multnomah (Portland, Oreg. ) Foundation for Medical Care (MFMC). The Baltimore City PSRO (BCPSRO) and the Central Maryland PSRO (CM-PSRO) combined to perform medical audits with MFMC on cataract and cardiac patients. The first audit, on cataract patients, was selected because the BPSROs and MFMC exhibited widely diverging lengths of stay for cataract surgery in 1977, Medicare patients stayed 3.8 days in the hospital for cataract surgery in MFMC, 7.1 days in CM-PSRO, and **7,2** days in BCPSRO. Analysis of their combined hospital discharge abstract data for

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1978 revealed that these differences persisted after controlling for sex, race, discharge status, and secondary operations. A small part of the variation was found to be due to the fact that some Baltimore patients had bilateral lens extractions but no MFMC patients did. Wide variations were found among physicians and hospitals in both MFMC and BPSRO in average LOS for cataract patients.

The medical audit was performed using identical criteria on a sample of BPSRO and MFMC patients from 1980. The audit found that 20 percent of BPSRO patients had preoperative stays of more than 1 day and that only 14 percent of these long stays passed the appropriateness criteria. In addition, **42** percent of BPSRO patients had lengths of stay greater than 4 days, and only 19 percent of these stays passed the appropriateness criteria for postoperative LOS. A 6-week followup assessment was requested from one-third of the physicians. Inhospital and 6-week rates of complications were comparable in the two areas (7).

Three cardiac diagnoses were studied in the second audit: myocardial infarction, congestive heart failure, and angina. LOS in MFMC was 4 to 7 days shorter than in the BPSROs for all of these diagnostic categories after controlling for age, sex, race, pay source, surgery, and multiple diagnoses. The audit established criteria for making these three diagnoses and for determining severity of illness. The results showed that coding accuracy was comparable across the two areas. In addition, Baltimore patients stayed 3 to 11 days longer than MFMC patients in each severity class of each of the three diagnostic categories. Once again, large differences were also found among hospitals within each PSRO area (7).

These studies are consistent with the two studies from Utah and Massachusetts in demonstrating that demographic and case mix differences cannot account for large LOS variations between east and west. Unlike the previously discussed PSRO studies, the Baltimore/Portland studies did not attempt to discover what was different about physician management in the two areas. One can also question the reliability of physician self-reports of complication rates. None of the four PSRO studies adequately assessed the outcome of the treatment rendered to their study patients. These investigations do, however, represent the best attempt to date to study in clinical detail an eastern and western patient population trying to find severity of illness differences. All four studies used carefully designed criteria to define graded classes of severity within the disease categories analyzed. All four found that large differences in LOS remained after controlling for severity of illness.

Complementing these PSRO studies on specific clinical conditions is the Stanford Institutional Differences Study, one part of which addressed regional differences in LOS and case mix from a more global perspective. This study (51) examined the records of 603,000 patients from 17 hospitals over the 4 years from 1970 to 1973. The hospitals were a representative sample from among those participating in the Professional Activities Survey (PAS) administered by the Commission on Professional and Hospital Activities. Using PAS abstract data, the study measured intensity of service, LOS, and outcomes. Intensity of service was measured as a composite variable that included measures of numbers of laboratory and X-ray procedures, surgical procedures, and transfusions; use of physical therapy or intensive care; and the number of different types of drugs used. Each of these components was weighted by the relative proportion of patient charges each area consumed in order to construct the single composite score for intensity of service. LOS was measured simply as the number of days of hospitalization. Outcome was measured as proportion of patients who died prior to discharge. Each of these measures was standardized for differences among hospitals in admitting diagnosis, additional diagnoses, age, sex, number of surgical procedures, and complications. This was done by pooling all 603,000 records and constructing regression equations for each diagnostic group to predict the values, in turn, of the composite intensity of service variable, LOS, and proportion of deaths. Each hospital's actual experience was then compared to its "expected" experience.

The results are striking. Hospitals that provided more services and kept their patients fewer days had better than predicted outcomes. Each of these factors had an independent and statistically significant effect. The combined effect of the two factors partitioned the 17 hospitals almost perfectly into performance subgroups. The four hospitals with the lowest standardized death rates all provided greater than expected intensity of service and shorter than expected lengths of stay. The five hospitals with the highest standardized death rates all provided less than expected intensity of service and longer lengths of stay. The remaining hospitals were intermediate. In a two-way analysis of variance, intensity of service and LOS explained 77 percent of the variance in mortality rates with all variables standardized.

Even more significant for the present study was the finding that virtually all of the variation in LOS could be explained by regional location of the hospitals. The usual pattern was found. The West and South had lower than expected standardized mortality rates while the North's was higher than expected. The West also provided a greater intensity of service than expected, while the North and South provided fewer than expected services. These results are summarized in table 9. The study then examined the effects of LOS and intensity of service within regions. The study found little variation in LOS within region but found that the intensity of service variable still predicted outcome within regions: the greater the intensity of service, the better the mortality rate.

This study is unique in its attempt to associate regional LOS differences with outcome differences. Several aspects of the study require further comment. First, after an extensive standardization process that controlled for demographic and case mix differences among patients, regional LOS differences in this sample were not only preserved, but enhanced. The average LOS difference between North and West before standardization was 2.1 days, while after standardization it was **2.4** days. Thus, this study provides further evidence that demographic and case mix differences do not account for regional LOS differences. The study also suggests one very general way in which eastern, western, and southern physicians may differ in their patient management practices. After adjusting for differences in patient characteristics, the study found that western patients received more services than expected, eastern patients received fewer than expected, and southern patients received even fewer. Table 9 shows these results. The study did not present data on the components of this difference, so it is not possible to analyze what this difference means for specific kinds of patients. One cannot determine the clinical meaningfulness of these differences in intensity of service. However, this study does provide convincing evidence of definite, if nonspecific, regional differences in patient management practices.

The most interesting finding of the study from the perspective of the present analysis is the association of lower lengths of stay with better outcomes. While this finding is suggestive, three important considerations mitigate its impact. The first is that the magnitude of the mortality difference is quite small. Table 9 reproduces the crude and standardized mortality rates for the hospitals in the sample by region. The data show that after adjusting for demographic and case mix differences among patients, regional mortality rates cluster very closely about their expected

**Table 9.— Regional Differences in Length of Stay, Intensity of Service, and Mortality Rates From the Stanford Institutional Differences Study**

| Region | Number of hospitals | Length of stay (days) | | Intensity of service score | | Mortality (percent of deaths at discharge) | |
|---|---|---|---|---|---|---|---|
| | | Crude | Standardized[a] | Crude | Standardized | Crude | Standardized |
| North . . . . . . . . . . . . . . . | 9 | 9.3 | 0.8 | 46.3 | -1.0 | 4.0 | 0.3 |
| South ., . . . . . . . . . . . . . . | 3 | 7,1 | -0,5 | 42.0 | -3.7 | 2.9 | -0.4 |
| West. . . . . . . . . . . . . . . ... | 5 | 7,2 | - 1,6 | 52.2 | 1.6 | 2,6 | -0.3 |
| p value for one-way analysis of variance . . . . . . | | 0.0007 | 0.0001 | 0.095 | 0.085 | 0,073 | 0.012 |

[a]Negative sign indicate values less than expected after standardization

SOURCE Adapted from table 5, A B Flood, W Ewy W R Scott, et al , "The Relationship Between Intensity and Duration of Medical Services and Outcomes for Hospitalized Patients," *Med* Care 17 10l381 102, 1979 values. The West is only 0.3 percent below expected and the North only 0.3 percent above.

The second consideration is the method chosen for standardization—using pooled PAS discharge abstracts. Hospital discharge abstracts, such as the PAS system, have repeatedly been found to be unreliable reporters of diagnostic and procedural information. The Institute of Medicine (IOM) studied private abstracting services (including PAS) in 1974 and found that principal diagnosis was incorrect 35 percent of the time and that principal procedure* was incorrect **27** percent of the time (128). Moreover, there is considerable room within these diagnostic categories, even when accurately reported, for large differences in severity of illness. It is true that the study did use other measures from the PAS abstract as proxies for severity of illness, including number and severity of surgical procedures and secondary diagnoses. However, these are likely to be subject to the same reliability problems as principal diagnosis and procedure. Nor can they entirely reflect severity of illness differences among patients in the same general diagnostic categories. For example, the Utah-Central Massachusetts PSRO study showed that MI patients who showed any degree of congestive heart failure but no signs of shock on admission (i. e., an intermediate level of severity) experienced more than twice the mortality of those admitted with no signs of heart failure (**32** v. 14 percent). This kind of difference in severity of illness could not be discerned from a hospital discharge abstract, and therefore, could not be controlled for in the Stanford study. Therefore, it is possible that the small differences in mortality that remained after the standardization method used in the study was carried out could still be explained by severity of illness differences not measured by PAS abstract variables.

The third and most important consideration is that the outcome measure assessed only inhospital mortality. Since the most important potential danger of short lengths of stay is the possibility that early discharge may lead to clinical deterioration and death after discharge, inhospital mortality is an incomplete outcome measure.

Despite these concerns, one must still emphasize that this study represents the best effort to control for regional differences in case mix and the only effort to assess the relationship of regional LOS variations to any sort of outcome measure. It is consistent with the date presented earlier that document large variations in regional LOS unexplained by demographic or case mix differences among patients. Making the most of its data base, the study documented small, but statistically significant differences in hospital mortality among regions, with the better outcome associated with shorter lengths of stay. Unfortunately, the inadequacy of hospital mortality rate as a measure of outcome when assessing LOS differences lessens the significance of this finding.

What then can be concluded concerning the possibility that differences in severity of illness might explain regional LOS variations? First, all of the available studies and data are consistent in failing to document any significant reduction in regional LOS differences by case mix adjustment. Second, with the exception of the PSRO studies discussed previously, there has been no attempt to scrutinize carefully the different patient populations for severity of illness differences not revealed in differences among diagnostic categories. The Stanford study did try to go somewhat beyond these bounds, and its limitations have already been addressed. The fact that no comprehensive study has been done that assessed regional severity of illness differences of the kind reported in the PSRO studies is a major deficiency in the existing literature. Until this deficiency is remedied, the possibility will remain open that some of the regional differences in LOS might be attributable to regional differences in severity of illness among hospitalized patients. Having admitted this possibility, one must stress that, given the broad similarity of populations across the four major census regions, it is unlikely that severity of illness differences large enough to explain the considerable regional LOS variations could exist.

If there is little evidence that demographic or case mix differences explain regional LOS variations, what factors are responsible? While a large

*Although not reported in the PAS study, IOM found in similar studies of the Medicare and the National Hospital Discharge Survey systems that, while patients undergoing no procedures were identified correctly about 80 percent of the time, of those patients undergoing procedures, the principal procedure was incorrectly recorded 36 to 43 percent of the time (126, 127).

number of studies have sought associations between LOS and other variables, few have explicitly addressed regional differences. The studies that have tried to explain differences in hospital LOS have examined vastly different samples of patients and hospitals. Table 10 provides a representative, but not exhaustive, list of the different kinds of samples that are reflected in the literature. Table 11 lists the factors that have and have not been shown to be statistically significantly associated with LOS differences in these studies.

For the purposes of this review, all of these studies are deficient in three crucial ways. First, none of them addresses the issue of *regional* LOS differences. Thus, it is unclear whether any of the factors identified in these studies is an important factor in explaining regional variations. Second, none of these studies attempts to discover differences in physician practices that might account for LOS differences. These factors have been left entirely out of account. It is only in the PSRO and Stanford studies discussed above that this issue has begun to be addressed. Third, none of these studies looks carefully at severity of illness differences, Where case mix differences are considered, most often only primary diagnosis are used to adjust for such differences. Some studies consider the presence or absence of secondary or multiple diagnoses. But none of them consider the variation in severity of illness that occurs within diagnostic groups. Again, the PSRO and Stanford studies cited previously are unique in their examination of this issue.

While the main body of the literature on hospital LOS and its associations may not be very useful in this analysis, one study does shed some additional light on regional LOS variations. The study by Gornick (61,62) has already been cited in other contexts in this review. She presents the results of a multiple regression study that was performed using average LOS for Medicare patients in 1979 as the dependent variable. The PSRO area was the unit of analysis. She studied the effect of region as a dummy variable after differences in demographic and supply variables had been controlled for. The study found that occupancy rate,

**Table 10.—Populations Studied for Length of Stay Associations**

1. Six hospitals in Sweden, pediatric enteritis, 1968 (166)
2. Scottish surgeons, eight procedures, 1974 (31)
3. Cholelithiasis patients, one Australian hospital, 1973-79 (89)
4. Winnipeg General Hospital (155)
5. Long-stay obstetrical and gynecological patients, Edmonton hospital (144)
6. Medicaid and Blue Cross patients, Maryland, 1967-77 (170)
7. Blue Cross/Blue Shield patients, Michigan, 1976 (94)
8. Patients in matched Veterans Administration and non-Federal hospitals (47)
9. Cesarean section patients, University of Virginia Hospital, 1978 (44)
10. Toronto West Hospital, 1974 (167)
11. Four Boston area hospitals, 1964 and 1974 (159)
12. Teaching hospital in Pittsburg, 1970-71 (104)
13. Two Baltimore hospitals, 1968-70 (132)
14. A Nottingham hospital, 1970 (181)
15. Two Washington, D. C., hospitals, 1973 (1 56)
16. Cataract patients, Washington, D. C., 1977-79 (185)
17. Patients with diabetic ketoacidosis, University of Missouri Hospital (67)

18.23 New York hospitals, Medicaid patients, 1972 (139)

19. Two London teaching hospitals, 1972-75 (50)

20.22 Pittsburg hospitals, 1963 (145)

21. Surgical patients, University of Virginia, 1973-74 (63)

NOTE See Reference llst for complete citations of stud!es in table

**Table 11.—Factors Found To Be Associated and Unassociated With Length of Stay**

*Factors associated with Increased LOS:*
Comorbid conditions (50,104,166,185)
Complications (44,50,63,144)
Medicaid insurance (170)
Use of consultations (94)
Federal hospital ownership (47)
Turnaround time for laboratory tests (47)
Adverse drug reactions (167)
Number of surgical procedures (104)
Emergency admissions (104)
Teaching hospital (145)

*Factors associated with decreased LOS:*
Teaching hospital (31)
Proportion of foreign medical graduates on staff (47)
Occupancy rate (47)
Private room use (104)
Close association with chronic disease hospital (132)
Appropriate drug prescribing (98,99)
Primary physician gatekeeper experiment (120)
Presence of outpatient clinic (145)

***Factors not* associated *with LOS:***
Distance patient lives from hospital (166)
Social disadvantages (166)
Occupancy rate (104)
Insurance status (104)
Continuity of care (181)
Teaching hospital (156)
Specialist v. generalist care (67)
Health maintenance organization delivery care (1 10)

NOTE See Reference llst for complete citations of studies In table hospital bed supply, and percent of total population living in Standard Metropolitan Statistical Areas were all positively and significantly associated with higher LOS. Nursing home bed supply was negatively correlated with LOS. Age, percent female, and percent non-white were also positively correlated with LOS, although only the latter two were statistically significant. Even after regional differences in these factors were taken into account, significant regional differences in LOS persisted. Dummy variables representing the difference between the West and each of the other three regions were tested. Those for the Northeast and Northcentral were highly significant, while the one for the South was not.

Two aspects of this study deserve further comment. First, no attempt was made to adjust for case mix differences. Thus, this study cannot further clarify the extent to which these case mix differences explain regional LOS variations. Second, from the perspective of the current analysis, it is not clear that one would want to adjust LOS differences for differences in area supply or personnel characteristics. Before assessing the magnitude of any regional LOS differences, it is appropriate to remove the effects of differences in variables that might contribute to LOS differences considered to be medically justifiable. Therefore, adjustments should be made for differences in patient demographic characteristics and case mix. However, it is not clear that differences in bed supply or occupancy rate result in medically justifiable differences in LOS. Indeed, any impact on LOS they may have is likely to be medically inappropriate. Areas with relatively too many hospital beds and low occupancy rates may, for example, be induced to keep patients in the hospital longer than necessary. If their lengths of stay are higher for these reasons, then it is not appropriate to adjust for the effects of these variables. The relationships of LOS to supply and personnel variables may be interesting from an econometric viewpoint, but they have little relevance to the question of whether Northeast lengths of stay are “too high” or those in the West “too low. ”

Thus far, it has been demonstrated that regional differences in hospital LOS cannot be explained by differences in patients’ demographic characteristics. In addition, there is no evidence that case mix differences explain these variations. It has been noted, however, that a comprehensive clinical study of regional case mix differences has not been done. Therefore, the first key question posed at the outset of this investigation can probably be answered in the negative. Regional LOS differences are probably not simple functions of population differences in demographic characteristics or case mix.

There are only fragmentary data with which to address the remaining two key questions. The two sets of PSRO studies discussed above provide some documentation that eastern and western physicians manage similar kinds of patients differently. One example of this phenomenon is the difference in cholecystectomy patients’ first day of ambulation in Utah and central Massachusetts. The Stanford study documented that the western patients in its sample received more services than the eastern and southern patients. However, it is simply not known in any clinical detail how eastern and western physicians vary in their patient management of a variety of similar conditions. There has been no comprehensive study of differences in eastern and western patient management techniques and how any such differences might account for regional LOS variations. Because data to answer this important question are largely absent, the answer to the third key question—how patient management differences affect outcome—must also remain presently unknown. No study has even attempted to measure regional differences in outcomes of hospital care in a way that would allow an assessment of the medical implications of regional LOS differences.

Does this lack of information mean that no conclusions can be drawn regarding the appropriateness of the large regional differences in LOS? Are there no other data that might illuminate the problem? While there have been no adequate studies of the relationship between regional LOS differences and health outcomes, a large number of studies have been done that examine the health consequences of differing lengths of hospital stay for the same clinical condition. This body of literature may be of help, assuming that practice patterns cause the LOS variations.

Since it has been demonstrated that differences in population demographics and case mix are unlikely to be important factors in explaining regional LOS differences, it thus appears that physicians treat similar kinds of patients differently in different regions of the country. If the medical literature clearly establishes that for a particular condition a 10-day LOS has the best health outcome, regions with lengths of stay for this condition of more than 10 days could be judged as keeping their patients too long while those under 10 days would be providing too little hospital care. In performing this analysis, one must be prepared for the possibility that all regions may exhibit current lengths of stay that are either above or below an optimal LOS determined from the literature. One must also be prepared for the more likely possibility that an optimal LOS cannot be inferred from the literature. However, because it may shed some additional light on the problem of regional LOS differences, this kind of analysis may assist health policy decisions in this area.

The remainder of this case study reviews the medical literature that describes the relationship between LOS and health outcomes. A review of this literature disclosed five clinical areas in which methodologically sound studies have been performed: acute myocardial infarction, certain elective surgical procedures, low risk newborn deliveries, low birth weight infants, and psychiatric hospitalization. The studies in each of these areas are carefully examined to discover what is known in each clinical condition about the health consequences of differing lengths of stay.

Before proceeding to examine each of these clinical conditions independently, it is important to consider conceptually the ways in which LOS and health outcomes might be related. One must first recognize that the duration of a hospital stay is not a directly manipulable factor in patient management. If LOS is shortened, then treatment schedules must be altered in very specific ways. Some treatments must be foregone, others changed, and others shortened in duration. For example, if a patient with pneumonia is sent home early, one might have to decrease the number of days during which intravenous antibiotics are given. The MI patient may be required to get out of bed and walk sooner. The surgical patient might have to begin a normal diet sooner and perhaps leave the hospital with his or her sutures still in place.

Each of these changes from preexisting practice may have negative health consequences. The pneumonia patient might experience a relapse because potent intravenous therapy was discontinued too soon. The MI patient might suffer an extension of the infarct, because too much work was required of the recuperating myocardium. The surgical patient might experience a wound infection or dehiscence if the wound is not watched closely and cared for antiseptically. In general, the potential negative health impact of decreasing LOS would flow from the failure to provide some aspect of treatment that is effective in improving the health outcome of a particular condition.

Hospital stays may also be beneficial in protecting patients from the adverse health effect of factors present in their home environments during especially vulnerable periods in their convalescence. Family conflicts may adversely affect recuperating MI patients. While compliance with therapeutic regimens can be assured to a great degree in hospital inpatients, the same is not true for those discharged. Lack of compliance may have particularly significant adverse effects early in convalescence. Early discharge of tuberculosis patients has been criticized as a possible danger to public health (133).

On the other hand, hospitals can be hazardous to one's health. Complications of hospital treatment are many, including nosocomial infections, adverse drug reactions (which may also occur with outpatient treatment, but those that occur in association with inpatient intravenous drug use are more frequently very serious), complications related to procedures, and others. Clearly, one's probability of experiencing one of these adverse effects of hospital care increases directly with one's exposure; the greater the LOS, the greater the chance.

It should be clear, therefore, that the health effect of decreasing LOS cannot be determined a priori; it is an empirical question that can be addressed only by careful research. The kind of study best able to illuminate this issue is one in which the patient population is carefully described and in which a clearly defined set of treatments is modified in order to effect a shortened LOS. Such a study must also measure a set of outcomes plausibly related to the treatments that have been altered. From a methodological viewpoint, the randomized clinical trial (RCT) offers the best chance at measuring the effects of such an experiment in an unbiased fashion. This case study, therefore, pays special attention to RCTs.

This case study also excludes studies if changes in clinical practice render them obsolete. One example is an RCT done in the late 1950's on early ambulation of patients with upper gastrointestinal tract bleeding that was done prior to the advent of flexible fiberoptic endoscopy and cimetidine (138). Another example is the question of the value of bed rest in the treatment of hepatitis. A series of studies, including some RCTs on military populations, has failed to demonstrate any benefit of bed rest in the treatment of this condition (32,91,142,176). But treatment for hepatitis now ordinarily takes place on an outpatient basis. Because hospital treatment is usually reserved only for patients who experience serious complications of their disease, this subject was considered outside the scope of this study.

One final point should be borne in mind. Because the effect of changes in treatments on health outcomes is so dependent on precisely which treatments are altered, in precisely what manner, in which kinds of patients, one cannot generalize the results of one study in a particular clinical area to another. Indeed, because of the many ways in which study populations can be defined even for a single condition, one may not be able to compare studies of the same condition very well. The general proposition of the relationship of LOS to health outcomes must be investigated by studying each medical condition of interest by itself.