# Chapter VIII

## Hospitalization

Hospitalization rates reflect many aspects of ESRD therapy. Among the most important are the frequency and duration of reported hospitalizations, both of which are significantly affected by the level of patient morbidity. Unfortunately, other influential (but unrelated) factors include the health insurance system and individual patient needs. Consequently, hospitalization data are subject to numerous sources of variability, and tend to be imperfectly reported at both patient and aggregate levels. Despite these faults, such data allow the USRDS to provide reasonably objective characterizations of the morbidity experience in the ESRD population.

The source of hospitalization data for this chapter are the Medicare billing records contained in the HCFA standard analysis files (SAF; see Chapters I and XII) for the years 1991-1993. This represents a significant change over previous USRDS reports, where data were taken from the PMMIS database. The net effect of this change is that the hospitalization data available to the USRDS are more complete than ever before. For example, previous problems encountered with information on zero (same-day admit/discharge) and one-night hospitalizations have been eliminated entirely. Nevertheless, some of the limitations encountered in the past are still problems today. For example, patients in their first 18 months of Medicare eligibility who have Medicare as their secondary insurance payer may have their hospital stays covered by another source first, with Medicare being the secondary payer. This may result in hospitalization profiles for a minority of patients that are incomplete during the first 18 to 21 months. Both the PMMIS and SAF files are likely to miss these hospitalization records for patients for whom Medicare is the secondary payer. However, the SAF records are much more complete than PMMIS, because the delay in reporting ESRD status caused problems for PMMIS but does not affect the SAF files. The new procedures with the SAF hospital records screen patients to determine if Medicare is likely to be a secondary payer by requiring that patients have Medicare paid dialysis bills to be included in analyses. This process removes bias of missed hospitalizations, but it does slightly decrease the degree of generalization possible. The change in data sources has allowed the USRDS to recapture some (but not all) hospitalization data. Such limitations, while somewhat less important for comparisons made in the aggregate, inhibit investigations into the use of serial hospitalizations as a measure of illness severity, longitudinal comorbidity, quality of life, and monetary cost of ESRD, at least on a per-patient basis.

The first part of this chapter summarizes the hospitalization experience of incident and prevalent dialysis patients through total hospital admissions and hospital days. The second part of this chapter describes the hospitalization rates of incident and prevalent *dialysis* patients, defined as the *total* number of admissions per year at risk for hospitalization. Only current dialysis patients, defined as those patients who have been on dialysis for at least 60 days by their study entry date (to be defined), are included in these analyses. Unlike the 1995 ADR, we no longer automatically exclude patients who have been previously transplanted. Summaries by age, race, sex, diabetic status and modality are given in the reference tables in Section H of the full report, and apply to data collected between 1991-1993. The last section of this chapter introduces a new comparison measure based on *first* hospital admission rates (Strawderman *et al.*, 1996). This standardized first hospitalization ratio (SHR) is an adaptation of the standardized mortality ratio (SMR) methodology described in Chapters V and XII. Using these standardized rates, we compare the SHR and SMR among dialysis units within the United States Department of the Census's nine census regions. We also investigate the relationship between SHR's and SMR's at the dialysis unit level, and study trends both

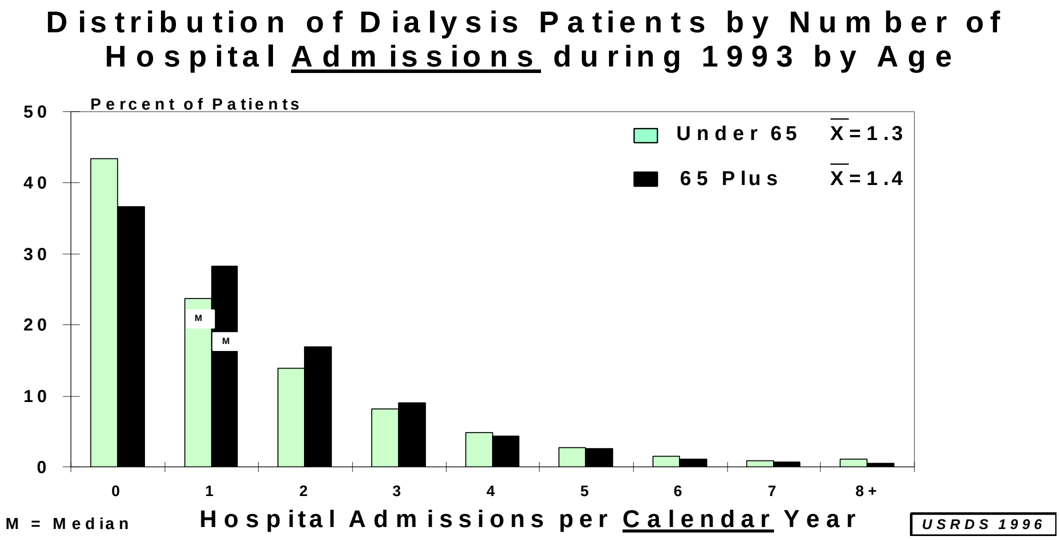



**Figure VIII-1**

*Percentages of dialysis patients with the given number of hospital admissions in a single year, by age, 1993. Mean and median are also denoted. Includes all Medicare dialysis patients. Please note that this figure shows counts of hospital admissions for the entire year rather than admissions per year at risk. As a result, the numbers here are lower than those for total admissions per year at risk. Source: Special Analysis.*

among the various facility types (i.e. free-standing/hospital and profit/not-for-profit status) and over time.

We note that most of the analyses in this chapter are meant to be descriptive, not definitive, and thus serve only to generate hypotheses for detailed study. Hypothesis testing, confidence intervals, etc. are reserved for future, more in-depth analyses of these data.

## Trends in Hospitalization

Both the yearly number of hospital admissions and days per patient are important measures in the study of hospitalization in dialysis patients. Figures VIII-1 and VIII-2 describe the distribution of hospital admissions and days for patients prevalent on January 1 or incident during 1993, by patient age under or over 65. It should be noted that these figures are based on the number of events per calendar year rather than the number per year at risk. Given that time at risk is often much less than one year, the number of hospital admissions and days per year at risk is greater than those numbers shown here.

Both distributions are positively skewed (i.e. the majority of patients have few days and admissions, but there is also a long tail extending to the right), the distribution of days more so than admissions. More patients have zero admissions and zero days than any other number. Figure VIII-1 shows that approximately 81 percent of the patients in both age groups had fewer than 3 hospital admissions, while 97 percent had 5 or fewer. The median number of admissions is 1 per year in both groups, while the mean number of admissions in the older and younger age groups are 1.4 and 1.3 respectively. In terms of hospital days, we see in Figure VIII-2 that 34 percent and 42 percent of the patients in the older and younger age groups had zero hospital days. Just over 11 percent had 30 or more days in both groups. The median and mean for hospital days were respectively 5 and 12 for patients age 65+ and 3 and 11.5 for patients less than 65.

As expected, these graphics indicate that younger patients tend to have less hospitalization, measured on either scale. The trends seen here are similar to those reported in the 1995 ADR; however, the distribution of both total hospital admissions and days has shifted slightly to the left, indicating an overall decrease in hospitalization. As noted in the 1995 ADR, this is consistent with the overall national trend of decreasing hospitalization.

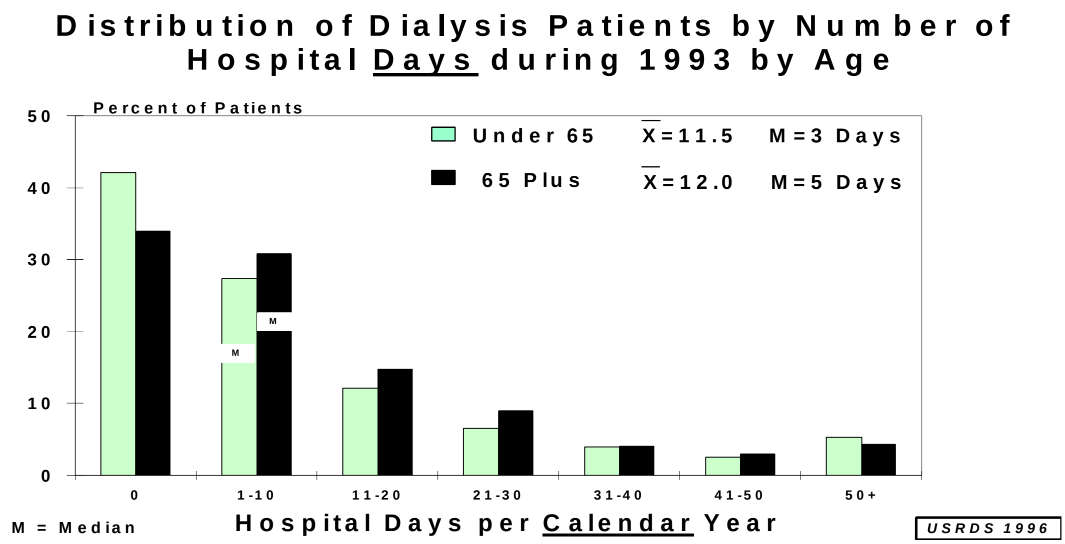



**Figure VIII-2**

*Percentages of dialysis patients with the given number of total days hospitalized in a single calendar year by age, 1993. Mean and median are also denoted. Includes all Medicare dialysis patients. Please note that this figure shows counts of days in the hospital for the entire year rather than days per year at risk. As a result, the numbers here are lower than those for days per year at risk. Source: Special Analysis.*

## Crude Hospitalization Rates Based on Total Admissions

The patient populations under study in Figures VIII-1 and VIII-2 include dialysis patients prevalent on January 1, 1991, or incident after that date until December 31, 1993, and hence includes patients having different lengths of followup. These descriptive analyses do not account for this fact, and therefore we computed an aggregated rate per year at risk for hospitalization, defined as the ratio of total hospital admissions or days to the total time at risk. In order to stabilize the estimated rates, we pooled data for the period 1991-1993, calculated yearly totals for the number of hospital admissions and years at risk for hospitalization, and use a weighted average of these numbers to obtain the overall rate. These rates are then computed for various age, race, sex, and modality groups within the ESRD population in order to compare the hospitalization experience among groups.

### Patient Eligibility and the "60 Day Rule"

To provide the most accurate snapshot of the hospitalization experience among *dialysis* patients, we restricted the population of patients used in calculating the rates. The rates are based on data pooled yearly over 1991-1993, meaning that the observed numbers of admissions and corresponding risk time are calculated yearly, and a weighted average of these numbers are taken to obtain the reported rate. To contribute data to the rate calculation in a given year, a patient must be on dialysis for at least 60 days prior to their study entry date. This is done primarily to ensure that adequate billing data (and hence information on hospitalizations) is available. Incident patients, classified as those patients whose 90th day of ESRD falls between January 1 and December 31, automatically satisfy this condition; correspondingly, the study entry date for each incident patient is set to their 90th day of ESRD. Prevalent patients have their eligibility determined as of January 1; any previously-transplanted patient currently on dialysis having a failed transplant within 60 days prior to January 1 is excluded. The latter is done under the presumption that such patients may contribute hospitalizations early during the followup period which are due to the transplant failure and not dialysis-related complications. Patients who start followup or die during a year are at risk for only a portion of the year, and eligible patients who are transplanted during a given year have their at-risk period censored 3 days prior to the date of transplantation. Finally, patients who switch modalities during the year are assigned to the new modality at the start of the next year. Collectively, these criteria will subsequently be

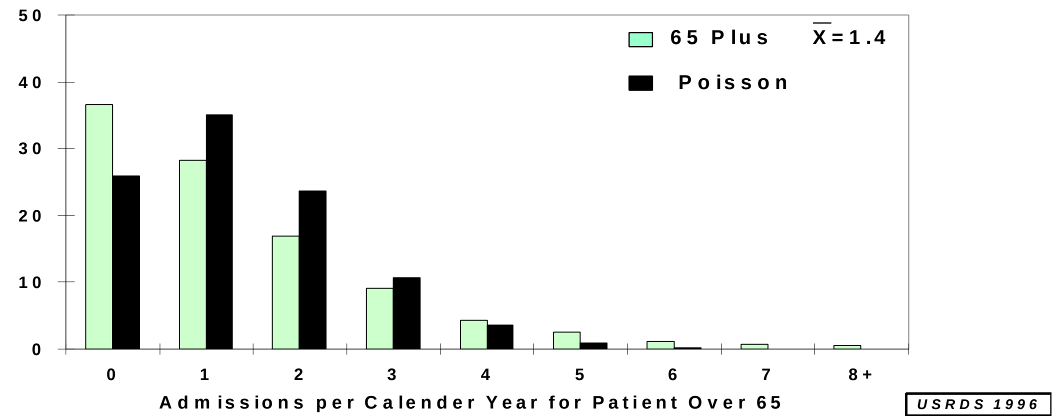



**Figure VIII-3**

*Percentage of dialysis patients over the age of 65 with the given number of hospital admissions in 1993 along with the respective Poisson distribution. This figure demonstrates that the Poisson distribution is not a good fit for the observed distribution. Source: Special Analysis.*

referred to as the "60 Day Rule," and help to ensure that the maximum amount of reliable information on the hospitalization of dialysis patients is included in the calculations.

## Rates Based on Total Admissions

The hospitalization rates summarized in Figures VIII-3 though VIII-5 are calculated under the "60 Day Rule". Our comparisons here are restricted to rates based on total admissions since corresponding rates based on hospital days are highly correlated. In addition, admission rates tend to exhibit greater stability than those based on days, in part due to more accurate recording and the fact that the distribution of hospital admissions tends to have a shorter right-hand tail (see Figures VIII-1 and VIII-2). For the admissions rates, the years at risk for hospitalization for each patient are determined by subtracting the time actually spent in the hospital from the total time on observation. This calculation explicitly accounts for the fact that one is not at risk for a new hospitalization while already in the hospital. Rates for hospital days may be found in Reference Table H.3 and use the full years at risk, including time spent in the hospital.

In order to draw inferences about the total admission rates (TAR), some assumptions must be made. Standard approaches to inference on rates (such as those used for the SMR; see, for example, Wolfe, 1994) are based on the Poisson distribution (Ross, 1983). In the case of hospitalization rates, this requires one to assume that the time between successive hospitalizations within each individual are uncorrelated, and that, within each individual, the distribution of the number of admissions over a fixed time period follows a Poisson distribution. Under these two assumptions, the aggregate number of hospitalizations in the same time period should follow a Poisson distribution, at least approximately (e.g. Ross, 1983). When these assumptions are violated, inference for hospitalization rates cannot be based upon the Poisson distribution. In addition, the interpretation of the numerical value of the rate may be affected. Figure VIII-3 compares the distribution of hospital admissions in 1993 among patients 65 years or older to that expected under a Poisson distribution having the same mean number of admissions. It is evident that the Poisson distribution provides a poor fit for the actual observed distribution of admissions. Consequently, the assumptions discussed above are not likely to be met, and hence the analyses we present below are of a descriptive nature and should be interpreted with caution. One reason for this problem may be related to a larger than average risk for future hospitalizations of patients who had more than one admission during the year. In the next section, an alternative method for computing hospital admission rates is presented, and largely avoids these problems by restricting the calculations to "first admissions" only.

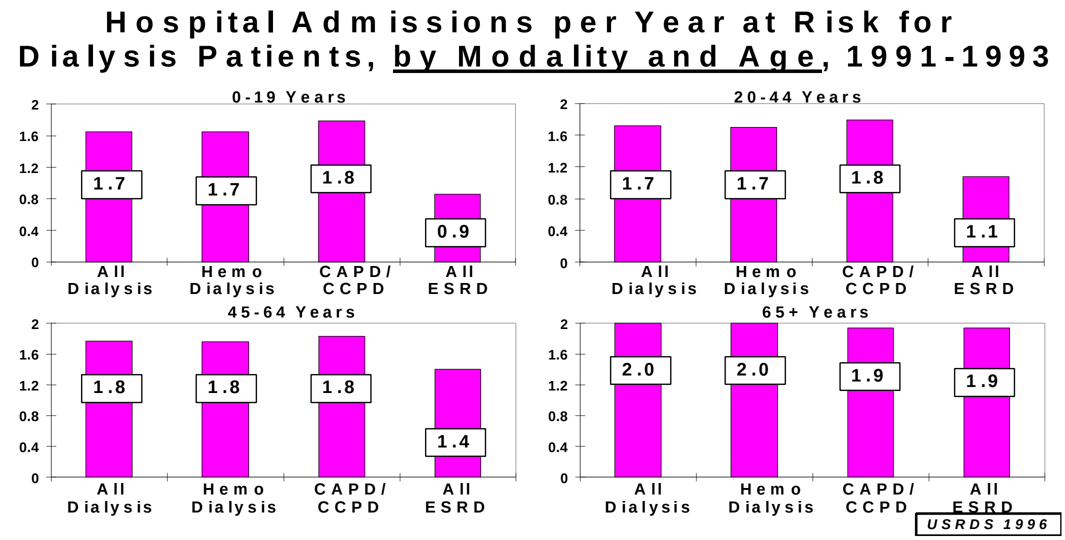



**Figure VIII-4**

*Number of hospital admissions per patient year at risk for ESRD patients by method of treatment for each age cohort, 1991-1993. Patients are grouped by treatment type based on the treatment method they were using on January 1 of each year. Those patients who switched modalities during a year are reclassified at the beginning of the following year. Medicare patients only. Source: Special Analysis.*

Figure VIII-4 shows the total admission rates by modality, stratified upon age. The rates increase with age for each treatment modality. The trends here are similar to those reported in the 1995 ADR. A notable difference is that the rates observed in the 0-19 age group are significantly higher than those reported in the 1995 ADR. We suspect that this is due to the change in the source of the hospitalization data rather than a significant change in hospitalization patterns. Comparative analyses done by the USRDS show that a more complete reporting of hospitalizations among younger patients has been obtained relative to previous years.

Hospitalization rates among CAPD patients are slightly higher than for hemodialysis patients in each age group, with the exception of those patients in the 65 and over age group. This is a minor change over the results reported in the 1995 ADR, and may potentially be due to the change in data sources. However, it is also the case that in recent years, hospitalization rates for CAPD patients have been steadily falling while those for hemodialysis patients have remained relatively stable; this can be seen by comparing the rates for CAPD in Figure VIII-4 to those in Figure XI-4 of the 1995 ADR. There are many possible explanations for this observed time trend, including reduced hospitalizations among CAPD patients, changes in the frequency of switching between modalities, and differences in age distributions among the two treatment groups. In general, these trends are similar to those reported in the 1995 ADR as well as with the findings of Habach *et al* (1995), who report such comparisons for 1988 through 1990. The differences reported here are smaller, perhaps due to improvements in connection devices for peritonitis risk or increased outpatient treatments of peritonitis in CAPD patients.

Actual differences between rates for CAPD and hemodialysis patients might be larger than are reported because we have used an "intent to treat" assignment of dialysis modality. That is, hospitalizations for patients who switch in the middle of the calendar year are not attributed to their new modality until January 1 of the following year. The USRDS has shown that CAPD patients switch to hemodialysis approximately three times as often as hemodialysis patients switch to CAPD (1995 Annual Data Report). If hemodialysis patients tend to incur less hospitalizations, rates for CAPD patients may be biased downward while rates for hemodialysis patients are likely to be biased upward (although much less so) since a switch to CAPD likely increases the hospitalization rate.

Figure VIII-5 shows rates by age, race, and sex. The trends seen here are similar to those reported in the 1995 ADR. It is important to note that the rates for patients aged 0-19 are, relative to the other age

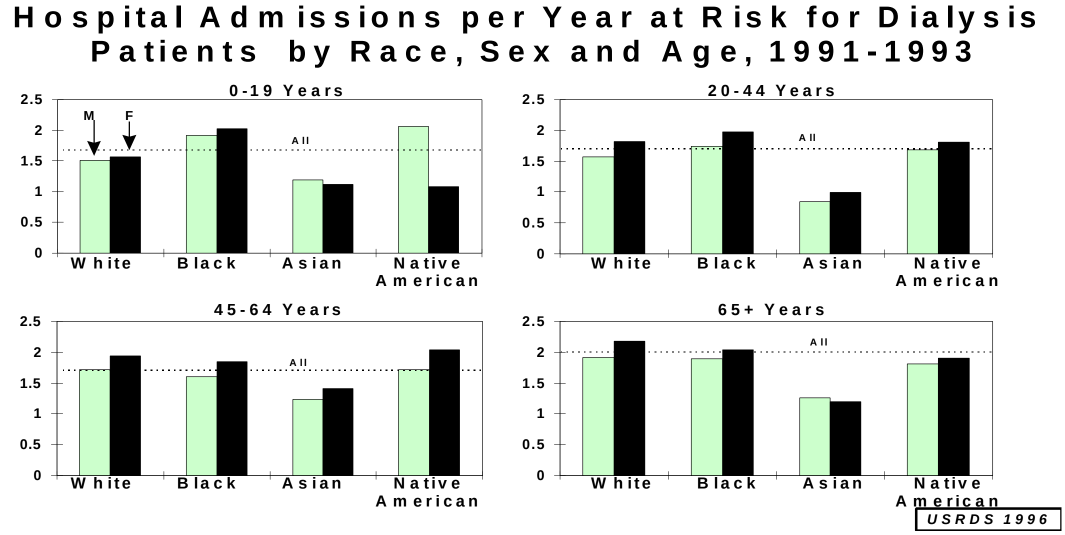



**Figure VIII-5**

*Number of hospital admissions per patient year at risk by sex and race for each age cohort, 1991-1993. Medicare dialysis patients only. Source: Special Analysis.*

groups, based on very small sample sizes. This is especially true for Asians and Native Americans; hence, interpretation of these rates should be done very cautiously. In addition, the rates for the youngest age group are likely to be affected by patient selection: dialysis patients in the 0-19 age group who have never been transplanted are among the least healthy of all dialysis patients, and hence are likely to have higher hospitalization rates.

In general, the results indicate that females have higher hospitalization rates than males, the exception being the Asian and Native American groups aged 0-19 where hospitalization among males appears to be higher. A striking difference over the 1995 ADR is that seen among Native American males and females aged 0-19, where the rate for males is nearly double that for females**.** However, it is important to note that these two groups have the smallest number of admissions and corresponding risk time; consequently, small changes in either may result in large changes in the calculated rates. Thus, the magnitude of the difference seen here is probably due to instability in the calculated rates rather than any real difference. Hospitalization rates are generally the lowest among Asians at all age levels, while rates are among the highest for Native Americans at all age levels. Blacks are hospitalized more frequently than Whites at younger ages, while the reverse occurs for ages 45-64 and 65+. The hospitalization rates among Whites and Blacks increase with age, while rates drop initially for Native Americans and Asians between the ages of 20-45 before rising again. Again, the pattern observed here may simply be due to rate instability rather than an actual trend, and thus should be interpreted very cautiously.

## Standardized Hospitalization Ratio (SHR)

### Methods

The standardized mortality ratio (SMR) is a ratio of the observed number of deaths for a given patient study group divided by expected number of deaths for that patient study group based on national death rates. Wolfe *et al* (1992) use the published USRDS national ESRD mortality rates given in deaths-per-patient-year by age, race, and diagnosis group. These can then be used, for example, to compare mortality rates among dialysis facilities with different patient mix characteristics by simply computing the ratio of the observed number of deaths to the expected number within each group, the latter being adjusted for differences in age, race, and diagnosis.

The expected number of deaths within a group is determined by multiplying the total patient-years observed within each age-race-diagnosis category by the corresponding national rate, and then summing over all of the categories. An observed SMR larger (smaller) than 1.0 denotes potentially a higher (lower) mortality rate than the national ESRD norm. The rates are subject to random variation, however, and so should be interpreted cautiously. Further discussion of interpretation and evaluation of the SMR, including tests of statistical significance, can be found in Wolfe *et al* (1992) and also Wolfe (1994).

The USRDS produces hospitalization tables in a similar fashion to these mortality tables. Hence, for patients eligible under the “60 day rule”, we can calculate a standardized hospitalization ratio (SHR) using the rates in the Reference Tables H.1. In calculating the SHR, we restrict our attention to the *first* hospitalization event for each individual. That is, within a given year, only the first hospitalization event for an individual is counted. Correspondingly, the risk time for that individual is defined as the days from entry until a first hospitalization, a censoring event, or December 31 occurs. Censoring events are death and transplant; a patient’s risk period is truncated 3 days prior to transplant in order to avoid attributing the transplant-related hospitalization to the observed count. This is a different approach than taken in the 1995 ADR, where the rates are based on total admissions; the primary reasons for this switch are outlined below. We expect, however, that the results of these analyses and those reported in the 1995 ADR will be reasonably similar since approximately 65 percent of the patients in either age group had 1 or fewer admissions ( see Figure VIII-1).

The rationale for considering only the first hospitalization event is explained in detail in Strawderman *et al* (1996). To summarize that discussion, let us first consider the SMR. In calculating the SMR, each individual makes at most one contribution to the observed death count. These independent contributions to the numerator of the SMR are in effect what allows inference about the SMR to be based on the Poisson distribution; Hoem (1987) provides an excellent discussion. As discussed earlier (see Figure VIII-3), the total observed hospitalization count does not appear to follow a Poisson distribution. This is primarily because the contributions to the observed total count are not necessarily (statistically) independent of each other; that is, there are many individuals who can contribute more than one hospitalization event in the same time period. Moreover (and more importantly), both intuition and empirical evidence suggest that the times between successive hospitalization events are not independent within an individual. Taken together, these two facts imply that the total observed count cannot be distributed as a Poisson random variable (e.g. Ross, 1983). The use of the first hospitalization event only for each individual helps to ensure that contributions to the observed count remain independent of each other, and consequently methods similar to the SMR may be used to draw inference about the calculated rates.

As pointed out in Strawderman *et al* (1996), the SHR reflects the useful information found in an appropriately defined standardized total admissions rate (STAR). For example, at the dialysis facility level, a low SHR necessarily indicates a low overall admissions rate; obviously, if there are few first admissions, there can be few total admissions (unless a few patients at the facility have particularly chronic hospitalization patterns). Correspondingly, a high SHR indicates that many more patients at the facility are entering the hospital than at the national level. Compared to the STAR, the SHR is less sensitive to the level of comorbidity at the patient level, and more sensitive to the scope (or distribution) of comorbidity at the facility. From the point of view of evaluation, the latter may be more relevant and (arguably) of potential concern.

To obtain the SHR for a specific dialysis unit in a specific year, the total number of *first* hospital admissions for each eligible patient treated during that time period is divided by the expected number of *first* hospitalizations. The expected number of first hospitalizations is calculated similarly to the expected number of deaths used in calculating the SMR. Specifically, the observed patient-years at risk for hospitalization in that unit is sub-divided by age, race, sex, and diagnosis, multiplied by the corresponding national rate for those groups, and then summed up over all groups to obtain the total expected number of first hospitalizations in that unit for that year. This produces standardized first hospitalization rates, adjusted for age, race, sex, and diagnosis, that share a similar interpretation to the adjusted SMR. That is, values of the SHR larger than 1.0 indicate first hospitalization rates above the national norm while values below 1.0 denote lower rates.

## Analyses by Region

The SHR's computed for the analyses of this section are based on data obtained for 1991-1993. The “60 Day Rule” is used to determine patient eligibility for each of the years 1991-1993. The rates presented here are based on first admissions and patient-years at risk pooled over the three year period 1991-1993. Also, except where indicated, units with fewer than 20 admissions in the three year period are excluded from the analyses to further ensure the stability of the calculated rates. Analyses are performed by census region as well as at the dialysis unit level based on unit-specific SHR's. Correlations between the admission rates and rates based on

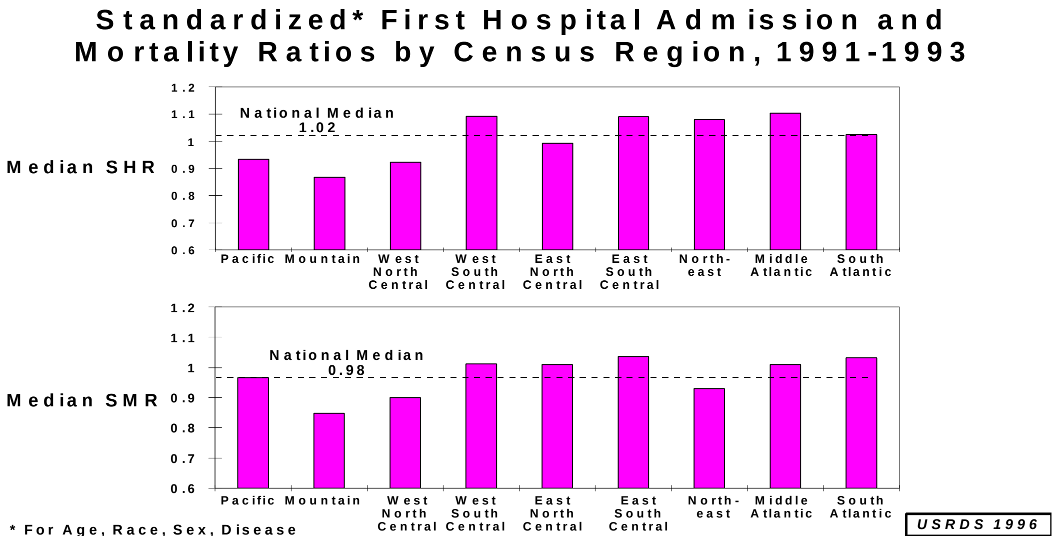



**Figure VIII-6**

*Median standardized first hospital admissions ratio (SHR) and mortality ratio (SMR) for each of the nine geographic census regions, 1991-1993. Ratios are standardized for sex, race, age and diabetic status. Rates are calculated by dividing the actual number of events (first admissions for hospitalization and deaths for mortality) for each dialysis unit by the expected number of events for that unit. Expected events numbers are calculated for each facility based on national data so that rates can be compared from region to region. National average is 1.0. Units with fewer than twenty expected first admissions in the three year period are excluded. Source: Special Analysis.*

hospital days at the unit level tend to be very high within each year, averaging 0.74. Correlations with rates based on length-of-stay (LOS) are much smaller (r=0.08); this is probably due to the much greater degree of regional variability in LOS. Where appropriate, comparisons to the SMR are also made.

Figure VIII-6 summarizes the median SHR and SMR for dialysis units within each of the nine census regions shown in Figure VIII-7. Smaller units have been excluded from these analysis, so the unit-

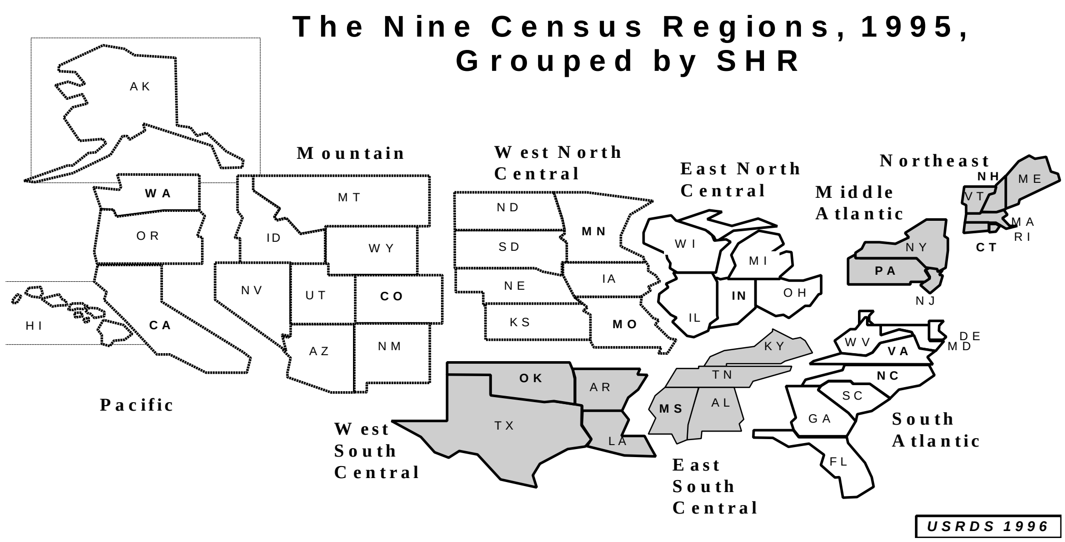



**Figure VIII-7**

*Map of United States indicating the nine Census regions. Shading indicates those regions with median standard first hospital admissions ratios greater than 1.05 in the three year period, 1991-1993. Source: Special Analysis.*

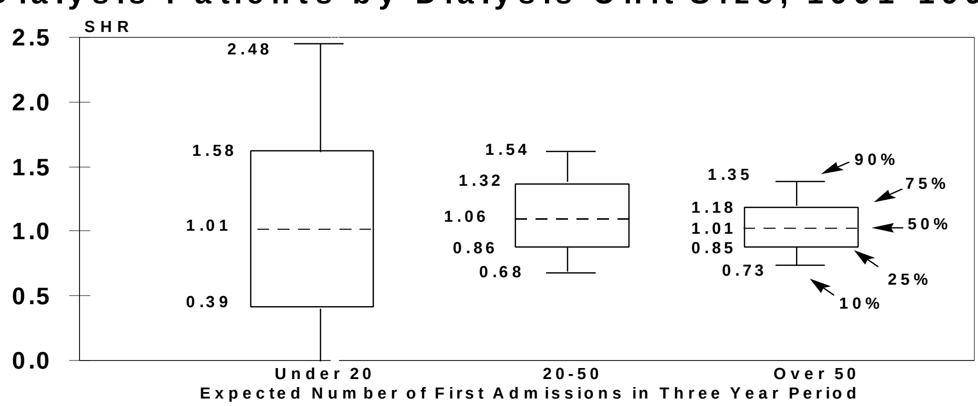
specific ratios are reasonably stable. Use of the median value provides a snapshot of the typical dialysis unit in each region. For five of the nine regions, the median SHR exceeded 1.0, indicating hospitalization rates above the ESRD norm; these regions are shaded in Figure VIII-7. The national median SHR is 1.02, indicating that 50 percent of the nations facilities are close to or below the national ESRD first hospitalization rate. Regions having the lowest SHR values are the Pacific, Mountain, and East and West North Central Regions. This trend is consistent with trends observed in studies of non-ESRD patients (Gornick, 1982) as well as past studies of hospitalization among ESRD patients (ADR, 1991, 1995).

The highest rate of hospitalization occurs in the Middle Atlantic region, followed by the East South Central, Northeast, and West South Central and regions. These patterns are very similar to those observed in the 1995 ADR, where the rates are based on total admissions. There is moderate positive correlation between these rates and the corresponding SMR For example, the Mountain region has both the lowest SHR and SMR, while the East South Central region has the highest SMR and second highest SHR. In contrast, the Northeast has the third highest SHR's, but the 7th smallest SMR. It is unclear which factors are primarily responsible for the geographic differences observed here; several major patient mix characteristics have been adjusted for, but other factors which have not been adjusted for may also important.

## Analyses by Facility Size

The SHR's can also be compared at the dialysis unit level. Figure VIII-8 contains box plots and summary statistics describing the distribution of SHR's by unit size, measured here in terms of the expected number of yearly first admissions between January 1, 1991, and December 31, 1993. The variability and skewness in the distribution of the SHR decreases with the increase in expected first admissions. For example, for units having 20 or fewer expected admissions over the 1991-93 period, the expected number of dialysis patient hospital first admissions ranged from a low of zero to a high of 28.6, with median and mean values of 1.01 and 1.4 respectively and 90 percent of the values falling below 2.48. For dialysis units having 50 or more expected first admissions, the SHR range was 0 to 2.4, having median and mean values of 1.01 and 1.00 respectively and with 90 percent of units having values below 1.35. The latter distribution is thus more symmetric and subject to less variation, which is to be

**Distribution of SHR for First Admissions of Dialysis Patients by Dialysis Unit Size, 1991-1993**




| | Under 20 | 20-50 | Over 50 |
|---|---|---|---|
| Number of Dialysis Units: | 514 | 407 | 1557 |
| Median Number Patients Per Unit Per Year: | 21 | 68 | 142 |

USRDS 1996

**Figure VIII-8**

*Distribution of standardized first hospital admissions ratio for each dialysis unit size. Ratios are standardized by sex, race, age and diabetic status. Facility sizes are determined by the expected number of first admissions for that unit in a three year period, 1991-1993. Those with fewer than twenty first admissions in that time are in the smallest group; those with twenty to fifty are in the next group; and those units with more than fifty first admissions are included in the last group. Ratios are given for the 10th percentile, the 25th percentile, the median, the 75th percentile and the 90th percentile. National average is 1.0. Source: Special Analysis.*

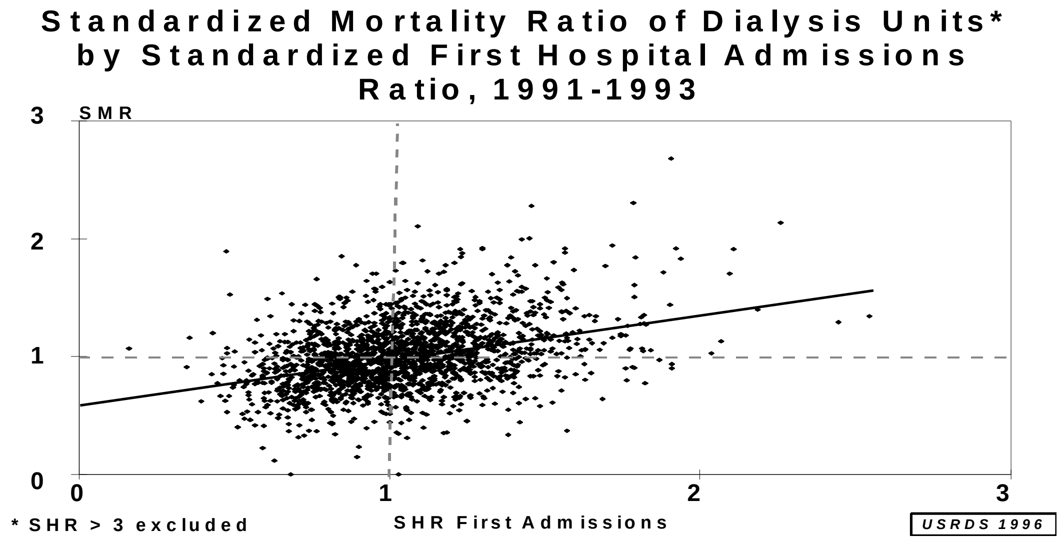



**Figure VIII-9**

Plot of standardized mortality ratio (SMR) by standardized first hospital admissions ratio (SHR) for each dialysis unit, 1991-1993. Rates are standardized by age, race, sex and diabetic status. Line represents linear regression of SMR on SHR, treating SMR as the dependent variable. The intercept is at 0.61 and the slope is 0.39. The adjusted R-Squared value is 0.14. Units with fewer than twenty expected first admissions in the three year period are excluded. Source: Special Analysis.

expected. However, the median SHR does not change dramatically with unit size.

A scatterplot for the SHR's and SMR’s for dialysis units having an expected number of first admissions exceeding 20 is given in Figure VIII-9. Evidently, there is significant variability in the relationship between the two. The fitted line represents the linear regression of SMR on SHR, SMR being the dependent variable. For these data, approximately 14 percent of the variability we see in the SMR can be explained by its (linear) relationship with the SHR, as measured by $R^2$. There is an obvious upward trend, indicating a positive correlation between the two measures. The linear correlation between the two rates is about 0.37 ($p < 0.0001$), and the Spearman rank correlation coefficient (Lehmann) is 0.35 ($p < 0.0001$). Rank correlations provide a robust measure of the degree to which higher (lower) SHR's are associated with higher (lower) SMR's. For example, the trend observed in the scatter plot becomes more difficult to identify when the units having less than 20 expected admissions are included. The rank correlation coefficient remains relatively unaffected, however. Evidently, these results suggest that the ability of the facility-level SHR in predicting its SMR is rather low, at least on the scale given here. We note that, even if the observed correlations were much higher, the presence of association alone could not be taken as evidence of the existence of a *causal* relationship.

## Comparisons by Profit Status and Facility Type

In Figure VIII-10, the SHR distributions, by whether a dialysis unit operates for profit (yes/no) and/or type of unit (hospital or freestanding), are shown in box plots. Standardized hospitalization ratios (SHR), when adjusted for age, race, sex and cause of ESRD, are typically higher in freestanding for-profit dialysis units (Median SHR = 1.04). Both hospitals (not-for-profit) and not-for-profit freestanding units have slightly lower median SHR’s, being at 1.00 and 0.95, respectively. The variability in the rates is approximately equal; for example, the inter-quartile ranges differ by a maximum of 0.10.

The dialysis policy literature has for years debated whether hospital outpatient dialysis units have a “sicker” (more comorbid conditions and more severe conditions) patient population than do the freestanding units. If we take the SHR as a measure of patient case-mix severity beyond age and diabetes, these estimates suggest that the freestanding for-profit units have a higher severity mix than do the not-for-profit dialysis units. If, on the other hand, one takes the SHR as a measure of resources used to produce

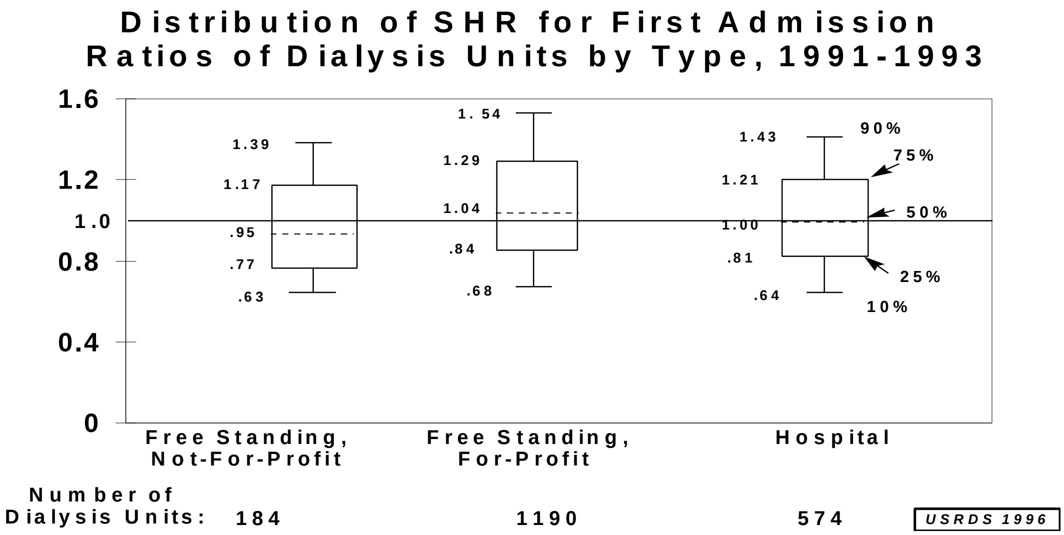



**Figure VIII-10**

*Distribution of standardized first hospital admissions ratios by type of unit, 1991-1993. Units are divided into three types: free standing dialysis units operating for a profit, free standing dialysis units not operating for a profit, and hospitals. Rates are standardized for age, race, sex and diabetic status. Units with fewer than twenty first admissions in the three year period are excluded. Ratios are given for the 10th percentile, the 25th percentile, the median, the 75th percentile and the 90th percentile. Source: Special Analysis.*

good patient health, then these data suggest that freestanding for-profit-units use a higher level of inpatient treatment resources than do the not-for-profit units.

This is an intriguing observation since the outpatient units will generally receive no reimbursement for dialysis treatments provided to their patients as an outpatient. It might also be argued that dialysis units do not admit patients to the hospital; physicians do, and their financial incentives

**SMRs and SHRs* by Dialysis Unit Type, 1991-1993**

Units with >20 Expected First Admissions per Year

| Statistic | Free Standing, Not-For-Profit | Free Standing, For-Profit | Hospital |
|---|---|---|---|
| SHR First Admissions | 0.95 | 1.03 | 0.99 |
| SMR | 0.95 | 1.00 | 1.00 |

* Single rate calculated for all units of each type

USRDS 1996

**Table VIII-1**

Standardized first hospital admission and mortality ratios calculated across each of the three types of dialysis units. Ratios are standardized for sex, race, age and diabetic status. Units with fewer than twenty expected first admissions are excluded. Source: Special Analysis.

have to be considered as well. In some situations, physicians who see patients in an outpatient dialysis unit may also have an arrangement with a hospital to provide inpatient dialysis which would complicate the interpretation of these hospitalization statistics. Clearly much more information is needed to discern among these many hypotheses.

The comparison of SHR's to SMR's is also interesting. In Table VIII-1, a *single pooled rate* is calculated for each facility type. A similar calculation is done for the SMR. The pooled first hospitalization rates are nearly identical to the median facility SHR values. This is not terribly surprising due to the symmetry apparent in the distribution of SHR's by facility type in Figure VIII-10. It is, however, very interesting to note that the free-standing-not-for-profit dialysis units have both a lower SHR and SMR than do either the freestanding for- profit units or the hospital units. This is similar to what we reported in the 1995 ADR. Interestingly, this trend cannot be attributed solely to the geographic locations of the free-standing/not-for-profit units since the Pacific, Mountain and West-North-Central regions, which have the lowest overall SHR's, comprise a relatively low percentage of the total number of those units (< 30 percent).

Depending on how one interprets the SHR, the SMR's become interesting indicators of outcomes. If SHR's reflect patient severity (beyond age, sex, race and diagnosis), then freestanding units (both profits and not-for-profit) have outcomes (mortality) that are in line with the severity of the patients. Hospital units, under this interpretation, have higher mortality than their severity indicator (SHR) would suggest (although not by much). If, however, SHR's measure the mix of input resources used with patient severity having an assumed constant grouping average across all three groupings, then patients of hospital outpatient dialysis units use less inpatient resources with the same outcomes as do the patients of freestanding for profit dialysis units. Again, more information is required on patient comorbid status and other unmeasured indicators regarding the practice of nephrology.

## Time Trends in the SHR

The unit specific SHR has a relatively stable value across years. Table VIII-2 describes all pairwise rank correlations between the SHR's within a dialysis unit over the three year period. Facilities with less than 5 expected first admissions have been excluded. The correlation for 1991 vs. 1992 and 1992 vs. 1993 are seen to be approximately the same, averaging about 0.57. The correlation between 1991 and 1993 is lower, but is still quite high at 0.49.

**Correlations* of SMRs and SHRs Across Years, 1991-1993**

**Units with >5 Expected First Admissions per Year**

| Statistic | 1991 vs. 1992 | 1991 vs. 1993 | 1992 vs. 1993 |
|---|---|---|---|
| SHR First Admissions | 0.57 | 0.49 | 0.57 |
| SMR | 0.27 | 0.26 | 0.23 |

* Spearman Rank Correlation

USRDS 1996

**Table VIII-2**

*Spearman Rank Correlations of first hospital admissions ratio and mortality ratio. Ratios are standardized for sex, race, age and diabetic status. Correlations compared ratios between 1991 and 1992, between 1991 and 1993, and between 1992 and 1993. Units with fewer than five expected first admissions per year are excluded. Source: Special Analysis.*

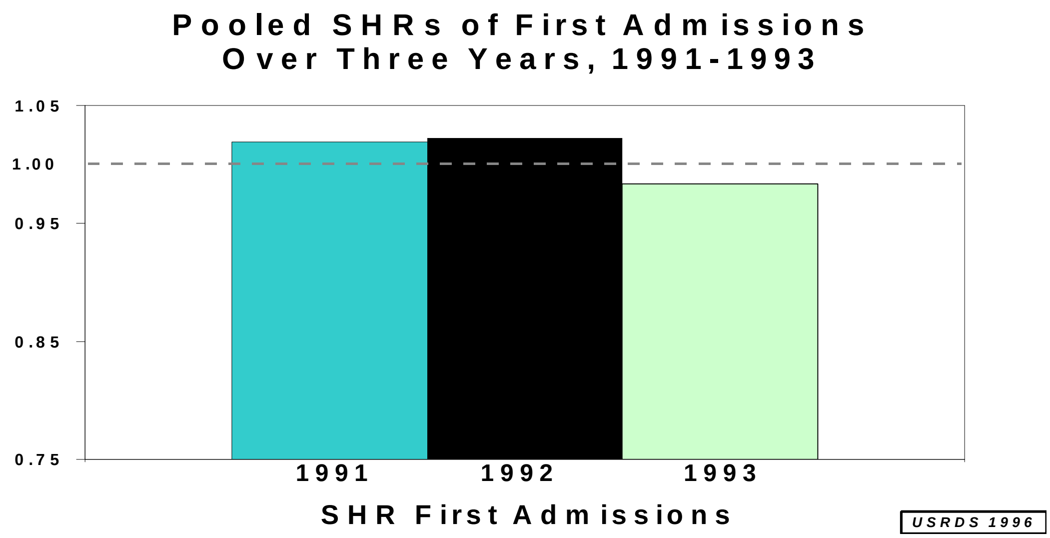



**Figure VIII-11**

*Standardized first hospital admissions ratio for all dialysis units over time, 1991-1993. Ratios are standardized for age, race, sex and diabetic status. Ratios are calculated by summing all observed first hospitalizations for each year and dividing them by the respective sum of expected first admissions. Source: Special Analysis.*

These correlations indicate that a dialysis unit with a high SHR in one year is likely to have a high SHR over the next two years. This is in marked contrast to the correlation between the SMR's for those units in the same period of time, which are relatively low (maximum correlation = 0.27). Note, however, that the level of correlation across years within each measure is reasonably constant, possibly suggesting that their predictive properties are similar. The lower correlation seen in the SMR is partly due to the fact that it is based on fewer events (i.e. deaths vs. hospitalizations) and is hence subject to greater variability.

The SHR has declined in recent years. In Figure VIII-11, we present the yearly SHR, which is a pooled rate calculated based on data from all dialysis units in a given year. Hospitalization is almost constant (there is a slight increase) from 1991 to 1992. There is then a substantial drop in hospitalization between 1992 and 1993. These results indicate that *dialysis* patients are experiencing less hospitalization overall with each passing year, with fewer admissions in the most recent year and an even greater reduction in the number of days spent in the hospital each year.

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