Does the road wind up-hill all the way?
Yes, to the very end.
Will the day’s journey take the whole long day?
From morn to night, my friend.
...
Shall I meet other wayfarers at night?
Those who have gone before.
Then must I knock, or call when just in sight?
They will not keep you standing at that door.

Shall I find comfort, travel-sore and weak?
Of labour you shall find the sum.
Will there be beds for me and all who seek?
Yea, beds for all who come.

Christina Rossetti
"Uphill"
xpansion of the ESRD program, particularly of the dialysis population, has required providers to keep pace by increasing the number of units in which patients receive services. Reimbursement for dialysis services, however, is capitated on a per treatment basis, with provisions for staff and supplies, overhead, and ancillary support services. This capitation places continued pressure on providers to reduce costs, particularly since rates of payment have changed little since their implementation in 1982. The consolidation of dialysis providers into large chains, and the transition of these providers from non-profit to for-profit status, are both consistent with the need for increased capital to build dialysis units; it has become increasingly difficult for non-profit and independent units to thrive.

In Chapter Twelve we provide detailed information on the costs associated with dialysis services, while in this chapter we present data on recent trends in the dialysis infrastructure and on how these changes relate to provider profit status and chain status, growth in the number of dialysis treatments, and differences in the geographic distribution of providers across ESRD networks, states, and Health Service Areas.

Starting with 2002, facility profit status is now determined from the CMS Dialysis Facility Compare data, as this information is no longer collected in the CMS Annual Facility Survey. Overall, the number of total providers increased 6 percent, within the 4–8 percent annual increase noted since 1996. The total number of hemodialysis treatments grew 27 percent between 1998 and 2002, while the number of peritoneal dialysis treatments fell 21 percent over the same period.

Dialysis chains—defined by the USRDS as corporations owning 20 or more freestanding units that are located in more than one state—continue to grow, and own the majority of units in the southern and southeastern states. Non-chain units are more widely dispersed across the country, particularly in the Upper Midwest and the northeastern states. By ESRD network, there are dramatic differences in unit ownership; in Network 2 (New York), for example, only 20 percent of units are owned by chains, compared to 82 percent in Network 8 (Alabama, Mississippi, and Tennessee). Most of the recent growth in the number of both units and patients has occurred in the large chains—Fresenius, Gambro, DaVita, Renal Care Group, Dialysis Clinics Inc., and National Nephrology Associates.

Unit density varies considerably, from a mean of 0.83 units per 100,000 people in California and rural areas to 4.2 units per 100,000 people in the southern and central states.
The care delivered by providers has been a focus of the USRDS for the last three years. Clinical results by provider vary widely. DaVita, for instance, appears to have the greatest percent of patients with hemoglobins of 12 g/dl and higher, and epoetin doses that are among the highest as well. Levels of dialysis therapy, in contrast, as measured by urea reduction ratio (URR), show that, 86 percent of hemodialysis patients across the country meet the K/DOQI URR target of ≥65 percent. The distribution of patients by vascular access is similar across chains, with patients treated by National Nephrology Associates most likely to have a synthetic graft. And patients receiving therapy in units owned by Renal Care Group are considerably more likely to receive a pneumococcal pneumonia vaccination than those in other units.

The CDC has monitored hemodialyzer reuse for many years through its annual National Surveillance of Dialysis-Associated Diseases in the United States. Survey data from 2002 were not available in time for this ADR; we present, then, data from the 2001 survey, which show a decline in the percent of units reusing dialyzers. Reuse practices vary widely nationwide. The most striking geographic differences are related to the practice of using bleach as a cleaning agent. In Louisiana, for example, two-thirds of dialysis units use bleach in their reuse process, while in the Great Plains states bleach is used in less than 3 percent of all units. Interestingly, units that do not reuse their dialyzers appear to have the lowest proportion of patients with hemoglobin levels of 12 g/dl and above; this may be related to the patient population in these units, and merits further investigation. Generally, there is little difference by reuse practice or germicide use when looking at hemoglobin levels, epoetin doses, serum albumin levels, and delivered dialysis therapy.

Provider-level information presented here can be examined in conjunction with data in Chapter Six on hospitalization and mortality ratios (pages 134–137), in Chapter Seven on transplantation ratios (page 145), and in Chapter Twelve on PMPM costs for clinical services (page 211). After addressing basic demographic differences, morbidity and mortality ratios are similar across providers. And there are clear differences in resource utilization between providers, yet outcomes on a gross scale are similar.

With attention being paid to the K/DOQI guidelines, many basic elements of dialysis care have improved in recent years. To improve patient outcomes even further, new and more detailed assessments may be required. The impact of diabetes, insulin resistance, and the heavy inflammatory load carried by both the chronic kidney disease and dialysis populations, for instance, each merit investigation. And while effective interventions are yet to be defined, observational studies support hypotheses that inflammation may be an important area to consider for clinical trials. These efforts would include current trials addressing the efficacy of daily dialysis.

![Diagram: Counts of dialysis & transplant units, by CMS certification type](image)

- Freestanding for-profit
- Freestanding non-profit
- Hospital center
- Hospital facility
- Transplant & dialysis center
- Transplant center

[11.1] Counts of dialysis & transplant units, by CMS certification type. Data are obtained from CMS’s annual End-Stage Renal Disease Facility Survey, CMS Independent Renal Facility Cost Reports, & the CMS “Dialysis Facility Compare” website. The leveling out of the number of freestanding, for-profit units in 2002 is due to the reclassification of units in the survey.

[11.2] In most networks the number of peritoneal dialysis treatments has fallen or remained relatively stable, though growth has occurred in Networks 9, 10, and 18.

[11.3] The number of patients receiving treatment in chain-affiliated units has increased six-fold since 1993, while the number treated in non-chain units fell after peaking in the early 1990s, and has remained stable during the past four years.

[11.12] While the dialysis chains, particularly Fresenius, have grown significantly, there has been little change in the number of non-chain and hospital-based units.

[11.19] Renal Care Group appears to have the highest rates of vaccination for influenza and pneumococcal pneumonia, and Gambro among the lowest rates.

[11.21] Dialyzer reuse grew during the 1990s, but since 1997 has fallen slightly.
Between 1998 and 2002, the number of in-center hemodialysis treatments increased 28 percent (Figure 11.2). Growth ranged from 16 percent in Networks 5 and 8 to nearly 37 percent in Networks 16 and 17—the northwestern states and northern California. Changes in the number of peritoneal dialysis treatments have been less consistent nationwide.

Figure 11.3 illustrates growth in the number of chain-affiliated and non-chain dialysis units. The Mid-Atlantic region and East Coast have seen the greatest increase in chain-affiliated units, while growth in non-chain units is more widespread, with the highest concentrations occurring in the northern half of the country.

In approximately half of the ESRD networks the proportion of units that are chain-affiliated has remained relatively stable, while Networks 8, 9, 10, 12, and 13 saw an increase in that proportion between 1998 and 2002 (Figure 11.4). The greatest growth—from 16 to 46 percent—occurred in Network 16. While the proportion of chain-affiliated units doubled in Network 2 (New York), this network continues to have the greatest percentage of independently owned units, at almost 80 percent.

Figure 11.5 illustrates the parallel growth of unit and patient counts, as well as the dramatic changes occurring in the composition of the ESRD program since 1988. The number of patients receiving treatment in chain-affiliated units, for instance, has increased six-fold since 1993, while the number treated in non-chain units fell after peaking in the early 1990s, and has remained stable during the past four years.

From 1998 to 2002 overall growth in unit and patient counts was quite similar, at 21–24 percent, but there are considerable variations across the country (Figure 11.6). In Networks 3, 4, and 10, for example, the increase in the number of units has been far higher than that in the number of patients. In the western states of Networks 16, 17, and 18, in contrast, growth in the number of patients has far outpaced that of new units.

Three-quarters of ESRD patients are treated in freestanding, for-profit dialysis units (Figure 11.7). Growth in the for-profit sector generally parallels that seen with chain affiliation (Figure 11.9). In Networks 6, 7, 13, and 14, nearly 90 percent of units are for-profit, while in Network 2 almost...
70 percent continue to be operated on a non-profit basis.

The number of units available per 100,000 population differs widely across the country, with a five-fold difference between upper and lower quintile averages (Figure 11.8). In the country as a whole, 81 percent of units are freestanding (Figure 11.10). In the southeastern states of Networks 6, 7, and 8 this number reaches more than 90 percent, while Network 2 (New York) has the largest proportion of hospital-based units, at 49 percent.

(Figures 11.2–10) data obtained from CMS’s annual End-Stage Renal Disease Facility Survey, CMS Independent Renal Facility Cost Reports, & the CMS “Dialysis Facility Compare” website. (Figures 11.8) data also obtained from estimates of the United States 2002 census, based on the 2000 census. — (Figure 11.2) Transient treatments, which account for less than 1 percent of all treatments, are not included. Hemodialysis includes outpatient hemodialysis & hemodialysis training treatments; peritoneal dialysis includes outpatient IPD treatments & IPD, CAPD, & CCPD training treatments. (Figure 11.8) 2002, by HSA, unadjusted.

The CDC did not conduct a survey in 1998, & data for 2002 were not available as this book went to press. Figure 2.38, in Chapter Two, contains a map of the ESRD networks; a list of network contacts can be found on page 230 of Appendix A.
Characteristics of incident dialysis patients, by unit affiliation, 2002

- **Age**: Mean age (years) by unit affiliation for the year 2002.
- **Gender**: Percentage female by unit affiliation.
- **Race**: Percentage of patients by race.
- **Hispanic ethnicity**: Percentage of patients by Hispanic ethnicity.
- **Diabetic status**: Percentage diabetic by unit affiliation.
- **Primary diagnosis**: Mean hemoglobin at initiation, percent receiving EPO at initiation.
- **Bmi initiation**: Mean BMI at initiation.
- **Mean eGFR at initiation**: Mean eGFR (mL/min/1.73 m²).
- **Median eGFR at initiation**: Median eGFR (mL/min/1.73 m²).
- **Mean BMI at initiation**: Mean BMI (kg/m²).
- **Mean eGFR at initiation**: Mean eGFR (mL/min/1.73 m²).

Unit affiliation (see table at right for codes): All 1 2 3 4 5 6 NC HB U.
The mean age of the incident ESRD population is 62.3, and with the exception of patients in facilities owned by Dialysis Clinics Incorporated, mean age varies little by unit affiliation (Figure 11.11). Differences in racial distribution among units are also unremarkable, as are differences by diabetic status, although there are fewer diabetics in hospital-based units. The majority of patients in all units have diabetes as their primary cause of renal failure, and over 90 percent are on hemodialysis. Mean hemoglobin at initiation average close to 10 g/dl, and on a unit level do not appear related to whether or not patients receive EPO prior to starting therapy. The percentage of patients with serum albumins below the test’s lower limit is highest for hospital-based units, and mean BMIs and eGFRs are similar for all unit types.

The number of chain-affiliated dialysis units, and their patient populations, have increased quite dramatically since 1998 (Figure 11.12). The number of patients treated by Renal Care Group, for example, has doubled, while the population in units owned by Fresenius has grown 42 percent. In units not affiliated with chains, in contrast, the number of patients has increased only 2 percent (growth in unit counts is slightly higher, at 7 percent), and it has fallen more than 12 percent in units that are hospital-based.

The prevalent ESRD population tends to be younger than the incident population, with a mean age of 56.9 across all units (Figure 11.13). The distribution of females by affiliation is similar. Across units the percent distribution of prevalent diabetics is similar, and is slightly lower than that found in the incident population.

(Figures 11.11–12) incident ESRD patients, 2002. Facility data obtained from the CMS annual End-Stage Renal Disease Facility Survey, the CMS Independent Renal Facility Cost Reports, & the CMS “Dialysis Facility Compare” website. (Figure 11.13) December 31 point prevalent ESRD patients, 2002. Facility data obtained from the CMS annual End-Stage Renal Disease Facility Survey, the CMS Independent Renal Facility Cost Reports, & the CMS “Dialysis Facility Compare” website. — (Figure 11.11) The lower limit of albumins measured by bromcresol purple is 3.2 g/dl, & by bromcresol green is 3.5 g/dl. (Figure 11.12) Chain 6 did not exist in 1998.
cross all unit affiliations, mean hemoglobin levels are at or above 11 g/dl—the K/DOQI target—in 77–89 percent of prevalent dialysis patients (Figure 11.14). In units owned by DaVita and Renal Care Group, 44–51 percent of patients have a mean hemoglobin of 12 g/dl or greater.

The percent of dialysis patients receiving mean weekly EPO doses of 16,000 units and above ranges from 34 in units owned by Dialysis Clinics, Inc. to 43 in those owned by DaVita.

K/DOQI also set a target urea reduction ratio (URR) guideline of ≥65 percent, which in the CPM dataset is met by 86 percent of hemodialysis patients—from 84 percent of patients in non-chain and hospital-based units to 91 percent of those treated in units owned by Gambro. Sixty percent of peritoneal dialysis patients in the CPM dataset have a mean weekly Kt/V of 2.6 or above.

Chain-affiliated units with the highest mean hemoglobin levels are more highly concentrated west of the Mississippi River; non-chain units with the lowest hemoglobins are located primarily in the southeast and southwestern states (Figure 11.15). Variations in mean EPO dose track according to hemoglobin levels, demonstrating a general tendency within providers to maintain established hemoglobin targets.

The percent of patients with internal accesses is slightly higher in chain-affiliated units across the country (Figure 11.16).

K/DOQI guidelines recommend increased use of arteriovenous fistulas. In 2001, 31 percent of hemodialysis patients had this type of vascular access, and use varied little by unit affiliation (Figure 11.17). Overall, less than a third of incident dialysis patients initiate therapy with a serum albumin above the test’s lower limit (Figure 11.15).
11.18 Nutritional & hemopoietic parameters in incident dialysis patients, by unit affiliation, 2002

![Graph showing nutritional & hemopoietic parameters in incident dialysis patients, by unit affiliation, 2002.]

11.19 Dialysis patient vaccinations, by unit affiliation, 2001

![Graph showing dialysis patient vaccinations, by unit affiliation, 2001.]

11.20 Hepatitis B: staff vaccination rates, 2001

![Graph showing hepatitis B: staff vaccination rates, 2001.]

All · All units
Chain 1 · Fresenius
Chain 2 · Gambro
Chain 3 · DaVita
Chain 4 · Renal Care Group
Chain 5 · Dialysis Clinics, Inc.
Chain 6 · Nat'l Nephrology Assoc.
NC · Non-chain units
HB · Hospital-based units
U · Unknown affiliation

11.18, and over 80 percent begin treatment with a serum creatinine of less than 10 mg/dl. Slightly more than one-quarter of new patients begin dialysis with a hemoglobin at or above the recommended K/DOQI guideline of 11 g/dl.

In 2001, nearly half of the dialysis units across the country reported giving influenza vaccinations to 75–100 percent of their patients (Figure 11.19). Sixty-two percent of units owned by Renal Treatment Centers achieved this rate, compared to fewer than one-third of those owned by Gambro.

Vaccinations for pneumococcal pneumonia are not offered in 41 percent of units nationwide. Units owned by Renal Treatment Centers are again most likely to vaccinate their patients, with almost one-third of these units reporting a pneumococcal pneumonia vaccination rate of 75–100 percent in 2001 (Figure 11.19).

Hepatitis B vaccination rates for dialysis unit staff range from 85 to 92 percent, with an overall rate of 87 percent nationwide (Figure 11.20).

11.14) period prevalent dialysis patients, 2002. Hemoglobin graph includes only patients treated with EPO, & the mean hemoglobin represents the average hemoglobin value for the year across all patients. EPO dose adjusted for inpatient days. URR & Kt/V data obtained from 2002 CPM data, & include only patients who are in both the USRDS & CPM databases. [Figure 11.15] period prevalent dialysis patients, 2002. Hemoglobin maps include only patients treated with EPO, & the mean hemoglobin represents the average hemoglobin value for the year across all patients. EPO dose adjusted for inpatient days. [Figure 11.16] prevalent hemodialysis patients from the 2002 CPM data who are also in the USRDS database; current access determined from CPM data. [Figure 11.17] prevalent hemodialysis patients. [Figure 11.18] incident dialysis patients, 2002. [Figures 11.17 & 11.19–20] data obtained from the CDC’s National Surveillance of Dialysis-Associated Diseases in the United States. — [Figure 11.18] The lower limit of albumins measured by bromcresol purple is 3.2 g/dl, & by bromcresol green is 3.5 g/dl.
fter peaking at 82 percent in 1997, the percent of units that reuse their dialyzers has dropped slightly, to 76 percent in 2001 (Figure 11.21). With Fresenius’ recent decision to discontinue reuse in its dialysis units, this decrease is likely to become more significant.

Changes in reuse practices are occurring primarily in chain-affiliated units (Figure 11.22). Since 1990, the proportion of non-chain units reusing dialyzers has fluctuated only between 65–70 percent, while in chain-owned units the proportion fell from 96–98 percent in the early 1990s to 82 percent in 2001.

Only 54 percent of Network 2 units practice reuse (Figure 11.23); this network also contains a large proportion of non-profit and hospital-based units. In Networks 17, 18, and 9, in contrast, 88–91 percent of units practice reuse.

The map of units that reuse hemodialyzers parallels that of chain-affiliated and non-chain units. There is a high concentration of reuse units in the eastern half of the country, with densities highest in the Mid-Atlantic and East Coast states (Figure 11.24). The map of non-reuse units shows no discernable pattern other than higher concentrations in the eastern United States, an area that contains the majority of dialysis units.

Due to its lack of carcinogenic properties and its efficacy as a disinfectant, the use of peracetic acid in the reuse process has grown steadily, from 49 percent in 1990 to 62 percent in 2002 (Figure 11.25). Rates of peracetic acid use do, however, vary quite widely across the country (Figure 11.26). In Networks 12, 16, and 11, the germicide is used in 78–80 percent of units; in Networks 3, 13, and 14, however, 41–48 percent of units continue to use formaldehyde. The wide use of peracetic acid is reflected geographically in Figure 11.27. Formaldehyde use is concentrated in units located in the eastern third of the country, and should decrease even more with Fresenius’ decision to discontinue reuse.

The percentage of units using bleach is highest in the southern and eastern states; this is most likely a direct correlation with the location of units using formaldehyde as a disinfectant (Figure 11.28). Differences in hemoglobin levels, EPO use, serum albumin
levels, and dialysis adequacy are unremarkable when based on germicide type (Figure 11.29).

(Figures 11.21–28) Data obtained from the CDC’s National Surveillance of Dialysis-Associated Diseases in the United States, 2001. Units in Figures 11.24 & 11.27 are mapped by zip code. (Figure 11.29) Prevalent hemodialysis patients treated in a known provider, 2001. Data on hemoglobin & EPO dose include only EPO-treated patients. Albumin & URR data obtained from CPM data, include only patients who are in both the CPM & USRDS database, reflect the median value for each patient. EPO doses adjusted for IP days. — (Figure 11.25) “Other” includes heat and Amuchina.

The CDC did not conduct a survey in 1998, & data are not available for 2002. Figure 2.38, in Chapter Two, contains a map of the ESRD networks; a list of network contacts can be found on page 230 of the Appendix.
Introduction

[Figure 11.1] The number of freestanding units continues to grow, and has more than tripled over the last twelve years.

Differences in provider growth

[Figure 11.2] Since 1998 the greatest growth in the number of in-center hemodialysis treatments has occurred in Network 17, and the smallest growth in Network 5. In most networks the number of peritoneal dialysis treatments has fallen or remained relatively stable, though significant growth has occurred in Networks 9, 10, and 18. [Figure 11.5] The number of patients receiving treatment in chain-affiliated units has increased six-fold since 1993, while the number treated in non-chain units fell after peaking in the early 1990s, and has remained stable during the past four years.

Patient characteristics by unit affiliation

[Figure 11.11] The distribution of incident patients by age is generally comparable across providers. There is considerable variation by provider in the pre-dialysis treatment of anemia, with the percent of patients receiving EPO prior to initiation ranging from 29 to 38. The percentage of patients with serum albumins below the test’s lower limit is highest in hospital-based units, and mean BMIs and eGFRs are similar for all unit types. [Figure 11.12] While the dialysis chains, particularly Fresenius, have grown significantly, there has been little change in the number of non-chain and hospital-based units.

Provider compliance with K/DOQI guidelines

[Figure 11.14] In the prevalent population, average hemoglobin levels vary by chain, with units owned by DaVita and Renal Care Group having the greatest percentage of patients with hemoglobins of 12 g/dl or higher for a year. EPO doses are highest in units owned by DaVita. The percent of dialysis patients receiving mean weekly EPO doses of 16,000 units and above ranges from 34 in units owned by Dialysis Clinics, Inc. to 43 in units owned by DaVita. [Figure 11.19] Patient vaccination rates differ across the dialysis providers. Renal Care Group appears to have the highest rates of vaccination for influenza and pneumococcal pneumonia, and Gambro among the lowest rates.

Reuse practices

[Figure 11.21] Dialyzer reuse grew during the 1990s, but since 1997 has fallen slightly. [Figure 11.22] Since 1990, the proportion of non-chain units reusing dialyzers has fluctuated only between 65–70 percent, while in chain-owned units the proportion fell from 96–98 percent in the early 1990s to 82 percent in 2001. [Figure 11.25] The use of peracetic acid in the reuse process has grown steadily since 1990, from 49 to 62 percent. [Figure 11.29] Hemoglobin levels and erythropoietin doses vary slightly in relation to the type of germicide used by a dialysis unit, while serum albumin levels and urea reduction ratios are relatively consistent. Since reuse practices and germicide use are highly dependent on providers, these results need to be factored into analyses of provider-specific outcomes.

Maps: National means & patient populations

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