Chapter 9: Transition of Care in Chronic Kidney Disease—Long-Term Trends across U.S. States and Territories

- Understanding geographic variations and trends in the transitions of care from advanced chronic kidney disease (CKD) to end-stage renal disease (ESRD) and other relevant outcomes across United States (U.S.) states and territories may help identify geographic areas of under- or over-utilization. This awareness can result in better resource allocation, more efficient health system performance, and improved patient outcomes.

- From 2000-2014, most U.S. states and territories demonstrated rising counts of incident ESRD and dialysis patients. During 2000-2013, the majority of states also showed an upward to stable trend in the proportions of incident ESRD and dialysis patients, relative to the state census point prevalent population. Yet most of these states demonstrated that the proportions of incident patients relative to the point prevalence have declined over this period, indicating a steeper rise in prevalent ESRD patients compared to that of incident ESRD or dialysis patients.

- In 2014, the five U.S. states and territories with the highest number of patients who newly transitioned to ESRD were California, Texas, Florida, New York, and Illinois. The states and territories with the highest proportions of incident ESRD and dialysis patients scaled to their point prevalent ESRD patients were Guam, West Virginia, Puerto Rico, Kentucky, and Arkansas. These findings suggest geographic regions with current and anticipated needs for additional resource allocation, ESRD services, and targeted preventative interventions. In contrast, we observed the lowest proportions in Vermont, Minnesota, Wyoming, Colorado, and New Hampshire.

- Over 2000-2014, the proportion of incident ESRD patients receiving in-center hemodialysis as their initial modality scaled to point prevalent ESRD patients has declined in all states and territories except Guam, where proportions have risen over this period.

- Since 2000, in many geographic regions the proportion of patients transitioning to peritoneal dialysis (i.e., incident peritoneal dialysis patients) relative to point prevalent ESRD patients in that state or territory has remained stable or declined. Since the advent of the ESRD Prospective Payment System Bundle in 2011, rising proportions have occurred in Alaska, Alabama, California, Colorado, Delaware, Florida, Georgia, Louisiana, Tennessee, Missouri, Montana, New Jersey, and Pennsylvania. In comparison, transitioning to ESRD using home hemodialysis has remained an under-utilized therapy across many states and territories.

- In 2014, the U.S. states and territories with the highest proportions of deaths after transition to ESRD, scaled to the point prevalence of ESRD patients in that given state or territory, included West Virginia, Guam, Kentucky, Ohio, and Arkansas. The lowest post-ESRD death proportions occurred in Alaska, Virgin Islands, American Samoa, District of Columbia, and Colorado.

- From 2000-2014, deceased donor kidney transplant (DDKT) counts rose or remained stable across almost all states and territories, except in Alabama, Maryland, Minnesota, Maine, New Jersey, and Ohio. A greater number of states and territories experienced a decline in living donor kidney transplant (LDKT) counts over this period.

Introduction

The Transition of Care in Chronic Kidney Disease (TC-CKD) Special Study Center examines the transition of care to renal replacement therapy—dialysis treatment or kidney transplantation—in patients with advanced, non-dialysis dependent chronic kidney disease (NDD-CKD). In the primary TC-CKD chapter (Volume 1, Chapter 8, Transition of Care in Chronic Kidney Disease) we featured pre-ESRD or “prelude” data on 102,477 U.S. veterans who
transitioned to ESRD between 10/1/2007 and 3/31/2015 (7.5 years), and 9,260 members from Kaiser Permanente Southern California (KP-SC) who transitioned between 1/1/2007 and 12/31/2014 (8 years).

Little is known, however, about how transitions to ESRD in the first two decades of the 21st century may vary across states and territories in the U.S., and in particular over long periods. Geographic variations in disease burden, presence of health care organizations, access to care, clinical practice patterns, patient preferences, and patient outcomes have been reported across various health conditions (OECD, 2014), including those specific to kidney disease. Epidemiologic data have shown geographic variations in the prevalence of CKD (Tanner et al., 2013) and its accompanying comorbidities (e.g., cerebrovascular disease; Wetmore et al., 2013). In addition, states clustered in the Middle Atlantic and Southern regions have demonstrated lower rates of pre-ESRD nephrology care compared to the Midwest and New England (Yan et al., 2015).

Whereas it may be expected that such disparities are mitigated in the non-private sector, data from the national Veterans Health Administration (VHA) has also shown substantial variations in the utilization of hospital and outpatient services, particularly for kidney disease (Ashton et al., 1999). Indeed, across eight chronic diseases examined in the national VA database (chronic obstructive pulmonary disease, pneumonia, congestive heart failure, angina, diabetes, bipolar disorder, major depression, and CKD), geographic variations in the rates of ambulatory clinic visits were the greatest for CKD. Among patients receiving dialysis, geographic variations have also been observed in levels of estimated glomerular filtration rate (eGFR) at dialysis initiation (Sood et al., 2014), vascular access (Clark et al., 2016), and CKD mineral bone disease management (i.e., parathyroideectomy; Wetmore et al., 2016).
Furthermore, data from the United States Renal Data System (USRDS) and the United Network for Organ Sharing (UNOS) have shown escalating geographic disparities in waiting times for kidney transplantation across the U.S. (Davis et al., 2014).

Understanding geographic variations in the transitions of care in ESRD (Kalantar-Zadeh et al., 2017) and other relevant kidney disease outcomes may have substantial implications for clinical practice and healthcare policy. For example, analyzing trends in the geographic variations of new (i.e., incident) ESRD patients relative to existing (i.e., prevalent) ESRD patients may identify current and/or anticipated geographic regions where there are under- or over-provision of particular healthcare services (e.g., dialysis and kidney transplantation). This information can be applied to more efficiently allocate resources, enhance health system performance, and ultimately improve patient outcomes.

This new supplementary chapter of the USRDS Annual Data Report 2017 is contributed by the Transition of Care in CKD Special Study Center. We present for the first time long-term (2000-2014) geographic trends of several novel transition metrics that examine transitions to ESRD, including dialysis and kidney transplantation, among the entire U.S. ESRD population across the 50 U.S. states and six U.S. territories (American Samoa, District of Columbia, Guam, Northern Mariana Islands, Puerto Rico, and Virgin Islands; Table 9.1). We granularly examine geographic trends in the selection of dialysis modality upon transition to ESRD, and feature data on geographic trends in mortality after transition to ESRD, including cause of death.

For inquiries and access to supplementary information related to this chapter, please contact Dr. Connie M. Rhee, MD, MSc (University of California Irvine School of Medicine) at crhee1@uci.edu.
## Table 9.1. Definitions of novel transition-to-ESRD metrics examined across U.S. states and territories

<table>
<thead>
<tr>
<th>Definitions</th>
<th>Proportion</th>
<th>Numerator</th>
<th>Denominator</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Transition to ESRD metrics scaled to prevalent ESRD population</strong></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Incident ESRD cases/point prevalence of ESRD</td>
<td></td>
<td>Number of incident ESRD patients in a specific year in that state or territory</td>
<td>Number of prevalent patients as of December 31 of that specific year in a state or territory</td>
</tr>
<tr>
<td>Incident dialysis cases/point prevalence of ESRD</td>
<td></td>
<td>Number of incident dialysis patients (all modalities) in a specific year in that state or territory</td>
<td>Number of prevalent patients as of December 31 of that specific year in a state or territory</td>
</tr>
<tr>
<td><strong>Transition to ESRD metrics scaled to state or territory census population</strong></td>
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<tr>
<td>Incident ESRD cases/point prevalence of state or territory census</td>
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<td>Number of incident ESRD patients in a specific year in that state or territory</td>
<td>Number of residents in a state or territory as of December 31 of that specific year</td>
</tr>
<tr>
<td>Incident dialysis cases/point prevalence of state or territory census</td>
<td></td>
<td>Number of incident dialysis patients (all modalities) in a specific year in that state or territory</td>
<td>Number of residents in a state or territory as of December 31 of that specific year</td>
</tr>
<tr>
<td><strong>Mortality metrics scaled to prevalent ESRD population</strong></td>
<td></td>
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<tr>
<td>Death events/point prevalence of ESRD</td>
<td></td>
<td>Number of patients who died in a specific year in that state or territory</td>
<td>Number of prevalent patients as of December 31 of that specific year in a state or territory</td>
</tr>
<tr>
<td>Death events by cause of death/point prevalence of ESRD</td>
<td></td>
<td>Number of patients who died, BY CAUSE, in a specific year in that state or territory</td>
<td>Number of prevalent patients as of December 31 of that specific year in a state or territory</td>
</tr>
<tr>
<td><strong>Dialysis metrics scaled to prevalent ESRD population</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incident dialysis by modality at day 1 of treatment/point prevalence of ESRD</td>
<td></td>
<td>Number of incident dialysis patients, BY MODALITY, in a specific year in that state or territory ON DAY 1 OF ESRD</td>
<td>Number of prevalent patients as of December 31 of that specific year in a state or territory</td>
</tr>
<tr>
<td><strong>Kidney transplantation metrics scaled to prevalent ESRD population</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Transplant cases/point prevalence of ESRD</td>
<td></td>
<td>Number of transplant patients (1st, 2nd, 3rd, etc.) in a specific year in that state or territory</td>
<td>Number of prevalent patients as of December 31 of that specific year in a state or territory</td>
</tr>
<tr>
<td>Transplant cases by donor type/point prevalence of ESRD</td>
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<td>Number of transplant patients (1st, 2nd, 3rd, etc.) BY DONOR TYPE in a specific year in that state or territory</td>
<td>Number of prevalent patients as of December 31 of that specific year in a state or territory</td>
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Trends in the Transition to ESRD and Dialysis across U.S. States and Territories

Over the period of 2000 to 2014, most U.S. states and territories demonstrated increases in the absolute counts of incident ESRD and dialysis patients (Reference Tables O.1-O.2). However, some states and territories showed stable to modest increases in incident ESRD counts over the 14-year period (e.g., Iowa, Maine, South Dakota, Wyoming), whereas other geographic regions showed a decline over time (e.g., District of Columbia, Connecticut, Massachusetts, Nebraska, New Hampshire, Rhode Island, Vermont).

In contrast, over the period 2004 to 2014, the proportion of incident ESRD patients relative to the point prevalence of ESRD patients declined across most U.S. states and territories (Reference Tables O.3-O.4). However, Montana and Northern Mariana Islands showed stable trends, whereas Guam showed an increase in proportions over time. Similar trends were observed for the proportion of incident dialysis patients relative to the point prevalence of ESRD patients.

In 2014, the U.S. states and territories with the highest absolute number of incident ESRD and dialysis patients were California, Texas, Florida, New York, and Illinois (Reference Tables O.1-O.2). However, the states and territories with the highest proportions of new patients who transitioned to ESRD, scaled to the point prevalence of ESRD patients, included Guam (24.58%), West Virginia (24.58%), Puerto Rico (21.70%), Kentucky (21.69%), and Arkansas (21.37%; Reference Table O.3 and Figure 9.1). In contrast, in 2014 the states and territories with the lowest proportions were Vermont (13.74%), Minnesota (14.40%), Wyoming (14.98%), Colorado (15.04%), and New Hampshire (15.12%).

Similarly, U.S. states and territories with the highest proportions of dialysis transition (i.e., incident dialysis patients, excluding pre-emptive kidney transplantation), scaled to the point prevalence of ESRD patients included Guam (24.42%), West Virginia (24.41%), Puerto Rico (21.58%), Kentucky (21.41%), and Arkansas (21.21%; Reference Table O.4 and Figure 9.2). The U.S. states and territories with the lowest proportions were Vermont (12.52%), Minnesota (13.68%), Colorado (14.23%), Utah (14.49%), and Wyoming (14.52%).
We examined 2013 transition to incident ESRD counts scaled to general population census data from each of the U.S. states and territories with available information; these included District of Columbia but excluded the other five U.S. territories. The highest observed proportions included District of Columbia (0.063%), Mississippi (0.052%), Louisiana (0.050%), Alabama (0.046%), and West Virginia (0.046%; Reference Table O.5 and Figure 9.3). In contrast, the U.S. states and territories with the lowest proportions were Utah (0.016%), Wyoming (0.017%), Alaska (0.018%), Colorado (0.018%), New Hampshire (0.019%), and Vermont (0.019%).
In 2013, the highest proportions of transition to dialysis (i.e., incident dialysis patients scaled to state and territory census data, excluding pre-emptive kidney transplantation) were observed for District of Columbia (0.063%), Missouri (0.052%), Louisiana (0.049%), Alabama (0.046%), and West Virginia (0.045%; Reference Table O.6 and Figure 9.4). The U.S. states and territories with the lowest proportions were Wyoming (0.015%), Utah (0.016%), Alaska (0.017%), Colorado (0.017%), New Hampshire (0.018%), and Vermont (0.018%).

**Trends in Selection of Dialysis Modality upon Transition to ESRD, across U.S. States and Territories**

Over the period of 2000 to 2014, the proportion of patients transitioning to in-center hemodialysis therapy (incident in-center hemodialysis), scaled to the point prevalence of ESRD patients, has declined over time in all states and territories except Guam, where rising proportions have been observed (Reference Table O.7). The proportion of patients transitioning to peritoneal dialysis therapy (incident peritoneal dialysis) relative to the point prevalence of ESRD patients has remained stable or declined over time in many states and territories. However, surrounding the time of the ESRD Prospective Payment System Bundle implementation in January 2011 rising proportions were observed in Alaska, Alabama, California, Colorado, Delaware, Florida, Georgia, Louisiana, Missouri, Montana, New Jersey, Pennsylvania, and Tennessee (Reference Table O.8).

In 2014, the U.S. states and territories with the highest proportions of de novo transition to in-center hemodialysis therapy, scaled to the point prevalence of ESRD patients in that given state or territory included Guam (23.42%), West Virginia (22.09%), American Samoa (20.00%), Puerto Rico (19.00%), and Virgin Islands (19.37%; Reference Table O.7 and Figure 9.5). In contrast, the states and territories with the lowest proportions were Alaska (10.09%), Vermont (11.53%), Utah (11.98%), Colorado (12.09%), and Wyoming (12.25%).
In 2014, the states and territories with the highest proportions of patients transitioning to incident peritoneal dialysis therapy, scaled to the point prevalence of ESRD patients, included Alaska (4.37%), Idaho (3.38%), Arkansas (2.58%), South Carolina (2.58%), and Mississippi (2.48%; Reference Table O.8 and Figure 9.6). The lowest proportions among the states and territories eligible for analysis (i.e., those with an absolute count of incident peritoneal dialysis patients ≥11) were observed in District of Columbia (0.52%), Rhode Island (0.72%), New York (0.78%), Minnesota (0.90%), and Vermont (0.98%).
From 2000 to 2014, incident home hemodialysis remained an under-utilized therapy across many states and territories (Reference Table O.9). In 2014, the areas eligible for analysis that had the highest proportions of patients transitioning to home hemodialysis therapy, scaled to the point prevalence of ESRD patients, included Illinois (0.18%), Ohio (0.13%), Texas (0.12%), Florida (0.11%) and North Carolina (0.09%; Reference Table O.9 and Figure 9.7).

In selected states, the proportions of patients transitioning to incident in-center self-care hemodialysis therapy, relative to the point prevalence of ESRD patients, have also been climbing in recent years (Reference Table O.10). In 2014, the U.S. states and territories eligible for analysis with the highest proportions, scaled to the point prevalence of ESRD patients, included Iowa (0.25%), North Carolina (0.17%), Oklahoma (0.17%), Illinois (0.12%), and Indiana (0.11%; Reference Table O.10 and Figure 9.8).
Trends in Mortality across U.S. States and Territories

In the majority of states and territories the proportions of ESRD deaths, scaled to the point prevalence of their ESRD patients, declined from 2000 to 2014. However, in Guam, Utah, Montana, and Northern Mariana Islands, the death proportions remained stable or have even slightly increased over time (Reference Table O.13).

In 2014, the states and territories with the highest proportions included West Virginia (20.53%), Guam (18.77%), Kentucky (17.98%), Ohio (17.30%), and Arkansas (17.01%; Reference Table O.13 and Figure 9.9). In contrast, the lowest proportions of deaths in 2014 occurred in Alaska (9.30%), Virgin Islands (9.86%), American Samoa (10.34%), District of Columbia (10.91%), and Colorado (11.07%).

During 2000 to 2014, and as ascertained by the Centers for Medicaid and Medicare Services 2746 form, the most common causes of death among all ESRD patients were cardiovascular (38%), other etiologies (43%), and infection (11%). The proportions of cardiovascular deaths scaled to the point prevalence of ESRD patients declined in all states and territories except North Dakota and New Mexico, where estimates remained stable (Reference Table O.14).

In 2014, the U.S. states and territories eligible for analysis that had the highest proportions of infectious deaths, scaled to the point prevalence of ESRD patients, included Puerto Rico (3.73%), Guam (2.33%), West Virginia (1.98%), Connecticut (1.88%) and New Jersey (1.64%). The lowest proportions were observed in Nevada (0.54%), Colorado (0.56%), Illinois (0.62%), Georgia (0.66%), and New Mexico (0.69%).

In 2014, the U.S. states and territories with the highest proportions included West Virginia (20.53%), Guam (18.77%), Kentucky (17.98%), Ohio (17.30%), and Arkansas (17.01%; Reference Table O.13 and Figure 9.9). In contrast, the lowest proportions of deaths in 2014 occurred in Alaska (9.30%), Virgin Islands (9.86%), American Samoa (10.34%), District of Columbia (10.91%), and Colorado (11.07%).
Trends in Transition to Kidney Transplantation across U.S. States and Territories

Over the period of 2000 to 2014, the absolute counts of transition to kidney transplantation (i.e., including repeat kidney transplantation[s]) remained relatively stable or increased across most states and territories except for Alabama, Arkansas, Maryland, Maine, Minnesota, Nevada, Ohio, and West Virginia, where trends have declined over time (Reference Table O.16). Kidney transplantation events remained sparse, however, in Alaska, Idaho, Montana, Wyoming, American Samoa, Guam, Northern Mariana Islands, and the Virgin Islands.

Over time, the proportion of kidney transplantations, scaled to the point prevalence of ESRD patients, has declined or remained stable in most states and territories except for Arizona, Delaware, Mississippi, New Hampshire, Oklahoma, and South Dakota where proportions have slightly increased over time (Reference Table O.17). In 2014, the U.S. states and territories with the highest proportions were District of Columbia (7.32%), Utah (6.05%), Minnesota (4.41%), Nebraska (4.30%), and Iowa (4.24%; Reference Table O.17 and Figure 9.10). It should be noted, however, that in analyses of kidney transplantation, state or territory assignment was based on patients’ outpatient dialysis facility location at the time of transplantation, if available. If this data was unavailable, location of residence at the time of transplantation was utilized. Therefore, estimates do not take into account kidney transplantations that were outsourced to areas outside of the patients’ area of residence or dialysis care.

Over the period of 2000-2014, the absolute count of deceased donor kidney transplant (DDKT) transplant cases rose or remained stable across almost all states and territories, except for Alabama, Maryland, Minnesota, Maine, New Jersey, and Ohio (Reference Table O.18). In 2014, the U.S. states and territories with the highest proportions of DDKT cases, scaled to the point prevalence of ESRD patients, included District of Columbia (5.08%), Utah (3.92%), Iowa (3.35%), Nebraska (3.19%), and Washington (3.01%; Reference Table O.19). In contrast, a greater proportion of states experienced a concurrent decline in the absolute count of living donor kidney transplant (LDKT) cases (Reference Table O.20). In 2014, the states and territories with the highest proportions of LDKT cases, scaled to the point prevalence of ESRD patients, included Minnesota (2.34%), District of Columbia (2.24%), Utah (2.13%), Massachusetts (1.71%), and Maine (1.50%; Reference Table O.21).
References


Notes