The USRDS Special Study Center: 
Transition of Care in CKD 
Prelude to Dialysis: Trends and Timely Transitions

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President Elect
International Society of Renal Nutrition & Metabolism (ISRNM)

www.RenalNutrition.com
Disclosure of Financial Relationships

Kamyar Kalantar-Zadeh, MD, MPH, PhD

Alphabetical order:

**Abbott**: Grant, Speaker bureau

**Alexion**: consultation

**Amgen**: Advisory Board, Speaker bureau

**DaVita**: grant, medical directorship

**Fresenius**: Speaker, Consultant

**Genzyme/Sanofi**: Consultant, proctorship

**NKF**: Grants, advisory boards

**NIH**: Study sections, grants

**Otsuka**: Speaker bureau, consultation

**Shire**: Speaker bureau, consultation

**Vifor**: consultation
Educational Objectives: Prelude to Dialysis: Trends and Timely Transitions

• To provide highlights of key concepts and Objectives of the Transition of Care in CKD (TC-CKD) Special Study Center of the United States Renal Data System (USRDS)

• Updates from recently published Annual Data Report (ADR) chapters, covering key topics and innovations such as national data of all veteran who transition to ESRD each year since 2007, and similar data from Kaiser Permanente of Southern California.

• Review data on the impact of pre-ESRD prelude on post-ESRD outcomes, prelude trends towards ESRD, high mortality during the first months upon transition to ESRD, comparing morbidities and hospitalization during prelude and upon transition to ESRD,
Pre-/Post- Questions

• **Question 1:** Among the 110,000 to 120,000 people who initiate maintenance dialysis therapy in the USA each year, what proportion are veterans (usually receiving general care in a Veterans Affairs medical center and clinics)?
  
  • A. 1 to 2% (approx. 2,000 veterans)
  • B. 5 to 6% (approx. 6,000 veterans)
  • C. 10 to 12% (approx. 13,000 veterans)
  • D. Almost 50% (approx. 50,000 veterans)
  
  • **Answer: C**
  • **Rationale:** USRDS data on Transition of Care in CKD have shown constantly that over the past several years since 2007, each year approximately 13,000 veterans transition to ESRD, mostly to maintenance dialysis therapy, making this 10 to 12% of the entire national ESRD incident population.
  • This question meets the objectives of reviewing/highlighting the national data of all veteran who transition to ESRD each year since 2007.
Pre-/Post- Questions

**Question 2**: What statement is true about the very high mortality in the first several month upon transition to dialysis?

- A. In the first 3 months of dialysis therapy the *annualized* mortality can reach as high as 40 to 50%.
- B. The very high first-3-month mortality is seen only in non-veterans patients.
- C. The very high first-3-month mortality is seen only in veterans who are dialyzed in a VA hospital based dialysis unit.
- D. The very high first-3-month mortality is seen only in the for-profit dialysis centers.

**Answer: A**

**Rationale**: *USRDS data on Transition of Care in CKD have shown that* the annualized first-3-month mortality approaches 40%-50%, if the monthly rate is annualized for the entire year, and that this very high mortality rate is seen universally in all hemodialysis patients, be it veterans or non-veterans, and in any dialysis clinic setting, be it a VA dialysis unit or a for-profit dialysis unit.

This question meets the objectives of reviewing/highlighting the high mortality during the first months upon transition to ESRD.
Question 3: Which of the following are examples of “transition” of care in CKD?

A. Transition from non-dialysis dependent CKD to in-center thrice-weekly maintenance hemodialysis therapy.

B. Transition from maintenance hemodialysis to kidney transplantation.

C. Transition from functioning (non-dialysis dependent) kidney transplant recipient to maintenance hemodialysis therapy.

D. Withdrawal from dialysis therapy after 3 years of maintenance hemodialysis.

E. All of the above

Answer: E

Rationale: Transition of kidney care among CKD patients happen frequently and in different formats, and A to D are all examples of these transitions.

This question meets the objectives of providing highlights of key concepts and objectives of the Transition of Care in CKD.
Pre-/Post- Questions

• **Question 4:** Which of the following are the CKD periods with least amount of data in the old USRDS reports prior to 2014?
  
  • A. Prelude time, i.e., the period of time prior to transition from non-dialysis CKD to ESRD
  
  • B. Transition to ESRD and the first 3 months after transition
  
  • C. ESRD prevalent time after 3 months of therapy.
  
  • D. Period of time after kidney transplantation

• **Answer: A**

• **Rationale:** The USRDS has traditionally had no data during the prelude period, i.e. the time prior to ESRD transition. The Transition of Care in CKD (TC-CKD) Special Study Center has provided data for the first time about this period of CKD care as patients progress towards ESRD. The first 3 months of ESRD have been well reviewed, so are the time after 3 months of dialysis and the transplant time, which have all been well presented in annual USRDS reports.

• This question meets the objectives of introducing the Transition of Care in CKD (TC-CKD) Special Study Center of the United States Renal Data System (USRDS) and the impact of pre-ESRD prelude on post-ESRD outcomes and prelude trends towards ESRD.
The United States Renal Data System (USRDS)
Special Study Center

Transition of Care in CKD (TC-CKD)

NIH, NIDDK, KUH
U01-DK102163 2014-2019

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Transition of Care in CKD (TC-CKD)

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Transition of Care in CKD: BACKGROUND & HYPOTHESES:

- In patients with very late stage non-dialysis dependent (NDD) CKD (eGFR <25 ml/min /1.73 m²) the optimal transition of care to kidney replacement therapy (KRT, i.e., dialysis or transplantation) is not known.

Klahr et al, *NEJM* 1994
~110,000 Americans TRANSITION to Dialysis Each Year (including 13,000 veterans)

**Historical Background:**
In 1973 the US Congress extended Medicare coverage to all persons under age 65 suffering from ESRD (End-Stage Renal Disease), i.e. individuals who cannot survive without kidney dialysis treatment, to cover all costs related to their dialysis Rx.

The intent of this law (PL 92-603, the Social Security Amendments of 1972) was to allow all Americans access to an emerging and very expensive technology, regardless of their ability to pay.

**The effectiveness of the ESRD program:**
No Kidney Function = No Life

→ Dialysis = Life (?)
**transition**

- [tran-zish-uh n, -sish-]
- noun 1. *movement, passage, or change from one position, state, stage, subject, concept, etc., to another;*
- “the transition from adolescence to adulthood.”

  – Dictionary.com

**start**

- [stahrt]
- 1. to begin or set out, as on a journey or activity.
- 2. to appear or come *suddenly* into action, life, view, etc.; rise or issue *suddenly* forth.
- 3. to spring, move, or dart *suddenly* from a position or place: The rabbit started from the bush.
- 4. to be among the entrants in a race or the initial participants in a game or contest.
- 5. to give a *sudden, involuntary* jerk, jump, or twitch, as from a *shock of surprise, alarm, or pain:*
  The sudden clap of thunder caused everyone to start.

**Very-Late-Stage Chronic Kidney Disease**

- **Late Start Dialysis**
  - eGFR Slope
  - Pre-RRT lab data
  - Comorbid conditions
    - Advanced age
    - Demographics
    - Frailty

- **Early Start Dialysis**

- **Never Started Dialysis**
  - eGFR slope?
  - Comorbid states?
  - Lab data?

- **Late Re-Start**
  - Dialysis Modality
    - HD
    - PD

- **Early Re-Start**
  - Case-Mix
  - Race

- **Transplant**

- **Kidney Transplantation**
  - Failing Allograft
  - Outcomes?
  - Lower Mortality?
  - Causal Association?
  - Biologically Plausible?

- **End-of-Life Issues ↔ Dialysis Withdrawal**

- **Outcomes?**
  - Loss of Residual Kidney Function
    - ↑Infection, dialysis access issues
    - ↑Protein Energy Wasting
    - Anxiety, psychosocial burden

- **Kalantar-Zadeh et al, NDT 2016 [in press]**
Questions re Transition of Care in CKD: Impact of pre-transition conditions?

Major uncertainty and significant knowledge gaps have persisted pertaining to differential or individualized transition of care across different pre-KRT categories of age and race and demographics and comorbid conditions and events in the following areas:

1. The best **timing** for KRT initiation (early vs. late?)

2. The optimal **KRT type** (dialysis vs. transplant); and in case of dialysis:
   a) Best **modality** (hemodialysis, HD, vs. peritoneal dialysis, PD)
   b) **Format** (in-center vs. home)
   c) **Frequency** (daily vs. thrice-weekly vs. infrequent e.g. 2x/week)
   d) Vascular **access preparation** (preemptive arteriovenous [AV] fistula; PD catheter placement vs. no access preparation)

3. The post-KRT impact of **pre-transition** conditions and events

4. The impact of pre-KRT conditions on end-of-life care and decision-making (deferring, interrupting or complete withdrawal of KRT).

KRT: kidney replacement therapy
Challenges of Transition Period from NDD to ESRD

1. Higher mortality
2. Higher costs
3. Best timing?
4. Transition of elderly to ESRD
5. Transition across race/ethnicity
6. Residual kidney function
7. Best format? Incremental vs. abrupt

Challenges of Transition Period from NDD to ESRD

1. Higher mortality
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Challenges of the CKD Transition

The first 3-6 months of dialysis or transplantation is associated with an even higher risk of death compared to prevalent dialysis patients.

Lukowsky ... Kalantar-Zadeh, Am J Nephrol 2012
Challenges of Transition Period from NDD to ESRD

1. Higher mortality
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Costs of CKD to ESRD Transition

AVERAGE $PPPM COST THROUGH TRANSITION TO DIALYSIS

- Cost $ PPPM
- Months on Pre- and Post-Initiation of Dialysis

CKD (STAGE 4, 5)
- Delay CKD Progression
- Transition to Dialysis (>30% mortality)
- Prepare for Dialysis (40% crash)
- Manage Hospitalizations (58% avoidable, 36% readmit rate)

For Commercial member; based on MarketScan data, from 2010 USRDS ADR, Volume 1, Page 137.
MarketScan is a commercial claims dataset comprised of 10.5 million covered lives that USRDS uses as a benchmark for CKD utilization.
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Late vs. Early Transition to Dialysis

- The IDEAL Study did not show any superiority of EARLY transition to dialysis.

Cooper et al NEJM 2010
Challenges of Transition Period from NDD to ESRD

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Transition of Care in ELDERLY and Multi-Morbid CKD Patients

The number of elders grew from 29.6 million in 1990 to 36.8 million in 2008, representing a 20% growth.

In 1990, 2000 and 2010, 39%, 43% and 44% of all prevalent dialysis patients, and 4%, 10% and 20% of all kidney transplant recipients were older than 65 years, respectively.

It is not clear whether the poor outcomes of KRT justify these expensive therapies in the elderly esp. if mortality remains essentially unchanged.

KRT: kidney replacement therapy
Challenges of Transition Period from NDD to ESRD

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Blacks are more likely to be a dialysis patient:

US General Population: 14% Blacks
US Dialysis Population: 35% Blacks

Kalantar-Zadeh et al, Seminars in Dialysis 2010
Blacks are more likely to be a dialysis patient:
US General Population: 14% Blacks
US Dialysis Population: 35% Blacks

Black Americans have lower life expectancy than the general population.

African American Dialysis paradox

African Americans have lower life expectancy than Blacks.

Does race/ethnicity impact transition from NDD to KRT?
Do different transition approaches result in different outcomes across different racial/ethnic groups?

Kalantar-Zadeh et al, Seminars in Dialysis 2010
Challenges of Transition Period from NDD to ESRD

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Residual Kidney Function (RKF) upon Transition and Dialysis Patients

**Therapeutic options**
- Avoidance of nephrotoxins
- RAAS blockade
- BP control?
- Avoidance of hypovolemia
- ↓Peritonitis in PD
- Twice-Weekly HD?
- Low protein diet?

**Benefits of RKF**
- ↑middle molecule & uremic toxins
- Maintenance of liquid balance
- Improved BP control & ↓in LVH
- **Endocrine:** Epo, Ca++, Pi, VitD3
- ↓Malnutrition and inflammation
- ↑Survival & quality of life

*Am J Kidney Dis 53:1068-1081. © 2009*
Challenges of Transition Period from NDD to ESRD

1. Higher mortality
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How About Twice-Weekly Hemodialysis?

In recent trips to India, China, Brazil, and other countries, I was intrigued by large numbers of patients with end-stage renal disease who underwent hemodialysis (HD) less frequently than three times per week. Indeed, I encountered patients who received HD infrequently as only once to twice per month! Dialysis treatment time could be as short as two to three hours per session. I was told that these patients were able to maintain HD adequacy and, therefore, were not at increased risk of mortality.

Twice-Weekly and Incremental Hemodialysis Treatment for Initiation of Kidney Replacement Therapy

Kamyar Kalantar-Zadeh, MD, MPH, PhD,1,2 Mark Unruh, MD,3 Philip G. Zager, MD,3 Csaba P. Kovesdy, MD,4 Joanne M. Bargman, MD,5 Jing Chen, MD,6 Suresh Sankarasubbiah, MD,7 Gaurang Shah, MD,2 Thomas Golper, MD,8 Richard A. Sherman, MD,9 and David S. Goldfarb, MD10

Mortality is highest in the first months of maintenance hemodialysis (HD) therapy. In many Western countries, patients who transition to kidney replacement therapy usually begin thrice-weekly HD regardless of their level of residual kidney function (RKF). RKF is a major predictor of survival. RKF may decline more rapidly with thrice-weekly HD treatments, is associated with a reduced need for dialytic solute clearance, and is an important factor in the prescription of peritoneal dialysis. In this article, we review the concept of incremental HD, in which weekly dialysis dose, in particular HD treatment frequency, is based on a variety of clinical
Our Recent Publications on:
(1) Residual Kidney Function in HD pts; and
(2) Infrequent (twice-weekly) HD


Challenges of Transition Period from NDD to ESRD

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### 6 Types of TRANSITION in CKD

Major knowledge gaps surrounding types of transitions of care during very-late-stage CKD (eGFR <25 ml/min):

1. **Transition from NDD-CKD to dialysis therapy** with different subtypes according to:
   a) Dialysis Modality (HD vs. PD)
   b) Format (in-center vs. home)
   c) Frequency (infrequent, conventional and frequent)

2. **Transition from NDD-CKD to pre-emptive transplantation**

3. **Transition among/within dialysis modalities**, formats and frequency (HD to PD or vice versa, in-center to home, and less to more frequent);

4. **Transition from dialysis to transplantation**, 

5. **Transition from gradually failing kidney transplantation back to dialysis therapy**

6. **Transition from any of the above stages to partial or full withdrawal of care**

KRT: kidney replacement therapy

VETERANS AFFAIRS (VA) patients with very-late-stage CKD (eGFR<25 ml/min/1.73m²)
. eGFR slope over 3 yrs
. Comorbid conditions
. Laboratory data over last 3 yrs prior to RRT transition
Phase I:
1/1/08-1/1/2013 n=15,000 pts in 5 yrs
Phase II:
Annual transitions 2013-2016 n=3,000 pts per yr

KAISER PERMANENTE of SOUTHERN CALIF. (KP-SC) members with very-late-stage CKD (eGFR<25 ml/min/1.73m²)
. eGFR slope over 3 yrs
. Comorbid conditions
. Laboratory data over last 3 yrs prior to RRT transition
Phase I:
1/1/08-1/1/2013 n=5,000 pts in 5 yrs
Phase II:
Annual transitions 2013-2016 n=1,000 pts per yr

USRDS linkage upon transition
N=36,000 patients linked

Questions:
• Timing of transition?
• Impact on post-transition outcomes?
• Individualized transition decisions?

Aim 1. Can pre-KRT data predict post-transition outcomes: (a) early death (first 6 month), (b) late-term mortality, (c) hospitalization, and (d) costs?
Aim 2. Can a scoring tool derived from pre-KRT data (eGFR slope, comorbid conditions, labs, and demographics) suggest best transition?

Figure 1. Overview of the “Transition of Care in CKD” Special Study Center Proposal
VA Healthcare System

22.6 Million Veterans
(>10% of US Adults)

- The Veterans Health Administration is home to the largest integrated health care system consisting of 150 medical centers, in addition to 800 community based outpatient clinics and 280 Vet Centers.

- Together these facilities provide comprehensive care to over 22.6 million veterans.

- Each year 13,000 veterans transition to KRT (mostly dialysis) (=11-12% of all incident dialysis pts in the nation!)

http://www.va.gov/vetdata/Quick_Facts.asp
National Veterans (VA) data to examine CKD transition

**Strengths:**
- Large cohort size with >10% CKD (millions-wise CKD!)
- Representation of the entire USA
- Access to healthcare not limited by socio-demographics: Lab data, CKD progression data,
- Excellent longitudinal and outcome data: including veterans who do not transition to dialysis

**Weaknesses:**
- Use of outside healthcare (for pre-dialysis care)
- Majority are men (but changing fast >10% women)
- Complex and redundant approval process
- Inherent limitations of a large administrative database
California

- The most populous US state (38 million, larger than Canada)
- Home to 1 out of 8 Americans
- The most racially/ethnically diverse US state
- Harbors the largest economy in the USA
  - The 8th largest economy in the world (US, China, Japan, Germany, France, Brazil, UK, California, Russia)

Southern California → Kaiser Permanente

- The most populous mega-region of California
  - 23 million people (60% of California's population)
  - Home to 4 of the nation's 50 most populated cities (Los Angeles, San Diego, Fresno, and Long Beach)
  - Encompasses Los Angeles Metropolitan (including LA and Orange Counties together, >17 million people, the 15th largest world’s economy), Inland Empire, and Greater San Diego.

- Substantial socio-economic diversity,
- Remarkable racial/ethnic diversity
  - 38% Hispanics, 14% Asians, and 7% Blacks
Kaiser Permanente of Southern California

- 3.8 M members
- > 6,000 physicians
- > 36,000 employees
- 14 Medical centers
- > 200 MOBs
- Integrated care model
- Care tracked by common EHR
- Strong culture of practice guidelines

Dept. Research at Kaiser Permanente Southern California

- 30 Scientists, 6 Post-docs, 300 support staff, (~200 clinicians)
- Eclectic backgrounds
- Descriptive epi studies to RCTs
- All have projects that could have impact on practice in portfolio

1,100 to 1,300 patients transition to ESRD each year!
Highlights of the USRDS 2014 Chapter:

Transition of Care in CKD

52,172 Incident ESRD Veterans
10/1/2007-9/30/2011

- Between 10/1/2007 and 9/30/2011 (4 fiscal years), a total of **52,172 veterans** transitioned to ESRD.
- They are **70.3 ±12.1** years old (mean ±SD).
- They include **24% Blacks** and **6% Hispanics**.
- The cause of ESRD is **diabetes in 42%** and hypertension in 31.4%.

[Transition of Care in CKD, Veterans Data, www.USRDS.org](http://www.USRDS.org)
Age at first ESRD service in 52,172 Incident Dialysis Veterans

Transition of Care in CKD, Veterans Data, www.USRDS.org
African American Race
in 52,172 Incident Dialysis Veterans (24%)

Blacks constituted 24% of the population (n=12,584), whereas Asians (n=957, 2%) and native American (n=543, 1%) had much smaller proportions.

Most Southeast states had larger proportions of black incident ESRD veterans.

Among mainland states and territories, District of Columbia had 92% blacks, followed by Maryland (55%), Georgia (49%) and South Carolina (46%)

Transition of Care in CKD, Veterans Data, www.USRDS.org
### Table 1.1. Status of 52,172 incident ESRD veterans during the first 90 days after transition to KRT, 10/1/2007-9/30/2011

<table>
<thead>
<tr>
<th>Dialysis Modality</th>
<th>Day 1</th>
<th>Day 30</th>
<th>Day 60</th>
<th>Day 90</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>In-center</td>
<td>43,256</td>
<td>82.9</td>
<td>43,258</td>
<td>82.9</td>
</tr>
<tr>
<td>Home HD</td>
<td>260</td>
<td>0.5</td>
<td>260</td>
<td>0.5</td>
</tr>
<tr>
<td>CAPD</td>
<td>1,405</td>
<td>2.7</td>
<td>1,405</td>
<td>2.7</td>
</tr>
<tr>
<td>CCPD</td>
<td>1,174</td>
<td>2.2</td>
<td>1,174</td>
<td>2.2</td>
</tr>
<tr>
<td>Uncertain*</td>
<td>5,287</td>
<td>10.1</td>
<td>3,495</td>
<td>6.7</td>
</tr>
<tr>
<td>Outcomes**</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Death</td>
<td>201</td>
<td>0.4</td>
<td>1,561</td>
<td>3.0</td>
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<td>Transplant</td>
<td>589</td>
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<td>654</td>
<td>1.3</td>
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<tr>
<td>Lost to f/u</td>
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<td>&lt;0.1</td>
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<td>&lt;0.1</td>
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<tr>
<td>Recovered</td>
<td>n/a</td>
<td>&lt;0.1</td>
<td>362</td>
<td>0.7</td>
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<tr>
<td>Total</td>
<td>52,172</td>
<td>100</td>
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<td>Uncertain*</td>
<td>5,287</td>
<td>10.1</td>
<td>3,495</td>
<td>6.7</td>
</tr>
</tbody>
</table>

| Outcomes**        |       |        |        |        |        |        |        |        |
|-------------------|-------|--------|--------|--------|
| Death             | 201   | 0.4    | 1,561  | 3.0    | 3,672  | 7.0    | 5,348  | 10.3   |
| Transplant        | 589   | 1.1    | 654    | 1.3    | 679    | 1.3    | 701    | 1.3    |
| Lost to f/u       | n/a   | <0.1   | 3      | <0.1   | 3      | <0.1   | 5      | <0.1   |
| Recovered         | n/a   | 0.7    | 362    | 0.7    | 1,204  | 2.3    | 1,798  | 3.5    |

| Total             | 52,172| 100    | 100    | 100    | 52,172 | 100    |        |        |
## Dialysis PROVIDERS

to 52,127 Incident ESRD Veterans


<table>
<thead>
<tr>
<th>Provider (%)</th>
<th>At Baseline</th>
<th>At 3 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>DaVita</td>
<td>24.5</td>
<td>24.6</td>
</tr>
<tr>
<td>Fresenius</td>
<td>27.6</td>
<td>27.8</td>
</tr>
<tr>
<td>Other Chains</td>
<td>13.1</td>
<td>13.2</td>
</tr>
<tr>
<td>Non-Chain</td>
<td>21.1</td>
<td>21.1</td>
</tr>
<tr>
<td><strong>VA units</strong></td>
<td>9.9</td>
<td><strong>10.7</strong></td>
</tr>
<tr>
<td>None Assigned</td>
<td>3.9</td>
<td>2.5</td>
</tr>
</tbody>
</table>

*Transition of Care in CKD, Veterans Data, www.USRDS.org*
**Table 1.2.** Day 1 of ESRD service in 52,172 incident ESRD veterans upon transition to KRT, 10/1/2007-9/30/2011

<table>
<thead>
<tr>
<th></th>
<th>All veterans</th>
<th>VA units</th>
<th>Fresenius</th>
<th>DaVita</th>
<th>Other Chains</th>
<th>Non-Chain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Veterans, n (%)</td>
<td>52,172 (100%)</td>
<td>5,157 (9.9%)</td>
<td>14,380 (27.6%)</td>
<td>12,766 (24.5%)</td>
<td>6,850 (13.1%)</td>
<td>11,007 (21.1%)</td>
</tr>
<tr>
<td>Number of facilities</td>
<td>5504</td>
<td>68</td>
<td>1686</td>
<td>1352</td>
<td>793</td>
<td>1425</td>
</tr>
<tr>
<td>Age, year (SD)</td>
<td>70.3 (12.1)</td>
<td>64.6 (11.4)</td>
<td>70.7 (11.8)</td>
<td>70.3 (12.1)</td>
<td>71.2 (11.9)</td>
<td>72.1 (11.8)</td>
</tr>
<tr>
<td>Older than 85 yrs (%)</td>
<td>11.4</td>
<td>4.6</td>
<td>11.1</td>
<td>11.3</td>
<td>12.2</td>
<td>14.3</td>
</tr>
<tr>
<td>Females (%)</td>
<td>5.7</td>
<td>2.5</td>
<td>6.1</td>
<td>6.0</td>
<td>6.1</td>
<td>5.7</td>
</tr>
<tr>
<td>Race/Ethnicity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Native American (%)</td>
<td>1.0</td>
<td>0.7</td>
<td>0.8</td>
<td>1.1</td>
<td>0.8</td>
<td>1.5</td>
</tr>
<tr>
<td>Asian (%)</td>
<td>1.8</td>
<td>1.8</td>
<td>1.3</td>
<td>1.7</td>
<td>3.4</td>
<td>1.2</td>
</tr>
<tr>
<td>Black (%)</td>
<td>24.1</td>
<td>41.3</td>
<td>23.4</td>
<td>24.9</td>
<td>22.1</td>
<td>18.5</td>
</tr>
<tr>
<td>White (%)</td>
<td>72.6</td>
<td>55.7</td>
<td>74.3</td>
<td>72.1</td>
<td>73.6</td>
<td>78.6</td>
</tr>
<tr>
<td>Hispanic (%)</td>
<td>6.0</td>
<td>8.8</td>
<td>5.9</td>
<td>5.4</td>
<td>6.1</td>
<td>5.3</td>
</tr>
<tr>
<td>Primary Cause of ESRD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diabetes (%)</td>
<td>41.7</td>
<td>47.0</td>
<td>42.6</td>
<td>42.7</td>
<td>41.7</td>
<td>40.1</td>
</tr>
<tr>
<td>Hypertension (%)</td>
<td>31.4</td>
<td>22.2</td>
<td>34.2</td>
<td>32.8</td>
<td>32.6</td>
<td>32.3</td>
</tr>
<tr>
<td>GN (%)</td>
<td>5.5</td>
<td>7.8</td>
<td>5.1</td>
<td>4.9</td>
<td>5.6</td>
<td>5.0</td>
</tr>
<tr>
<td>Cystic Kidney (%)</td>
<td>1.5</td>
<td>1.6</td>
<td>1.5</td>
<td>1.5</td>
<td>1.3</td>
<td>1.4</td>
</tr>
<tr>
<td>KRT modality</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HD (%)</td>
<td>82.9</td>
<td>90.6</td>
<td>84.8</td>
<td>84.6</td>
<td>84.9</td>
<td>78.2</td>
</tr>
<tr>
<td>PD (%)</td>
<td>4.9</td>
<td>3.6</td>
<td>4.9</td>
<td>5.1</td>
<td>4.9</td>
<td>5.7</td>
</tr>
</tbody>
</table>

*Transition of Care in CKD, Veterans Data, www.USRDS.org*
During the first 3 months, 10.4% of all incident ESRD Veterans died and 1.4% received a kidney transplantation.
Annualized Mortality Rates over 24 Months in 52,172 Incident Dialysis Veteran Patients

Transition of Care in CKD, Veterans Data, www.USRDS.org
Figure 2. "Annualized" mortality in the first 24 mo. in 21,772 incident (dialysis-naïve) thrice weekly HD patients.

Annualized Mortality Rate over 24 Months by Provider in 52,172 Incident Dialysis Veterans 2007-2011

Dialysis vintage month

Mortality Rate (annualized)

DaVita
Fresenius
Other chains
Non-chains
VA Medical Centers

Transition of Care in CKD, Veterans Data, www.USRDS.org
The Concept of PRELUDE

Time prior to TRANSITION to ESRD

- How to count the time prior to ESRD transition point?
- It is going backward in time
  - Hence, a NEGATIVE count!

Kalantar-Zadeh ... Kovesdy, NDT 2016 [in press]
New Nomenclature has come to the USRDS ADR: “Prelude” Analyses

- **Vintage**: The time from transition to dialysis (or KRT) forward, a positive count (in month or years)

- **Prelude**: The time from transition to dialysis (or KRT) backwards, a negative count (in month or years)
Hemoglobin by Prelude Quarters

Mean Hemoglobin Over 20 Quarters Prior to Dialysis Start in 28,717 TCCKD Patients
Hemoglobin by Prelude Quarters

Mean Hemoglobin Over 20 Quarters Prior to Dialysis Start in 28,717 TCCKD Patients
Key Messages & Highlights of the TCCKD Chapter:  
Transition of Care in CKD, Year 2 (Nov 2015 USRDS ADR)

1. Almost 30% of all 52,172 veterans who transitioned to ESRD across the nation over a 4-year period (10/2007-9/2011) received *anti-depressants* prior to transition (prelude period), while after transition to ESRD (vintage period) the anti-depressants prescription rate increased slightly.

2. **Phosphorus binders** were rarely prescribed during the prelude time prior to ESRD transition, but a major surge was observed in the final 6 months of the prelude period, followed by a substantial rise during the dialysis vintage period.

3. Among comorbid conditions that were obtained from multiple sources for 47,555 veterans who transitioned to ESRD with at least one identified comorbidity, congestive heart failure (CHF) and diabetes mellitus were each present in over half of the veterans, chronic pulmonary disease was recorded in over 40%, and almost a quarter of all patients had the diagnosis of cancer, while 28% had prior myocardial infarction.

4. Among the 46,625 veterans who transitioned to ESRD over the 4-year period with at least one hospitalization event, the most common causes of hospital admission that also included the ESRD transition day in the hospital included: acute kidney injury (AKI, acute renal failure), hypertension, congestive heart failure, and CKD per se, while septicemia related hospital admissions increased dramatically after ESRD transition.

5. Congestive heart failure (CHF) was the most common reason for hospital admission prior to ESRD transition (prelude time), whereas dialysis access complications was the most common cause after ESRD transition (vintage time).

6. For hospitalizations that included the transition to ESRD event, i.e., the first hemodialysis treatment, AKI was the leading cause of hospitalization.

7. Prelude trend analyses provide important information about changes in clinical and laboratory measures over time during several years prior to transition to ESRD, including measured serum phosphorus in 11,896 veterans who eventually transitioned to ESRD over 5 years, which gradually increased from the 3.8 to 4.0 range to above 5.5 mg/dL immediately prior to transition to ESRD.

USRDS ADR Nov 2015
ESRD Rates among Veterans

- Each year ~13,000 veterans transitioned to ESRD, with an average rate of ESRD transition of 1,087 veterans per month across the entire nation (Concept of “ESRD Fountain”).

- For the three calendar years 2008, 2009 and 2010, the ESRD incident rates among veterans were 604.6, 624.0 and 604.1 per million veterans, respectively.

- Given the ESRD incident rates of 488.0, 499.3 and 495.6 per million per the USRDS population, the calculated crude rate ratio of ESRD incidence among veterans compared to the US general population is 1.24, 1.25, and 1.22 for calendar years 2008 through 2010, respectively, suggesting that the ESRD is 22% to 25% more likely to occur among veterans than the general US population.

- However, the VA population is considerably older than the general US population.

Transition of Care in CKD (TC-CKD)
N=52,152, 4 years, 10/1/2007-9/30/2011
Table x.1. Rates and ratio of the incident ESRD among veterans and in the US adults for calendar years 2008, 2009 and 2010 across age strata of 55-64, 65-74, and 75+ years, data are derived from US veteran incident dialysis patients during 10/1/2007-9/30/2011

<table>
<thead>
<tr>
<th>Age Strata</th>
<th>55-64 years</th>
<th>65-74 years</th>
<th>75 years or older</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calendar Year</td>
<td>2008</td>
<td>2009</td>
<td>2010</td>
</tr>
<tr>
<td>Incident ESRD veterans</td>
<td>3180</td>
<td>3292</td>
<td>3115</td>
</tr>
<tr>
<td>All veterans</td>
<td>5,718,302</td>
<td>5,441,739</td>
<td>5,340,529</td>
</tr>
<tr>
<td>ESRD rate in veterans, PM</td>
<td>556</td>
<td>605</td>
<td>583</td>
</tr>
<tr>
<td>ESRD rate in the USA, PM</td>
<td>773</td>
<td>778</td>
<td>752</td>
</tr>
<tr>
<td>ESRD rate ratio (Vet:US)*</td>
<td>0.72</td>
<td>0.78</td>
<td>0.78</td>
</tr>
</tbody>
</table>

Transition of Care in CKD (TC-CKD)
N=52,152, 4 years, 10/1/2007-9/30/2011
ESRD Rates among Veterans

- On an age specific and age adjusted basis, the rate of ESRD is 25 to 40 percent lower than the US rate of ESRD.

- This lower-than-expected risk occurs despite the fact that the VA population is predominantly male.

- The remarkably low rate of ESRD among VA patients is unexplained.
  - Is it because the VA system provides an integrated health care system with better care to CKD patients?
  - Is it because there is a selection bias of persons into military service?
  - After all, there is a screening of military candidates that could remove persons with greater risk of ESRD from the resultant VA pool of persons.

- Further research may shed some light on this issue.

Transition of Care in CKD (TC-CKD)
N=52,152, 4 years, 10/1/2007-9/30/2011
MEDICATIONS

• Almost 30% of all 52,172 veterans who transitioned to ESRD across the nation over a 4-year period (10/2007-9/2011) received **anti-depressants** prior to transition (prelude period), while after transition to ESRD (vintage period) the anti-depressants prescription rate increased slightly.

• **Phosphorus binders** were rarely prescribed during the prelude time prior to ESRD transition, but a major surge was observed in the final 6 months of the prelude period, followed by a substantial rise during the dialysis vintage period.
Prescribed Medications

Creating “6-month” periods (n=13) for PRELUDE (n=7) and VINTAGE (n=6)

<table>
<thead>
<tr>
<th>Prelude</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>60 mo to &lt;36 mo **</td>
<td>28361</td>
</tr>
<tr>
<td>36 mo to &lt;30 mo</td>
<td>29012</td>
</tr>
<tr>
<td>30 mo to &lt;24 mo</td>
<td>30460</td>
</tr>
<tr>
<td>24 mo to &lt;18 mo</td>
<td>31706</td>
</tr>
<tr>
<td>18 mo to &lt;12 mo</td>
<td>32669</td>
</tr>
<tr>
<td>12 mo to &lt;6 mo</td>
<td>33572</td>
</tr>
<tr>
<td>6 mo to &lt;ESRD</td>
<td>34970</td>
</tr>
<tr>
<td>Vintage</td>
<td></td>
</tr>
<tr>
<td>ESRD to &lt;6 mo</td>
<td>34630</td>
</tr>
<tr>
<td>6 mo to &lt;12 mo</td>
<td>29427</td>
</tr>
<tr>
<td>12 mo to &lt;18 mo</td>
<td>25235</td>
</tr>
<tr>
<td>18 mo to &lt;24 mo</td>
<td>21792</td>
</tr>
<tr>
<td>24 mo to &lt;30 mo</td>
<td>18840</td>
</tr>
<tr>
<td>30 mo to &lt;36 mo</td>
<td>16171</td>
</tr>
</tbody>
</table>

**prelude up to -5 years

Transition of Care in CKD (TC-CKD)
N=52,152, 4 years, 10/1/2007-9/30/2011
Medications by "6 month periods" (n=13)

n=52,152, 4 years (10/1/2007-9/30/2011)

Transition of Care in CKD (TC-CKD)
N=52,152, 4 years, 10/1/2007-9/30/2011
Medications in Prelude and Vintage


B. Cholesterol 1. Statin 2. Non statin

C. Diabetic- 1. Insulin 2. Oral hypoglycemic.

D. Anemia- 1. EPO 2. Iron


F. Bicarbonate- 1. Bicarbonate

G. Phosphorus Binder 1. Sevelamer, 2. Lanthanm, 3. Calcium Acetate

H. Antidepressants- 1. Antidepressants

NOTE- Bone Mineral and Phos Binder Groups overlap meds.

Transition of Care in CKD (TC-CKD)
N=52,152, 4 years, 10/1/2007-9/30/2011
Blood Pressure Medications

Granular Medication Analyses

Transition of Care in CKD (TC-CKD)
N=52,152, 4 years, 10/1/2007-9/30/2011
Anemia and Bone Mineral Medications

Granular Medication Analyses

Transition of Care in CKD (TC-CKD)
N=52,152, 4 years, 10/1/2007-9/30/2011
Granular Medication Analyses

Diabetes, Cholesterol, Analgesics

Transition of Care in CKD (TC-CKD)
N=52,172, 4 years, 10/1/2007-9/30/2011
Blood thinners, Anti-depressant

Granular Medication Analyses

Transition of Care in CKD (TC-CKD)
N=52,172, 4 years, 10/1/2007-9/30/2011
Granular Medication Analyses

Thyroid, Calcium Medications

Transition of Care in CKD (TC-CKD)
N=52,172, 4 years, 10/1/2007-9/30/2011
Comorbidities

Among comorbid conditions that were obtained from multiple sources for 47,555 veterans who transition to ESRD with at least one identified comorbidity,

• congestive heart failure (CHF) and diabetes mellitus were each present in over half of the veterans,

• chronic pulmonary disease was recorded in over 40%, and

• almost a quarter had the diagnosis of cancer,

• while 28% had prior myocardial infarction.
Figure x.7. Selected comorbid conditions for calculation of the Charlson Comorbidity Index prior to transition to ESRD in 47,555 incident ESRD veterans who would transition to ESRD.
Among the 46,625 veterans who transitioned to ESRD over the 4-year period with at least one hospitalization event, the most common causes of hospital admission that also included the ESRD transition day in the hospital included: acute kidney injury (AKI, acute renal failure), hypertension, congestive heart failure, and CKD per se, while septicemia related hospital admissions increased dramatically after ESRD transition.

Congestive heart failure (CHF) was the most common reason for hospital admission prior to ESRD transition (prelude time), whereas dialysis access complications was the most common cause after ESRD transition (vintage time).

For hospitalizations that included the transition to ESRD event, i.e., the first hemodialysis treatment, AKI was the leading cause of hospitalization.
Source of Hospitalization Data

• To obtain accurate hospitalization data for the 52,172 veterans who transitioned to ESRD over the 4 years (10/2007-9/2011),

• Additional database merging
  – Inpatient Acute Care Main,
  – Inpatient Acute Care Surgery,
  – MedSAS Outpatient Event file,
  – MedSAS Inpatient Encounters file
  – CMS Medicare-Inpatient and Outpatient data sources (including CMS RIF- Outpatient, and Additional Chronic Conditions Obtained from CMS Beneficiary Files under BASF & MBSF).
Hospitalization

- 46,625 (89.4%) of all veterans who transitioned to ESRD were hospitalized at least once during a period of -5 yrs prior to (prelude) and +2 yrs after transition (vintage).
- 6,610 were hospitalized only before but not after ESRD
- 6,743 were hospitalized only after but not before ESRD,
- 33,272 were in the hospital both before and after transition.

- 27,503 veterans (52.7%) the transition to ESRD happened while they were in the hospital,
  - including 22,817 veterans (43.7%) whose only hospitalization event during the entire 7 years of observation was to transition to ESRD
Figure x.5. **Hospitalization** events in 46,625 incident ESRD veterans who transitioned to ESRD during 10/1/2007-9/30/2011, with data ranging from -60 months prior to transition (prelude) to +24 months after transition (vintage), Upper Venn diagram: Three major hospitalization categories; Lower Venn diagram: Focus of hospital events during transition to ESRD.
Cause-Specific Hospitalization

The graph illustrates the percentage of hospitalized patients across various conditions and time frames:
- **CHF** (Congestive Heart Failure)
- **Graft complication**
- **Hypertension**
- **Acute renal failure**
- **Septicemia**
- **Diabetes**
- **ASHD** (Acute Myocardial Infarction)
- **Pneumonia**
- **Acute MI** (Myocardial Infarction)
- **Cardiac dysrhythmias**

The time frames include:
- **12-60 Month Prelude**
- **12 Month Prelude**
- **During Dialysis**
- **6 Month Vintage**
- **6-24 Month Vintage**

Each condition is represented by a bar, with the height indicating the percentage of hospitalization.
Cause-Specific Hospitalization

![Graph showing cause-specific hospitalization rates for various conditions and vintage periods. The graph compares percent hospitalized for conditions such as Fluid Disorder, Rehab, Surg Complications, CKD, GI Hem, Chest Pain, Resp Fail, Skin Inf, COPD, and CVD across different vintage periods: 12-60 Month Prelude, 12 Month Prelude, During Dialysis, 6 Month Vintage, and 6-24 Month Vintage.]
# Cause-Specific Hospitalization:

Table x.4. Ranking of the top 20 causes of hospitalization in 46,625 incident ESRD veterans who were hospitalized at least once during the period of -60 months prior to transition (prelude) to +24 months after transition (vintage)

<table>
<thead>
<tr>
<th>Hospitalization Event</th>
<th>Overall (7 year cohort)</th>
<th>-60 to -12 months of prelude</th>
<th>Last 12 months of Prelude</th>
<th>During ESRD transition</th>
<th>First 6 months of vintage</th>
<th>+6 to +24 months of vintage</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHF</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Dialysis access (Graft) complication</td>
<td>2</td>
<td>9</td>
<td>10</td>
<td>10</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Hypertension</td>
<td>3</td>
<td>7</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Acute renal failure (AKI)</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Septicemia</td>
<td>5</td>
<td>18</td>
<td>8</td>
<td>7</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Diabetes</td>
<td>6</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>ASHD</td>
<td>7</td>
<td>2</td>
<td>9</td>
<td>12</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>8</td>
<td>5</td>
<td>7</td>
<td>8</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>Acute MI</td>
<td>9</td>
<td>6</td>
<td>5</td>
<td>6</td>
<td>13</td>
<td>8</td>
</tr>
<tr>
<td>Cardiac dysrhythmias</td>
<td>10</td>
<td>8</td>
<td>12</td>
<td>13</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td>Fluid Disorder (Fluid overload)</td>
<td>11</td>
<td>13</td>
<td>11</td>
<td>11</td>
<td>12</td>
<td>7</td>
</tr>
<tr>
<td>Rehabilitation</td>
<td>12</td>
<td>12</td>
<td>15</td>
<td>14</td>
<td>9</td>
<td>12</td>
</tr>
<tr>
<td>Surgical Complications</td>
<td>13</td>
<td>14</td>
<td>19</td>
<td>15</td>
<td>11</td>
<td>9</td>
</tr>
<tr>
<td>CKD</td>
<td>14</td>
<td>16</td>
<td>16</td>
<td>16</td>
<td>17</td>
<td>14</td>
</tr>
<tr>
<td>GI Hemorrhage</td>
<td>15</td>
<td>16</td>
<td>16</td>
<td>16</td>
<td>17</td>
<td>14</td>
</tr>
<tr>
<td>Chest Pain</td>
<td>16</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Respiratory Failure</td>
<td>17</td>
<td>14</td>
<td>9</td>
<td>14</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Skin Infection</td>
<td>18</td>
<td>11</td>
<td>18</td>
<td>18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COPD</td>
<td>19</td>
<td>15</td>
<td>17</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CVD</td>
<td>20</td>
<td>17</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peripheral and visceral atherosclerosis</td>
<td>19</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Anemia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>13</td>
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<tr>
<td>UTI</td>
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<td></td>
<td></td>
<td></td>
<td>18</td>
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<tr>
<td>Other circulatory disease</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Intestinal infection</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aortic; periph., visceral artery aneurysm</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>19</td>
</tr>
<tr>
<td>Multiple myeloma</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>20</td>
</tr>
</tbody>
</table>
Prelude Trends (pre-ESRD)

Prelude trend analyses provide important information about changes in clinical and laboratory measures over time during several years prior to transition to ESRD.
Hemoglobin by Prelude Quarters

Mean Hemoglobin Over 20 Quarters Prior to Dialysis Start in 28,717 TCCKD Patients
Hemoglobin by Prelude Quarters

Mean Hemoglobin Over 20 Quarters Prior to Dialysis Start in 28,717 TCCKD Patients

Mean Hemoglobin (g/dL)

Prelude, Quarter Prior to Dialysis
Phosphorus Trend during Prelude

Figure x.9. Trend in serum phosphorus level during the prelude (pre-ESRD) time over 36 months in 11,896 veterans who later transitioned to ESRD.
Table x.2. Status of 52,172 incident ESRD veterans on Day 1 and Day 90 after transition to ESRD, 10/1/2007-9/30/2011 (adapted from ADR 2014)

<table>
<thead>
<tr>
<th>Dialysis Modality</th>
<th>Day 1</th>
<th>Day 90</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>In-center</td>
<td>43,256</td>
<td>82.9</td>
</tr>
<tr>
<td>Home HD</td>
<td>260</td>
<td>0.5</td>
</tr>
<tr>
<td>CAPD</td>
<td>1,405</td>
<td>2.7</td>
</tr>
<tr>
<td>CCPD</td>
<td>1,174</td>
<td>2.2</td>
</tr>
<tr>
<td>Uncertain*</td>
<td>5287</td>
<td>10.1</td>
</tr>
</tbody>
</table>

| Outcomes**        |        |        |        |        |
| Death             | 201    | 0.4    | 5,348  | 10.3   |
| Transplant        | 589    | 1.1    | 701    | 1.3    |
| Lost to follow-up |        |        | 5      | <0.1   |
| Recovered         |        |        | 1,798  | 3.5    |
| Total             | 52,172 | 100    | 52,172 | 100    |
TCCKD Reports and Publications
TC-CKD ASN 2015 abstracts: 8 posters + 2 orals

Thursday, Nov 5

1. **ORAL: [TH-OR008]** The Impact of Pre-ESRD Glycemic Status on Early Post-ESRD Mortality Among U.S. Veterans: A Transition of Care in CKD Study

2. [TH-PO536] Association Between **Vascular Access Creation** and Regression of eGFR Decline in Late-Stage CKD Patients Transitioning to ESRD

3. [TH-PO587] Serum **Triglyceride** Levels during Progression to ESRD and Early Dialysis Mortality among U.S. Veterans: A Transition of Care in CKD Study

Friday, Nov 6

1. [FR-PO795] Association of **Dialysis Provider Assignment** with Early Dialysis Mortality in U.S. Veterans: A Transition of Care in CKD Study

2. [FR-PO845] Associations of Prelude (Pre-ESRD) **BMI** and **Weight Change** with Early Dialysis Mortality Among U.S. Veterans: A Transition of Care in CKD Study

3. [FR-PO900] Serum **Phosphorous** Levels prior to Transition to Dialysis and Early Dialysis Mortality Among U.S. Veterans: A Transition of Care in CKD Study

Saturday, Nov 7

1. **ORAL: [SA-OR010]** Association of **eGFR Decline** with Post Dialysis Mortality in Late-Stage CKD Patients Who Transitioned to ESRD

2. [SA-PO790] Identifying Advanced Chronic Kidney Disease Patients with Same Survival Under **Conservative Care** versus Dialysis

3. [SA-PO796] Association of Pre-ESRD **Hemoglobin** with Early Post-ESRD Mortality Among U.S. Veterans: A Transition of Care in CKD Study

4. [SA-PO922] Association of 6-Month Pre-ESRD **Potassium** with Immediate Post-ESRD Survival: A Transition to CKD Study
The United States Renal Data System (USRDS)
Special Study Center
Transition of Care in CKD (TC-CKD)

KPSC Report
Steven J. Jacobsen, John J. Sim, Hui Zhou,
Jiaxiao Shi, David K. Yi, Jose Pio

Oct 9, 2015
## Linkage Results with USRDS

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Number</th>
<th>Sent for linkage</th>
<th>Matched persons</th>
<th>Unmatched</th>
</tr>
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<tbody>
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<td>2007</td>
<td>1,189</td>
<td>1,182</td>
<td>1,143</td>
<td>39 (3.36%)</td>
</tr>
<tr>
<td>2008</td>
<td>1,169</td>
<td>1,163</td>
<td>1,125</td>
<td>38 (3.35%)</td>
</tr>
<tr>
<td>2009</td>
<td>1,311</td>
<td>1,293</td>
<td>1,246</td>
<td>47 (3.67%)</td>
</tr>
<tr>
<td>2010</td>
<td>1,306</td>
<td>1,293</td>
<td>1,231</td>
<td>62 (4.79%)</td>
</tr>
<tr>
<td>2011</td>
<td>1,239</td>
<td>1,228</td>
<td>1,159</td>
<td>69 (5.79%)</td>
</tr>
<tr>
<td>2012</td>
<td>1,219</td>
<td>1,216</td>
<td>1,120</td>
<td>106 (8.72%)</td>
</tr>
<tr>
<td>2013</td>
<td>1,260</td>
<td>1,253</td>
<td>1,161</td>
<td>92 (7.34%)</td>
</tr>
<tr>
<td>2014</td>
<td>1,372</td>
<td>1,365</td>
<td>562</td>
<td>803 (58.83%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>10,065</strong></td>
<td><strong>9,993</strong></td>
<td><strong>8,747</strong></td>
<td><strong>1,246</strong></td>
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</tbody>
</table>

Note: Considering possible delay in the reporting system, if exclude number from 2014, unmatched rate between 2007 and 2013 was 443 (5.13%).
Demographic Distribution of KPSC 7,885 Dialysis Patients Between 2007-2013

Race/Ethnicity

<table>
<thead>
<tr>
<th>Race/Ethnicity</th>
<th>Percent (%)</th>
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<tbody>
<tr>
<td>White</td>
<td>30</td>
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<tr>
<td>Black</td>
<td>40</td>
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<tr>
<td>Hispanic</td>
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<td>Asian</td>
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<tr>
<td>Other</td>
<td>5</td>
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<tr>
<td>Unknown</td>
<td>0</td>
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</table>

Sex

<table>
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<th>Gender</th>
<th>Percent (%)</th>
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<tbody>
<tr>
<td>Female</td>
<td>40</td>
</tr>
<tr>
<td>Male</td>
<td>60</td>
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</table>

Age

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<th>Age Group</th>
<th>Percent (%)</th>
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<tr>
<td>20-24</td>
<td>5</td>
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<tr>
<td>25-34</td>
<td>5</td>
</tr>
<tr>
<td>35-44</td>
<td>5</td>
</tr>
<tr>
<td>45-54</td>
<td>10</td>
</tr>
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<td>55-64</td>
<td>15</td>
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<td>65-69</td>
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<td>70-74</td>
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<td>75-79</td>
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<td>80-84</td>
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<td>85-89</td>
<td>2</td>
</tr>
<tr>
<td>90-94</td>
<td>1</td>
</tr>
<tr>
<td>≥95</td>
<td>1</td>
</tr>
</tbody>
</table>
Creatinine trajectory in 20 quarters prior to Dialysis among 7,885 Incident Patients
eGFR trajectory in 20 quarters prior to Dialysis among 7,885 Incident Patients
Transition of Care in CKD (TC-CKD): What can investigators study using the TCCKD data?

The post-ESRD impact of pre-ESRD comorbid conditions and events (up to -3 years prior to transition):

- NDD-CKD-related events:
  - Speed of CKD progression (eGFR slope)
  - Episodes of acute kidney injury (AKI)
  - Need for prior temporary dialysis therapy
  - Dialysis access placement and type
  - Nephrologist care & case-load

- NDD-CKD-specific comorbidities:
  - Mineral and bone disorders [MBD]
  - Metabolic acidosis
  - Protein-energy wasting and malnutrition,
  - Anemia

- Non-renal conditions:
  - Glycemic control
  - Treatment of hypertension
  - Hypercholesterolemia
  - Obesity and frailty
  - Management of heart failure, liver disease and hypothyroidism
Summary and conclusions:
TRANSITION of Care in CKD (TC-CKD)

- In patients with very-late-stage NDD-CKD (eGFR <25 ml/min/1.73 m²) the optimal transition of care to kidney replacement therapy (ESRD) is not known.

- Major uncertainty and significant knowledge gaps have persisted pertaining to differential or individualized transitions of care across different age, race and other demographics and different pre-Transition conditions and events as well as dialysis format (frequency, mode, timing, etc.).

- The use of pre-Transition (PRELUDE) data to assess the approach to ESRD transition decisions including timing and modality selection to achieve the best outcomes will be the focus of the 2014-2019 USRDS Special Study Center IC-CKD.

- The National Veterans Data and the Kaiser Permanente of Southern California data will serve for the first time for pre-ESRD analyses and annual reports 2014-2019.
Acknowledgement

The Harold Simmons Center for Kidney Disease Research & Epidemiology

Investigators and Staff
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- Jongha Park, MD
- Daniel Gillen, PhD
- Danh Nguyen, PhD
- Allen Nissenson, MD,
- Steven Brunelli, MD, MS
Appendix A

• TCCKD Data 2014/2015
Appendix B

- USRDS TCCKD ADR Chapter 2015/16
Chapter 8: Transition of Care in Chronic Kidney Disease
Figure 8.1 Distribution of preemptive kidney transplant rates among 52,172 incident ESRD veterans across the states and territories of the United States, 10/1/2007-9/30/2011

Data source: VHA Administrative data, USRDS ESRD Database. States and territories of the United States of America. Abbreviations: ESRD, end-stage renal disease.
Table 8.1 Rates and ratios of incident ESRD among veterans and in U.S. adults, 10/1/2007-9/30/2011

<table>
<thead>
<tr>
<th></th>
<th>55-64 years</th>
<th></th>
<th></th>
<th>65-74 years</th>
<th></th>
<th></th>
<th>75 years or older</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Incident ESRD veterans</td>
<td>3180</td>
<td>3292</td>
<td>3115</td>
<td>3054</td>
<td>3187</td>
<td>3080</td>
<td>5924</td>
<td>5787</td>
<td>5740</td>
</tr>
<tr>
<td>All veterans</td>
<td>5718302</td>
<td>5441739</td>
<td>5340529</td>
<td>4148572</td>
<td>4152331</td>
<td>4294221</td>
<td>4911012</td>
<td>4851671</td>
<td>4839173</td>
</tr>
<tr>
<td>ESRD rate in veterans, per million</td>
<td>556</td>
<td>605</td>
<td>583</td>
<td>736</td>
<td>768</td>
<td>717</td>
<td>1206</td>
<td>1193</td>
<td>1186</td>
</tr>
<tr>
<td>ESRD rate in the U.S., per million</td>
<td>773</td>
<td>778</td>
<td>752</td>
<td>1297</td>
<td>1311</td>
<td>276</td>
<td>545</td>
<td>1559</td>
<td>1582</td>
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<tr>
<td>ESRD rate ratio (Vet: U.S.)</td>
<td>0.72</td>
<td>0.78</td>
<td>0.78</td>
<td>0.57</td>
<td>0.59</td>
<td>0.56</td>
<td>0.78</td>
<td>0.76</td>
<td>0.75</td>
</tr>
</tbody>
</table>

Data source: VHA Administrative data, USRDS ESRD Database, CMS Medicare Inpatient and Outpatient data, U.S. Census Bureau; data derived from U.S. veteran incident dialysis patients. a Veterans to U.S. rate ratios.

Abbreviations: ESRD, end-stage renal disease; PM; per million; Vet, veterans.
### Table 8.2 Status of 52,172 incident ESRD veterans on Day 1 and Day 90 after transition to ESRD, 10/1/2007-9/30/2011

<table>
<thead>
<tr>
<th>Dialysis Modality</th>
<th>Day 1</th>
<th>Day 90</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>In-center</td>
<td>43,256</td>
<td>82.9</td>
</tr>
<tr>
<td>Home HD</td>
<td>260</td>
<td>0.5</td>
</tr>
<tr>
<td>CAPD</td>
<td>1,405</td>
<td>2.7</td>
</tr>
<tr>
<td>CCPD</td>
<td>1,174</td>
<td>2.2</td>
</tr>
<tr>
<td>Uncertain</td>
<td>5287</td>
<td>10.1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Day 1</th>
<th>Day 90</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Death</td>
<td>201</td>
<td>0.4</td>
</tr>
<tr>
<td>Transplant</td>
<td>589</td>
<td>1.1</td>
</tr>
<tr>
<td>Lost to follow-up</td>
<td>5</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td>Recovered</td>
<td>1,798</td>
<td>3.5</td>
</tr>
</tbody>
</table>

**Total** 52,172 100 52,172 100

*Data source: USRDS ESRD Database. Table adapted from the 2014 USRDS Annual Data Report. a Uncertain groups have no known dialysis modality. b n for outcomes is cumulative for subsequent periods after Day 1. Abbreviations: CAPD, continuous ambulatory peritoneal dialysis; CCPD, continuous cycling peritoneal dialysis; ESRD, end-stage renal disease; HD hemodialysis.*
Figure 8.2 Annualized monthly unadjusted mortality of incident ESRD veterans who transitioned to ESRD during 10/1/2007-9/30/2011 and who were followed for up to 36 months, by dialysis provider.

Data source: VHA Administrative data, USRDS ESRD Database, CMS Medicare Inpatient and Outpatient data.
Abbreviation: DaVita, DaVita Kidney Care; ESRD, end-stage renal disease; LDO, large dialysis organization; VA, Veterans’ Affairs.
Table 8.3 Annualized month-by-month unadjusted mortality in 52,172 incident ESRD veterans during the first 24 months after transition to ESRD by dialysis provider, 10/1/2007-9/30/2011

<table>
<thead>
<tr>
<th>Month</th>
<th>DVT Died</th>
<th>DVT Alive</th>
<th>FMC Died</th>
<th>FMC Alive</th>
<th>Other Chains Died</th>
<th>Other Chains Alive</th>
<th>Non-Chain Died</th>
<th>Non-Chain Alive</th>
<th>VHA Died</th>
<th>VHA Alive</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>355</td>
<td>12763</td>
<td>418</td>
<td>14376</td>
<td>202</td>
<td>6847</td>
<td>358</td>
<td>11005</td>
<td>86</td>
<td>5100</td>
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<tr>
<td>2</td>
<td>538</td>
<td>12408</td>
<td>615</td>
<td>13958</td>
<td>300</td>
<td>6645</td>
<td>543</td>
<td>10647</td>
<td>112</td>
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<tr>
<td>3</td>
<td>449</td>
<td>11870</td>
<td>480</td>
<td>13343</td>
<td>246</td>
<td>6345</td>
<td>392</td>
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<td>4902</td>
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<td>4</td>
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<td>12863</td>
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<td>6099</td>
<td>318</td>
<td>9712</td>
<td>100</td>
<td>4792</td>
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<td>12475</td>
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<td>5891</td>
<td>254</td>
<td>9394</td>
<td>83</td>
<td>4692</td>
</tr>
<tr>
<td>6</td>
<td>306</td>
<td>10736</td>
<td>315</td>
<td>12122</td>
<td>142</td>
<td>5711</td>
<td>250</td>
<td>9140</td>
<td>82</td>
<td>4609</td>
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<td>7</td>
<td>244</td>
<td>10430</td>
<td>277</td>
<td>11807</td>
<td>126</td>
<td>5569</td>
<td>255</td>
<td>8890</td>
<td>71</td>
<td>4527</td>
</tr>
<tr>
<td>8</td>
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<td>10186</td>
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<td>11530</td>
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<td>5443</td>
<td>213</td>
<td>8635</td>
<td>61</td>
<td>4456</td>
</tr>
<tr>
<td>9</td>
<td>217</td>
<td>9969</td>
<td>219</td>
<td>11290</td>
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<td>5327</td>
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<td>8422</td>
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<td>4395</td>
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<td>205</td>
<td>10024</td>
<td>79</td>
<td>4682</td>
<td>130</td>
<td>7369</td>
<td>62</td>
<td>4007</td>
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</table>

(Continued on next slide)
Table 8.3 Annualized month-by-month unadjusted mortality in 52,172 incident ESRD veterans during the first 24 months after transition to ESRD by dialysis provider, 10/1/2007-9/30/2011 (Continued)

<table>
<thead>
<tr>
<th>Month</th>
<th>DVT Died</th>
<th>DVT Alive</th>
<th>DVT Rate %</th>
<th>FMC Died</th>
<th>FMC Alive</th>
<th>FMC Rate %</th>
<th>Other Chains Died</th>
<th>Other Chains Alive</th>
<th>Other Chains Rate %</th>
<th>Non-Chain Died</th>
<th>Non-Chain Alive</th>
<th>Non-Chain Rate %</th>
<th>VHA Died</th>
<th>VHA Alive</th>
<th>VHA Rate %</th>
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</thead>
<tbody>
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<td>16</td>
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<td>4603</td>
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<td>8508</td>
<td>21.16</td>
<td>182</td>
<td>9600</td>
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<td>88</td>
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<td>143</td>
<td>8191</td>
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<td>6829</td>
<td>21.61</td>
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<td>3799</td>
<td>14.53</td>
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<td>21</td>
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<td>7917</td>
<td>22.13</td>
<td>159</td>
<td>8885</td>
<td>21.47</td>
<td>79</td>
<td>4198</td>
<td>22.58</td>
<td>119</td>
<td>6582</td>
<td>21.7</td>
<td>53</td>
<td>3708</td>
<td>17.15</td>
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<tr>
<td>22</td>
<td>151</td>
<td>7771</td>
<td>23.32</td>
<td>157</td>
<td>8726</td>
<td>21.59</td>
<td>73</td>
<td>4119</td>
<td>21.27</td>
<td>119</td>
<td>6463</td>
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<td>37</td>
<td>3655</td>
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<td>23</td>
<td>121</td>
<td>7620</td>
<td>19.06</td>
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<td>51</td>
<td>3573</td>
<td>17.13</td>
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</tbody>
</table>

Data source: VHA Administrative data, USRDS ESRD Database, CMS Medicare Inpatient and Outpatient data. Provider is based on the patient's provider on Day 1. Rates represent the 12-month annualized rate. Abbreviations: DVT, DaVita Kidney Care; ESRD, end-stage renal disease; FMC, Fresenius Medical Care; VHA, Veterans' Health Administration.
Figure 8.3 Medications prescribed to 52,172 incident ESRD veterans who transitioned to ESRD from 10/1/2007-9/30/2011

Data source: VHA Administrative data, CMS Medicare Inpatient and Outpatient data. An individual's data includes the period from 60 months prior to transition (prelude) to 24 months following transition (vintage).

Abbreviations: ESRD, end-stage renal disease; mo, month.
Figure 8.4  Detail of the medications prescribed to 52,172 incident ESRD veterans who transitioned to ESRD during 10/1/2007-9/30/2011

Data source: VHA Administrative data, USRDS ESRD Database, CMS Medicare Inpatient and Outpatient data. An individual's data includes the period from 60 months prior to transition (prelude) to 24 months following transition (vintage). Abbreviations: ESRD, end-stage renal disease; K, potassium; mo, month.
Figure 8.5 Hospitalization events in 46,625 incident ESRD veterans who transitioned to ESRD during 10/1/2007-9/30/2011

Data source: VHA Administrative data, USRDS ESRD Database, CMS Medicare Inpatient and Outpatient data. An individual's data includes the period from 60 months prior to transition (prelude) to 24 months following transition (vintage). Upper Venn diagram: three major hospitalization categories; Lower Venn diagram: focus of hospital events during transition to ESRD. Abbreviations: ESRD, end-stage renal disease.
Figure 8.6 The top 20 causes of hospitalizations in 46,625 incident ESRD veterans who were hospitalized at least once during the period between 60 months prior to ESRD transition (prelude) and 24 months following ESRD transition (vintage)
(a) 10 of the top 20 causes of hospitalizations
Figure 8.6 The top 20 causes of hospitalizations in 46,625 incident ESRD veterans who were hospitalized at least once during the period between 60 months prior to ESRD transition (prelude) and 24 months following ESRD transition (vintage) (b) 10 of the top 20 causes of hospitalizations
### Table 8.4 Ranking of the top 20 causes of hospitalization in 46,625 incident ESRD veterans who were hospitalized at least once during the period between 60 months prior to ESRD transition (prelude) and 24 months following ESRD transition (vintage)

<table>
<thead>
<tr>
<th>Hospitalization Event</th>
<th>Overall (7 year cohort)</th>
<th>-60 to -12 months of prelude</th>
<th>Last 12 months of prelude</th>
<th>During ESRD transition</th>
<th>First 6 months of vintage</th>
<th>+6 to +24 months of vintage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Congestive heart failure</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Dialysis access (graft) complication</td>
<td>2</td>
<td>9</td>
<td>10</td>
<td>10</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Hypertension</td>
<td>3</td>
<td>7</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Acute renal failure</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Septicemia</td>
<td>5</td>
<td>18</td>
<td>8</td>
<td>7</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Diabetes</td>
<td>6</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Atherosclerotic heart disease</td>
<td>7</td>
<td>2</td>
<td>9</td>
<td>12</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>8</td>
<td>5</td>
<td>7</td>
<td>8</td>
<td>7</td>
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<tr>
<td>Acute myocardial infarction</td>
<td>9</td>
<td>6</td>
<td>5</td>
<td>6</td>
<td>13</td>
<td>8</td>
</tr>
<tr>
<td>Cardiac dysrhythmias</td>
<td>10</td>
<td>8</td>
<td>12</td>
<td>13</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td>Fluid disorder/fluid overload</td>
<td>11</td>
<td>13</td>
<td>11</td>
<td>11</td>
<td>12</td>
<td>7</td>
</tr>
<tr>
<td>Rehabilitation</td>
<td>12</td>
<td>15</td>
<td>15</td>
<td>14</td>
<td>9</td>
<td>12</td>
</tr>
<tr>
<td>Surgical complications</td>
<td>13</td>
<td>14</td>
<td>19</td>
<td>15</td>
<td>11</td>
<td>9</td>
</tr>
<tr>
<td>Chronic kidney disease</td>
<td>14</td>
<td>6</td>
<td>4</td>
<td>5</td>
<td>15</td>
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</tr>
</tbody>
</table>

*(Continued on next slide)*
Table 8.4 Ranking of the top 20 causes of hospitalization in 46,625 incident ESRD veterans who were hospitalized at least once during the period between 60 months prior to ESRD transition (prelude) and 24 months following ESRD transition (vintage) (Continued)

<table>
<thead>
<tr>
<th>Hospitalization Event</th>
<th>Overall (7 year cohort)</th>
<th>-60 to -12 months of prelude</th>
<th>Last 12 months of prelude</th>
<th>During ESRD transition</th>
<th>First 6 months of vintage</th>
<th>+6 to +24 months of vintage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gastrointestinal hemorrhage</td>
<td>15</td>
<td>16</td>
<td>16</td>
<td>16</td>
<td>17</td>
<td>14</td>
</tr>
<tr>
<td>Chest pain</td>
<td>16</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td>16</td>
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<tr>
<td>Respiratory failure</td>
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<td>14</td>
<td>9</td>
<td>14</td>
<td>13</td>
<td>16</td>
</tr>
<tr>
<td>Skin infection</td>
<td>18</td>
<td>11</td>
<td>18</td>
<td>18</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>Chronic obstructive pulmonary disease</td>
<td>19</td>
<td>15</td>
<td>17</td>
<td></td>
<td></td>
<td>17</td>
</tr>
<tr>
<td>Acute cerebrovascular disease</td>
<td>20</td>
<td>17</td>
<td></td>
<td></td>
<td>19</td>
<td>19</td>
</tr>
<tr>
<td>Peripheral and visceral atherosclerosis</td>
<td>19</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anemia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Urinary tract infection</td>
<td>20</td>
<td>20</td>
<td>18</td>
<td>18</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Other circulatory disease</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>Intestinal infection</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Aortic; peripheral, visceral artery aneurysm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>Multiple myeloma</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>20</td>
<td></td>
</tr>
</tbody>
</table>

Data source: VHA Administrative data, USRDS ESRD Database, CMS Medicare Inpatient and Outpatient data. Abbreviation: ESRD, end-stage renal disease.
Figure 8.7 Selected comorbid conditions for calculation of the Charlson Comorbidity Index prior to transition to ESRD in 47,555 incident ESRD veterans

(a) Common comorbidities among veterans prior to transition to ESRD
Figure 8.7 Selected comorbid conditions for calculation of the Charlson Comorbidity Index prior to transition to ESRD in 47,555 incident ESRD veterans

(b) Charlson Comorbidity Index Score

Data source: VHA Administrative data, USRDS ESRD Database. Abbreviations: CHF, congestive heart failure; compl, complications; COPD, chronic obstructive pulmonary disease; CVD, cerebrovascular disease; Dz, disease; ESRD, end-stage renal disease; MI, myocardial infarction; Mod, moderate; PVD, peripheral vascular disease; PUD, peptic ulcer disease; Sev, Severe.
Figure 8.8 Trend in blood hemoglobin levels during the prelude (pre-ESRD) period, over 20 calendar quarters in 28,717 veterans who later transitioned to ESRD during 10/1/2007-9/31/2011.

Data source: VHA Administrative data, USRDS ESRD Database. Abbreviations: ESRD, end-stage renal disease; g/dL, grams per deciliter.
Figure 8.9 Trend in serum phosphorus level during the prelude (pre-ESRD) period, over 36 months in 11,896 veterans who later transitioned to ESRD during 10/1/2007-9/31/2011.

Data source: VHA Administrative data, USRDS ESRD Database. Abbreviations: ESRD, end-stage renal disease; g/dL, grams per deciliter.
Figure 8.10 Trend in eGFR during the prelude (pre-ESRD) period, over 20 calendar quarters in 30,245 veterans who later transitioned to ESRD during 10/1/2007-9/31/2011
(a) Stratified by age
Figure 8.10 Trend in eGFR during the prelude (pre-ESRD) period, over 20 calendar quarters in 30,245 veterans who later transitioned to ESRD during 10/1/2007-9/31/2011
(b) Stratified according to ESRD etiology

Data source: VHA Administrative data, USRDS ESRD Database. Abbreviations: eGFR, estimated glomerular filtration rate; ESRD, end-stage renal disease.
Figure 8.11 Trend in blood glucose level during the prelude (pre-ESRD) period, over 20 calendar quarters in 29,920 veterans who later transitioned to ESRD during 10/1/2007-9/31/2011

Data source: VHA Administrative data, USRDS ESRD Database. Abbreviations: ESRD, end-stage renal disease.
Table 8.5 Age distribution of 5,989 KP-SC patients who transitioned to ESRD, 1/1/2007-12/31/2011

<table>
<thead>
<tr>
<th>Age group</th>
<th>Frequency</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;20</td>
<td>23</td>
<td>0.38</td>
</tr>
<tr>
<td>20-24</td>
<td>48</td>
<td>0.8</td>
</tr>
<tr>
<td>25-29</td>
<td>67</td>
<td>1.12</td>
</tr>
<tr>
<td>30-34</td>
<td>117</td>
<td>1.95</td>
</tr>
<tr>
<td>35-39</td>
<td>167</td>
<td>2.79</td>
</tr>
<tr>
<td>40-44</td>
<td>278</td>
<td>4.64</td>
</tr>
<tr>
<td>45-49</td>
<td>369</td>
<td>6.16</td>
</tr>
<tr>
<td>50-54</td>
<td>550</td>
<td>9.18</td>
</tr>
<tr>
<td>55-59</td>
<td>712</td>
<td>11.89</td>
</tr>
<tr>
<td>60-64</td>
<td>767</td>
<td>12.81</td>
</tr>
<tr>
<td>65-69</td>
<td>770</td>
<td>12.86</td>
</tr>
<tr>
<td>70-74</td>
<td>748</td>
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<td>75-79</td>
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<td>11.24</td>
</tr>
<tr>
<td>80-84</td>
<td>432</td>
<td>7.21</td>
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<tr>
<td>85-89</td>
<td>222</td>
<td>3.71</td>
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<td>90-94</td>
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<td>0.68</td>
</tr>
<tr>
<td>95+</td>
<td>5</td>
<td>0.08</td>
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</table>

Data source: Kaiser Permanente Southern California Electronic Health Records. Also see Figure 8.12. Abbreviations: ESRD, end-stage renal disease; KP-SC, Kaiser Permanente Southern California.
Figure 8.12 Age distribution of 5,989 KP-SC patients who transitioned to ESRD, 1/1/2007-12/31/2011

Data source: Kaiser Permanente Southern California Electronic Health Records. Also see Figure 8.6. Abbreviations: ESRD, end-stage renal disease; KP-SC, Kaiser Permanente Southern California.
Figure 8.13 Annualized mortality rate of the 5,989 incident dialysis patients over the first 24 months after ESRD transition (vintage)

Figure 8.14 Gradual rise in serum creatinine level during the period prior to ESRD transition (prelude) of 20 calendar quarters, among 5,989 patients who would transition to dialysis.

Data source: Kaiser Permanente Southern California Electronic Health Records. Abbreviation: ESRD, end-stage renal disease; mg/dL, milligrams per deciliter.
Figure 8.15 eGFR during the period prior to ESRD transition (prelude) of 20 calendar quarters, among 5,989 patients who would transition to dialysis.

Data source: Kaiser Permanente Southern California Electronic Health Records. Abbreviation: eGFR, estimated glomerular filtration rate; ESRD, end-stage renal disease; mL/min, milliliters per minute.
Figure 8.16 Selected comorbid conditions for calculation of the Charlson Comorbidity Index prior to transition to ESRD in 5,858 KP-SC patients

(a) Common comorbidities among veterans prior to transition to ESRD
Figure 8.16 Selected comorbid conditions for calculation of the Charlson Comorbidity Index prior to transition to ESRD in 5,858 KP-SC patients

(b) Charlson Comorbidity Index Score

Percent (%)

Charlson Comorbidity Index

Data source: Kaiser Permanente Southern California Electronic Health Records. Abbreviations: CHF, congestive heart failure; compl, complications; COPD, chronic obstructive pulmonary disease; CVD, cerebrovascular disease; Dz, disease; ESRD, end-stage renal disease; KP-SC, Kaiser Permanente Southern California; MI, myocardial infarction; Mod, moderate; PVD, peripheral vascular disease; PUD, peptic ulcer disease; Sev, Severe.