DATA-DRIVEN COLLABORATION

To Improve Dialysis Services in Arizona

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Division of Licensing Services
The Arizona Department of Health Services
History of Current Practice:

• Renal failure was untreatable, and fatal until the development of modern dialysis.

• 1861 – Thomas Graham, professor of Chemistry at Anderson’s University, Glasgow
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• 1945 – Willem J. Kolff, resident physician at Groningen University, Netherlands
History of Current Practice:
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Take Home Messages:

• All it takes to make advances in quality of care is individuals who take the initiative to make improvement a part of their daily effort.

• Failure, and persistence are essential to the discovery of new knowledge, and the best path to success.
Primary Data Sources for Summary:

• Community Health Survey, US Census Bureau population estimates.
National Data Summary

- Data from NHANES are a single point sample, and components covering Chronic Kidney Disease are administered to only a voluntary subset of respondents.
- Values found among NHANES participants for Chronic Kidney Disease are expected to be slightly higher than the actual numbers in the US general population.
- 5% reported only Diabetes
- 3.9% reported only Cardiovascular Disease
- 1% reported both Diabetes and Cardiovascular Disease
- 13.6% reported Chronic Kidney Disease
The Situation Today: Prevalence by Stage

Stage 1: $\text{dGFR} \geq 90 \text{ ml/min/1.73m}^2$ and $\text{ACR} \geq 30\text{mg/g}$

Stage 2: $\text{dGFR} 60-89 \text{ ml/min/1.73m}^2$ and $\text{ACR} \geq 30\text{mg/g}$

Stage 3: $\text{dGFR} 30-59 \text{ ml/min/1.73m}^2$

Stage 4: $\text{dGFR} 15-29 \text{ ml/min/1.73m}^2$

2014 US Renal Data System Annual Report - Chronic Kidney Disease Trends. Figure 1.1: Prevalence of Chronic Kidney Disease by Stage among NHANES participants 1988-2012
## The Situation Today: Prevalence Percent

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>12.0</td>
<td>14.0</td>
<td>13.6</td>
<td>1.6</td>
</tr>
<tr>
<td>Age 20 - 39</td>
<td>5.1</td>
<td>5.9</td>
<td>5.7</td>
<td>0.6</td>
</tr>
<tr>
<td>Age 40-59</td>
<td>8.4</td>
<td>9.8</td>
<td>8.9</td>
<td>0.5</td>
</tr>
<tr>
<td>Age 60 +</td>
<td>32.2</td>
<td>37.5</td>
<td>33.2</td>
<td>1</td>
</tr>
<tr>
<td>Male</td>
<td>10.2</td>
<td>12.3</td>
<td>12.1</td>
<td>1.9</td>
</tr>
<tr>
<td>Female</td>
<td>14.2</td>
<td>15.7</td>
<td>15.1</td>
<td>0.9</td>
</tr>
<tr>
<td>White non-Hispanic</td>
<td>12.3</td>
<td>14.0</td>
<td>13.9</td>
<td>1.6</td>
</tr>
<tr>
<td>Black Non-Hispanic</td>
<td>14.5</td>
<td>14.9</td>
<td>15.9</td>
<td>1.4</td>
</tr>
<tr>
<td>All Others</td>
<td>10.5</td>
<td>13.5</td>
<td>11.7</td>
<td>1.2</td>
</tr>
<tr>
<td>Diabetes</td>
<td>43.1</td>
<td>42.0</td>
<td>39.2</td>
<td>-3.9</td>
</tr>
<tr>
<td>Hypertension</td>
<td>33.3</td>
<td>32.7</td>
<td>31.0</td>
<td>-2.3</td>
</tr>
<tr>
<td>Cardiovascular Disease</td>
<td>25.4</td>
<td>40.0</td>
<td>39.5</td>
<td>14.1</td>
</tr>
<tr>
<td>Obesity</td>
<td>16.6</td>
<td>16.8</td>
<td>16.6</td>
<td>0</td>
</tr>
</tbody>
</table>
The Situation Today: Awareness of Disease

2014 US Renal Data System Annual Report - Chronic Kidney Disease Trends
Figure 1.11: Percentage of Survey Participants Aware of their Chronic Kidney Disease by stage of disease 1999-2010
The Situation Today: Hospitalization Rates

Admissions per 1,000 patient years

<table>
<thead>
<tr>
<th>Condition</th>
<th>Admissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>No CKD</td>
<td>190</td>
</tr>
<tr>
<td>All CKD</td>
<td>270</td>
</tr>
<tr>
<td>Stages 1-2</td>
<td>330</td>
</tr>
<tr>
<td>Stage 3</td>
<td>350</td>
</tr>
<tr>
<td>Stages 4-5</td>
<td>580</td>
</tr>
<tr>
<td>Unk/unspc</td>
<td>360</td>
</tr>
</tbody>
</table>

2014 US Renal Data System Annual Report - Chronic Kidney Disease Trends
Figure 3.5: Adjusted Hospitalization Rates per 1000 patient years at risk among Medicare Patients, aged 66 or older with Chronic Kidney Disease
The Situation Today: Incident Cases

- All ESRD (2012: 114,813)
- Hemodialysis (102,277)
- Peritoneal Dialysis (9,451)
- Transplant (2,995)

2014 US Renal Data System Annual Report
– End Stage Renal Disease Trends in the number of incident cases, USA, 1980 - 2012
The Situation Today: Incidence Rates

Incidence rates in the US, by age category
1980 - 2012
The Situation Today: Incident Cases

![Graph showing the number of patients according to age group (0-19, 20-44, 45-64, 65-74, 75+) and years (1980 to 2012). The number of patients increases over time for each age group.](image-url)
The Situation Today: Death Rate - Mode

Deaths per 1,000 patient years

Year

2014 US Renal Data System Annual Report – End Stage Renal Disease Trends
Mortality rates, 1985 - 2012
The Situation Today: Death Rate - Hemodialysis

![Graph showing death rate per 1,000 patient years over years from 1985 to 2012, with trends for different duration of dialysis: <2 years, 2-<5 years, 5+ years.]
The Situation Today: Death Rate - Peritoneal

The Situation Today: Death Rate – Mode, Age
The Situation Today: Prevalence counts – by Mode

- All ESRD (2012: 636,905)
- Hemodialysis (408,711)
- Peritoneal Dialysis (40,631)
- Transplant (186,303)
The Situation Today: Prevalence counts – by age
The Situation Today: Prevalence rates

2014 US Renal Data System Annual Report
- End Stage Renal Disease Trends
Prevalence in the US, 1980-2012

[Graph showing prevalence rates from 1980 to 2012 for different age groups]
Take Home Messages:

• Death rates are declining, new diagnoses are rising, and the combined effect is a persistent increase in the number of persons who are living with ESRD.

• Low levels of awareness (<10%) among persons with chronic kidney disease present an opportunity for expansion of early treatment and prevention/delay of ESRD.

• The primary drivers of ESRD are diabetes, hypertension, cardiovascular disease, and obesity.
The Situation in Arizona:

Prevalence, Incidence, and Licensed Providers

The Situation in Arizona:
Licensed Providers by Region – Urban/Rural
The Situation in Arizona:

Death rate and Percent

The Situation in Arizona:
Transplants, and Transplant Demand Time

The Situation in Arizona:

• In Arizona, Native Americans among race/ethnicity groups as significantly more likely to have ESRD.

• Males are also at greater likelihood of having ESRD
The Situation in Arizona: Arizona Renal Failure Deaths and Death Rates 2010 - 2014

Number of Deaths

Death Rate per 100K Population

Deaths Under 45
Deaths 45 - 64
Deaths 65 and Above
Death Rate Under 45
Death Rate 45 - 64
Death Rate 65 and Above
The Situation in Arizona: Deaths and Death Rates in Urban and Rural Regions

Number of Deaths

Rate of Death per 100K Population

- Urban Deaths
- Rural Deaths
- Urban Death Rate
- Rural Death Rate
The Situation in Arizona: Arizona Hospitalizations related to Chronic Kidney Disease – Urban/Rural

Arizona Hospital Discharge Data

Number of Hospitalizations

Rate of Hospitalizations per 100K Population

Urban Hospitalizations
Rural Hospitalizations
Urban Hospitalization Rates
Rural Hospitalization Rates
The Situation in Arizona: Arizona Hospitalizations related to Chronic Kidney Disease – Payer Source

Arizona Hospital Discharge Data

[Graph showing hospitalization data by payer source from 2010 to 2014, with trends for Self Pay, Commercial/Non-Public Insurance, Medicare/Medicare Advantage, AHCCCS, and All Others.]
The Situation in Arizona: Arizona Hospitalizations related to Chronic Kidney Disease – Race/Ethnicity

Arizona Hospital Discharge Data

<table>
<thead>
<tr>
<th>Year</th>
<th>White</th>
<th>Black</th>
<th>Hispanic</th>
<th>Native American</th>
<th>Asian/Pacific Islander</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td></td>
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<tr>
<td>2014</td>
<td></td>
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</tr>
</tbody>
</table>
Take Home Messages:

• Arizona trends of declining death rates, rising prevalence of persons with ESRD, and increasing death rates by age mirror those of the nation.

• Males in Arizona are more likely to be living with ESRD, or newly diagnosed with ESRD than females, mirroring national trends.

• Native Americans with ESRD in Arizona are 3 times more likely to die than persons of other race/ethnicity groups.

• Rural regions of Arizona have significantly higher rates of death and hospitalization from renal disease, but no increase in licensed providers during recent years.
Licensing Data: Survey Numbers and Types

Federal Survey Types by Period

<table>
<thead>
<tr>
<th>PERIOD</th>
<th>Certification/Complaint</th>
<th>Complaint</th>
<th>Initial</th>
<th>Other</th>
<th>Re-certification</th>
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<tbody>
<tr>
<td>FFY 2010</td>
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<td>FFY 2011</td>
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<td>FFY 2012</td>
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<tr>
<td>FFY 2013</td>
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<td>FFY 2014</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FFY 2015</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Licensing Data: Federal Citations by Year

Federal Citations by category

CATEGORY

Governance, Hemodialysis, Home Care, Infection Control, Lab, Medical Director, Medical Records, Patient Assess., Patient Rights, Personnel, Physical Environ., Plan Of Care, Quality Assess., Water Quality

PERIOD

Licensing Data: Federal Infection Control Citation Trend

Parameter Estimates
- Intercept = -52.39
- Slope = 37E-9

Federal Infection Control Trend

Month:
- Nov 2009
- Mar 2010
- Jul 2010
- Nov 2010
- Mar 2011
- Jul 2011
- Nov 2011
- Mar 2012
- Jul 2012
- Nov 2012
- Mar 2013
- Jul 2013
- Nov 2013
- Mar 2014
- Jul 2014
- Nov 2014
- Mar 2015
- Jul 2015
- Nov 2015
- Mar 2016

Frequency
- 0
- 5
- 10
- 15
- 20

Periods:
- FFY 2010
- FFY 2011
- FFY 2012
- FFY 2013
- FFY 2014
- FFY 2015
Licensing Data: State Surveys

State Survey Types by Period

<table>
<thead>
<tr>
<th>PERIOD</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>FFY 2010</td>
<td>60</td>
</tr>
<tr>
<td>FFY 2011</td>
<td>60</td>
</tr>
<tr>
<td>FFY 2012</td>
<td>80</td>
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<tr>
<td>FFY 2013</td>
<td>80</td>
</tr>
<tr>
<td>FFY 2014</td>
<td>100</td>
</tr>
<tr>
<td>FFY 2015</td>
<td>50</td>
</tr>
</tbody>
</table>

Legend:
- Complaint
- Initial
- Licensure/Complaint
- Other
- Renewal
Licensing Data: State Citations by Category

State Citations by category

CATEGORY

---|---|---|---|---|---|---
Admin | | | | | | |
Ancil | | | | | | |
Clinical | | | | | | |
Contract | | | | | | |
Dialysis | | | | | | |
Discharge | | | | | | |
ER | | | | | | |
Environ. | | | | | | |
Environ./Physical Plant | | | | | | |
Infection Control | | | | | | |
Medical Records | | | | | | |
NClinical | | | | | | |
Patient Rights | | | | | | |
Personnel | | | | | | |
Physical Plant | | | | | | |
Quality | | | | | | |
Tb | | | | | | |
Licensing Data: State Infection Control Citation Trend

Parameter Estimates:
- Intercept = -49.61
- Slope = 35E-9
Licensing Data: Infection Control Citations per survey

Distribution of Infection Control Citations

Number of Citations

Percent

Normal, $\mu=11.301$
Licensing Data: Infection Control Citations from 10/2012

Parameter Estimates
Intercept = 54.556
Slope = -27E-9

Citation Trend

Frequency

Month

period FFY 2013 FFY 2014 FFY 2015

Licensing Data: Types of Infection Control Citations

Citations by Type

Type of Citation

<table>
<thead>
<tr>
<th>Type of Citation</th>
<th>FFY 2013</th>
<th>FFY 2014</th>
<th>FFY 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biohazard Disposal</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cleaning Equipment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrective Measures</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hand Hygiene</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Handling Soiled Linens</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Infection Control Policies</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Isolation of Patients</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personal Protective Equipment Use</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Response to Infection Control Concern</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Take Home Messages:

• Infection Control Citations remain the leading citation category for both Federal and State Surveys.
• The most recent data suggest that the number of Infection Control Citations are declining.
• The leading types of surveys are re-certification/re-licensure, and complaint surveys.
• The average number of infection control citations per survey is 11.
• The leading categories of infection control citations have to do with hand hygiene, cleaning of equipment, use of personal protective equipment, and infection control programming.
Challenges with Using the Data

• Current data provides only monitoring capability
• Data availability is often a full year behind
• To prevent negative health outcomes, you have to be able to anticipate them
• A predictive model could be a tool to prevent negative health outcomes before they occur.
• In 2014 we began to search for a mathematical predictive data model using more complex types of analysis on existing data resources.
New Data Sources Used

- NHSN 10/1/2012 – 9/30/2014 Data at the facility level
- 2010 – 2013 calendar year Dialysis Facility Report data at the facility level as reported in the 2014 Master File.
- ASPEN Licensing Database – survey and citation events data among ESRD providers from 2010 – 2013.
Per capita cheese consumption correlates with Number of people who died by becoming tangled in their bedsheets.

R = 0.947091, Correlation = 94.7%
NHSN Data:

- Linear regression – infection outcomes x infection citations for all outcome variables (28 factors). Repeated with temporal analysis (6-month and 12-month windows).
- Identified no predictive models for health outcomes. Most correlations substantially failed the significance test ($p \leq .05$)
- Just 3 met significance, but all failed heteroscedascity (variance in $Y$ markedly differs at different values of $X$), and correlation slopes were unimpressive (flat line)
### NHSN Data:

<table>
<thead>
<tr>
<th>NHSN Infection Events for Arizona</th>
<th>FFY2013</th>
<th>FFY2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV Antimicrobial Start</td>
<td>2149</td>
<td>2209</td>
</tr>
<tr>
<td>IV Vancomycin Start</td>
<td>1655</td>
<td>1657</td>
</tr>
<tr>
<td># of Fistulas</td>
<td>1173</td>
<td>1311</td>
</tr>
<tr>
<td># Tunneled Central Line</td>
<td>1271</td>
<td>1190</td>
</tr>
<tr>
<td>Vascular Access Infection</td>
<td>1155</td>
<td>953</td>
</tr>
<tr>
<td>Pus, Redness, Swelling Event</td>
<td>844</td>
<td>676</td>
</tr>
<tr>
<td>Hospitalization Outcome</td>
<td><strong>561</strong></td>
<td><strong>612</strong></td>
</tr>
<tr>
<td>Local Access Site Infection</td>
<td>721</td>
<td>579</td>
</tr>
<tr>
<td>Fever</td>
<td>734</td>
<td>552</td>
</tr>
<tr>
<td>Positive Blood Culture</td>
<td><strong>518</strong></td>
<td><strong>476</strong></td>
</tr>
<tr>
<td>Chills or Rigors</td>
<td>481</td>
<td>408</td>
</tr>
<tr>
<td># of Grafts</td>
<td>350</td>
<td>405</td>
</tr>
<tr>
<td>Access Related Bloodstream Infection</td>
<td><strong>434</strong></td>
<td><strong>374</strong></td>
</tr>
<tr>
<td>Pus, Redness, Swelling Event Tunneled CL</td>
<td>454</td>
<td>306</td>
</tr>
<tr>
<td>Pus, Redness, Swelling Event Fistula</td>
<td>264</td>
<td>262</td>
</tr>
<tr>
<td>Cellulitis</td>
<td>209</td>
<td>195</td>
</tr>
<tr>
<td>Wound with Pus or Redness</td>
<td>118</td>
<td>158</td>
</tr>
<tr>
<td>Pus, Redness, Swelling Event Graft</td>
<td>116</td>
<td>102</td>
</tr>
<tr>
<td>Loss of Vascular Access</td>
<td>0</td>
<td>95</td>
</tr>
<tr>
<td>Pneumonia or Respiratory Infection</td>
<td>67</td>
<td>63</td>
</tr>
<tr>
<td># of Other Access Device</td>
<td>21</td>
<td>20</td>
</tr>
<tr>
<td>Death Outcome</td>
<td>22</td>
<td>17</td>
</tr>
<tr>
<td># Non Tunneled Central Line</td>
<td>26</td>
<td>14</td>
</tr>
<tr>
<td># Catheter graft H1 bird</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>Pus, Redness, Swelling Event Other Access Device</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Pus, Redness, Swelling Event Non Tunneled CL</td>
<td>6</td>
<td>1</td>
</tr>
</tbody>
</table>
NHSN Data:

Event Counts Trend

Parameter Estimates
Intercept = -0.652
Slope = 0.0101

NHSN FFY2013 and FFY2014 Data Set
NHSN Data: Infection events x patient count
NHSN Data: infection citations x per patient infection rate

Significance Test: P = 0.2453
NHSN Data: Limitations We Found

• There were some extremely small outcome event counts over the two-year period for which we had data.
• Some incompleteness of reporting – some null response values (10 of 28 outcomes were effected to some extent).
• ESRDs are on a 3 year certification survey cycle. With only 2 years of data, we only had data for 90 of 117 (77%).
• No patient populations per facility with the NHSN data. Forces invalid comparison of large facilities to small ones because rates per patient cannot be produced.
• Attempt to use ADHS re-licensure patient population counts to merge with NHSN only provided data for 79 sites, and the counts were found to be inaccurate in many cases.
DRF Data: Infection Citations x Death rate

Parameter Estimates

| Variable | DF | Parameter Estimate | Standard Error | t Value | Pr > |t| |
|----------|----|--------------------|----------------|---------|------|---|
| Intercept| 1  | 0.35123            | 1.53560        | 0.24    | 0.8145|
| deathrate| 1  | 40.29331           | 12.13396       | 3.32    | 0.0013|

Fit Plot for inf_tot

Observations: 97
Parameters: 2
Error DF: 95
MSE: 24
R-Square: 0.104
Adj R-Square: 0.0946
**DRF Data:** Infection Citations x Hospitalization rate

![Fit Plot for inf_tot](image)

### Parameter Estimates

| Variable          | DF | Parameter Estimate | Standard Error | t Value | Pr > |t| |
|-------------------|----|-------------------|----------------|---------|------|---|
| Intercept         | 1  | 0.18403           | 2.22941        | 0.08    | 0.9344 |
| pat_yar_HOSP_RATE | 1  | 0.36591           | 0.15876        | 2.30    | 0.0233 |

- Observations: 97
- Parameters: 2
- Error DF: 95
- MSE: 25.367
- R-Square: 0.053
- Adj R-Square: 0.043
DRF Data: Infection citations x Septicemia rate

Fit Plot for inf_tot

Parameter Estimates

| Variable      | DF | Parameter Estimate | Standard Error | t Value | Pr > |t| |
|---------------|----|--------------------|----------------|---------|------|---|
| Intercept     | 1  | 0.96137            | 1.44254        | 0.67    | 0.5067|
| pat_yar_sept_RATE | 1  | 22.82309           | 7.30990        | 3.12    | 0.0024|

Observations: 97
Parameters: 2
Error DF: 95
MSE: 24.293
R-Square: 0.0931
Adj R-Square: 0.0835
DRF Data: Infection Citations x Patient Emergency Dept. Visit Rate

Parameter Estimates

| Variable                  | DF | Parameter Estimate | Standard Error | t Value | Pr > |t| |
|---------------------------|----|--------------------|----------------|---------|------|---|
| Intercept                 | 1  | 0.44527            | 1.61924        | 0.27    | 0.7639|
| pat_yar_ed_visit_RATE     | 1  | 1.52594            | 0.49566        | 3.08    | 0.0027|

Observations: 97
Parameters: 2
Error DF: 95
MSE: 24.356
R-Square: 0.0907
Adj R-Square: 0.0811
Take Home Messages:

• NHSN data indicate, and DFR data confirm that Infection Control Citations can be used as a (weak) predictor of higher rates of death, hospitalization, septicemia, and patient emergency department visits.

• Additional outcome variables in DRF data have yet to be tested, and may contribute to a stronger predictive model.

• With further years of data, we are considering merging NHSN and DFR data elements.
Recommendations:

• Improve data quality of NHSN – importance of reporting all elements.
• Validation of Arizona outcomes data is needed.
• Reducing the size and scope of Government means fewer resources.
• Collaboration should focus on assisting providers to develop independent outcome monitoring.
• Collaboration should focus on targeted technical support to achieve quality improvement.
• How can we promote awareness of Chronic Kidney Disease?
• How can we resolve outcome disparities in Arizona’s rural regions?
Send you ideas/suggestions to:

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