Disclosure of Interests

- Amgen Australia – travel support to meetings
- Quanta Fluid Solutions – advisory board.
NOTHING

Scorched Desert

Cyclones

Coral

Sharks

Crocodiles

Angry Natives

Backpacker Murderers

Giant Rats

Scorpions

Baby Killer Dingos

Stingrays

Steve Irwin

Poisonous Snakes

Maneating Koalas

Mosquitoes

Sharks

Stinging Jellyfish

Sharks with Frickin' Lasers

Convicts

Fires

Danni Minogue

Giant Spiders

Deranged Gunmen
Current status

KDIGO
All renal replacement therapy:

vol 2 Figure 13.12 Percent distribution of type of renal replacement therapy modality used by ESRD patients, by country, in 2014

AJKD Suppl, March 2017
Dialysis only:

vol 2 Figure 13.15 Distribution of the percentage of prevalent dialysis patients using in-center HD, home HD, or peritoneal dialysis (CAPD/APD/IPD), 2014

AJKD Suppl, March 2017
Dialysis Modality by Country 2015

Australia
- PD: 20%
- Home HD: 9%
- Facility HD: 70%

New Zealand
- PD: 30%
- Home HD: 18%
- Facility HD: 52%

2016 ANZDATA Annual Report, Figure 2.4
RRT Modality by State
at end of 2015

2016 ANZDATA Annual Report, Figure 2.5
Age distribution of incident home dialysis patients
Australia 2015

2016 ANZDATA Annual Report, Figure 6.1
Cumulative incidence of home dialysis at 12 months
Censored at transplantation; competing risk death
By age, Australia and New Zealand 2006-2015

2016 ANZDATA Annual Report, Figure 6.5
Outcomes

KDIGO
Incident home dialysis technique survival
2004-2015
Censored for transplant - Australia

Age
<40 (n=2035)
40-59 (n=4675)
60-74 (n=4567)
=75 (n=1886)

Years
0 1 2 3 4 5

2016 ANZDATA Annual Report, Figure 6.18
Incident home dialysis technique survival
2004-2015
Censored for transplant and death - Australia

2016 ANZDATA Annual Report, Figure 6.19
It’s getting better...
Adjusted Technique Survival

Proportion Survived

Years from HHD initiation

At Risk (n)

1996-2002 233
2003-2007 568
2008-2012 1068

1996-2002 161 126 87 67
2003-2007 431 324 244 185
2008-2012 595 331 154 55

Figure 1. | Continued.
Integrated Dialysis

- Transition from PD to Home HD poor.
- ANZ – 5% only (ANZDATA)
- Canada – 2 -14% (McCormick BB et al, CJASN)
- Planned vs emergency
Incident home dialysis patient survival
2004-2015
Censored for transplant - Australia

Cohort
- 2013-2015 (n=3663)
- 2010-2012 (n=3146)
- 2007-2009 (n=3309)
- 2004-2006 (n=3045)

2016 ANZDATA Annual Report, Figure 6.14
ANZDATA Analysis


• Dataset
  • All adult patients starting renal replacement therapy in Australia and New Zealand since March 31, 1996, followed up to December 31, 2011
  • n = 38773 (2,054,990 patient-months)

• Marginal structural model
  • Able to adjust for the majority of cases who now have time-varying medical co-morbidity
ANZDATA analysis - definitions

• Separating HD into
  • **Conventional HD**: 3 x a week, <=6 hours/session
  • “True” Freq / Ext HD: >=5 x a week (no short daily)
  • “Quasi” Freq / Ext HD: Anything more than conventional, but less than …….

• Competing risks regression
  • No informative censoring, only censoring for loss to follow up
  • Transplantation explicitly modelled as a competing risk using multinomial regression with discretised time (patient moth episodes) in a panel (longitudinal time series) data
Initial analysis – HR for death

- Transplant
- PD
- All Facility HD
- All Home HD

Hazard Ratio

KDIGO
Detailed analysis – HR for death
**Figure 5** Analyses of the mortality data from the RCT study and the observational studies respectively for the comparison PD home versus HD hospital.
Why should there be benefits?

KDIGO
• Increased hours and frequency
  – Solute clearances
  – Fluid management
9 patients;
90 litres dialysate

Blood flow rate = dialysate flow rate

Same system used for 4, 6 or 8 hours

Therefore testing influence of time only with equivalent amount of blood processed.


---

Table 1 | Percentage increase of TSR, TCV, dialyzer ER, and RR during a dialysis session of 6 and 8 h compared to 4 h dialysis

<table>
<thead>
<tr>
<th></th>
<th>TSR 6 vs 4 h</th>
<th>TSR 8 vs 4 h</th>
<th>TCV 6 vs 4 h</th>
<th>TCV 8 vs 4 h</th>
<th>ER 6 vs 4 h</th>
<th>ER 8 vs 4 h</th>
<th>RR 6 vs 4 h</th>
<th>RR 8 vs 4 h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urea</td>
<td>6.1</td>
<td>26.1†</td>
<td>0.7</td>
<td>33.3†</td>
<td>1.0</td>
<td>33.2†</td>
<td>4.1</td>
<td>1.1</td>
</tr>
<tr>
<td>CTN</td>
<td>21.7</td>
<td>35.5</td>
<td>16.7</td>
<td>32.1†</td>
<td>17.1</td>
<td>32.0†</td>
<td>−2.9</td>
<td>−0.3</td>
</tr>
<tr>
<td>P</td>
<td>26.7</td>
<td>48.9†</td>
<td>22.4</td>
<td>32.5†</td>
<td>22.7</td>
<td>32.4†</td>
<td>2.1</td>
<td>−5.8</td>
</tr>
<tr>
<td>β2M</td>
<td>42.5</td>
<td>81.2</td>
<td>48.5</td>
<td>94.4</td>
<td>48.9</td>
<td>94.3</td>
<td>5.2</td>
<td>9.3</td>
</tr>
</tbody>
</table>

β2M, β2-microglobulin; CTN, creatinine; ER, extraction ratio; RR, reduction ratio; P, phosphorus; TSR, total solute removal; TCV, total cleared volume.

†P < 0.05 percentages ‘8 vs 4 h’ vs ‘6 vs 4 h.’
### Mathematical modelling  – Clark WR et al, JASN, 1999

<table>
<thead>
<tr>
<th>Regimen</th>
<th>Frequency (per week)</th>
<th>Time (min)</th>
<th>$Q_B/Q_D$ (ml/min)</th>
<th>$K_{urea}$ (ml/min)</th>
<th>$K_{inulin}$ (ml/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>3</td>
<td>240</td>
<td>350/600</td>
<td>231</td>
<td>75</td>
</tr>
<tr>
<td>B</td>
<td>7</td>
<td>100</td>
<td>350/600</td>
<td>231</td>
<td>75</td>
</tr>
<tr>
<td>C</td>
<td>3</td>
<td>480</td>
<td>300/100</td>
<td>101</td>
<td>56</td>
</tr>
<tr>
<td>D</td>
<td>5</td>
<td>480</td>
<td>300/100</td>
<td>100</td>
<td>54</td>
</tr>
<tr>
<td>E</td>
<td>7</td>
<td>480</td>
<td>300/100</td>
<td>99</td>
<td>53</td>
</tr>
</tbody>
</table>

- Conventional
- Short Daily
- Nocturnal regimens

Normalized Equivalent urea clearance (EKR, ml/min) during the different dialysis regimens

<table>
<thead>
<tr>
<th>Regimen</th>
<th>Urea</th>
<th>Creatinine</th>
<th>Vancomycin</th>
<th>Inulin</th>
<th>$\beta_2$-Microglobulin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional hemodialysis</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Short daily hemodialysis</td>
<td>1.04</td>
<td>1.03</td>
<td>1.06</td>
<td>1.05</td>
<td>1.00</td>
</tr>
<tr>
<td>Long 3 times per week</td>
<td>0.96</td>
<td>1.08</td>
<td>1.32</td>
<td>1.54</td>
<td>1.27</td>
</tr>
<tr>
<td>Long 5 times per week</td>
<td>1.58</td>
<td>1.80</td>
<td>2.21</td>
<td>2.57</td>
<td>1.73</td>
</tr>
<tr>
<td>Long 7 times per week</td>
<td>2.22</td>
<td>2.55</td>
<td>3.12</td>
<td>3.62</td>
<td>2.19</td>
</tr>
</tbody>
</table>

Vancomycin – MW 1448; Inulin – MW 5200; B2m – MW 11,800
Not seen in Australian data examining nocturnal HD (3.5+ times per week)
Table 3
Associations Between Continuous and Finely Categorized Prescribed Ultrafiltration Rate and All-Cause Mortality

<table>
<thead>
<tr>
<th>Mean UF rate</th>
<th>No. (%)</th>
<th>HR (95% CI) Unadjusted</th>
<th>HR (95% CI) Adjusted a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean UF rate per 1-mL/h/kg</td>
<td>118,394 (100.0)</td>
<td>1.01 (1.01-1.02)</td>
<td>1.03 (1.02-1.03)</td>
</tr>
<tr>
<td>&lt;6 mL/h/kg</td>
<td>23,813 (20.1)</td>
<td>1.00 (reference)</td>
<td>1.00 (reference)</td>
</tr>
<tr>
<td>6--&lt;8 mL/h/kg</td>
<td>21,729 (18.4)</td>
<td>0.99 (0.96-1.02)</td>
<td>1.03 (1.00-1.07)</td>
</tr>
<tr>
<td>8--&lt;10 mL/h/kg</td>
<td>24,323 (20.5)</td>
<td>1.01 (0.98-1.04)</td>
<td>1.09 (1.06-1.12)</td>
</tr>
<tr>
<td>10--&lt;12 mL/h/kg</td>
<td>19,457 (16.4)</td>
<td>1.04 (1.01-1.07)</td>
<td>1.15 (1.12-1.19)</td>
</tr>
<tr>
<td>12--&lt;14 mL/h/kg</td>
<td>13,086 (11.1)</td>
<td>1.08 (1.05-1.12)</td>
<td>1.23 (1.18-1.27)</td>
</tr>
<tr>
<td>≥14 mL/h/kg</td>
<td>15,986 (13.5)</td>
<td>1.19 (1.15-1.23)</td>
<td>1.43 (1.39-1.48)</td>
</tr>
</tbody>
</table>

View Table in HTML

Assimon MM … Flythe JE, AJKD, 2016
Myocardial Stunning

Transient myocardial ischemia leading to LV dysfunction which can persist after restoration of normal perfusion

HD is the perfect setup for STUNNING

HD $\Rightarrow$ ↓MBF $\Rightarrow$ RWMA (in absence of coronary disease)
### Burden et al. CJASN 2009; 4:914

#### Change in Blood Pressure (mmHg) vs. Time (minutes)
- **WITHOUT HD-induced RWMA**
- **WITH HD-induced RWMA**

#### Percent survival vs. Days elapsed
- **WITHOUT HD-induced RWMA**
- **WITH HD-induced RWMA**

#### Factor associated with presence of myocardial stunning

<table>
<thead>
<tr>
<th>Factor</th>
<th>Odds Ratio</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>UF volume during HD of 1L</td>
<td>5.1</td>
<td>0.007</td>
</tr>
<tr>
<td>UF volume during HD of 1.5L</td>
<td>11.6</td>
<td></td>
</tr>
<tr>
<td>UF volume during HD of 2L</td>
<td>26.2</td>
<td></td>
</tr>
<tr>
<td>Maximum SBP reduction during HD of 10 mmHg</td>
<td>1.8</td>
<td>0.002</td>
</tr>
<tr>
<td>Maximum SBP reduction during HD of 20 mmHg</td>
<td>3.3</td>
<td></td>
</tr>
<tr>
<td>Maximum SBP reduction during HD of 30 mmHg</td>
<td>6.0</td>
<td></td>
</tr>
</tbody>
</table>
Jefferies et al. CJASN 2011; 6:1326

SDHD
UF/session 2.12 L
UF rate 800 ml/hr

NHD
UF/session 1.95 L
UF rate 300 ml/hr
The Choice of Renal Replacement Therapy (CORETH) project: dialysis patients' psychosocial characteristics and treatment satisfaction

Maxi Robinski, Wilfried Mau, Andreas Wienke, Matthias Girndt


Effect of a behavioral self-regulation adherence in hemodialysis.

Table 2. Primary Outcomes: Clinical Markers Across Assessment Points for Each Trial Arm

<table>
<thead>
<tr>
<th></th>
<th>HED-SMART (n = 101)</th>
<th>Usual Care (n = 134)</th>
<th>Between-Arm Comparisons</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P^a</td>
<td>Mean ± SD</td>
<td>%b</td>
</tr>
<tr>
<td>IDWG, kg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T1</td>
<td>* 2.49 ± 0.71</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>T2</td>
<td>* 2.32 ± 0.59</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>T3</td>
<td>* 2.34 ± 0.55</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>T4</td>
<td>* 2.32 ± 0.60</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>IDWG, % of dry weight</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T1</td>
<td>* 3.91 ± 1.02</td>
<td>39.6%</td>
<td>—</td>
</tr>
<tr>
<td>T2</td>
<td>* 3.67 ± 0.84</td>
<td>32.7%</td>
<td>—</td>
</tr>
<tr>
<td>T3</td>
<td>* 3.71 ± 0.79</td>
<td>30.7%</td>
<td>—</td>
</tr>
<tr>
<td>T4</td>
<td>* 3.66 ± 0.84</td>
<td>30.7%</td>
<td>—</td>
</tr>
<tr>
<td>Phosphate, mg/dL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T1</td>
<td>* 5.16 ± 1.45</td>
<td>45.5%</td>
<td>—</td>
</tr>
<tr>
<td>T2</td>
<td>* 5.05 ± 1.41</td>
<td>46.5%</td>
<td>—</td>
</tr>
<tr>
<td>T3</td>
<td>* 4.87 ± 1.26</td>
<td>34.7%</td>
<td>—</td>
</tr>
<tr>
<td>T4</td>
<td>* 5.06 ± 1.11</td>
<td>39.6%</td>
<td>—</td>
</tr>
<tr>
<td>Potassium, mEq/L</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T1</td>
<td>* 5.00 ± 0.64</td>
<td>49.5%</td>
<td>—</td>
</tr>
<tr>
<td>T2</td>
<td>* 4.90 ± 0.63</td>
<td>36.6%</td>
<td>—</td>
</tr>
<tr>
<td>T3</td>
<td>* 4.70 ± 0.62</td>
<td>31.7%</td>
<td>—</td>
</tr>
<tr>
<td>T4</td>
<td>* 4.82 ± 0.65</td>
<td>33.7%</td>
<td>—</td>
</tr>
</tbody>
</table>

Note: Intention-to-treat values shown.

Not all sustained – need recurrent reinforcement
Barriers to home dialysis.

- Financial – patient, doctor and institution
- Physical infrastructure – home, hospital training facilities
- Lack of expertise – nephrologists, nurses
- Lack of industry support – hardware, consumables, deliveries
- Lack of belief/trust in home dialysis – doctors, nurses, patients
- Patient – demography, geography, comorbidities

Adapted from Ludlow, Kerr et al, Nephrology, 2011.
I believe there is no evidence that home-based HD offers enough of an advantage to encourage this therapy.

I believe that HD with long hours and/or frequent sessions confers an advantage to the patient.

The best way to achieve longer or more frequent dialysis is in the home.

What do the patients want?

Patients and caregivers perceive that home HD offers the opportunity to thrive; improves freedom, flexibility, and well-being; and strengthens relationships.
NZ study of patient preferences

- Discrete choice study of 143 participants – preferences and trade-offs
- Preferred home dialysis if unlimited nursing support available
- Willing to pay US$271/month for that support
- Preferred home Dialysis if out of pocket costs minimised
- Preferred home Dialysis if nocturnal Dialysis available
- Willing to pay US$151/month to gain treatment flexibility

Walker RC, Morton RL, ..Tong A et al, CJASN, 2018
Number of Home Dialysis Patients at End of Year

By age
Australia 1996-2015

2016 ANZDATA Annual Report, Figure 6.12
Need to avoid delays to start

Time to home dialysis
Censored at transplantation; competing risk death
By country 2006-2015

- Patients too comfortable in a facility
- AND
- A long lag will influence your interpretation of outcomes

2016 ANZDATA Annual Report, Figure 6.3
**Economic evaluation, including QoL**

**Table 37: Results of the base-case cost-effectiveness analyses from societal perspective (discounted); HD home compared with Hospital, Satellite, Self-care Hemodialysis and Peritoneal Dialysis**

<table>
<thead>
<tr>
<th></th>
<th>Total costs (NOK)</th>
<th>Effects (QALYs)</th>
<th>Incremental cost (NOK)</th>
<th>Incremental (QALYs)</th>
<th>ICER (NOK/QALY)</th>
<th>INHB</th>
</tr>
</thead>
<tbody>
<tr>
<td>HD home</td>
<td>1,705,865</td>
<td>1.8613</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HD satellite</td>
<td>2,629,801</td>
<td>1.7181</td>
<td>923,936</td>
<td>-0.1443</td>
<td>Dominated</td>
<td>-1.71</td>
</tr>
<tr>
<td>HD self-care</td>
<td>1,951,610</td>
<td>1.7169</td>
<td>386,161</td>
<td>-0.1444</td>
<td>Dominated</td>
<td>-0.80</td>
</tr>
<tr>
<td>HD hospital</td>
<td>2,371,729</td>
<td>1.7169</td>
<td>665,864</td>
<td>-0.1432</td>
<td>Dominated</td>
<td>-1.28</td>
</tr>
<tr>
<td>PD</td>
<td>1,230,613</td>
<td>1.6825</td>
<td>-475,252</td>
<td>-0.1789</td>
<td>2,657,211</td>
<td>0.63</td>
</tr>
</tbody>
</table>

QALY: quality-adjusted life year; ICER: incremental cost-effectiveness ratio; INHB: incremental net health benefit; HD: hemodialysis; PD: peritoneal dialysis

**Economic evaluation**

- In our model analyses all dialysis modalities were almost equally effective.
- Hemodialysis at home was the most effective and cost-effective alternative compared to all other hemodialysis modalities from both healthcare and societal perspectives.
- Peritoneal dialysis was the least costly, and hence the most cost-effective alternative compared to all hemodialysis modalities.
Economic evaluation of dialysis therapies

Scott W. Klarenbach, Marcello Tonelli, Betty Chui and Braden J. Manns

Figure 1 | Annual health-care costs of dialysis stratified by modality in Canada.

Home Dialysis: summary

- Patients prefer it
- Outcomes are excellent
- Administrators love it – it’s cheaper
- Practicalities will demand it

- Let’s do it.
  - (but it means you have to support it)