Modifying the Highest Mortality Rate in the Major AKI Adverse Outcome Other than Death:

Loss ESRD & Incident Hemodialysis

The EVA QI Program

Integrated Inpatient Early Vascular Access Planning
Targets Mortality & Hospitalization

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Vascular Access is the Largest Modifiable Mortality Risk Factor in Hemodialysis During 1st Year

Why the importance of *early* permanent vascular access placement (arteriovenous fistula / AVF, arteriovenous graft / AVG) and *early* discontinuation of tunneled dialysis catheter (TDC) use?
Grave Reality of Tunneled Dialysis Catheters

- TDCs are associated with increased complications compared to AV fistulas: infection, inadequate clearance, thrombosis, hospitalization
- **Most important**: TDCs are associated with *higher mortality* in prevalent and incident HD patients
- **Without** prior nephrology care, 91% of incident HD patients had TDCs at start of dialysis - 2.9% patients with AVFs
- **With >12 months** nephrology care, 55.1% patients had TDCs - 24.4% patients started with AVFs
- But over 80% of incident HD patients used a TDC at the initiation of HD in U.S. in 2007
- Only **14.5%** of incident HD patients used a functional AV fistula for their first outpatient HD treatment

USRDS Annual Data Report 2009
VA Type Affects Mortality in HD Patients

- In 79,545 prevalent HD patients (mean vintage 3.6 yrs)
  - Compared with AVFs, mortality risk is 34% greater for prevalent TDCs
- Effect is even more pronounced in the 4,741 incident HD patients (vintage <90 d)
  - Compared with AVFs, mortality risk is 119% greater for TDCs and 43% greater for baseline AV grafts

Lacson Jr E et al. AJKD 2009; 54:912-921
Vascular Access Type Accounts For HD vs. PD Mortality

**Observation:** PD patients – lower early mortality risk in Year 1 compared to HD patients - Why?

**Canadian Organ Replacement Register (2001-2008)**
38,512 Canadian

**Incident Dialysis (HD/PD) patients**
(63% HD-CVC; 17% HD-AVF/AVG; 19% PD)

- Year-1 mortality of HD-AVF/AVG patients (n=6,663): the **same** as PD patients (n=7,412)

- In contrast Year-1 mortality: **80% higher** for HD-CVC patients (n=24,437) (HR1.8, 95%CI:1.6-1.9)

**Conclusion:** Incident HD patients with AVF/AVG have the same Year-1 mortality rate as PD patients: *TDCs are the issue*

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Perl J et al. JASN 2011; 22:1113-1121
Risk of Death is Highest During 1st 120 Days

- One-half of deaths (46%) occur within the 1st 120 days
- Dialysis catheters account for largest attributable fraction of mortality risk during Year 1 (\( \leq 120 \) d and >120 d) on HD among modifiable risk factors
- Primary cause of death = Cardiac

27.5 (\( \leq 120 \) d) vs 21.9 deaths (>120 d) /100 pers-yrs

n = 4,802 incident HD patients (U.S.)

Dialysis Outcomes & Practice Patterns Study (DOPPS), 1996-2004

Converting Vascular Access Affects Mortality

- Conversion of vascular access in prior 4 months resulted in a change in mortality risk during next 8 months
  - In 70,852 prevalent HD patients
    - Converting TDC to AVF/AVG: 29% decrease in mortality risk
  - In 3,904 incident HD patients
    - Conversion of TDC to AVF: 50% decrease in mortality risk
    - Change in TDC to AVF/AVG: 15% decrease in mortality risk

Fresenius Medical Care, North America

Lacson Jr E et al. AJKD 2009; 54:912-921
Does this Vascular Access Issue Impact Patient Care in Our Hospital System? – and in the U.S. in general?

Early Vascular Access Planning & Early AV Fistula Placement Improve Survival when Hemodialysis Mortality Risk is Greatest During Year 1
Dialysis Catheter to Permanent Vascular Access in Incident HD Inpatients who Transition to Outpatient Hemodialysis

Mortality risk peaks in the first 90-120 days after starting hemodialysis when >80% incident U.S. HD patients use TDCs

Clinical Problem Targeted for Quality Improvement

- 18 UPMC-DCI/FMC JV Dialysis Units (The Renal Network/CMS-Form 2728)
- 1,335 JV Incident HD Patients (7/05-6/09)
  - Male/female (%) 56.0/44.0
  - Eur Amer/Afr Amer/Other (%) 66.0/33.2/1.0
- Pre-ESRD Nephrology Care (54.2%)
  - <6 Mo 41.2%, 6-12 Mo 31.3%, >12 Mo 27.5%
- Vascular access used for 1st outpatient HD treatment
  - TDC 82.5% vs. AVF 15.5% (AVG 2.0%)
  - If TDC, immature AVF present 12.5%
Dialysis Catheter to Permanent Vascular Access in Incident HD Inpatients who Transition to Outpatient Hemodialysis

• **Critical observation**: Of 175 incident UPP hemodialysis patients (Presbyterian Hospital) referred to outpatient dialysis units (4/08-12/08)
  - *85.1% initiated hemodialysis acutely as inpatients* (149 of 175)
  - Contributes to observed low rate of pre-ESRD nephrology care

• Current national vascular access guidelines (Fistula First) address only progression of CKD to ESRD in *outpatients* initiating hemodialysis (Stage 4 CKD: eGFR 15 – 29 ml/min/1.73m²)
  - Basis for concept of *inpatient early vascular access planning*

• **Baseline data** (4/08-6/10): 826 patients initiated on hemodialysis, 459 patients were discharged on hemodialysis to outpatient dialysis units

• Of these *incident HD inpatients*, we examined a subset of 88 patients discharged on hemodialysis to 8 of 18 JV dialysis units
  - *90.9% initiated hemodialysis using a TDC*
  - Only 13.6% with pre-existing AVF/AVG

Dialysis Catheter to Permanent Vascular Access in Incident HD Inpatients who Transition to Outpatient Hemodialysis

Inpatient Hemodialysis Initiation

Initial Vascular Access Used for Inpatient HD

90.9% TDC
9.1% AVF

13.6% Pts Pre-existing AVFs

12.2% Pts
mean 5d
median 7d

11.6% Pts
mean 2.8d
median 2.0d

54% Pts Initiating HD with TDC Received AVF/AVG

Ultrasound Vein Mapping

AV Fistula (AV Graft) Surgery/Creation

Inpatient (Pre-Discharge)

Outpatient (Post-Discharge)

Outpatient Hemodialysis Units

DISCHARGE

826 Inpatients Initiate HD

4/08-6/10

88.4% Pts
mean 112d
median 105.4d

459 Inpatients Discharged on HD

Ultrasound Vein Mapping

AV Fistula (AV Graft) Surgery/Creation

87.8% Pts
mean 92.4d
median 67.5d

Andersen S...Ho K. Amer J Kidney Dis 2011; 57(4): A21, P-19
In our subset of incident HD inpatients, conversion from TDC to permanent vascular access required a median time = 101 days.

Compare to: 4,532 U.S. incident HD patients (<30d) in DOPPS Study I, II

Bradbury BD et al. AJKD 2009; 53:804-814
Dialysis Catheter to Permanent Vascular Access in Incident HD Inpatients who Transition to Outpatient Hemodialysis

- Ultrasound vein mapping (VM) is a threshold event
  - VM preceded AVF placement in 93% of patients converting
  - VM to AVF surgery time = median 24 days
    BUT the pre-surgical TDC to VM time = median 60 days
  - Only 12% of VM occurred Pre-discharge
    Compared to 88% of VM occurring Post-discharge
  - Pre-discharge TDC to VM time was significantly shorter, median of 7 days vs median of 68 days post-discharge

- Suggests an inpatient QI intervention may decrease TDC conversion time (105 d) to permanent vascular access

Inpatient vascular access planning for incident HD inpatients is clinically appropriate if specific patients can be predicted early on to remain dialysis-dependent with no renal recovery at 3 months following dialysis initiation, thereby fulfilling the CMS definition of ESRD.

**Are There Data to Justify Early Vascular Access Planning in *Inpatients***?

Are there data predicting which inpatients acutely initiated on hemodialysis for AKI will require outpatient hemodialysis 3 months later for ESRD?

Yes. We have.
THE KEY: Low Renal Recovery in Inpatients Starting Hemodialysis Transitioning to Outpatient Hemodialysis

54 Inpatients Known CKD Status (no ESRD/CKD-T) Initiated on Hemodialysis

<table>
<thead>
<tr>
<th>Pre-Admission CKD Stage (GFR ml/min/1.73m²)</th>
<th>Total Patients</th>
<th>Prior Renal Care</th>
<th>Renal Recovery at 3 Months Post-Initiation</th>
</tr>
</thead>
<tbody>
<tr>
<td>No CKD</td>
<td>6 n/a</td>
<td>2 (33)</td>
<td></td>
</tr>
<tr>
<td>Stage 1 (≥90)</td>
<td>1 0 (0)</td>
<td>0 (0)</td>
<td></td>
</tr>
<tr>
<td>Stage 2 (60 to &lt;90)</td>
<td>0 n/a</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>Stage 3A (30 to &lt;45)</td>
<td>7 2 (29)</td>
<td>0 (0)</td>
<td></td>
</tr>
<tr>
<td>Stage 3B (45 to &lt;60)</td>
<td>14 6 (43)</td>
<td>0 (0)</td>
<td></td>
</tr>
<tr>
<td>Stage 4 (15 to &lt;30)</td>
<td>19 15 (79)</td>
<td>0 (0)</td>
<td></td>
</tr>
<tr>
<td>Stage 5 (&lt;15)</td>
<td>7 6 (86)</td>
<td>0 (0)</td>
<td></td>
</tr>
<tr>
<td>Total CKD Stages 1-5</td>
<td>48 29 (60)</td>
<td>0 (0)</td>
<td></td>
</tr>
</tbody>
</table>

**Pre-Admission CKD Stage**: Determined within 1 Yr prior to admission - nephrology documentation > other MD documentation > average of ≥ 3 baseline Cr values.

**Prior Renal Care**: Nephrology followup (including renal transplantation followup for CKD-T)

**Renal Recovery at 3 Months**: Discontinuation of hemodialysis as a result of improved renal function within 90 days of initiating hemodialysis as inpatient.

39% CKD 3A+3B
35% CKD 4
13% CKD 5
11% No CKD

Clinical Basis for Early Vascular Access Planning Initiative in Inpatients

Does Earlier AVF Placement Translate to Earlier AVF Use & Fewer TDC-Associated Treatments in Year 1?

**Functional** measure of outpatient TDC use,
**Defined**: \( \text{HD}_{\text{TDC}} = \frac{(\text{No. outpatient HD treatments using TDC})}{(\text{No. of total outpatient HD treatments})} \) during time interval (\( \text{HD}_{\text{TDC}} \) is inverse to AVF/G use)

- EARLY AVF/G group exhibited lower TDC use with mean \( \text{HD}_{\text{TDC}} \) values of 57% and 33% for months 3 to 6 months and months 6 to 12, respectively, in comparison to 91% and 74% for the LATE AVF/G group

**Early AVF placement**
\( \leq 90 \text{ days} \) (n=29)

**Late AVF placement**
> 90 days (n=38)

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Early Vascular Access Planning Initiative
New Paradigm: EVA

What is our proposed approach?

_Early Vascular Access Planning Initiative_ aims to reduce conversion time from TDC to permanent vascular access & reduce hospitalization and mortality of hemodialysis patients in Year 1
Shifting & Modifying Access Conversion Curve

Hypothesis: Early Vascular Access Conversion Reduces Mortality in Year 1

TDC to Permanent Vascular Access Conversion

% Patients with AVF (AVG)

Time (months)

Discharge

EVA

Mortality Rate

Usual
Effect of Inpatient Early Vascular Access Planning on Outpatient Hemodialysis Vascular Access Outcomes, Hospitalization, Mortality

UPMC Inpatient Early Vascular Access (EVA) Planning Initiative

– Approval: Nov. 4, 2010 to K. Ho / UPMC QI Review No. 0000593
– Nephrology-activated EMR menu (MD, MLP)
– Bundled, multi-component, multi-level mechanism at Presbyterian Hospital

EVA Basic Components

• ✓ Cerner EMR order menu “Hemodialysis Vascular Access Planning”
  – Vascular Surgery consultation for AVF/AVG placement
  – Vein mapping (ultrasound, bilateral upper extremities)
  – Hemodialysis Nurse Educator for vascular access (Acute HD Unit)

• ✓ Monthly tracking of incident HD inpatients by Acute Dialysis Unit
• ✓ Hemodialysis RN “champion” vascular access educator
• ✓ Cerner/Powerchart Vascular Access Planning Patient Tracking list
• ✓ Vascular Surgery NP “champion” planning coordinator
• ✓ PSD-created MD billing code – 9999903 – tag incident HD patients
• ❌ UPMC Hemodialysis Vascular Access Planning Real-Time Database
• ✓ The Renal Network-UPMC data-sharing agreement (submitted 2/12)
• ✓ Dialysis Clinic Inc (DCI) provider QI data-sharing agreement
• ❌ Fresenius Medical Care (FMC) provider QI data-sharing agreement
• ❌ Electronic hospital discharge tracking of hemodialysis patients
Effect of Inpatient Early Vascular Access Planning on Outpatient Hemodialysis Vascular Access Outcomes, Hospitalization, Mortality

**EVA QI Measures**

- Pre-implementation baseline status of inpatient vascular access planning
- Evaluate post-discharge outpatient effectiveness of QI mechanism

  Data-sharing agreements: The Renal Network, DCI and FMC dialysis providers

- **Primary Measures**
  
  - **EVA planning event occurrence** (vein mapping, Vascular Surgery consultation, vascular surgery, followup visit)
  
  - **Conversion time from initial inpatient TDC placement to (a) initial AVF/AVG placement (inpatient or outpatient) and (b) initial AVF/AVG use (two-needle) in outpatient dialysis center setting**
  
  - **Hospitalization & mortality rates of incident HD inpatient patients during the first 6 months and 12 months post-index hospital discharge**

  - date of initial TDC placement
  - date of vein mapping procedure
  - date of Vascular Surgery inpatient / outpatient consultation
  - date of Vascular Surgery outpatient follow-up appointment
  - date of initial AVF/AVG placement (inpatient or outpatient)
  - date of conversion from TDC use to AVF/AVG use for outpatient HD treatments
  - duration of pre-ESRD nephrology care prior to hemodialysis initiation
  - occurrence of pre-dialysis erythropoiesis stimulating agent (ESA) therapy
  - total hospital days post-index hospitalization within 1 year
  - mortality events post-index hospitalization within 1 year
Effect of Inpatient Early Vascular Access Planning on Outpatient Hemodialysis Vascular Access Outcomes, Hospitalization, Mortality

**EVA PROJECT** QI Review Number 0000593
Approved 11/4/10 UPMC QI Review Committee

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- **Dialysis Clinics Inc**
  Klemens Meyer, MD (New England Medical Center); Geraldine Bojarski, RN, CNN, CCRN
Acute Kidney Injury - Early Vascular Access
AKI - EVA Transition of Care Predictive Analytics

Can an analytical system be developed to predict which inpatients -- develop acute kidney injury (AKI), initiate on hemodialysis, transition to ESRD on hemodialysis -- while assessing outpatient outcomes (vascular, hospitalization, mortality)?
Contact Kevin Ho, M.D. for AKI - EVA Transition of Care Predictive Analytics Model & Data Concept presented but not available online
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