Appropriate Dialysis Access - Timing & Preparation for Dialysis Initiation

KDIGO Controversies Conference on Dialysis Initiation, Modality Choice and Prescription, Madrid, Spain, Jan 2018

Kevan Polkinghorne

Monash Medical Centre, Melbourne, Australia

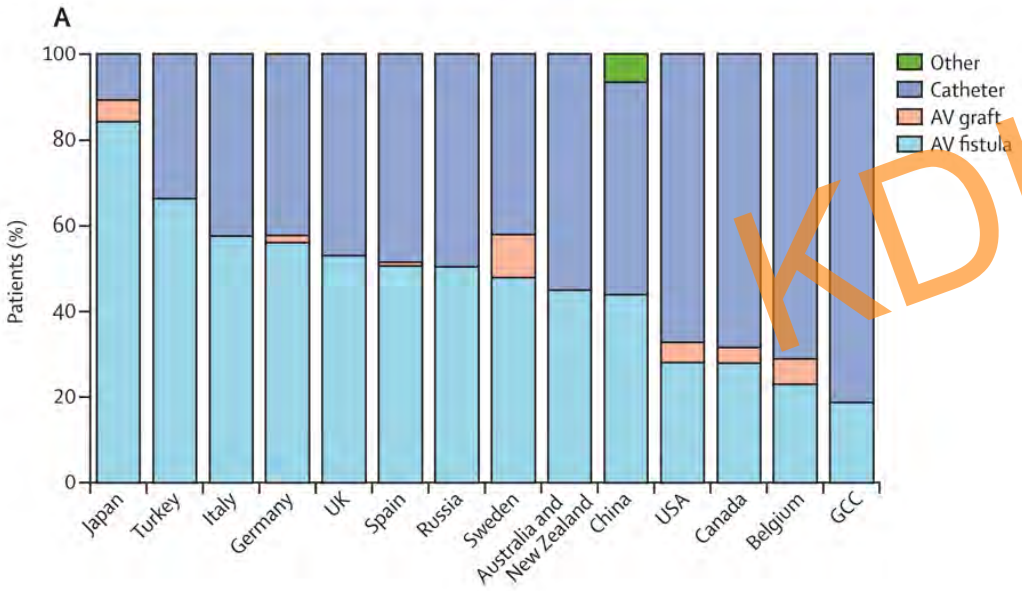
Talk Summary

- Dialysis Access Practice Patterns
- Dialysis Access Types
  - Advantages/Disadvantages
  - Patency/Complications
- Determining the Timing of Dialysis Access Placement
  - Individual Patient Factors - Morbidity
  - Physician Based Factors
  - "Patient Factors" – Traits/Cultural Factors

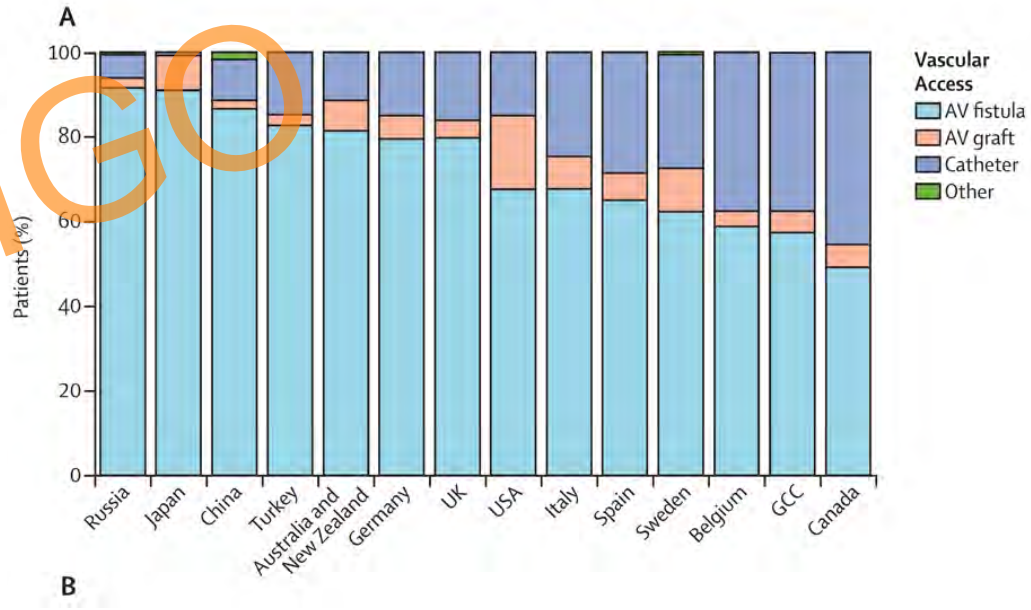
Current Dialysis Access Access Practice

Current Dialysis Access Access Practice (2012-2015)

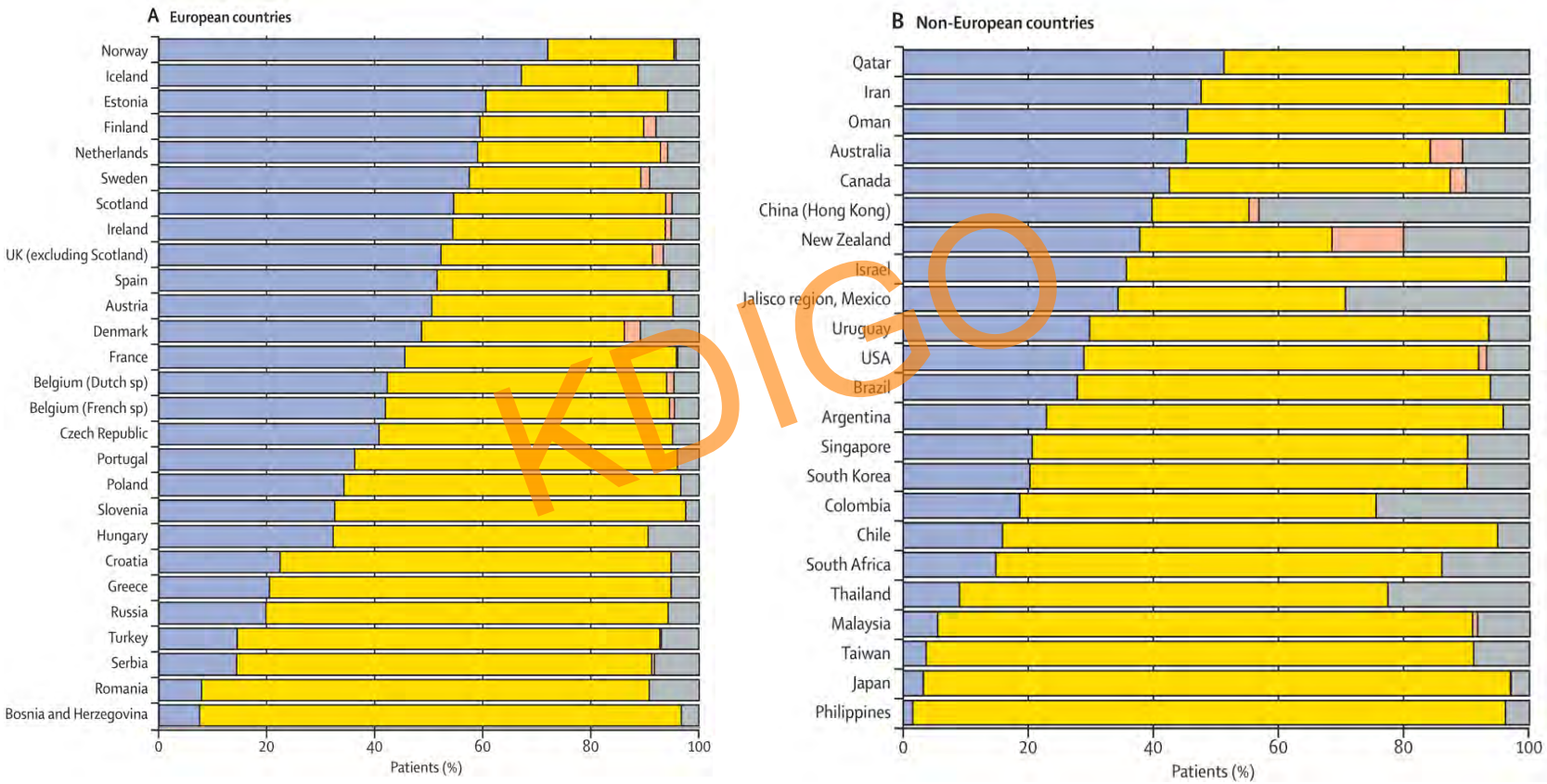
Incident Patients



Prevalent Patients



Peritoneal Dialysis (2013)



Dialysis Access Types

- Advantage and Disadvantages

Arteriovenous fistula

- Advantages
  - Lower risk of Mortality (?)
  - Lowest infection risk
  - Lower risk of hospitalisation
  - Longer patency once established
  - Cheaper especially if no primary failure
  - Adequate Blood Flow once mature

- Disadvantages
  - High rate primary failure
  - Prolonged maturation time
  - Ischaemic Steal
  - Not suitable in all patients
    - Elderly ?
    - Sign morbidity ?
  - ?Expensive

Arteriovenous graft

- Advantages
  - No prolonged maturation period
  - Patency comparable to AVF if include primary failure
  - Lower infection risk compared to CVC
  - ? Good Choice in Elderly
  - Reduce line exposure time
- Disadvantages
  - Higher Infection risk compared to AVF
  - Need for (multiple) interventions to maintain patency
  - Vascular Steal
  - Cost

CVC

- Advantages
  - No maturation period
  - Suitable in Co-morbid Patients
  - Patient Factors eg Needle Phobia
- Disadvantages
  - Increased Mortality (?)
  - Infection
  - Dysfunction common
  - Central Venous Stenosis
  - Higher costs
  - Patient Factors (dressings etc)

Peritoneal Dialysis

- Advantages
  - Survival Advantage in first year?
  - No prolonged maturation period
  - Home based therapy (Predominantly)
  - QOL ?
- Disadvantages
  - Home based therapy
  - Infection
  - Patency/Technique Failure
  - Not suitable for a large number of patients

Dialysis Access Types

- Patency
- Other Complications
- Mortality

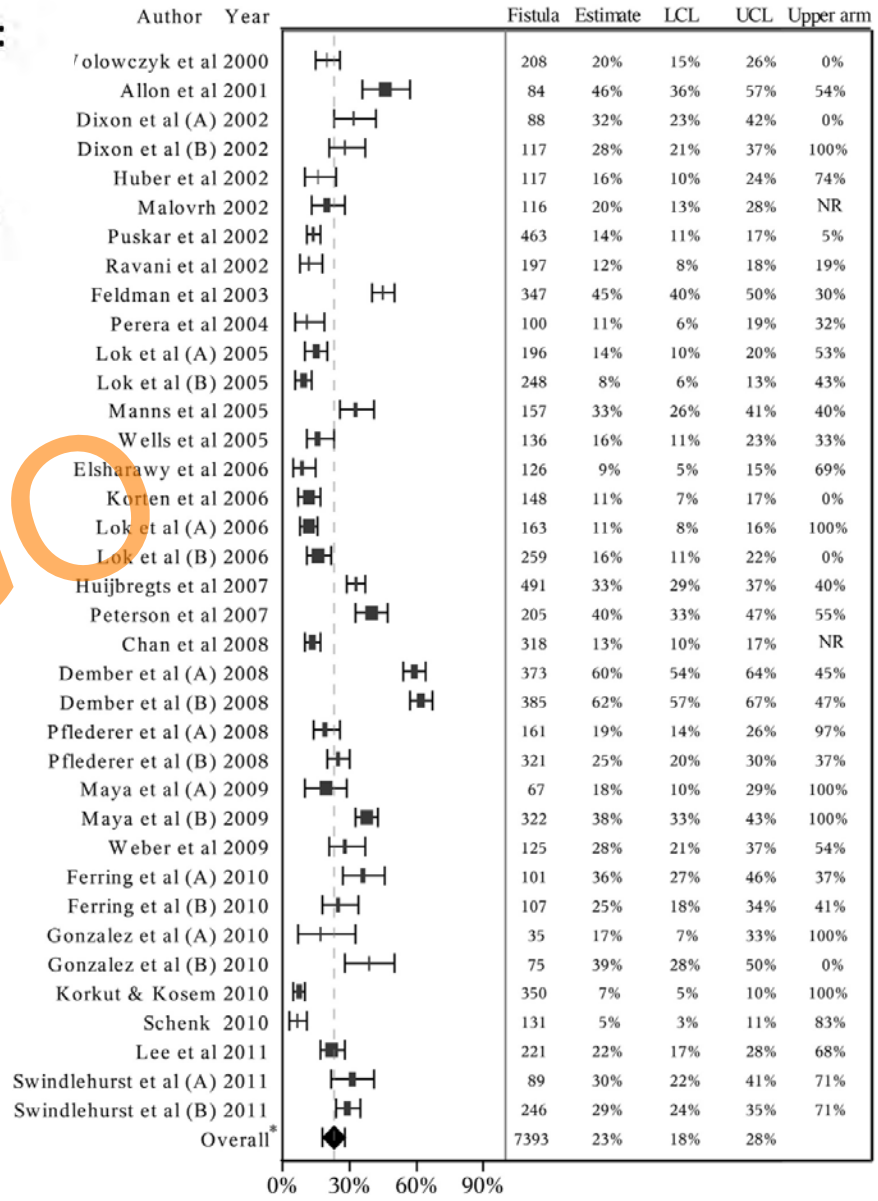
Vascular Access Patency

- Patency definitions vary enormously in the literature
- Need to consider effects of changes in nature of dialysis population from 1980's – 1990's to 2000's
- Majority Non-randomized comparisons

Patency Rates of the Arteriovenous Fistula for Hemodialysis: A Systematic Review and Meta-analysis

Ahmed A. Al-Jaishi, MSc,[1,2,3] Matthew J. Oliver, MD,[4] Sonia M. Thomas, MSc(c),[1,2,3] Charmaine E. Lok, MD, MSc,[4,5,6] Joyce C. Zhang, MD(c),[2,3] Amit X. Garg, MD, PhD,[1,2,3] Sarah D. Kosa, MSc(c),[6] Robert R. Quinn, MD,[7] and Louise M. Moist, MD, MSc[1,2,3]

Primary Failure Rate 23% (18-28%)



Al-Jaishi etal , AJKD 2014

Arteriovenous Fistulae for Haemodialysis: A Systematic Review and Meta-analysis of Efficacy and Safety Outcomes

L.C. Bylsma [a], S.M. Gage [b,c], H. Reichert [a], S.L.M. Dahl [b,c], J.H. Lawson [b,c,*]

[a] EpidStat Institute, Ann Arbor, MI, USA
[b] Humacyte Incorporated, Morrisville, NC, USA
[c] Department of Surgery, Duke University, Durham, NC, USA

Overall 1 year Primary Unassisted Patency 64%

Mean of 20 months

Table 1. Meta-analyses of primary unassisted patency in arteriovenous fistulae.

Analysis	1 year rate				Mean in months			
	n^a	n^b	Rate (95% CI)	I^2; p-Het	n^a	n^b	Mean (95% CI)	I^2; p-Het
Overall	59	11,433	0.64 (0.59–0.68)	94.6%; <.001	52	10,735	20.09 (17.65–22.54)	99.53%; <.001
Overall restricted	43	7919	0.63 (0.58–0.67)	93.1%; <.001	37	7221	20.71 (17.82–23.60)	99.51%; <.001
USA	18	3379	0.57 (0.49–0.64)	93.7%; <.001	18	3379	18.23 (14.33–22.13)	98.93%; <.001
Other countries	41	8054	0.66 (0.61–0.71)	94.8%; <.001	34	7356	21.17 (17.99–24.34)	99.64%; <.001
<65 years old	7	1373	0.63 (0.51–0.72)	93.4%; <.001	3	936	16.41 (9.09–23.74)	98.14%; <.001
65+ years old	10	1194	0.60 (0.52–0.68)	85.5%; <.001	6	883	19.10 (13.48–24.73)	97.82%; <.001
Diabetic	7	377	0.67 (0.60–0.73)	25.4%; .235	4	251	28.78 (19.3–38.26)	92.77%; <.001
Non-diabetic	6	848	0.72 (0.61–0.80)	88.3%; <.001	3	331	27.06 (9.34–44.77)	98.97%; <.001
Incident access	14	3688	0.69 (0.57–0.77)	96.8%; <.001	6	2807	15.49 (8.91–22.06)	99.69%; <.001
Prevalent access	4	183	0.57 (0.42–0.70)	58.1%; .067	4	183	13.34 (9.93–16.76)	78.51%; .003
Access created post-initiation of dialysis	3	199	0.54 (0.46–0.61)	0.0%; .379	3	199	9.00 (0.85–17.16)	99.08%; <.001
Location: upper arm	4	401	0.69 (0.37–0.87)	95.9%; <.001	4	401	23.89 (12.36–35.43)	98.74%; <.001
Location: forearm/wrist (RCAVF, snuffbox, ulnaris)	15	1718	0.55 (0.46–0.63)	89.9%; <.001	22	1768	21.14 (18.09–24.20)	98.76%; <.001
Location: mixed arm	18	4262	0.52 (0.46–0.58)	92.3%; <.001	16	4472	15.51 (13.07–18.55)	98.47%; <.001
Location: brachiocephalic only	10	996	0.52 (0.41–0.61)	87.1%; <.001	10	996	16.12 (12.28–19.95)	97.32%; <.001
Location: brachiobasilic and/or brachiobrachial only	16	1264	0.55 (0.47–0.63)	82.6%; <.001	16	1264	17.52 (13.77–21.26)	96.88%; <.001
Basilic vein transposition	17	1237	0.57 (0.49–0.65)	83.5%; <.001	17	1237	18.51 (14.93–22.08)	96.71%; <.001
No superficialisation	17	2329	0.61 (0.54–0.68)	86.7%; <.001	22	2379	17.91 (15.45–20.38)	98.27%; <.001
Mixed superficialisation	15	3376	0.59 (0.49–0.67)	95.8%; <.001	15	3376	19.58 (14.91–24.24)	99.13%; <.001
Studies conducted pre-2005	19	3375	0.71 (0.63–0.77)	93.5%; <.001	11	3026	20.30 (15.27–25.33)	99.29%; <.001
Mixed years (pre- and post-2005)	18	4785	0.62 (0.56–0.68)	94.0%; <.001	18	4789	22.43 (17.76–27.10)	99.23%; <.001
Studies conducted post-2005	17	2603	0.54 (0.44–0.63)	94.9%; <.001	18	2653	18.73 (15.56–21.89)	99.24%; <.001

RCAVF = radiocephalic arteriovenous fistula.
[a] Number of studies.
[b] Number of accesses.

Bylsma, et al Eur J Vasc Endovasc Surg 2017

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Overall 1 year Secondary Patency 79% Mean of 28 months

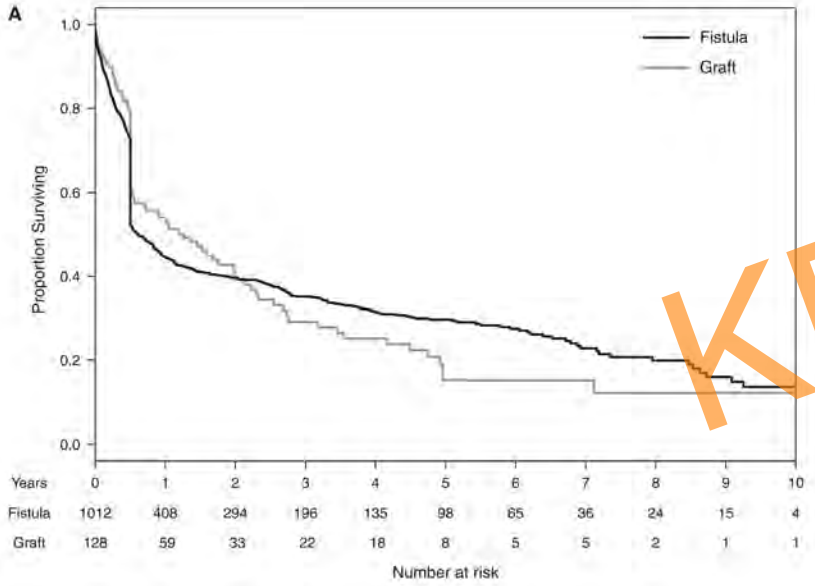
Analysis	1 year rate				Mean in months			
	n^a	n^b	Rate (95% CI)	I^2; p-Het	n^a	n^b	Mean (95% CI)	I^2; p-Het
Studies conducted pre-2005	21	3171	0.81 (0.75–0.86)	89.9%; <.001	14	2495	27.45 (22.56–32.34)	98.37%; <.001
Mixed years (pre- and post-2005)	22	6975	0.82 (0.75–0.87)	97.3%; <.001	21	6875	35.63 (29.20–42.06)	99.74%; <.001
Studies conducted post-2005	18	2813	0.75 (0.68–0.80)	90.5%; <.001	18	2583	23.27 (19.24–27.30)	99.54%; <.001

Bylsma, et al Eur J Vasc Endovasc Surg 2017

Cumulative Patency of Contemporary Fistulas versus Grafts (2000–2010)

Charmaine E. Lok, Jessica M. Sontrop,† George Tomlinson,‡ Dheeraj Rajan,§ Mark Cattral,§ George Oreopoulos,‖ Jeremy Harris,¶ and Louise Moist†*

Primary Failure Included



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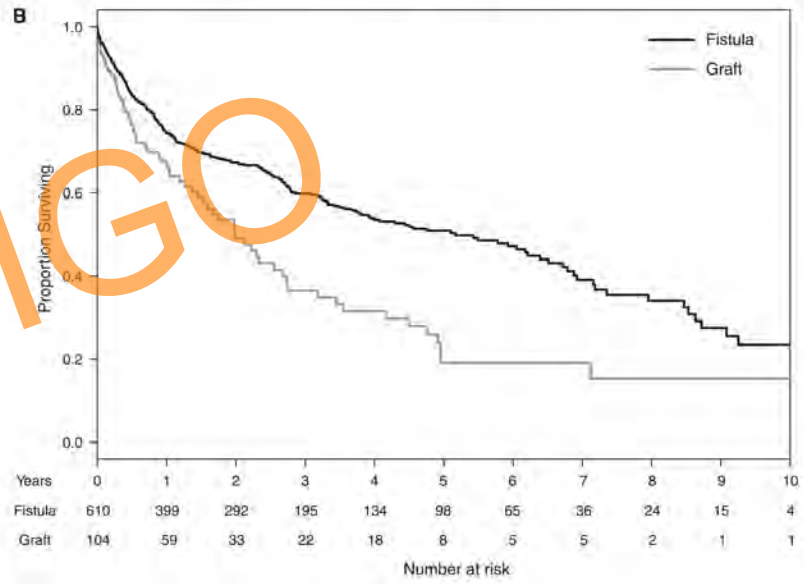


2x angioplasties in AVG, more thrombosis

Lok, C. E., et al cJASN 2013

CVC Patency

- No Large contemporary studies of CVC complications.
- CVC Patency estimates range between 34 to 78% over 1 year
  - » NDT 1992, NDT 2004, J Vasc Radiol 2013
- Up to 87% of catheters develop dysfunction during the course of their use and 30% develop dysfunction monthly
  - » AJKD 1996, In J Nephrol 2011
- <10% of CVC survive 1 year without need for intervention

CVC and Central Vein Stenosis

- Central Vein Stenosis can be as high as 40% in haemodialysis population
- Risk factors include previous CVC placement, number of CVC's and duration of CVC placement.
- Again not well studied

Other Dialysis Access Complications

Vascular Access Complications: DOPPS

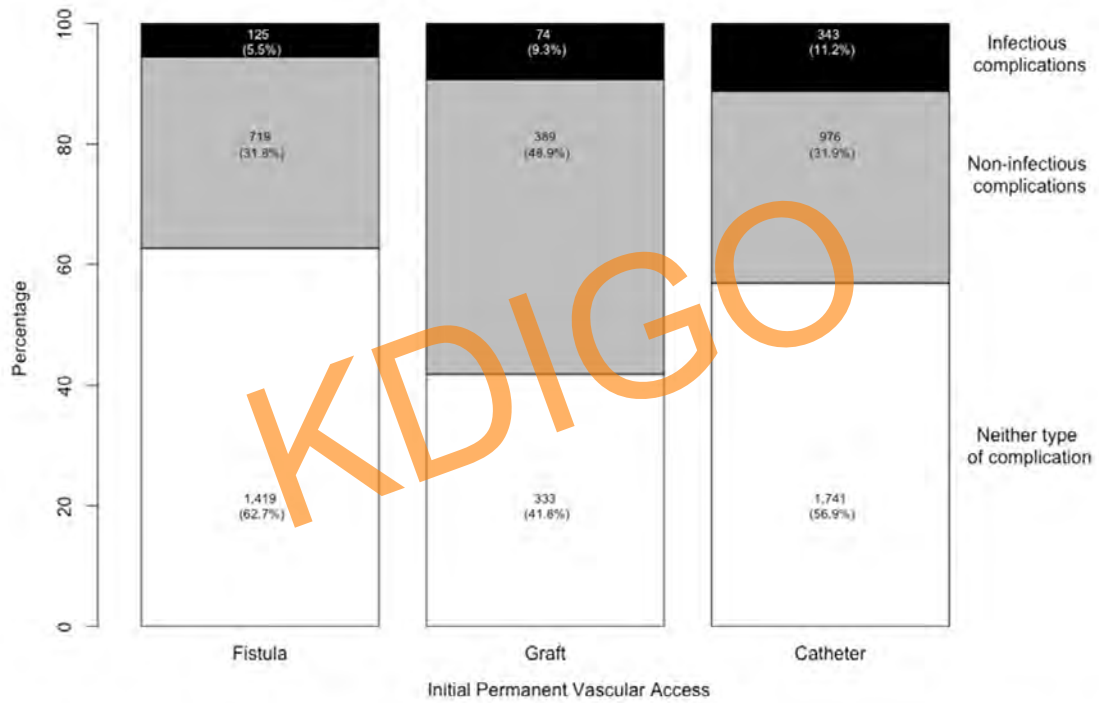
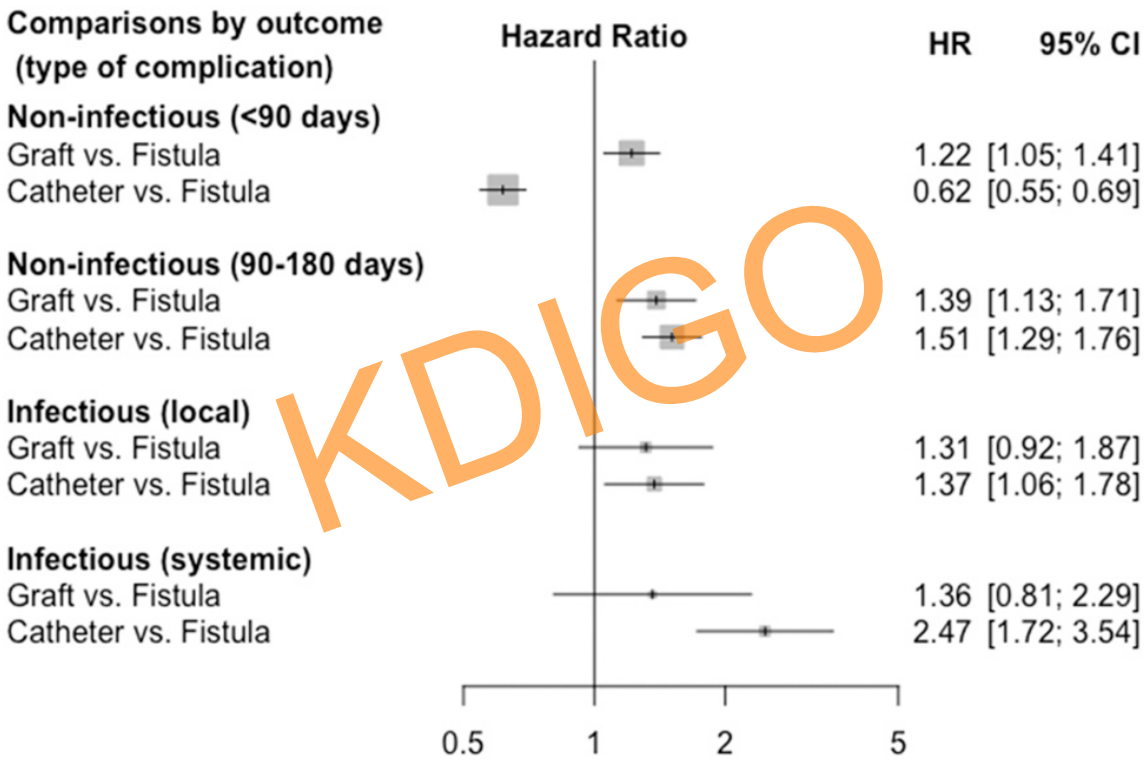


Figure 3. | Distribution of access complications by initial permanent access type. Access complications include noninfectious complications only (n=2084) and any infectious complications (n=542). In this plot, people who experienced both complications (n=325) were included in the infectious complication group only.

Ravani P cJASN 2017.

Vascular Access Complication: DOPPS



Ravani P cJASN 2017.

Other Dialysis Access Complications

Associations between Hemodialysis Access Type and Clinical Outcomes: A Systematic Review

Reference Annual Event Risk[a]	Vascular Access Comparison	Meta-Analytical RR (95% CI)	Heterogeneity (I^2; *P* Value)	Number of Additional Events per 1000 Patients Exposed per Year (95% CI)
Major cardiovascular events				
0.10 for fistula users	Catheter versus fistula	1.38 (1.24–1.54)	0%; 0.47	38 (24–54) excess with catheter
0.11 for graft users	Catheter versus graft	1.26 (1.11–1.43)	0%; 0.57	28 (12–46) excess with catheter
0.10 for fistula users	Graft versus fistula	1.07 (0.95–1.21)	0%; 0.52	7 (−5–21)[b] excess with graft
Fatal infections				
0.03 for fistula users	Catheter versus fistula	2.12 (1.79–2.52)	0%; 0.82	28 (20–38) excess with catheter
0.04 for graft users	Catheter versus graft	1.49 (1.15–1.93)	0%; 0.23	17 (5–32) excess with catheter
0.03 for fistula users	Graft versus fistula	1.36 (1.17–1.58)	0%; 0.78	9 (4–15) excess with graft

Also No Differences Age<65 versus Age≥65 years

Ravani, P., et al JASN 2013

Dialysis Access and Mortality

Woman Accused Of Cutting Catheter, Killing Husband

POSTED: 9:07 am CDT September 21, 2007
UPDATED: 9:25 am CDT September 21, 2007

BRYAN, Texas -- A 23-year-old Bryan woman faces a murder indictment in the January death of her 25-year-old husband.

The Brazos County grand jury accused Dorian Michelle Cooper of killing Shawn Cooper by cutting his catheter

Bryan police said the man had been receiving dialysis treatment at home when his catheter was cut. Cooper was hospitalized on life support for several days before he died.

No possible motive for killing has been disclosed.

Cooper was arrested Thursday and booked into the Brazos County Jail in Bryan. No bond has been set.

Dialysis Access and Mortality

Associations between Hemodialysis Access Type and Clinical Outcomes: A Systematic Review

Reference Annual Event Risk[a]	Vascular Access Comparison	Meta-Analytical RR (95% CI)	Heterogeneity (I^2; *P* Value)	Number of Additional Events per 1000 Patients Exposed per Year (95% CI)
All-cause mortality				
0.20 for fistula users	Catheter versus fistula	1.53 (1.40–1.67)	83.9%; <0.01	106 (80–134) excess with catheter
0.24 for graft users	Catheter versus graft	1.38 (1.25–1.52)	86.2%; <0.01	91 (60–125) excess with catheter
0.20 for fistula users	Graft versus fistula	1.18 (1.09–1.27)	82.1%; <0.01	36 (18–54) excess with graft

Also No Differences Age<65 versus Age≥65 years

Selection Bias, Residual Confounding

Ravani, P., et al JASN 2013

Determining the Timing of Dialysis Access Placement

Determining the Timing of Dialysis Access Placement

- What do the guidelines say?

KDIGO

Timing of PD Catheter Placement

- ISPD Guidelines 2010
  - We suggest that, whenever possible, catheter insertion should be performed at least 2 weeks before starting PD.
- UK Renal Association 2017
  - We recommend that, where possible, timing of PD catheter insertion should be planned to accommodate patient convenience, commencement of training between 10 days and 6 weeks and before RRT is essential to enable correction of early catheter-related problems without the need for temporary haemodialysis.
- KDOQI 2006
  - A peritoneal dialysis (PD) catheter ideally should be placed at least 2 weeks before the anticipated start of dialysis treatments.
  - A backup HD access does not need to be placed in most patients. A PD catheter may be used as a bridge for a fistula in “appropriate” patients.

Timing of AVF/AVG Creation ??

- KHA/CARI Guidelines 2013
  - All patients, especially those with co-morbid conditions, should be referred to a vascular access surgeon well in advance of the anticipated need for haemodialysis. The exact timing depends on patient-related factors and local facilities.
  - Several procedures may be required to establish a useable native AVF. Maturation of AVF may be prolonged (3 months or more) in some patients.

- KDOQI 2006
  - A fistula should be placed at least 6 months before the anticipated start of HD treatments. This timing allows for access evaluation and additional time for revision to ensure a working fistula is available at initiation of dialysis therapy.
  - A graft should, in most cases, be placed at least 3 to 6 weeks before the anticipated start of HD therapy. Some newer graft materials may be cannulated immediately after placement.

Timing of AVF/AVG Creation ??

- Canadian Society of Nephrology
  - Set specific targets for tasks during CKD Stages 3, 4, and 5 management according to the rate of decline of eGFR:
  - (a) Assuming a usual rate of decline of 2–5 ml/min/yr, modality education should usually begin at eGFR=30 ml/min, modality decisions should usually be finalized by eGFR=20 ml/min, and that those who choose HD (and who are expected to survive long enough and are suitable), should usually be referred to a vascular surgeon for consideration/evaluation of AVF when eGFR=15–20 ml/min (as per 2006 CSN guideline).
  - (b) In patients whose rate of decline of eGFR over time is greater than 5 ml/minute/year, these tasks should be undertaken earlier than proposed before. . . Assuming that local resources are available, we recommend that if and when patients reach eGFR=15 ml/minute and are unable or unwilling to make a modality decision, consideration should be given to refer suitable patients to the VA surgical team for assessment concerning possible dialysis access options. . . Note that this recommendation is about when to consider referral to the surgeon for evaluation, and does not contemplate when vascular surgery is to be scheduled.

Determining the Timing of Dialysis Access Placement

- *1. Individual Patient Factors - Morbidity*
- *2. Physician Based Factors*
- *3. "Patient Factors" – Traits/Cultural Factors*

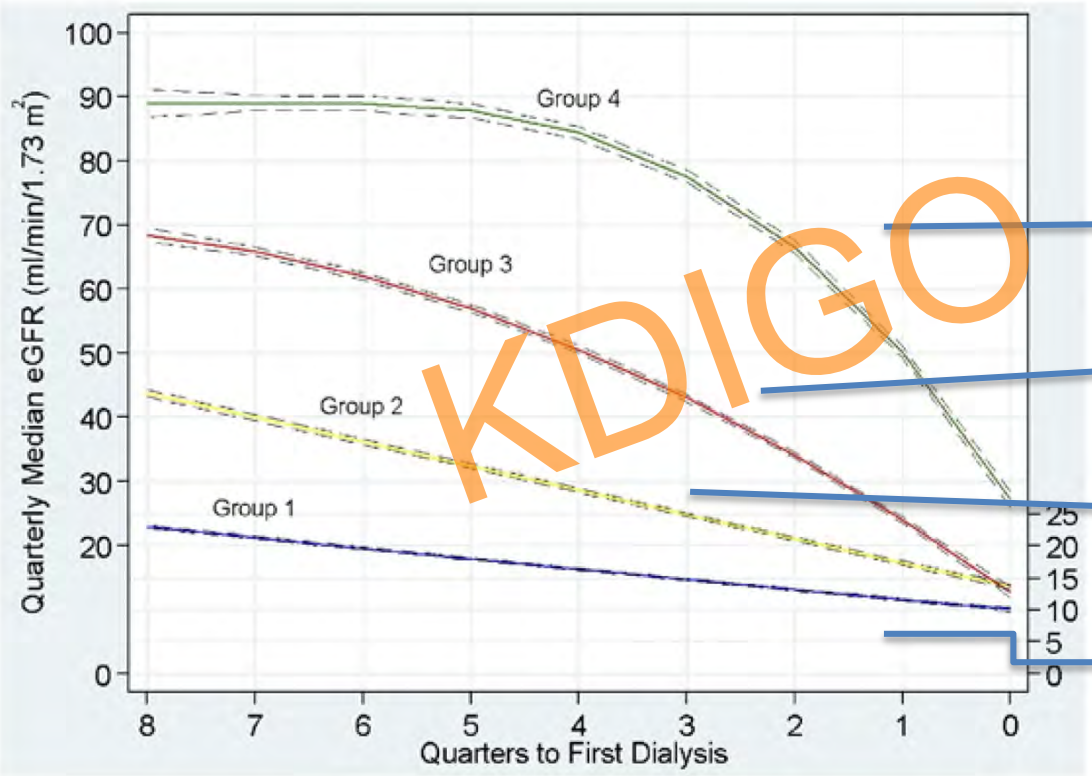
Determining the Timing of Dialysis Access Placement

- *1. Individual Patient Factors*
- A number of individual patient factors are associated with primary failure/catheter use e.g. Age, gender, DM, vascular disease
- Are largely un-modifiable factors

Determining the Timing of Dialysis Access Placement

- *2. "Physician" Based Factors*
  - Level of kidney function
  - Trajectory of decline

Trajectories of Kidney Function Decline in the 2 Years Before Initiation of Long-term Dialysis



% of Cohort

3%

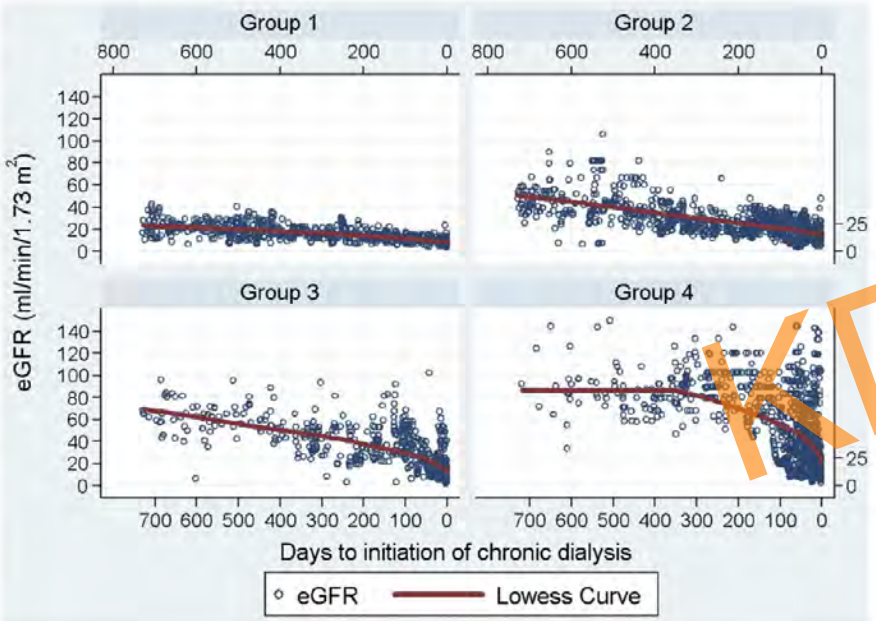
9%

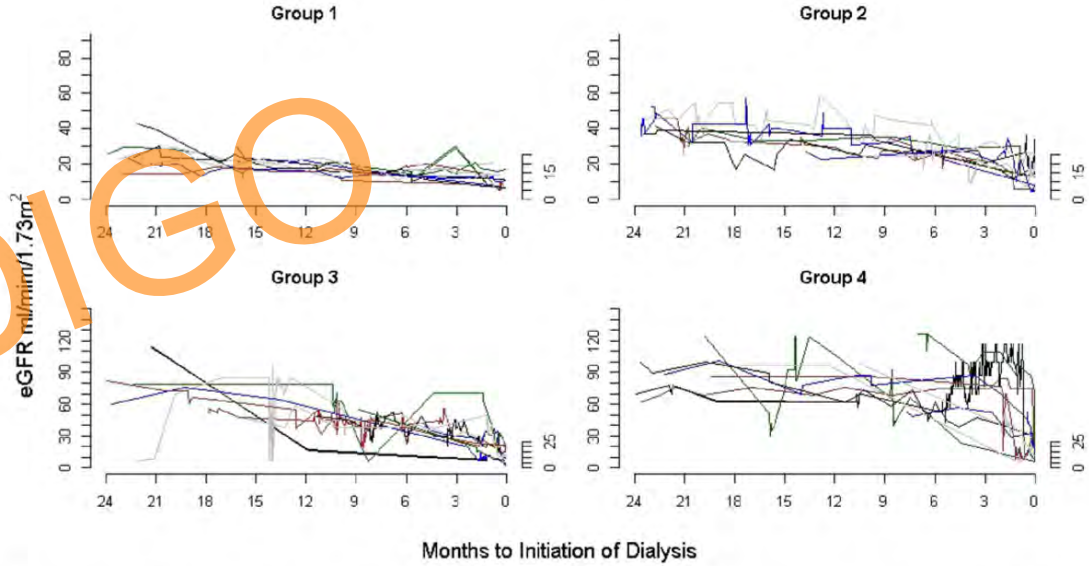
25%

63%

O'Hare et al. AJKD, 2012

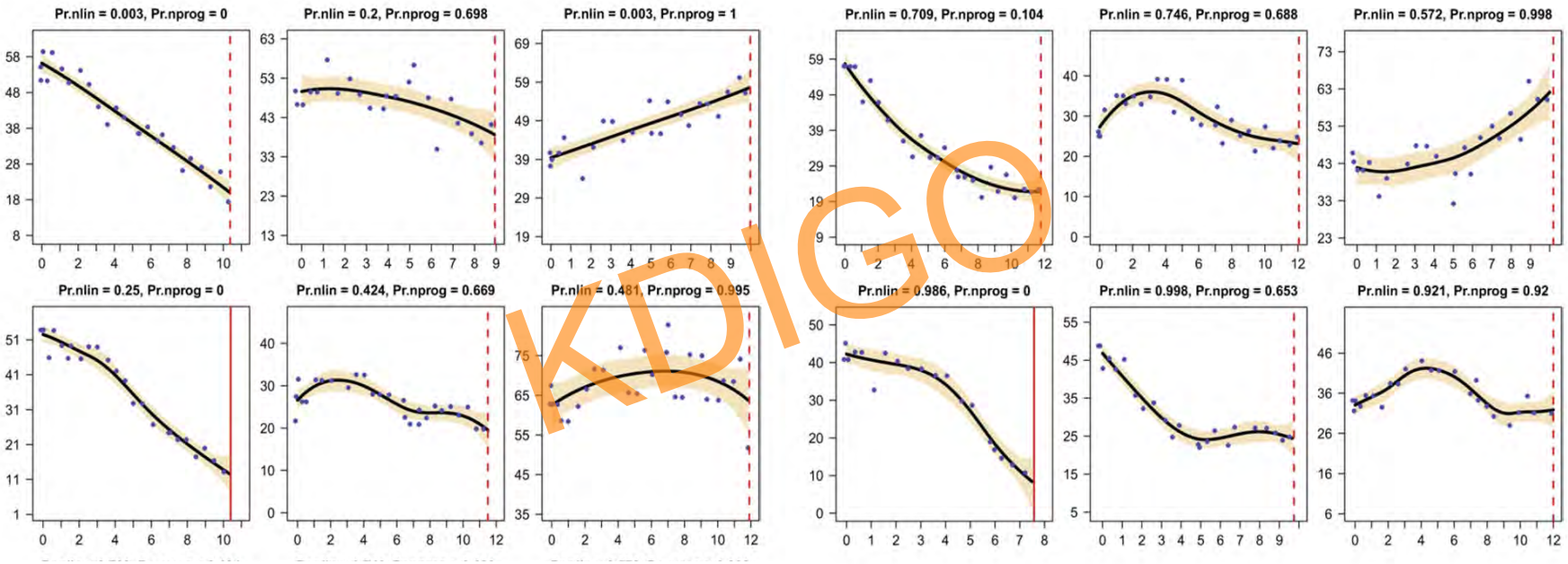
Trajectories of Kidney Function Decline in the 2 Years Before Initiation of Long-term Dialysis





O'Hare et al. AJKD, 2012

Longitudinal Progression Trajectory of GFR Among Patients With CKD



African American Study of Kidney Disease and Hypertension

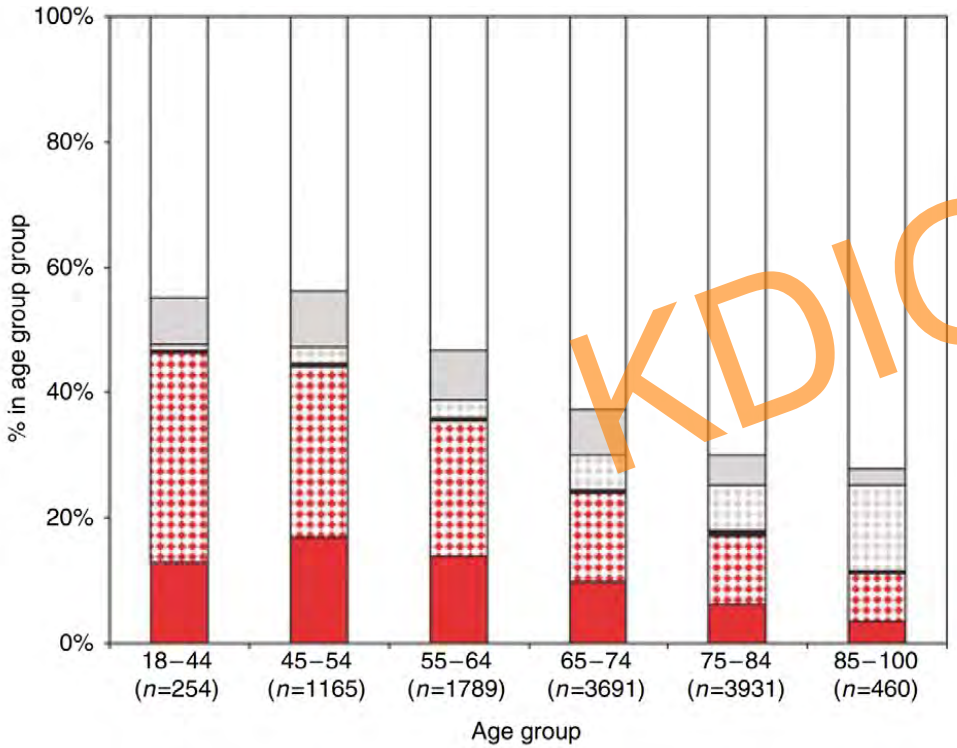
Li L et al AJKD 2012

Determining the Timing of Dialysis Access Placement

- *2. "Physician" Based Factors*
  - Level of kidney function
  - Trajectory of decline
  - Likelihood of Starting Dialysis if AVF created

When to refer patients with chronic kidney disease for vascular access surgery: Should age be a consideration?

AM O'Hare[1,2], D Bertenthal[2], LC Walter[1,2], AX Garg[3], K Covinsky[1,2], JS Kaufman[4], RA Rodriguez[5] and M Allon[6]



eGFR <25 ml/min, 1 yr F/U

- survived without dialysis – access not placed
- survived without dialysis – access placed
- died without dialysis – access not placed
- died without dialysis – access placed
- started dialysis – access not placed
- started dialysis – access placed

O'Hare et al Kidney Int 2007: 71; 555–561

When to refer patients with chronic kidney disease for vascular access surgery: Should age be a consideration?

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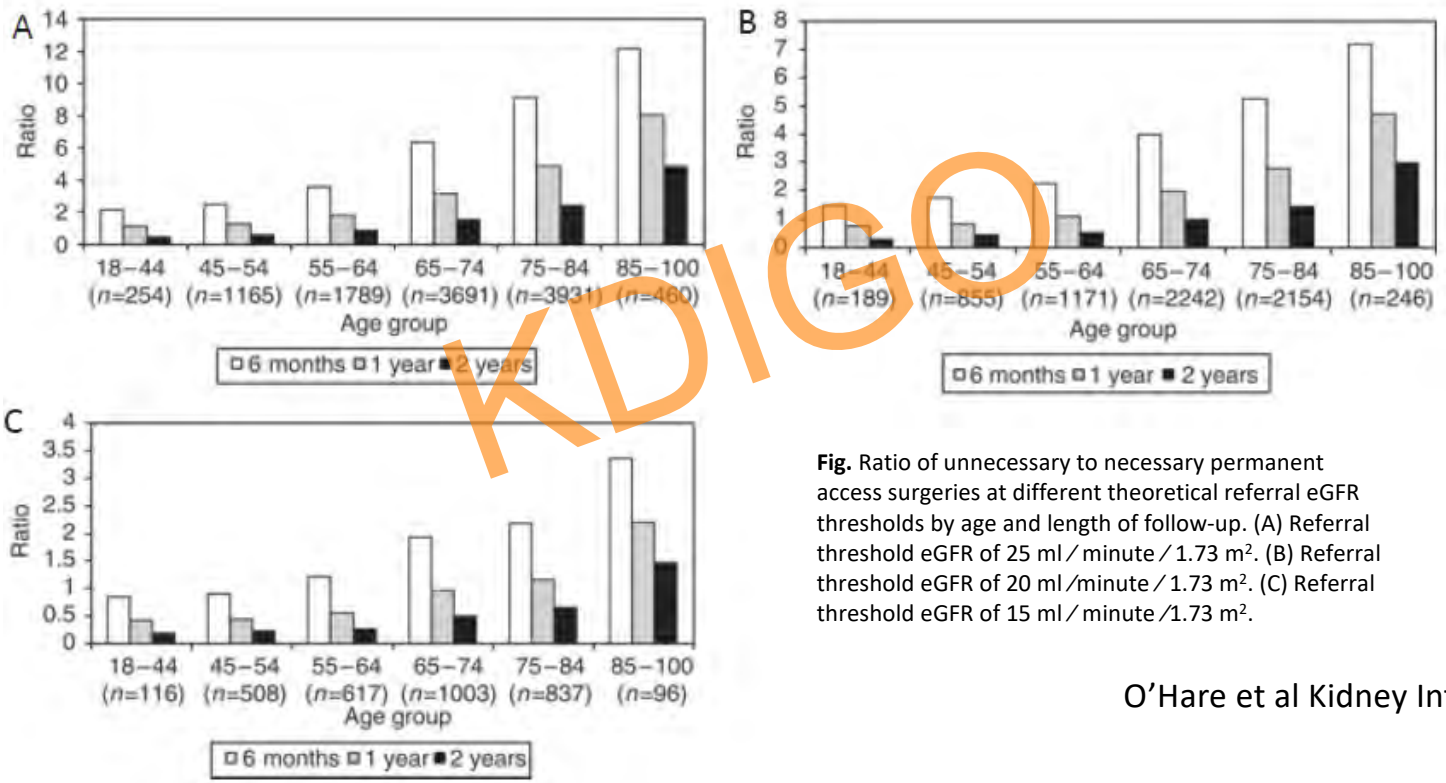
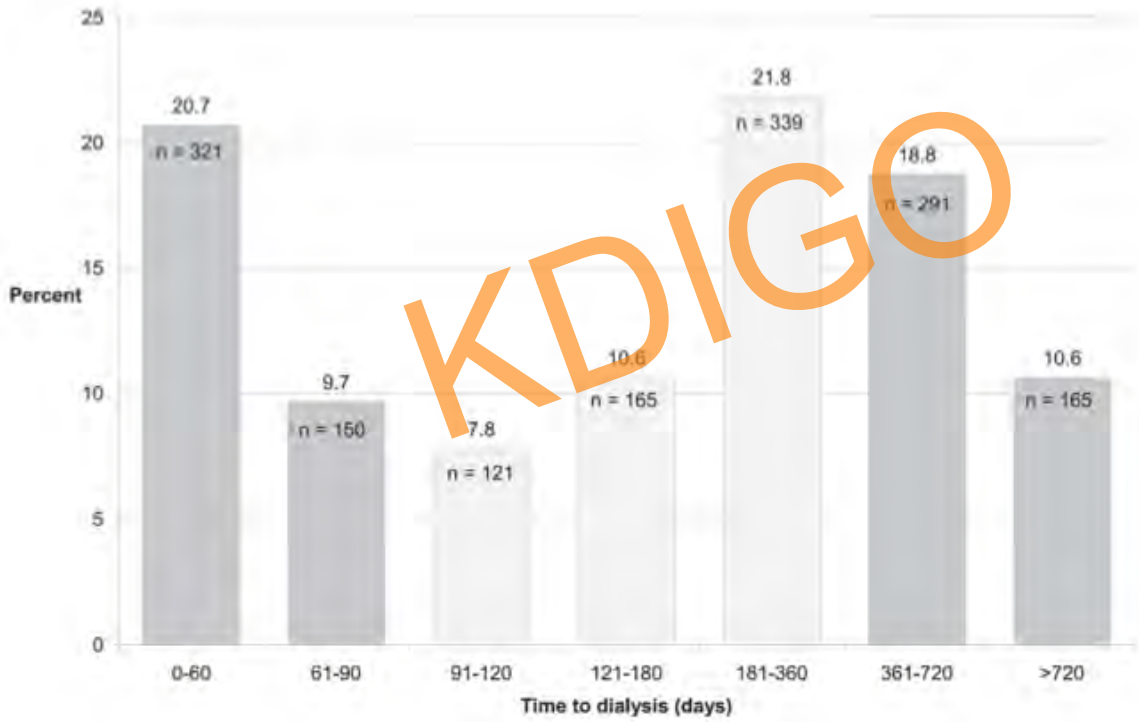


Fig. Ratio of unnecessary to necessary permanent access surgeries at different theoretical referral eGFR thresholds by age and length of follow-up. (A) Referral threshold eGFR of 25 ml / minute / 1.73 m^2. (B) Referral threshold eGFR of 20 ml /minute / 1.73 m^2. (C) Referral threshold eGFR of 15 ml / minute /1.73 m^2.

O'Hare et al Kidney Int 2007: 71; 555–561

Likelihood of Starting Dialysis after Incident Fistula Creation

Matthew J. Oliver,† Robert R. Quinn,‡ Amit X. Garg,§‖ S. Joseph Kim,*†‖ Ron Wald,* and J. Michael Paterson†‖¶*



Oliver et al. cJASN, 2012

Likelihood of Starting Dialysis after Incident Fistula Creation

Matthew J. Oliver,*† Robert R. Quinn,* Amit X. Garg,‡§ S. Joseph Kim,*†‖ Ron Wald,* and J. Michael Paterson†‖¶

Increased age associated with lower "hazard" of commencing dialysis

Table 2. Association of age, sex, and comorbidity on the likelihood of initiating dialysis after incident fistula creation compared with remaining in predialysis, adjusting for the competing risk of death

Covariate	Hazard Ratios	95% CI	*P* Value
Age: 18–54 (reference)			
55–64	0.90	0.78–1.05	0.17
65–74	0.79	0.69–0.91	<0.001
75–84	0.67	0.58–0.78	<0.001
85+	0.56	0.41–0.75	<0.001
Sex: male (reference)			
Female	0.90	0.81–1.00	0.04
Deyo-Charlson Comorbidity Index: 0–2 (reference)			
3–4	1.04	0.92–1.16	0.55
≥5	1.22	1.07–1.39	0.003

CI, confidence interval.

Oliver et al. cJASN, 2012

Determining the Timing of Dialysis Access Placement

- *1. Individual Patient Factors - Morbidity*
- *2. Physician Based Factors*
- *3. "Patient Factors" – Traits/Cultural Factors*
  - Patient Education

Patient Dialysis Knowledge Is Associated with Permanent Arteriovenous Access Use in Chronic Hemodialysis

Kerri L. Cavanaugh,* Rebecca L. Wingard,† Raymond M. Hakim,*† Tom A. Elasy,‡ and T. Alp Ikizler*

- Assessed 490 incident haemodialysis patients with the Chronic Hemodialysis Knowledge Survey
  - The Chronic Hemodialysis Knowledge Survey (CHeKS) evaluates patient knowledge about important issues in CHD care including dialysis adequacy, nutrition, anemia, access care, medications, and safety.
  - The scale included 23 multiple-choice items

  with only one correct response

2. You are ordering food from a restaurant menu.
   Which item below is best for you to avoid to control your potassium?
   - ☐ Steamed rice
   - ☐ Corn
   - ☐ Baked potato
   - ☐ Noodles

3. The preferred dialysis access that has the least chance of problems is a:
   - ☐ Fistula
   - ☐ Graft
   - ☐ Tubule
   - ☐ Catheter

Clin J Am Soc Nephrol 2009, 4: 950–956

Patient Education

Table 3. Adjusted Logistic Regression Analyses: Association between baseline CHeKS score and use of an arteriovenous fistula or graft at baseline and three- and six-months after dialysis initiation

Characteristic[a]	OR [95% CI] Baseline $n = 426$	P	OR [95% CI] 3–Months $n = 395$	P	OR [95% CI] 6–Months $n = 367$	P
Dialysis Care Knowledge CHeKS Score (20% points)	1.34 [1.02, 1.76]	0.03	1.49 [1.16, 1.93]	0.002	1.33 [1.03, 1.72]	**0.03**
Age (per year)	1.00 [0.99, 1.02]	0.69	1.00 [0.99, 1.02]	0.81	1.00 [0.98, 1.01]	0.64
Sex (Female *versus* Male)	1.22 [0.78, 1.90]	0.38	1.18 [0.78, 1.78]	0.44	1.10 [0.72, 1.68]	0.64
Race (Non-white *versus* White)	1.07 [0.66, 1.73]	0.78	1.04 [0.67, 1.63]	0.85	0.95 [0.61, 1.50]	0.84
Education (HS or greater *versus* less than HS)	0.88 [0.52, 1.50]	0.65	0.91 [0.56, 1.48]	0.70	0.88 [0.54, 1.45]	0.62
Diabetes (Yes *versus* no)	1.08 [0.69, 1.69]	0.74	1.25 [0.82, 1.90]	0.30	1.24 [0.81, 1.90]	0.33

[a]OR, odds ratio; CI, confidence interval; HS, high school.

Clin J Am Soc Nephrol 2009, 4: 950–956

Effects of a Nationwide Predialysis Educational Program on Modality Choice, Vascular Access, and Patient Outcomes

Eduardo Lacson Jr, MD, MPH, Weiling Wang, MS, Cari DeVries, Keith Leste, MA, Raymond M. Hakim, MD, PhD, Michael Lazarus, MD, and Joseph Pulliam, MD

Table 2. Odds Ratios Comparing Modality Choice and Vascular Access Type for Incident Patients

Baseline Outcomes	All TOPs Patients	Matched TOPs Cohort[a]
Peritoneal dialysis		
Unadjusted	8.45 (7.63-9.37)	7.51 (6.10-9.24)
Case-mix adjusted	5.51 (3.85-7.88)	8.37 (3.54-19.78)
Case-mix + laboratory adjusted	5.13 (3.58-7.35)	7.73 (3.26-18.32)
Noncatheter access		
Unadjusted	2.14 (1.96-2.33)	1.82 (1.61-2.06)
Case-mix adjusted	2.17 (1.99-2.37)	1.83 (1.61-2.07)
Case-mix + laboratory adjusted	2.06 (1.88-2.26)	1.73 (1.51-1.97)

Am J Kidney Dis. 2011; 58 :235-242

CARI Project: Patient Education

Variable	OR (95% CI)
Physician factors	
First nephrology review <3 mo before dialysis start (vs >3 mo)	32.77 (8.66-123.97)[d]
First nephrology review <12 mo before dialysis start (vs >12 mo)	8.20 (5.92-11.36)[d]
Predialysis education (vs no education)	0.44 (0.27-0.71)[e]
eGFR at AVF/AVG creation (/5-mL/min/1.73 m^2 increase)	0.22 (0.10-0.50)[d]

Lopez-Vargas et al AJKD 2011

Adjusted for patient age, sex, late referral, cause of ESKD, cigarette smoking, peripheral vascular disease, presentation type and pre-dialysis education.

Determining the Timing of Dialysis Access Placement

- *1. Individual Patient Factors - Morbidity*
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  - Patient Education
  - Patients Views

The Vascular Access Questionnaire: assessing patient-reported views of vascular access

- Older patients with fistulas:
  - more likely to be at least moderately bothered by bleeding and bruising
- Younger patients with catheters:
  - were more likely to be bothered by having to protect their access, having the access interfere with leisure and social activities, and worrying about the longevity of their access

Quinn, R, et al. J Vasc Access, 2008, 9(2), 122–128.

The Vascular Access Questionnaire: assessing patient-reported views of vascular access

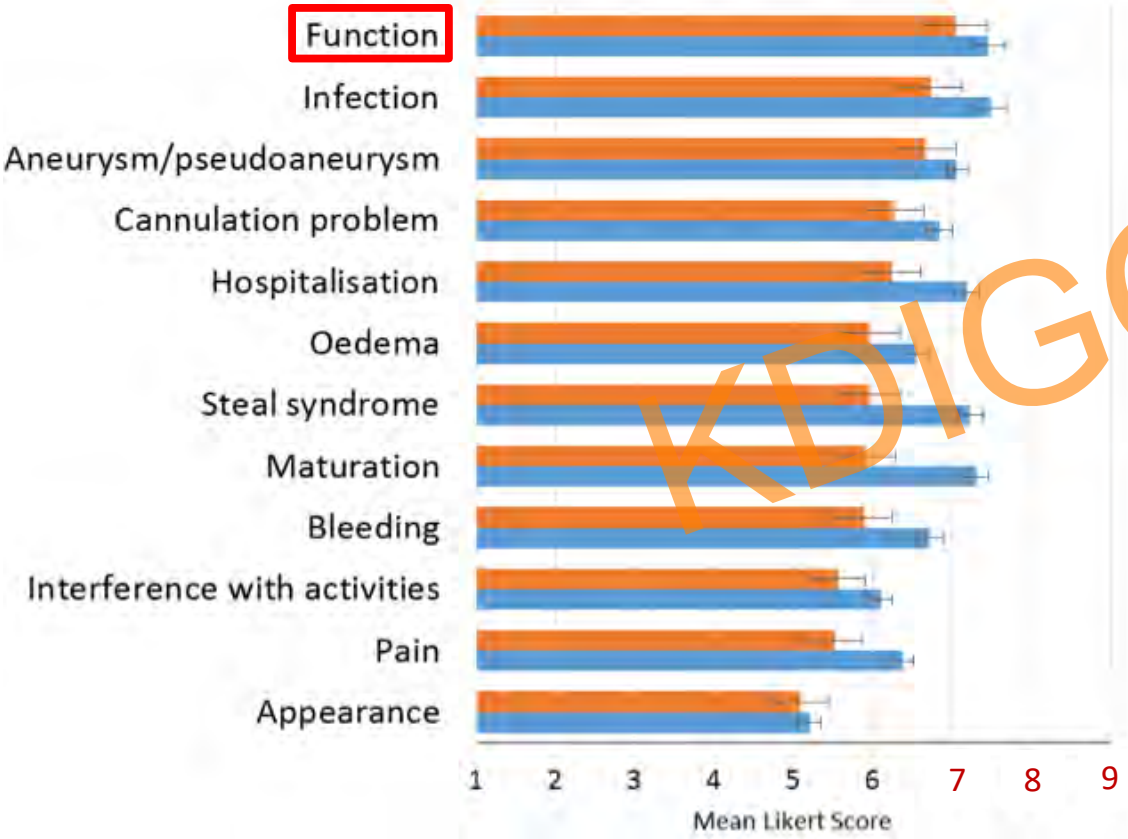
TABLE III - RESPONSES TO MEASURES OF OVERALL PATIENT SATISFACTION WITH VASCULAR ACCESS

	Fistula (n=118)	Catheter (n=104)
Somewhat or very satisfied, %	55	63
Probably or definitely recommend, %	62	77[a]
Somewhat or very easy to use, %	86	97[b]
Would change type of access if possible, %	11	32[b]

[a] $p = 0.01$; [b] $p < 0.01$

Quinn, R, et al. J Vasc Access, 2008, 9(2), 122–128.

What's Important to Patients? SONG-HD



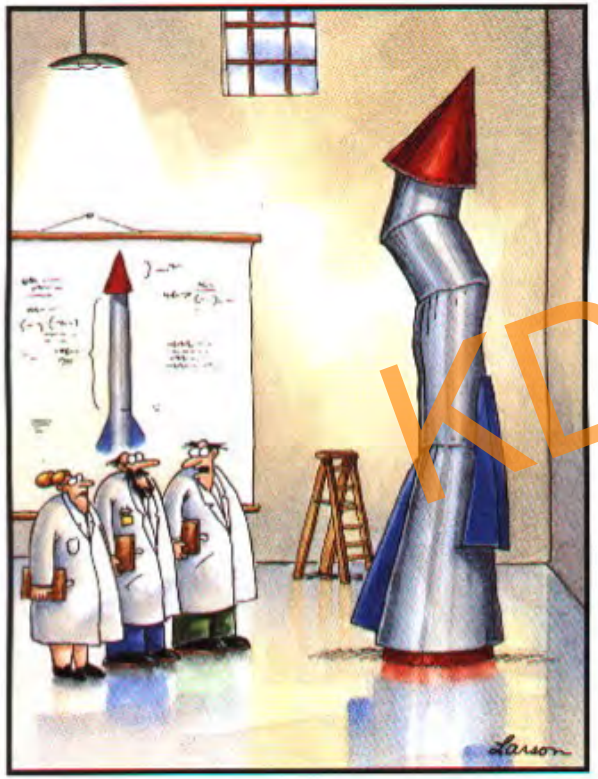
Absolute importance score with 95% CI
Ordered by patients/caregivers' priority

Patient/caregivers
Health professionals

Unpublished Survey

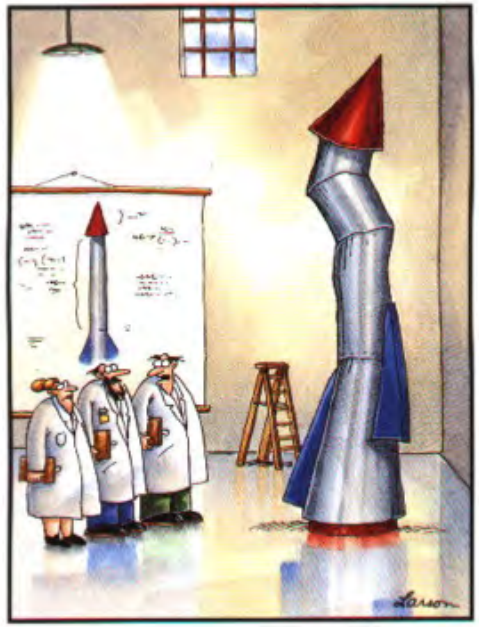
Conclusions: Appropriate Dialysis Access - Timing & Preparation for Dialysis Initiation

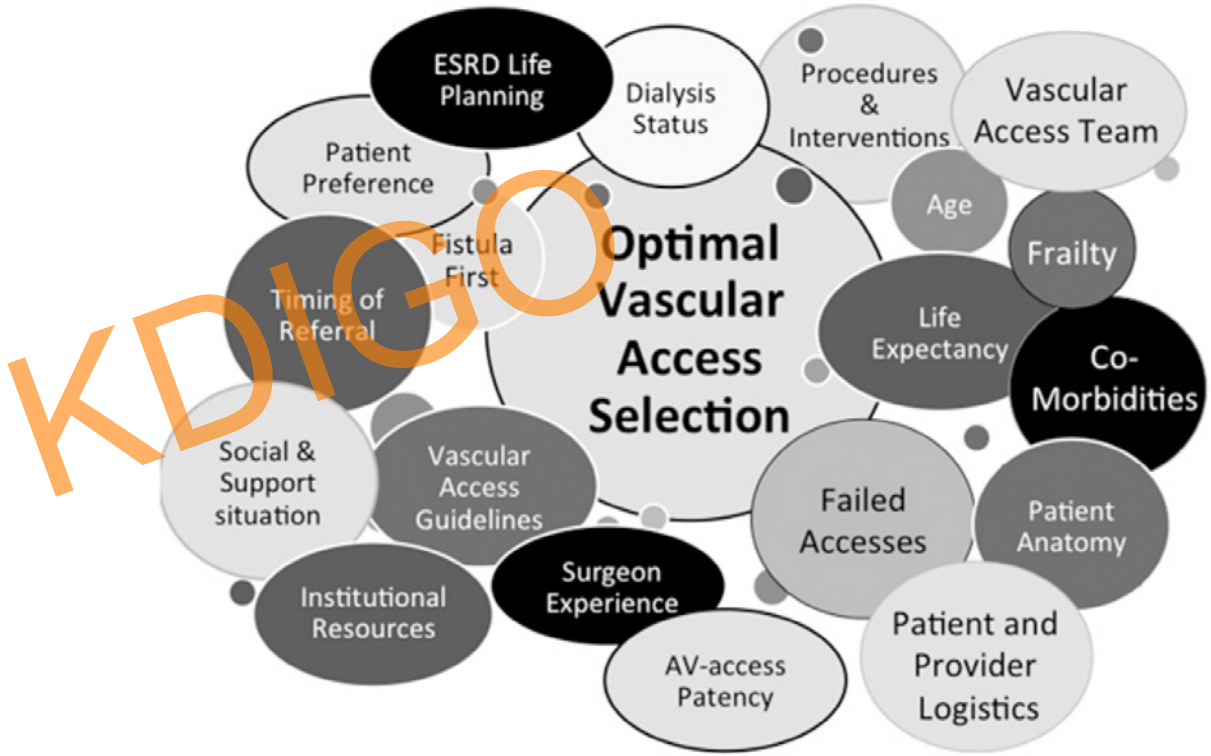
Is It Rocket Science?



It's time to face reality, my friends. We're not exactly rocket scientists.

Conclusion: Appropriate Dialysis Access





Woo & Lok. cJASN 2016