



# Access Care for the patient undergoing Intensive Hemodialysis

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# Objectives

- Define intensive HD
- Benefits of intensive HD
- Review association between intensive HD and VA morbidity

# Intensive Hemodialysis

- Frequency > 3 sessions / week (2-8 hours) or extended duration > 4hours/session
- Includes both home and in centre HD pts
- Unclear number of patients in US

# Benefits of Intensive HD

- Quality of Life
- Cardiac benefits
  - BP control, reduction anti-hypertensive meds
  - Volume control
  - LVH reduction
  - LVEF improvement
- Phosphate control, reduction phosphate binders

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In-Center Hemodialysis Six Times per Week  
versus Three Times per Week

The FHN Trial Group\*

# In-Center Hemodialysis Six times per week vs Three times per week

- Frequent HD Network Daily Trial (FHN)
  - Randomized controlled trial; n =245; duration 12m
  - Coprimary composite outcome:
    - Death or increase in LVMI
    - Death or decrease in physical health composite score
  - 5.2 sessions/wk (154 min) vs 3/wk (214min)

# FHN Daily Trial: VA Outcomes

- VA related complications
  - access failure,
  - infection requiring a procedure,
  - thrombectomy,
  - angioplasty and
  - fibrin sheath stripping or replacement of catheters

# FHN Daily Trial: Results

- 60% AVF, 20% CVC and 19% AVG
- Primary composite outcome death /reduction LVM significantly lower in frequent group:
  - HR 0.6 (0.46 – 0.82)
  - adjusted mean decrease in LV mass was 16 g vs 2.6;  $p < 0.001$  in frequent pts
- No significant impact of Intensive HD on hospitalization (unrelated to vascular access)



# FHN Daily Trial: VA results

Outcome	Conventional Hemodialysis (N = 120)		Frequent Hemodialysis (N = 125)		Hazard Ratio (95% CI)	P Value
	no. of events	no. of patients with event	no. of events	no. of patients with event		
Death	9		5		—	—
All hospitalizations	114	47	109	58	0.88 (0.60–1.28)	0.50
Unrelated to vascular access	90	44	79	47	0.80 (0.53–1.21)	0.30
Related to vascular access	24	14	30	20	0.99 (0.54–1.82)	0.97
Cardiovascular-related	15	12	17	15	0.83 (0.44–1.59)	—
Infection related	27	20	27	23	0.83 (0.49–1.40)	—
All interventions related to vascular access	65	29	95	47	1.35 (0.84–2.18)	0.22
Correction of access failure	23	15	19	15	0.71 (0.35–1.44)	0.35
Other procedures	42	21	76	38	1.71 (0.98–2.97)	0.06

No increased rate of access failure despite increased number of VA procedures  
 ? Hypervigilance with monitoring

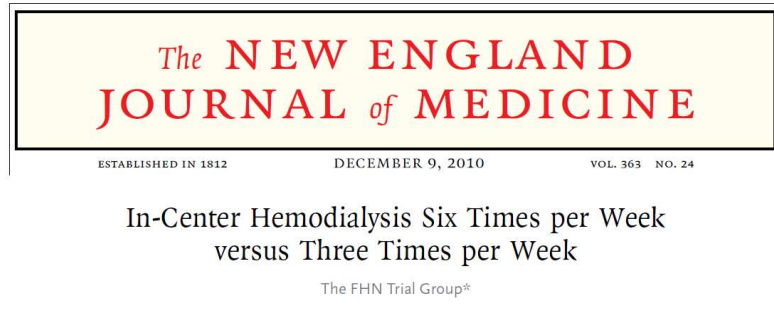
Chertow NEJM 2010

# FHN Daily Trial: VA Results

- 47% FHD underwent one procedure
  - 51% AVF, 32% AVG, 17% CVC had a VA event
- 29% CHD underwent one procedure
  - 48% AVF, 38% AVG, 14% CVC had a VA event

?Did ↑HD frequency lead to ↑ VA dysfunction?

# So What is the impact of Frequent or Intensive HD on VA?



*Kidney Int.* 2011 November ; 80(10): 1080–1091. doi:10.1038/ki.2011.213.

## The effects of frequent nocturnal home hemodialysis: the Frequent Hemodialysis Network Nocturnal Trial

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# HD Frequency and VA Complications

- Combine VA data from FHN daily and FHN Nocturnal trials (6x NHD vs 3x CHD)
- Primary VA outcome time to first access event (repair, loss, access hospitalizations)
- Secondary VA outcomes: time to all repairs and time to all losses

**Table 1.** Baseline characteristics

Variable	Daily Trial			Nocturnal Trial		
	Conventional (n=120)	Daily (n=125)	All (n=245)	Conventional (n=42)	Nocturnal (n=45)	All (n=87)
Age (yr)	52.0±14.1	48.9±13.6	50.4±13.9	54.0±12.9	51.7±14.4	52.8±13.6
Male sex	73 (60.8)	78 (62.4)	151 (61.6)	28 (66.7)	29 (64.4)	57 (65.5)
Race/ethnicity						
Black	53 (44.2)	49 (39.2)	102 (41.6)	11 (26.2)	12 (26.7)	23(26.4)
White	46 (38.3)	43 (34.4)	89 (36.3)	21 (50.0)	27 (60.0)	48 (55.2)
Native American, aboriginal Canadian, Alaska Native, First Nation	4 (3.3)	4 (3.2)	8 (3.3)	2 (4.8)	1 (2.2)	3 (3.4)
Asian	5 (4.2)	11 (8.8)	16 (6.5)	7 (16.7)	5 (11.1)	12 (13.8)
Native Hawaiian/other Pacific Islander	3 (2.5)	1 (0.8)	4 (1.6)	0 (0)	0 (0)	0 (0)
Other/mixed/unknown	9 (7.5)	17 (13.6)	26 (10.5)	1 (2.4)	0 (0)	1 (1.2)
Hispanic/Latino	31 (26)	38 (30)	69 (28.2)	0 (0)	0 (0)	0 (0)
ESRD vintage						
<2 yr	35 (29.2)	37 (29.6)	72 (29.4)	30 (71.4)	28 (62.2)	58 (66.7)
2–5 yr	42 (35.0)	34 (27.2)	76 (31.0)	5 (11.9)	8 (17.8)	13 (14.9)
>5 yr	43 (35.8)	54 (43.2)	97 (39.6)	7 (16.7)	9 (20.0)	16 (18.4)
Comorbid conditions						
Diabetes	50 (41.7)	50 (40.0)	100 (40.8)	18 (42.9)	19 (42.2)	37 (42.5)
Congestive heart failure	24 (20)	25 (20)	49 (20.0)	7 (16.7)	5 (11.1)	12 (13.8)
Laboratory values						
Albumin (g/dl)	3.94±0.46	3.94±0.37	3.94±0.42	3.92±0.51	3.90±0.48	3.91±0.49
Hemoglobin (g/dl)	12.0±1.2	11.9±1.3	11.9±1.3	11.9±1.1	11.6±1.1	11.8±1.1
Vascular access used at randomization						
Arteriovenous fistula	71 (59)	82 (66)	153 (63)	17 (40)	22 (49)	39 (45)
Arteriovenous graft	23 (19)	22 (18)	45 (18)	4 (10)	3 (7)	7 (8)
Tunneled catheter	26 (22)	21 (17)	47 (19)	21 (50)	20 (44)	41 (47)
Buttonhole technique used (n)	—	—	—	14	19	33

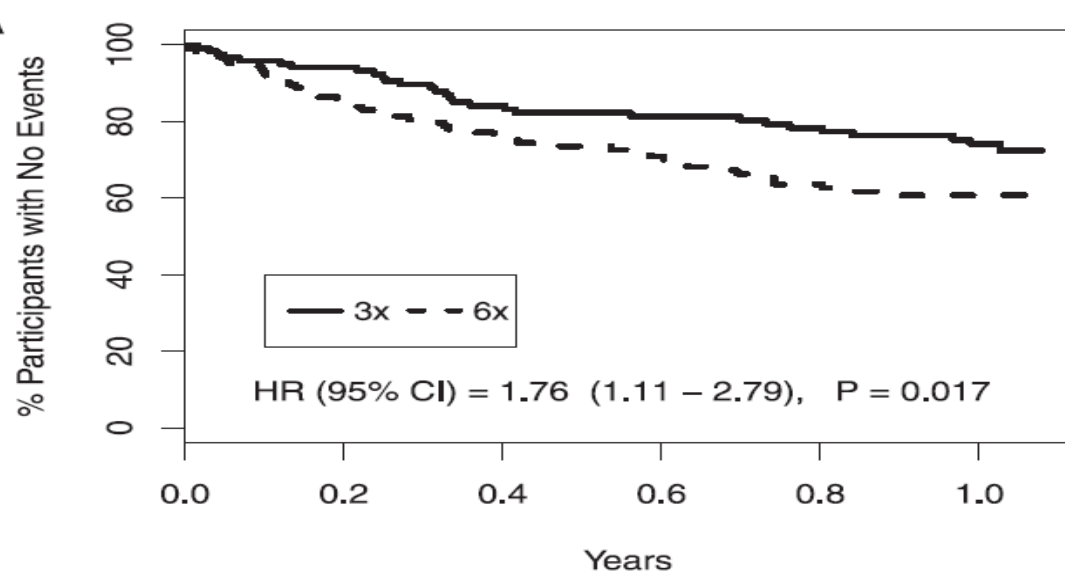
Unless otherwise indicated, values are expressed as number of patients (percentage). Values expressed with a plus/minus sign are the mean ± SD.

# HD Frequency and VA Complications

Table 2. Description of all repairs and losses, considering all accesses used during follow-up

Variable	Daily Trial			Nocturnal Trial		
	Conventional	Daily	HR (95% CI)	Conventional	Nocturnal	HR (95% CI)
<b>AVF/AVG<sup>a</sup></b>						
Patients (n)	106 (79/28) <sup>b</sup>	114 (90/28) <sup>b</sup>		28 (23/6) <sup>b</sup>	32 (29/3) <sup>b</sup>	
Total follow-up (yr)	87.9 (67.1/20.8)	95.8 (76.9/18.9)		24.2 (18.8/5.4)	24.3 (22.0/2.3)	
<b>Repairs</b>						
Angioplasty	21 (11/10)	28 (14/14)		5 (3/2)	14 (13/1)	
Stent placement	2 (2/0)	2 (1/1)		0 (0/0)	0 (0/0)	
Thrombectomy	10 (3/7)	22 (5/17)		1 (0/1)	2 (1/1)	
Surgical revision	5 (3/2)	14 (7/7)		1 (1/0)	0 (0/0)	
Overall rate (per 100 patient-yr)	43	69	1.68 (1.13–2.51) P=0.011	29	66	2.29 (0.94–5.59) P=0.069
<b>Losses</b>						
Stenosis/thrombosis	8 (5/3)	13 (5/8)		2 (1/1)	2 (2/0)	
Sitenosis/thrombosis						
Infection	2 (0/2)	2 (0/2)		1 (0/1)	0 (0/0)	
Other <sup>c</sup>	1 (1/0)	3 (2/1)		0 (0/0)	0 (0/0)	
Unknown	4 (2/2)	2 (1/1)		1 (0/1)	2 (2/0)	
Overall rate (per 100 patient-yr)	17	21	1.21 (0.61–2.39) P=0.58	—	—	—
<b>Catheters</b>						
Patients (n)	34	37		24	23	
Total follow-up (yr)	20.8	18.9		19.0	18.1	
<b>Repairs (n)</b>						
Fibrin sheath stripping	1	4		0	1	
Repair broken component	0	0		1	0	
<b>Losses (n)</b>						
Poor flows/thrombosis	7	2		8	8	
Infection	2	7		4	5	

# Time to VA Complication: Daily FHN



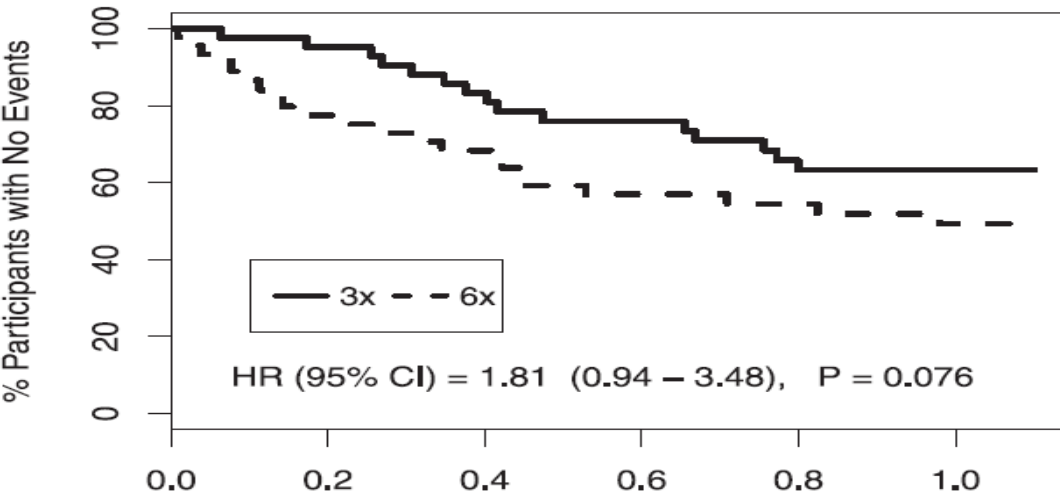
HR of VA event 1.76 (1.11- 2.79) p=0.017

AVF/AVG HR 1.9(1.11 – 3.25);p=0.02

CVC HR2.7(0.71-10); p=0.14

Time to first access loss, first access repair or access hospitalization in Daily FHN trial

# Time to VA Complication: Nocturnal FHN



HR of VA event 1.81(0.94- 3.48) p=0.07

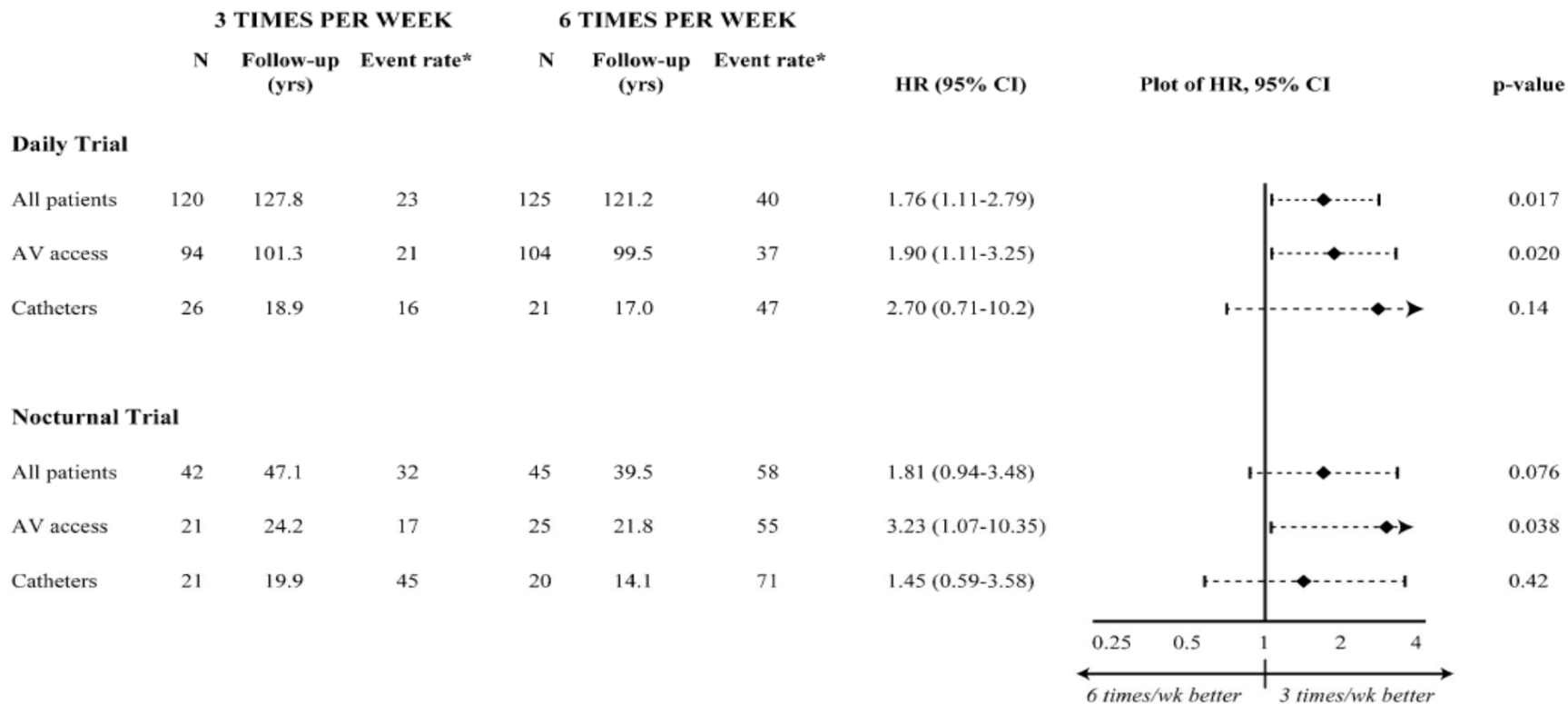
AVF/AVG HR 3.2(1.07 - 10.3);p=0.038

CVC HR 1,45(0.59-3.58); p=0.42

Time to first access loss, first access repair or access hospitalization in Nocturnal FHN trial



# HD Frequency and VA



**Figure 2.** Forest plot of time to first access repair, access loss, or access hospitalization by trial and access subgroup. \*Event rates expressed as number of events per 100 patient-years. AV access, arteriovenous fistulae and arteriovenous grafts.

# Summary: HD Frequency and VA

- Daily FHN
  - More total AV access repairs occurred in daily group (HR 1.68 (1.13-2.51); p=0.011)
  - HR higher for repairs in AVG than AVF: 2.2(1.26-3.87); p=0.0059
  - No significant difference in AV losses between groups
- Nocturnal FHN
  - More total AV access repairs occurred in nocturnal but not significant; HR 2.29; p=0.069
  - Trend to higher AVF repairs: HR 2.87;p=0.063

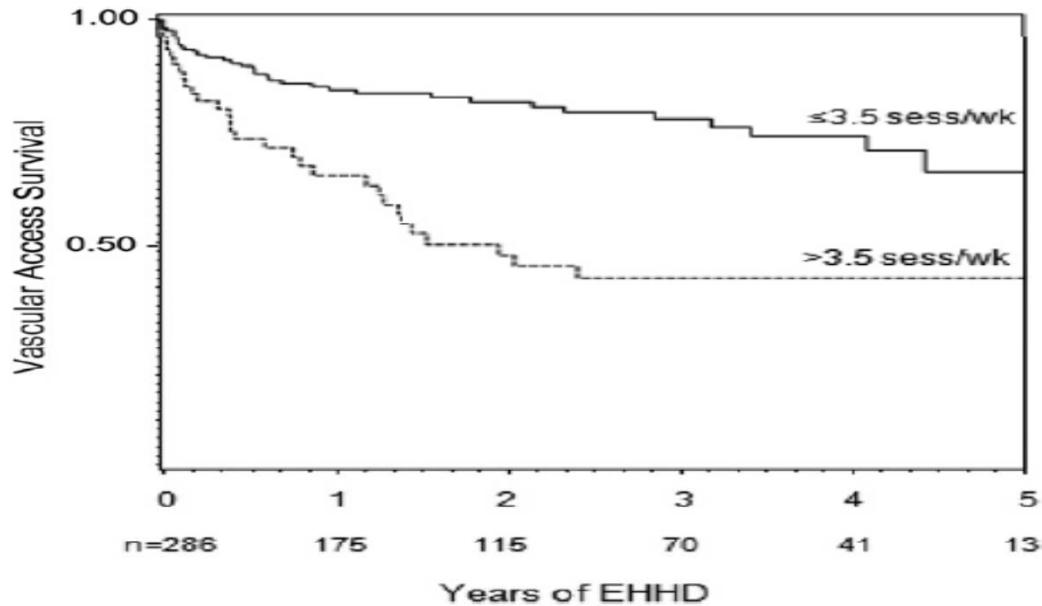


# Increased VA Events in Intensive HD: What About Other Studies?

# Frequent Home N-HD and VA Complications

- Australian observational cohort of extended hours N-HD ( $\geq 24$ h/week) 1999 - 2009
- Outcomes: all cause mortality, technique failure and access related events
- Access related event: any type of VA related intervention

# Frequent N-HD and VA Dysfunction



Access events predicted by dialysis frequency and age

Access events predicted death:  
HR 2.85(1.14 – 7.15)

**Figure 2.** Unadjusted Kaplan-Meier access survival curves comparing patients dialyzing for 3.5 or fewer sessions per week (solid line) with patients dialyzing for more than 3.5 sessions per week (dashed line). HR 2.85(1.14 – 7.15).

# Frequent Home N-HD and VA Dysfunction

Table 2. Outcomes Analyzed

Outcome	No. (%)
<b>All-cause mortality</b>	
Cardiac death	7 (29.2)
Sepsis	5 (20.8)
Hemorrhage	1 (4.2)
Renal carcinoma	1 (4.2)
Unknown	10 (41.7)
<b>Technique failure</b>	
Failing health	17 (26.9)
Dialysis facility issues	8 (12.7)
Not coping with the modality	4 (6.4)
Not sleeping properly	4 (6.4)
Psychosocial issues	1 (1.6)
Access-related events	2 (3.2)
Patient choice	1 (1.6)
Other	4 (6.4)
Unknown	22 (34.9)
<b>Access-related adverse events<sup>a</sup></b>	
Infection	47 (59.5)
Bacteremia	14 (29.8)
Local AVF infection	22 (46.8)
Unspecified infection	11 (23.4)
Thrombosis/occlusion	12 (15.2)
AVF aneurysm	5 (6.3)
Stenosis	8 (10.1)
AVF revision requirement	3 (3.8)
Other	4 (5.1)

28% (79/286) had adverse VA event

~60% VA infection

Note: Based on unadjusted Kaplan-Meier survival rates.

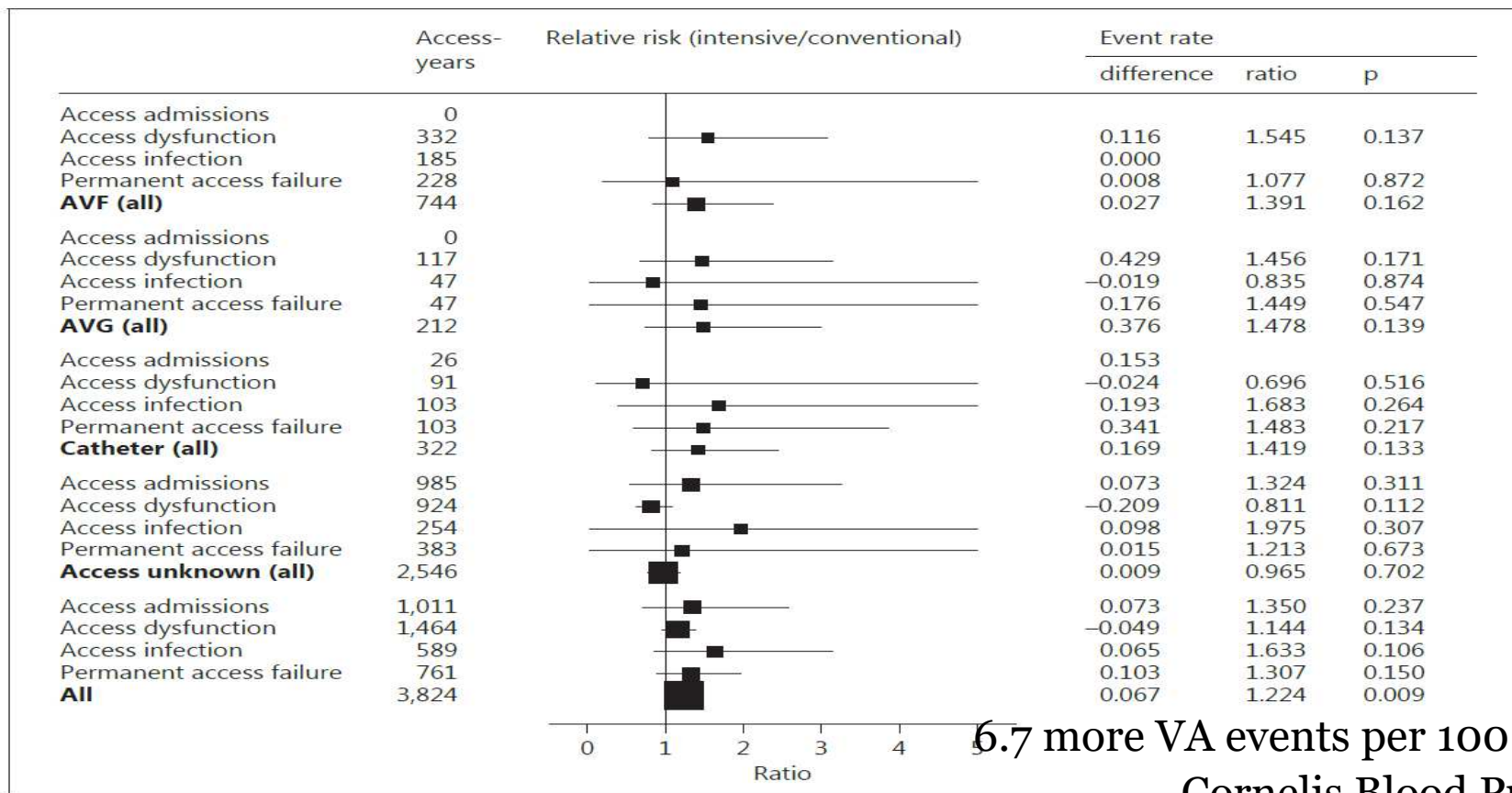
Abbreviation: AVF, arteriovenous fistula.

# VA outcomes and intensive HD

- Meta analysis of studies including home and intensive HD patients and VA outcomes
- 3 RCTS (Chertow NEJM 2010, Rocco KI 2011, Culleton JAMA 2006)
- 11 prospective & 5 retrospective cohorts
- Most studies >4 x per week, > 4 hours



# More VA events in Intensive HD





T Vachharajani Atlas of Dialysis Access

So Why Might Intensive HD promote VA complications?

# VA dysfunction with Intensive HD

- Vascular access used twice as often
- Increased surveillance

# VA dysfunction with Intensive HD

- Infection
  - Increased exposure to inflammatory stimuli on HD
  - Potential exposure to bacterial pathogens (skin, water)
- Trauma
  - Frequent venipuncture
  - Increased shear stress on endothelium → promotes remodeling
  - Impact of blood flow rate and needle size?

# How to Mitigate risk in Intensive HD

- Reduce frequency of HD (alternating days)
- Use of lower blood flow rates eg 200 vs 400
  - Nocturnal HD had fewer thrombectomy and surgical revisions than Daily HD
- Maintain vigilance for impending VA dysfunction (home)
- Train (home) patients regarding signs of VA dysfunction
- Regular audits in home patients
- Reduce buttonhole cannulation to lower infection risk



Questions? Thank You

# VA Resources

International Society of HD (ISHD) Manual for Home HD Care Module 7 (VA)

<http://www.ishd.org/7-the-care-and-keeping-of-vascular-access-for-home-hemodialysis-patients/>

Canadian Journal of Kidney Health and Disease VA Core Curriculum

1. Arteriovenous access selection and evaluation

<http://journals.sagepub.com/doi/full/10.1177/2054358116669125>

2. Arteriovenous access failure, stenosis and thrombosis

<http://journals.sagepub.com/doi/full/10.1177/2054358116669126>

3. Arteriovenous access infection, neuropathy and other complications

<http://journals.sagepub.com/doi/full/10.1177/2054358116669127>

4. Practical aspects of tunneled and nontunneled HD catheters

<http://journals.sagepub.com/doi/full/10.1177/2054358116669128>

5. Hemodialysis tunneled catheter related infections

<http://journals.sagepub.com/doi/full/10.1177/2054358116669129>

6. Hemodialysis tunneled catheter non-infectious complications

<http://journals.sagepub.com/doi/full/10.1177/2054358116669130>



Anne

