ESRD: No place like home

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Goals for today: peritoneal and home hemodialysis

- Why are home therapies NOT predominant among dialysis patients?

- Advantages + Disadvantages of home therapies over in-center therapy.

- Practical considerations of home dialysis therapies.

Why should your patient (and their nephrologist) consider home therapy?

From surveys of patients:
in-center vs home dialysis:

"I hate dialysis"

http://www.ihatedialysis.com/
For patients, by patients. Doctors not invited

The downsides of in-center dialysis are:
- Length of treatment
- Needle sticks/access
- Fatigue/weakness
- Cramping/sick after treatment
- Frequency of treatment
- Transportation to unit- 1.4-3 hrs

Clin J Am Soc Nephrol 1: 1191–1196, 2006

Kidney Int. 2017 March ; 91(3): 746–754.

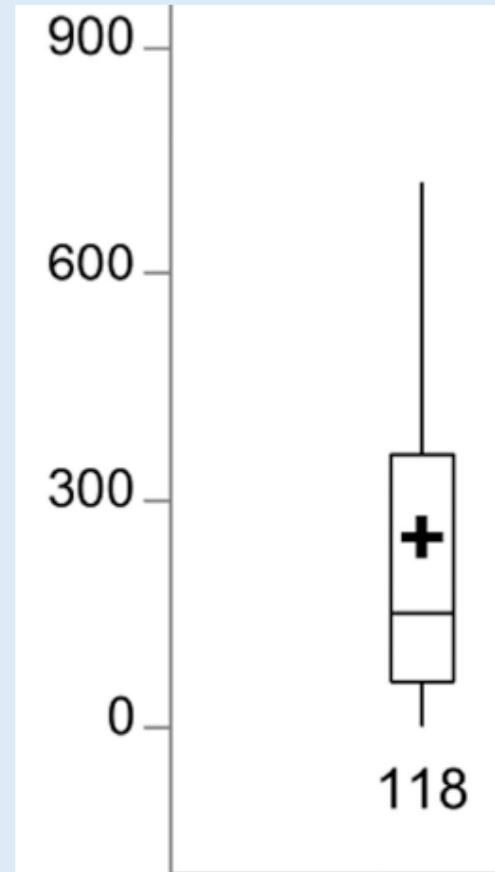# Imagine that you go to dialysis, and then to work/home

Health Related QoL

average time needed to recover after every dialysis treatment

mean ~ 4 hours.

118

HOME

"Those who don't know history are doomed to repeat it."
— Edmund Burke, 1729-1797

"Those unable to catalog the past are doomed to repeat it."
— Lemony Snicket, a series of unfortunate events

1960: Scribner shunt (first prosthetic AV graft) for chronic dialysis

1962: First outpatient dialysis unit (Seattle Artificial Kidney Center)

1962-1979: High demand for dialysis at SAKC. Selection board created.
   "Who Shall Live?" NBC documentary by Edwin Newman
     https://www.youtube.com/watch?v=FMay5zw1loA

1964: 15-16 year-old girl in Seattle became the first home hemodialysis patient

1973: The ESRD Medicare program was created to pay for dialysis nationwide.
     That year, **30%** of the US population used home hemodialysis

1974-2000: home hemodialysis declined due to financial incentives
        AND lack of training during fellowship

The similarly ancient history of peritoneal dialysis:

1968: Tenkoff and Scheckter, "A bacteriologically safe peritoneal access device"
1980s: Rates of peritonitis, clearance failure and sclerosing peritonitis remain high.
1985: "CAPD is a second-class therapy for second-class patients by second-class doctors."

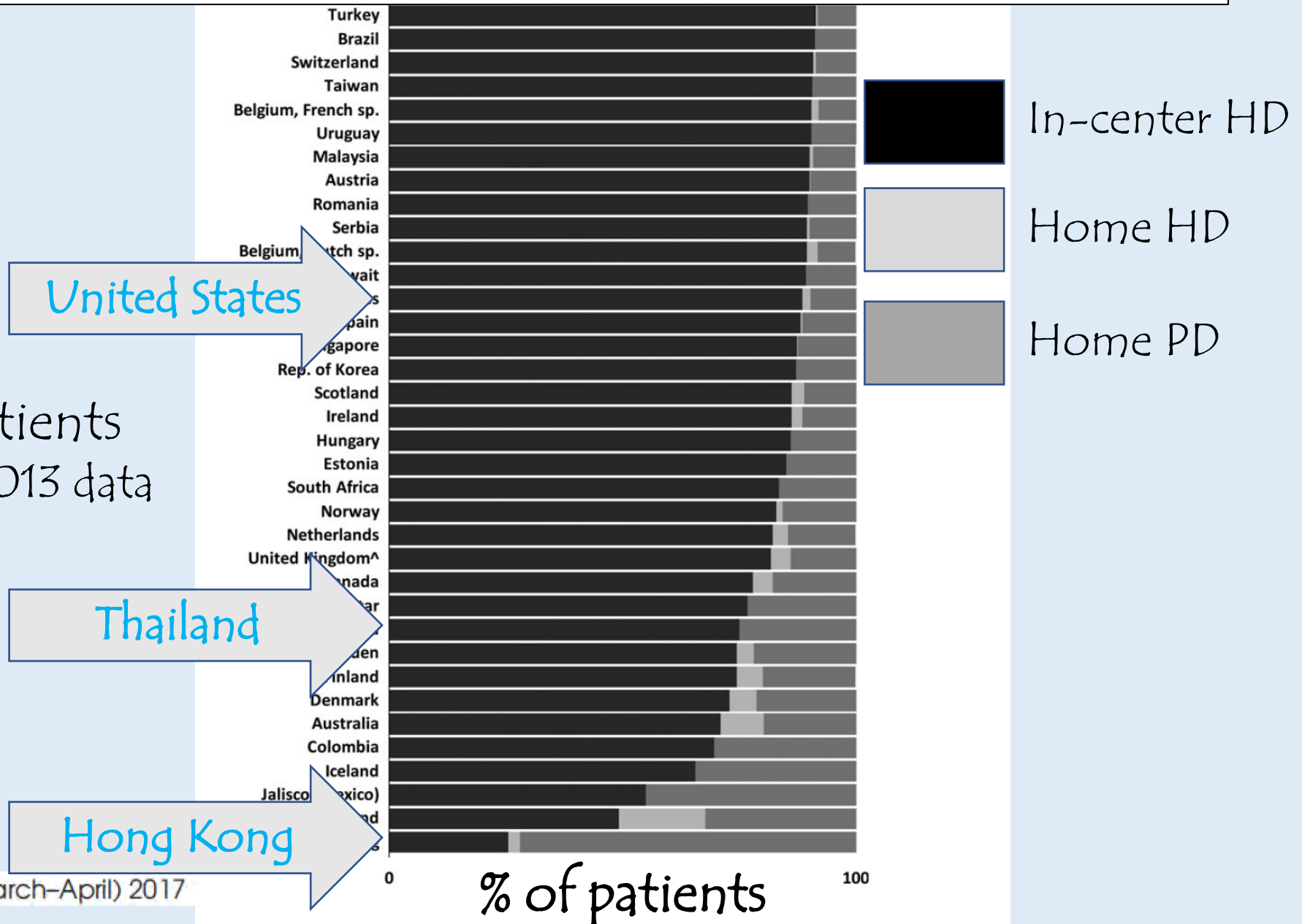Contr. Nephrol., vol. 44, pp. 163–172 (Karger, Basel 1985)

CAPD is a Second-Class Treatment

1990: Technical refinements in PD transfer sets, surgical techniques, prophylaxis:
2000 to present: PD outcomes are at least comparable to hemodialysis,
       but financial incentives still favored in-center hemodialysis

Public Policy influences Home Dialysis vs. In-Center Dialysis

prevalent dialysis patients
US Renal Data System, 2013 data

United States

Thailand

Hong Kong

In-center HD

Home HD

Home PD

% of patients

Turkey
Brazil
Switzerland
Taiwan
Belgium, French sp.
Uruguay
Malaysia
Austria
Romania
Serbia
Belgium, Dutch sp.
Kuwait
Spain
Singapore
Rep. of Korea
Scotland
Ireland
Hungary
Estonia
South Africa
Norway
Netherlands
United Kingdom^
Canada
Sweden
Finland
Denmark
Australia
Colombia
Iceland
Jalisco (Mexico)
New Zealand

0   100

Why should your patient (and their nephrologist) consider home therapy?

"hard" outcomes:
Survival
Blood pressure
Hospitalizations
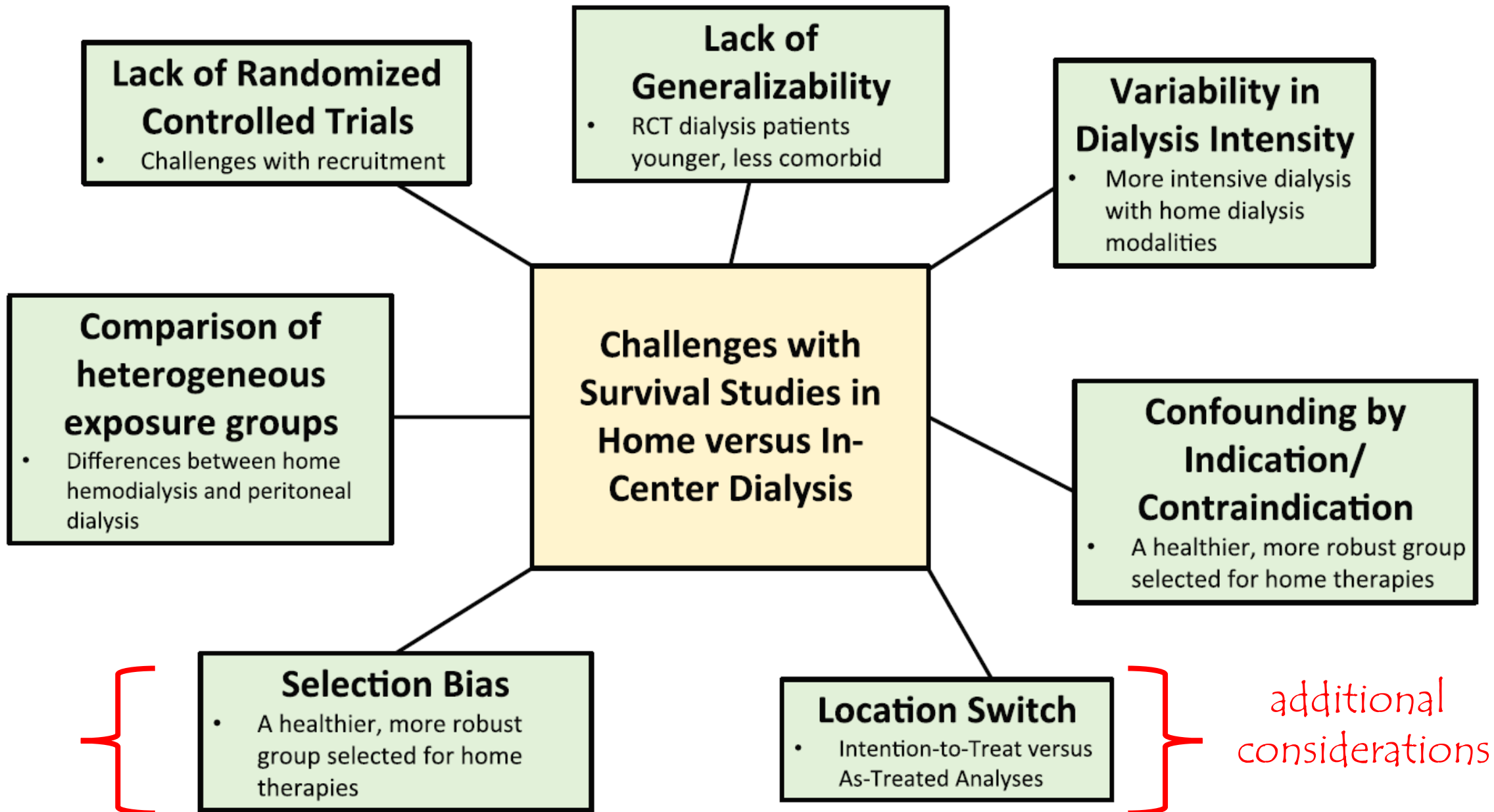Cardiovascular events

"soft" outcomes:
Quality of Life measures
Ability to work
Ability to contribute to family
Independence, empowerment
Travel

Lack of Randomized Controlled Trials
- Challenges with recruitment

Lack of Generalizability
- RCT dialysis patients younger, less comorbid

Variability in Dialysis Intensity
- More intensive dialysis with home dialysis modalities

Comparison of heterogeneous exposure groups
- Differences between home hemodialysis and peritoneal dialysis

Challenges with Survival Studies in Home versus In-Center Dialysis

Confounding by Indication/ Contraindication
- A healthier, more robust group selected for home therapies

Selection Bias
- A healthier, more robust group selected for home therapies

Location Switch
- Intention-to-Treat versus As-Treated Analyses

additional considerations

1. Location or modality switch is <u>common</u> for home dialysis patients:

From a 5-year analysis of United States Renal Data System:

15% of home HD switched to in-center hemodialysis
1% of home HD switched to Peritoneal

44% of home Peritoneal switched to in-center hemodialysis
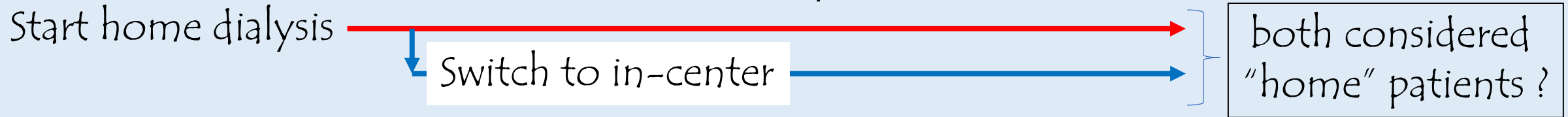25% of home Peritoneal switched to home HD

This has implications for how we compare outcomes

2. Difficulties analyzing retrospective data in ESRD dialysis patients:

Compelling reasons to analyze as "Intention to Treat" in RCT
But in retrospective analyses of dialysis:
- "intention to treat" preserves bias of patients who chose + "were chosen" for home Rx

- and "intention to treat" even when modality switch is so common?

Start home dialysis ──────────────────────────────────────▶ ⎱ both considered
                    │   ⎰ "home" patients ?
                    ▼
              Switch to in-center ──────────────────────────▶

- "as treated" can loose information on WHY a modality switch occurred
Example: ANZDiTa: PD who switch to in-center have increased mortality (avoid PD?)
- PD patients who switched for social reasons/compliance, mortality IS increased
- But PD patients who switched due to infection or UF failure, mortality risk is <u>lower</u>

3. Selection bias is HUGE: comparing home vs. in-center dialysis patients

Or comparing 1 home therapy vs. another home therapy:

"Treatment with home hemodialysis was associated with significantly better patient survival than treatment with peritoneal dialysis"
(5-year survival: 85% versus 44%, respectively; log-rank P,0.001).

- 2015 Aus and NZ dialysis and Txp registry.

	Home HD (706	Peritoneal (10,710)	P value
Median age	50 +/- 8	62 +/- 12	0.001
Polycystic ADPKD	19 %	6 %	0.001

Adjusted mortality on PD
– might be lower
– certainly is not higher.

Adjusted mortality by treatment modality and number of months after treatment initiation (a) under age 65 and (b) aged 65 and over, 2015

(a) Under age 65
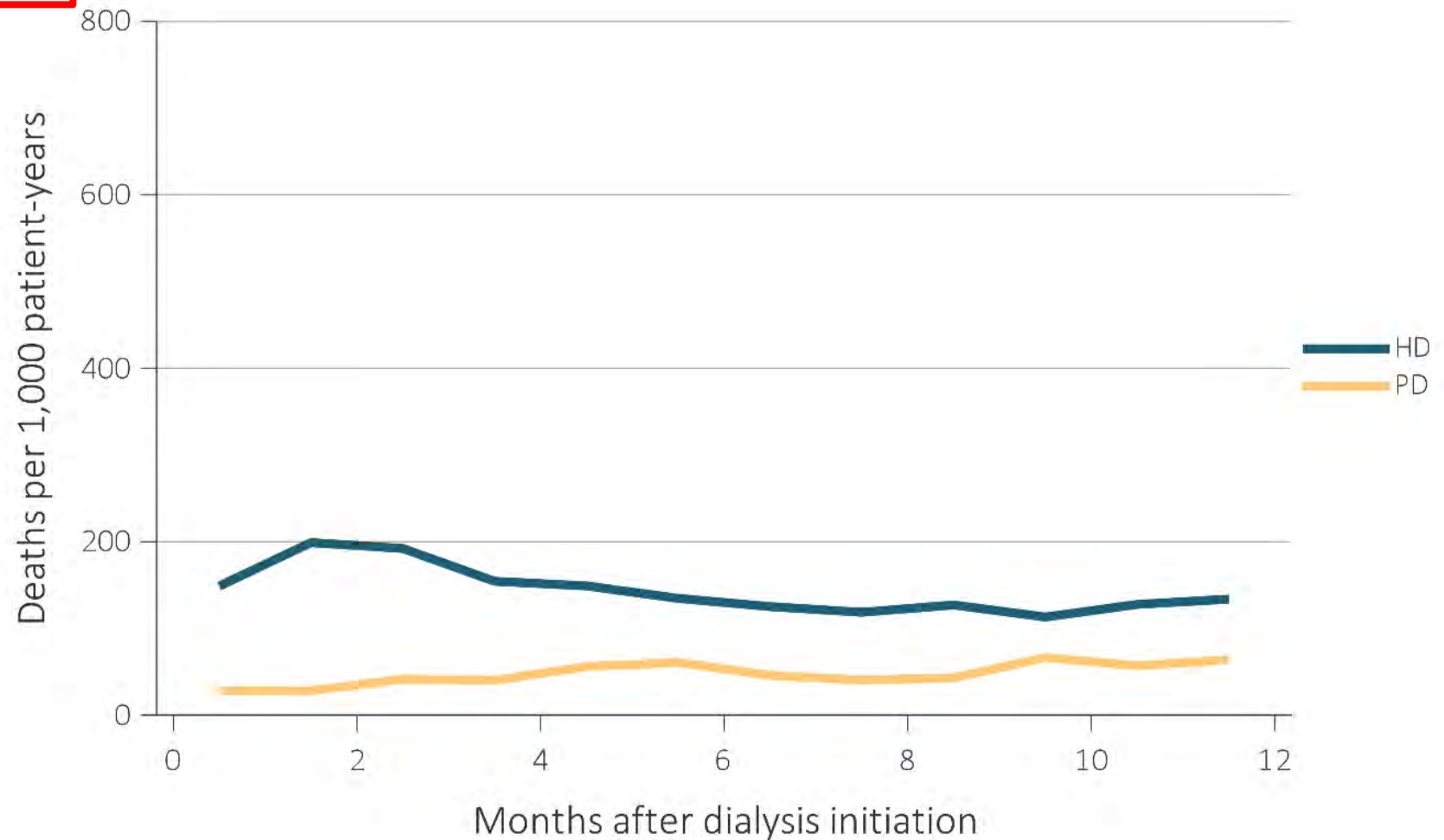
Similarly, PD mortality for the "Aged" is comparable to HD
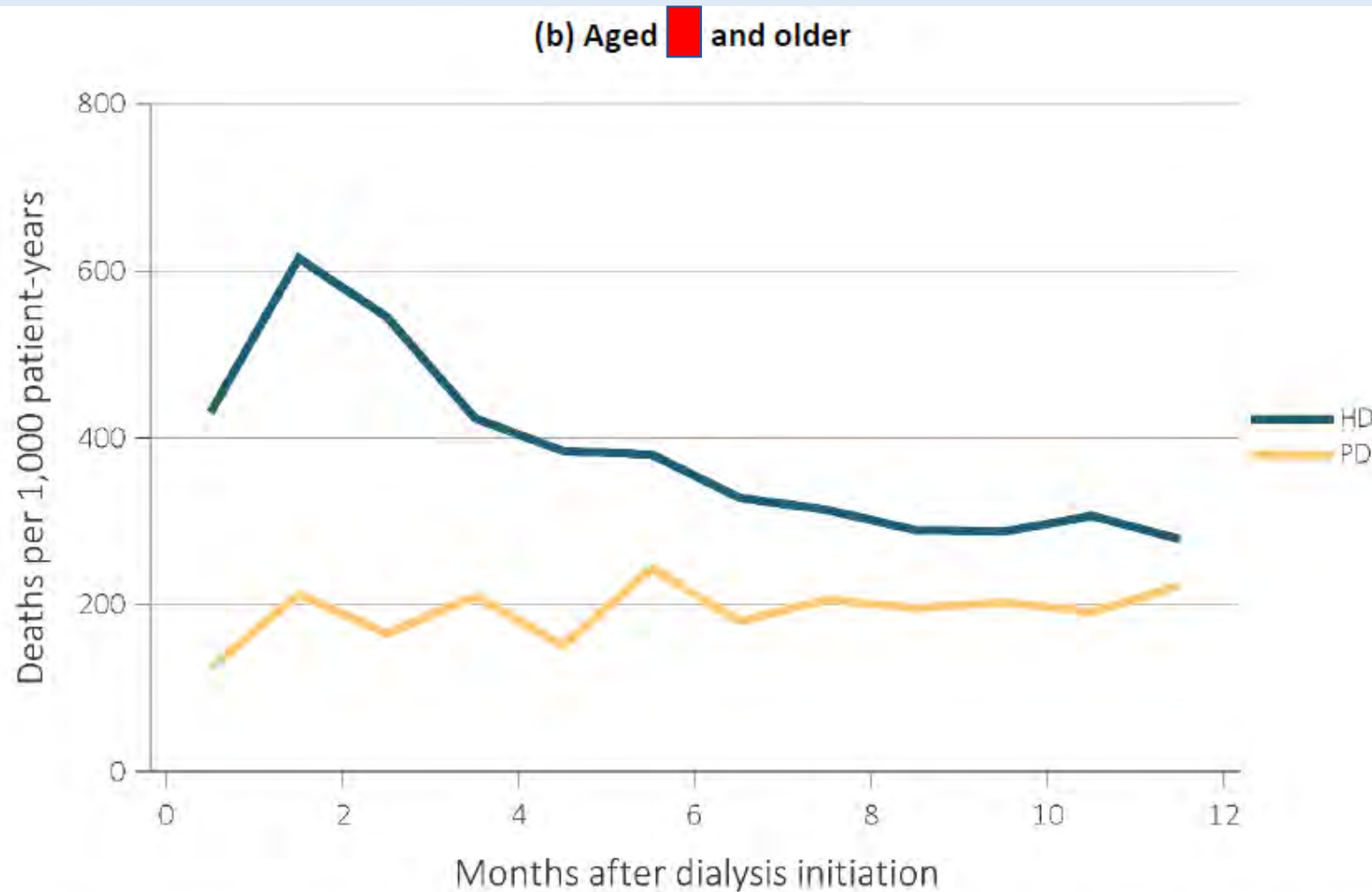
Data Source: Special analyses, USRDS ESRD Database. Adjusted (age, race, sex, ethnicity, and primary diagnosis) mortality among 2015 incident ESRD patients during the first year of therapy. Reference population: incident ESRD patients, 2011. Abbreviations: ESRD, end-stage renal disease; HD, hemodialysis; PD, peritoneal dialysis.

Other benefits of home peritoneal dialysis

- 24/7 therapy with peritoneal dialysis, instead of 4 hrs x 3 days.
    absence of large fluid/electrolyte shifts

- Residual renal function is preserved longer with PD
    a GFR of 10 with dialysis $\neq$ a GFR of 10 with native kidneys
    middle molecule clearance, inflammatory mediators

- Higher scores on health QoL with peritoneal dialysis
    less cramping/fatigue
    greater dietary options
    greater independence for work and travel

Benefits of home hemodialysis

Survival as an index of adequacy of dialysis

BERNARD CHARRA, EDOUARD CALEMARD, MARTIAL RUFFET, CHARLES CHAZOT,
JEAN-CLAUDE TERRAT, THIERRY VANEL, and GUY LAURENT

Centre de rein artificiel, Tassin, France

Tassin-la-Demi-Lune

Survival with long, aggressive HD

24 hours/week (8hr x 3), compared to 9-12 hrs in USA
- 87% at 5 yrs, compared to ~33% USRDS
- 75% at 10 yrs, compared to ~ 10%
        (59% at 10 yrs if initial age >65)
- 55% at 15 yrs
- 43% at 20 yrs

n= 445 patients

Hypertension in dialysis patients:

all anti-hypertensives stopped within six months by challenging dry weight
- only 7 patients = 1.6% needed meds

Renal osteodystrophy / serum phos:
- all controlled without binders. and this is near Lyons, France.

Table 4. Demographic factors and patient survival at 5, 10, 15 and 20 years of hemodialysis

Initial age years	# pts	% Patient survival, years			
		5	10	15	20
<35	112	93	88	80	71
35–44	84	92	79	62	39
45–54	111	89	76	54	—
55–64	98	83	62	23	—
>64	40	67	59	—	—
Total	445	87	75	55	43
Etiology					
Chronic GN	138	93	85	76	66
Interstitial N	98	95	84	67	—
Polycystic KD	60	88	78	50	—
Nephrosclerosis	44	81	60	23	—
DM/system D	40	65	58	—	—
Unknown	65	84	66	50	33
Total	445	87	75	55	43
Sex					
Female	142	94	90	67	64
Male	303	85	69	54	38
Total	445	87	75	55	43

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

The FHN Trial Group*

Randomized trial for 12 months. 245 patients

Primary end points
(1) Death or change in LVM.
(2) Death or composite physical–health score

Secondary end points: Nine domains
(a) SBP pre-HD,
(b) number of BP meds

Table 1. Baseline Characteristics of the Study Participants.*

Characteristic	Conventional Hemodialysis (N=120)	Frequent Hemodialysis (N=125)	P Value
Age (yr)	52.0±14.1	48.9±13.6	0.07
Female sex (%)	39.2	37.6	0.80
Race or ethnic group (%)†			0.32
Black	44.2	39.2	
White	38.3	34.4	
Native American, Aboriginal Canadian, Alaskan Native, or First Nation	3.3	3.2	
Asian	4.2	8.8	
Native Hawaiian or other Pacific Islander	2.5	0.8	
Other or mixed	7.5	13.6	
Body-mass index‡	27.5±7.1	27.3±6.5	0.82
Weight after dialysis (kg)	78.7±20.5	77.6±20.6	0.68
Anthropometric volume (liters)§	39.5±8.3	39.3±8.1	0.90
Cause of end-stage renal disease (%)			0.89
Diabetic nephropathy	32.5	36.0	
Glomerulonephritis	19.2	19.2	
Hypertensive nephrosclerosis	20.0	21.6	
Polycystic kidney disease	5.0	3.2	

In-Center Hemodialysis Six Times per Week versus Three Times per Week
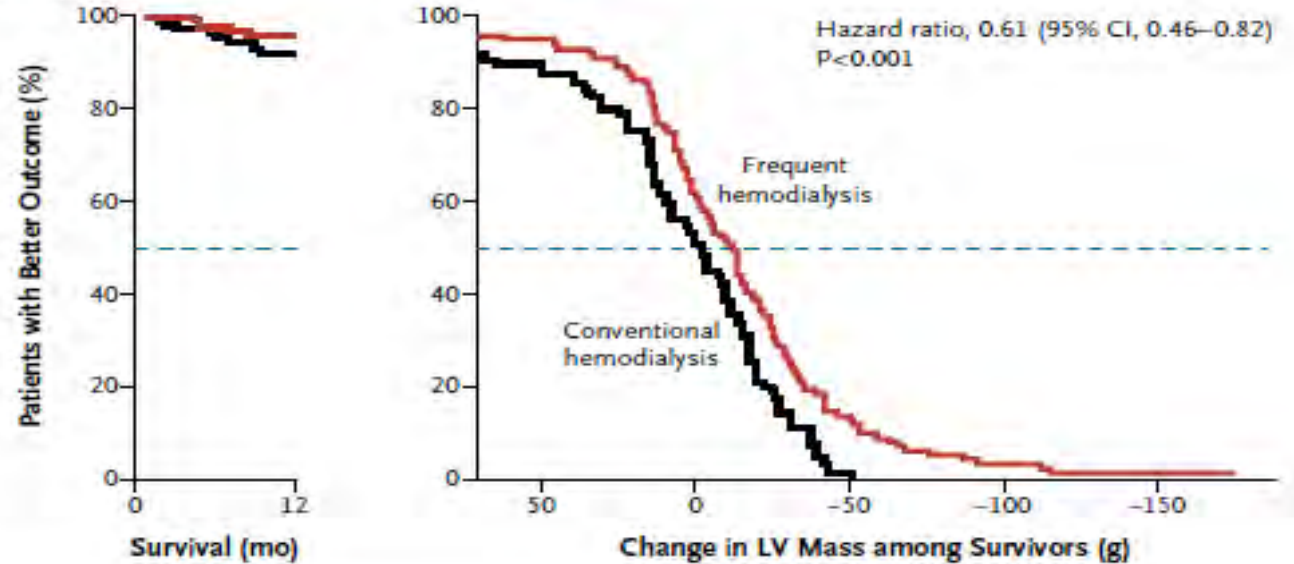
The FHN Trial Group*
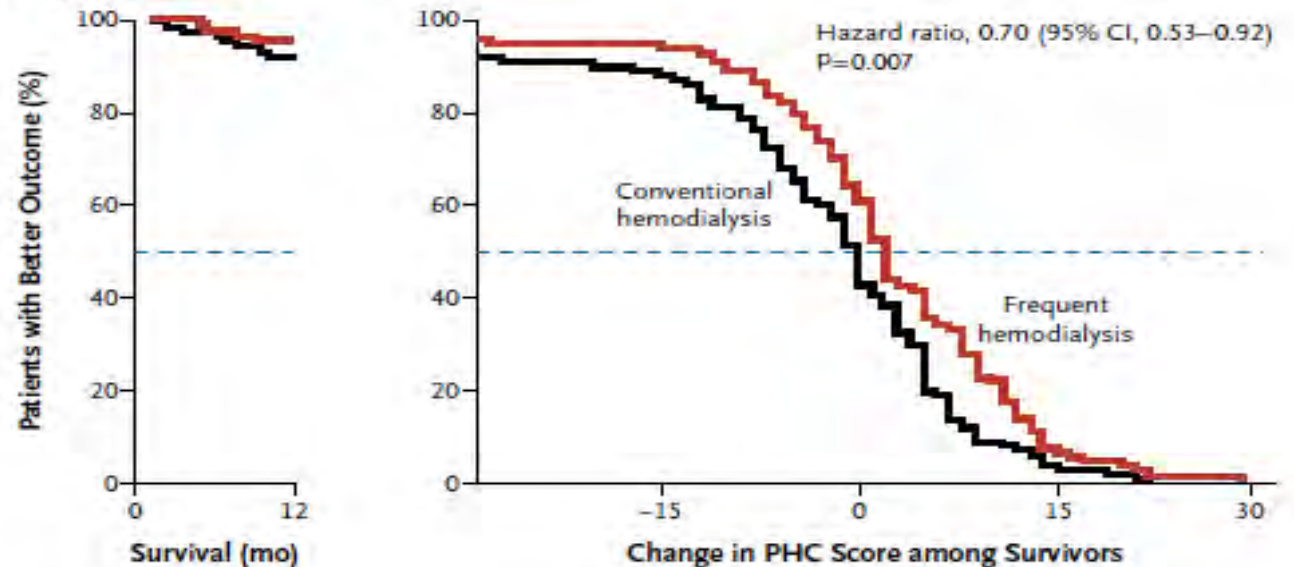
<u>Primary endpoint #1</u>
Decreased Death
or LV mass*

*surrogate for CV risk

<u>Primary endpoint #2</u>
Decreased Death
or Physical Health
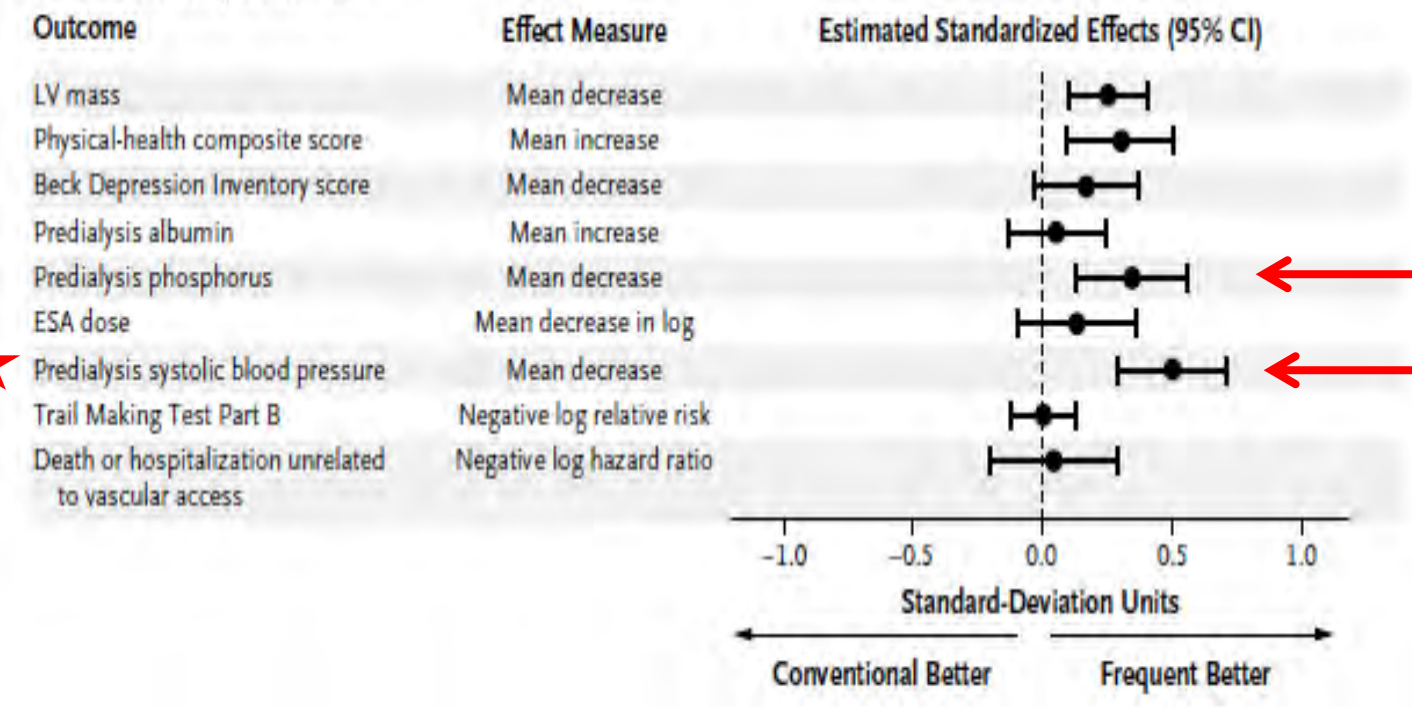Composite Score

A Death or Change in LV Mass

Hazard ratio, 0.61 (95% CI, 0.46–0.82)
P<0.001

Frequent hemodialysis

Conventional hemodialysis

Patients with Better Outcome (%)

Survival (mo)

Change in LV Mass among Survivors (g)

B Death or Change in PHC Score

Hazard ratio, 0.70 (95% CI, 0.53–0.92)
P=0.007

Conventional hemodialysis

Frequent hemodialysis

Patients with Better Outcome (%)

Survival (mo)

Change in PHC Score among Survivors

Secondary End Points after 12 months

C Main Secondary Outcomes

Outcome	Effect Measure	Estimated Standardized Effects (95% CI)
LV mass	Mean decrease	
Physical-health composite score	Mean increase	
Beck Depression Inventory score	Mean decrease	
Predialysis albumin	Mean increase	
Predialysis phosphorus	Mean decrease	
ESA dose	Mean decrease in log	
Predialysis systolic blood pressure	Mean decrease	
Trail Making Test Part B	Negative log relative risk	
Death or hospitalization unrelated to vascular access	Negative log hazard ratio	

Standard-Deviation Units

Conventional Better ← → Frequent Better

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

The FHN Trial Group*

– decreased phosphorous
– decreased blood pressure

Antihypertensive agents consumed — no.				
Conventional hemodialysis	92	2.80±1.69	2.58±1.68	−0.23±1.35
Frequent hemodialysis	103	2.69±1.80	1.82±1.73	−0.87±1.85

– decreased # of BP medications

Home hemodialysis and the motivated patient:

- Longer, slower dialysis
- More frequent dialysis than 3x/ week
- Better control of blood pressure & volume*

- Timing dialysis at the end of the day
   so "recovery time" does not disrupt activities
- Greater independence
- Greater dietary freedom
- Fertility

Downsides:

Practical considerations: <u>in brief</u>

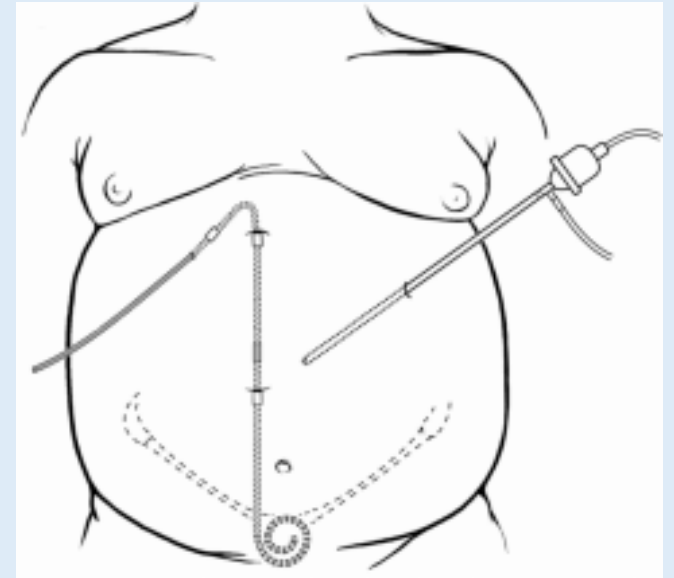Who is appropriate for home PD, and who is not?
    obesity?
    diabetes?
    elderly?
Who is appropriate for home HD, and who is not?
    education level?
    needle phobia

Absolute requirement for either form of home treatment:
    - clean home (no cats …) and absence of unstable behaviors
    - supportive family can overcome many barriers
    - motivated patient
    - additional considerations: right heart failure

Special situations ?

All Kaiser-Permanante patients on PD from 1994-2008 who underwent CABG or valve replacement

After CT surgery:
- 36 patients on PD who continued PD
- 72 matched ESRD who had HD

Matched for patient age
      years on dialysis
      % with diabetes
      Charlson co-morbidity index

PD with more CABG (78% ot 65%)

Baseline Patient Demographics			
Variable	PD	HD	p Value
Patients (n)	36	72	—
Mean age (years)	58.8±9.4	59.4±8.8	0.71
Men [n (%)]	24 (67)	46 (64)	0.82
Mean dialysis vintage (months)	32.5±27.4	39.8±41.2	0.73
Race [n (%)]			0.21
White	12 (33)	16 (22)	
African American	10 (28)	16 (22)	
Asian	9 (25)	17 (24)	
Hispanic	5 (14)	23 (32)	
Surgery type (%)			0.33
CABG	28 (78)	47 (65)	
Valve replacement	5 (14)	19 (26)	
CABG + valve replacement or other	3 (8)	6 (8)	
Diabetes mellitus [n (%)]	26 (72)	52 (72)	0.82
Mean Charlson comorbidity index	6.6±2.0	6.8±2.1	0.70
Elective surgery [n (%)]	13 (36)	34 (47)	0.37

PD patients with:
- equal operative mortality
- shorter ICU stay (2 vs 4 days)
- trend to shorter hospital stay (9.5 vs 10 days)
- trend to fewer infections (2 vs. 14)

Early Postoperative Outcomes by Dialysis Modality

Outcome	PD (n=36)	HD (n=72)	p Value
Median CSU LOS [days (IQR)]	2 (1.75–5)	4 (2–5.25)	0.05
Median hospital LOS [days (IQR)]	9.5 (7–13)	10 (7–15)	0.40
Median intubation time [hours (IQR)]	24 (24–24)	24 (24–48)	0.06
Postoperative infection (%)			
Pneumonia	1	6	
Wound infection/cellulitis	0	2	
Bacteremia	0	3	
Multiple infections/other	1	3	
TOTAL	2	14	0.08
Operative mortality [n (%)]	4 (11)	7 (10)	1.0

Kaplan_Meir 2 years later:
– PD patients vs. HD patients
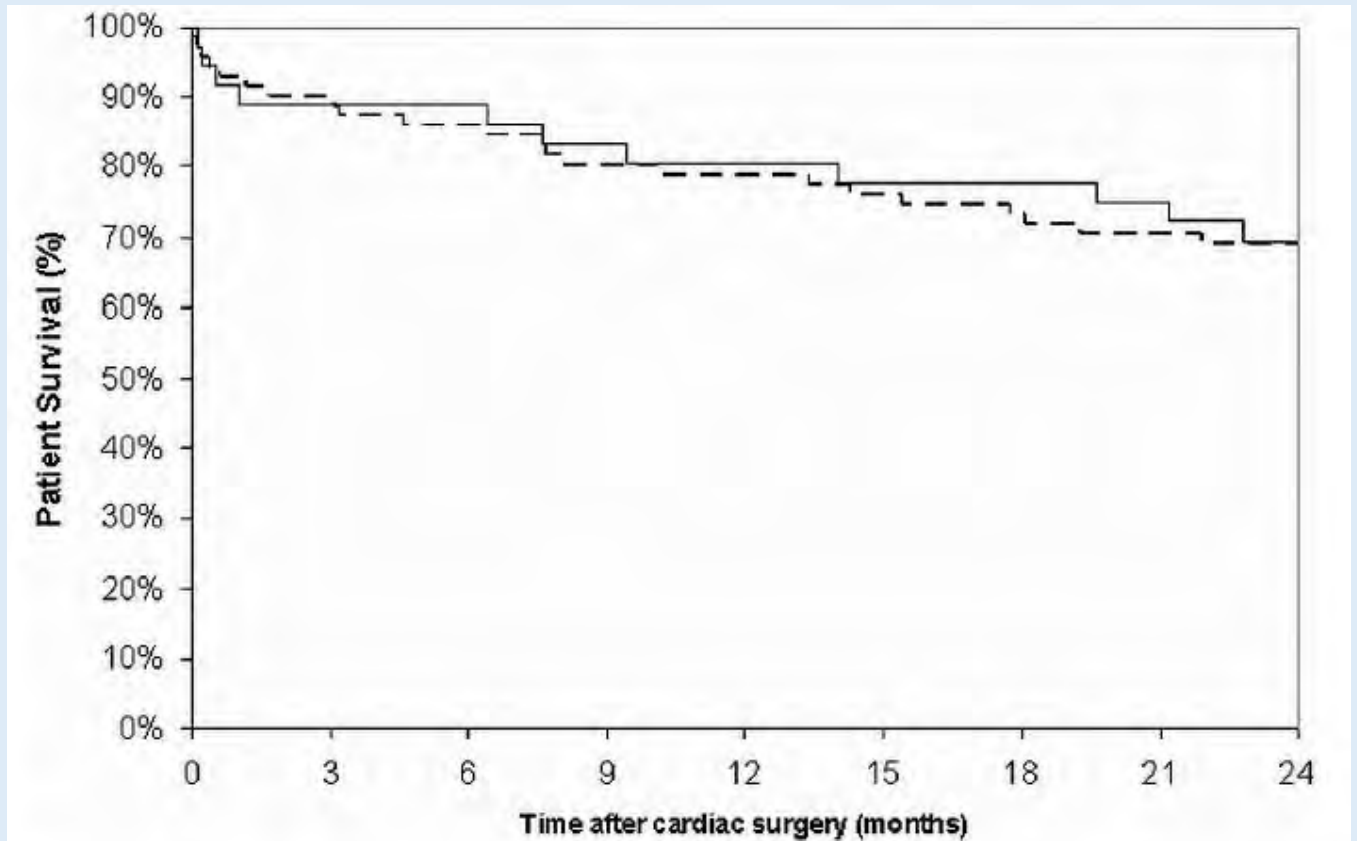
Figure 1 — Two-year patient survival after cardiac surgery for peritoneal dialysis patients (solid line) and hemodialysis patients (dashed line).

Burden of home dialysis on patients and caregivers

- Patient's perception as a burden on the family
- Patient's fear, anxiety and social isolation
- Caregiver stress and burnout

Anticipation / prevention:
- Lengthy discussions at the outset (transitional care unit)
- Include these topics at every monthly home dialysis visit

Interventions:
- Assisted home dialysis? (the Toronto example)
- Intermittent respite at in-center dialysis
- Flexibility in the dialysis prescription

Home therapy: an up-front investment of effort & time

129 patients from 7 centers performing
home HD in Europe

Average patient training time for home HD
- 3-4 weeks
- 10-25 sessions

Therefore, consider anticipated time on dialysis
when choosing patient modality

Cherukuri et al. BMC Nephrology (2018) 19:262

Number of weeks   Number of sessions
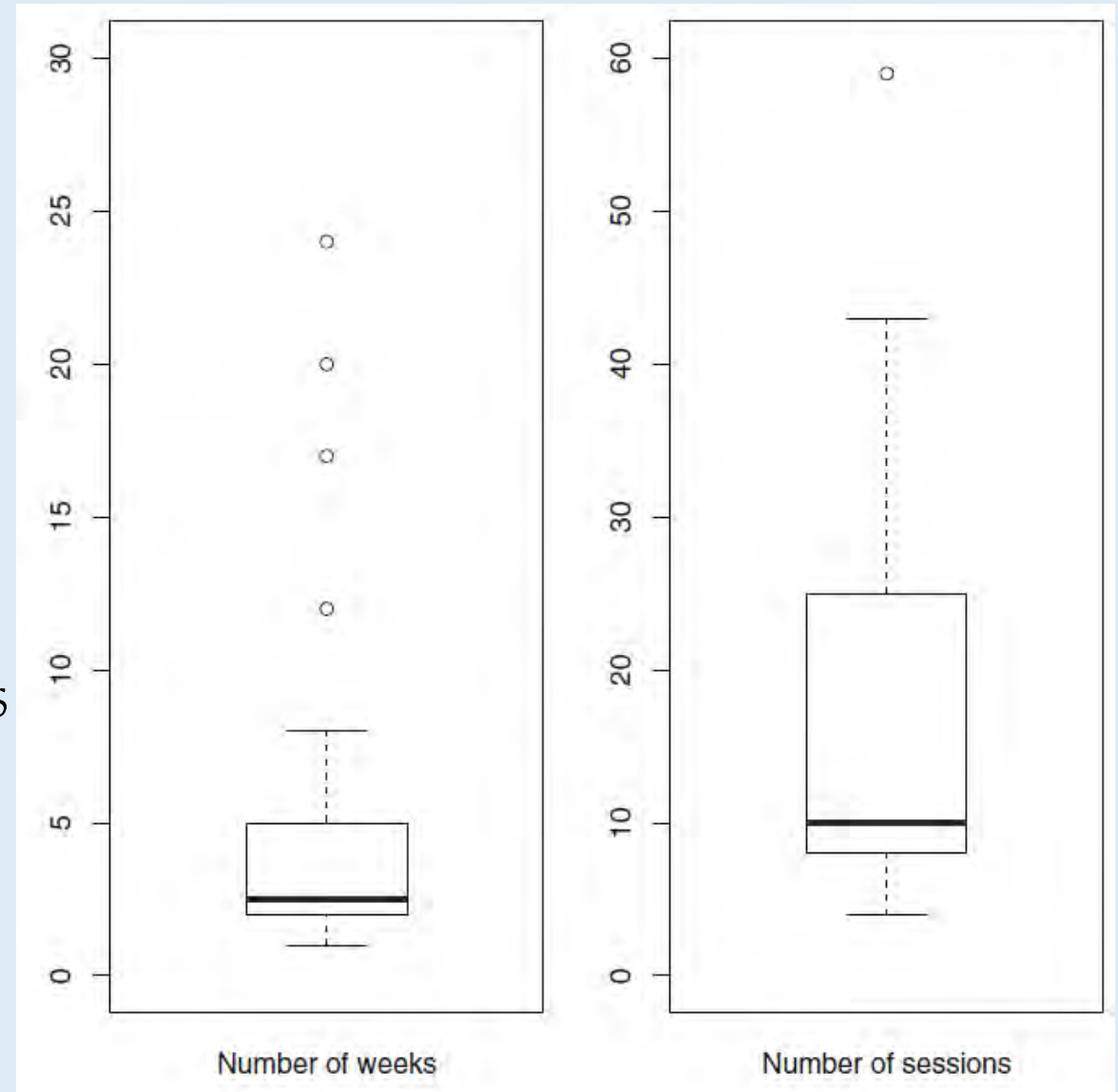
dialysis and public policy
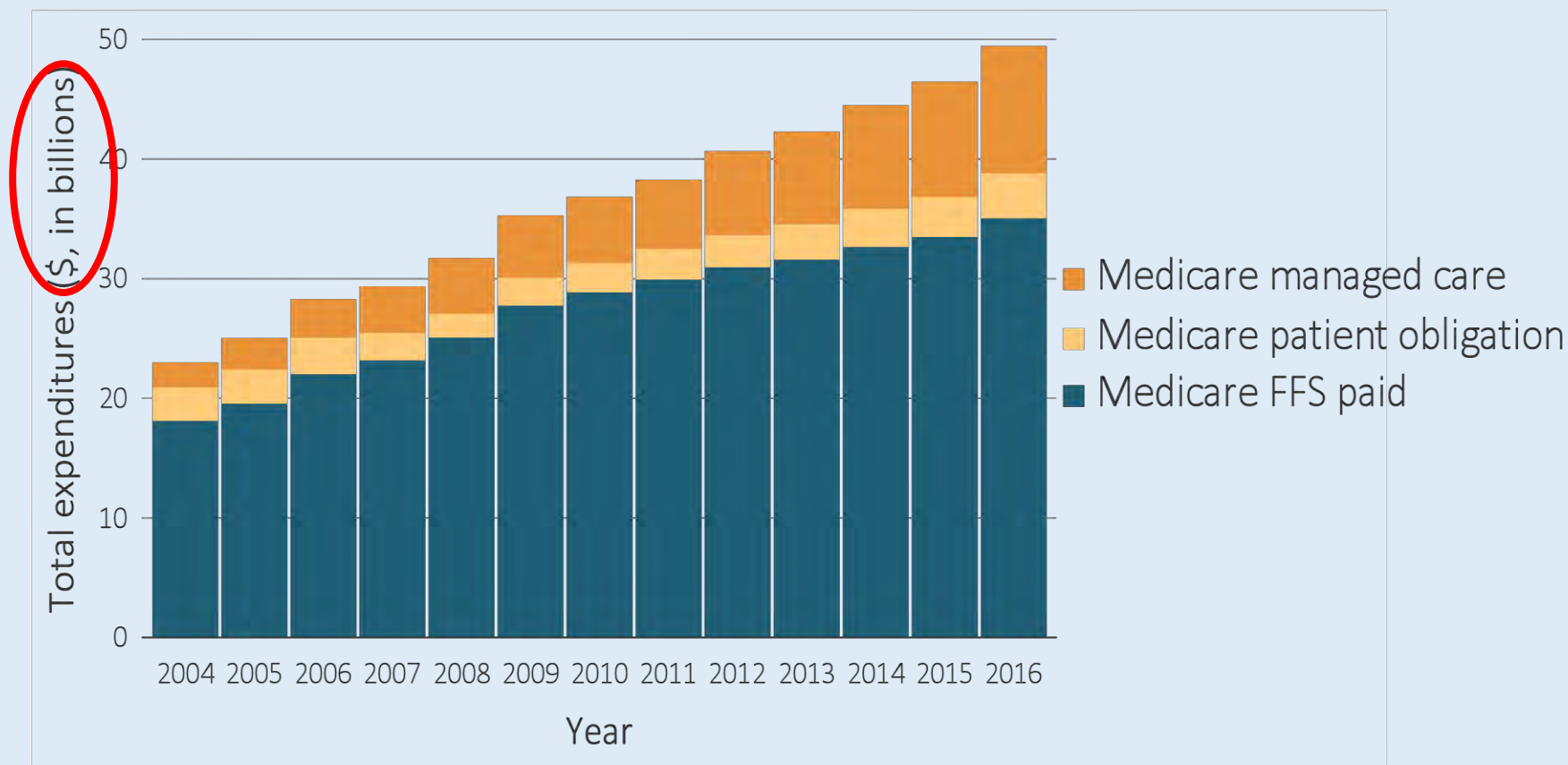
Data Source: USRDS ESRD Database; Reference Table K.1. Abbreviations: ESRD, end-stage renal disease; FFS, fee-for-service.

Trends in ESRD expenditures, 2004–2016
2018 Annual Data Report Volume 2 ESRD, Chapter 9 Fig 9.1

Home dialysis and public policy

Personal choice

Societal costs
- home therapies are less expensive per year
- over 90% of working-age dialysis patients are classified as disabled
- "automatic" SSI disability approval

"Justice" and public policy can consider <u>comprehensive</u> costs:
- cost of dialysis
- cost and rates of hospitalization
- benefit of a return to productive work
- mental health

...

So, why should your patient (and their nephrologist) consider home therapy?

Hard outcomes:
Survival
Blood pressure
Hospitalizations
Cardiovascular events

Other outcomes:
Quality of Life
Ability to work

Public policy considerations:
Comprehensive cost-benefit analysis of home vs in-center

Patient surveys show the main reason they did NOT pick a home therapy was....
never being told about home therapies.

Among patients on home therapy, which is best- PD or HD?

1999-2003

Survival probability
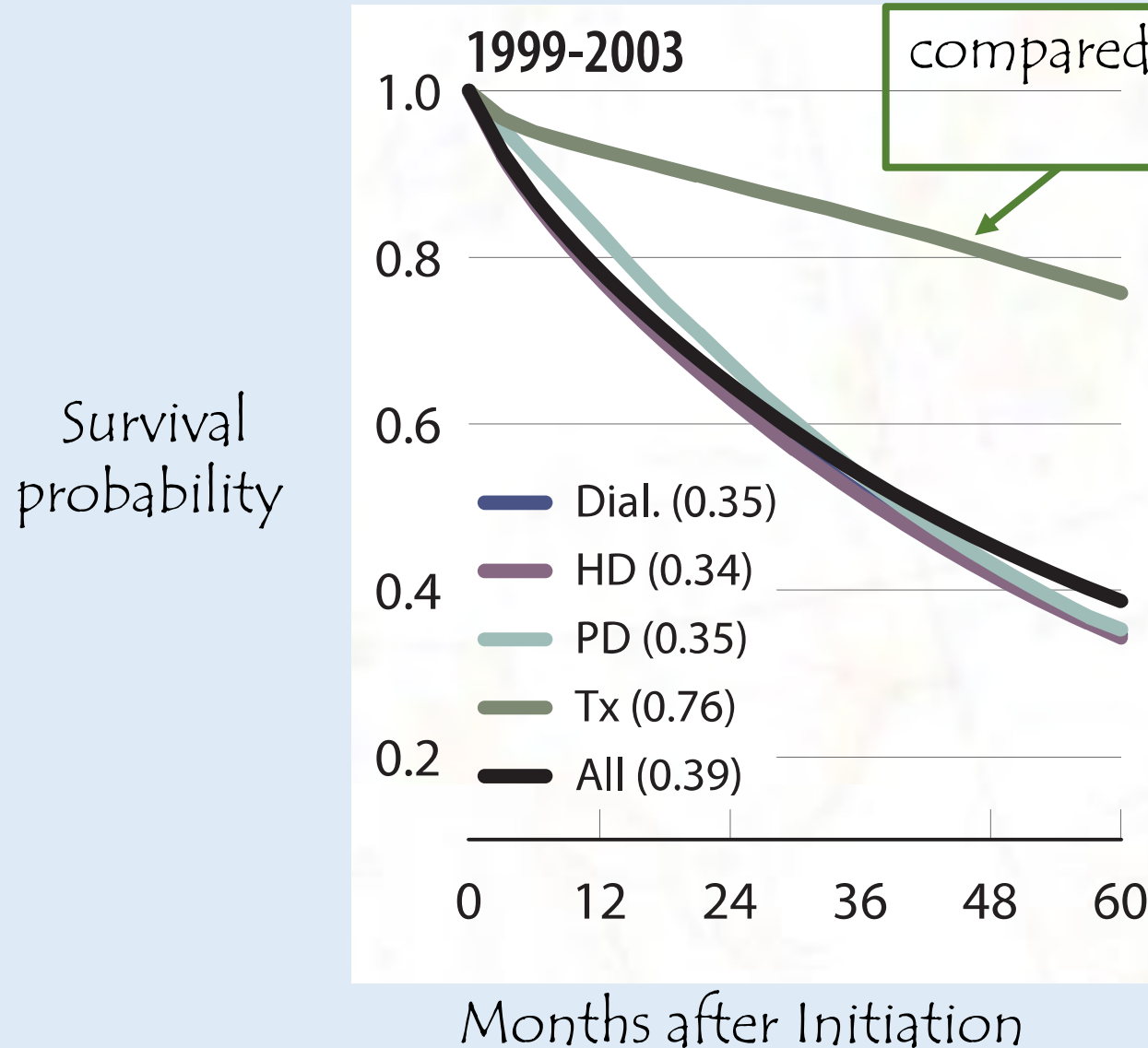
compared with kidney transplantation, the debate is moot

Dial. (0.35)
HD (0.34)
PD (0.35)
Tx (0.76)
All (0.39)

Months after Initiation

United States Renal Data System
2010 Annual Data Report

In the end:
- start dialysis as late as possible with good nephrology care
- help patients learn about home dialysis options and choose
- use dialysis as a bridge to transplantation whenever possible

Testimonials from patients:
Short testimony on home hemodialysis from FMC: https://www.youtube.com/watch?v=kKn2CDVRvjk

Short testimony on home PD from DCI: https://www.youtube.com/watch?v=W9wnqu07-p8

Multiple patients in Manitoba: https://www.youtube.com/watch?v=fpENA5GJSuc

Solo needle placement for home HD: https://www.youtube.com/watch?v=SSA_9cO5fQU

THANK YOU

Few slides if questions arise:
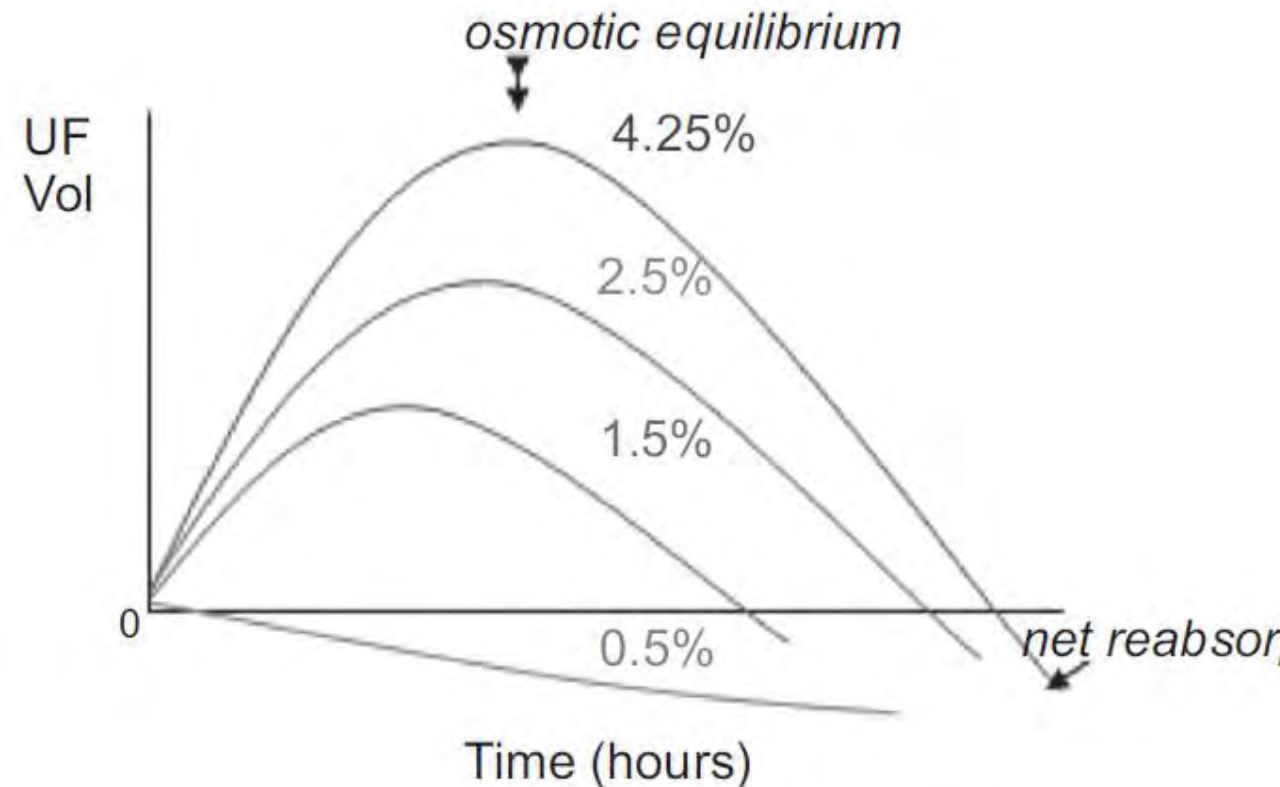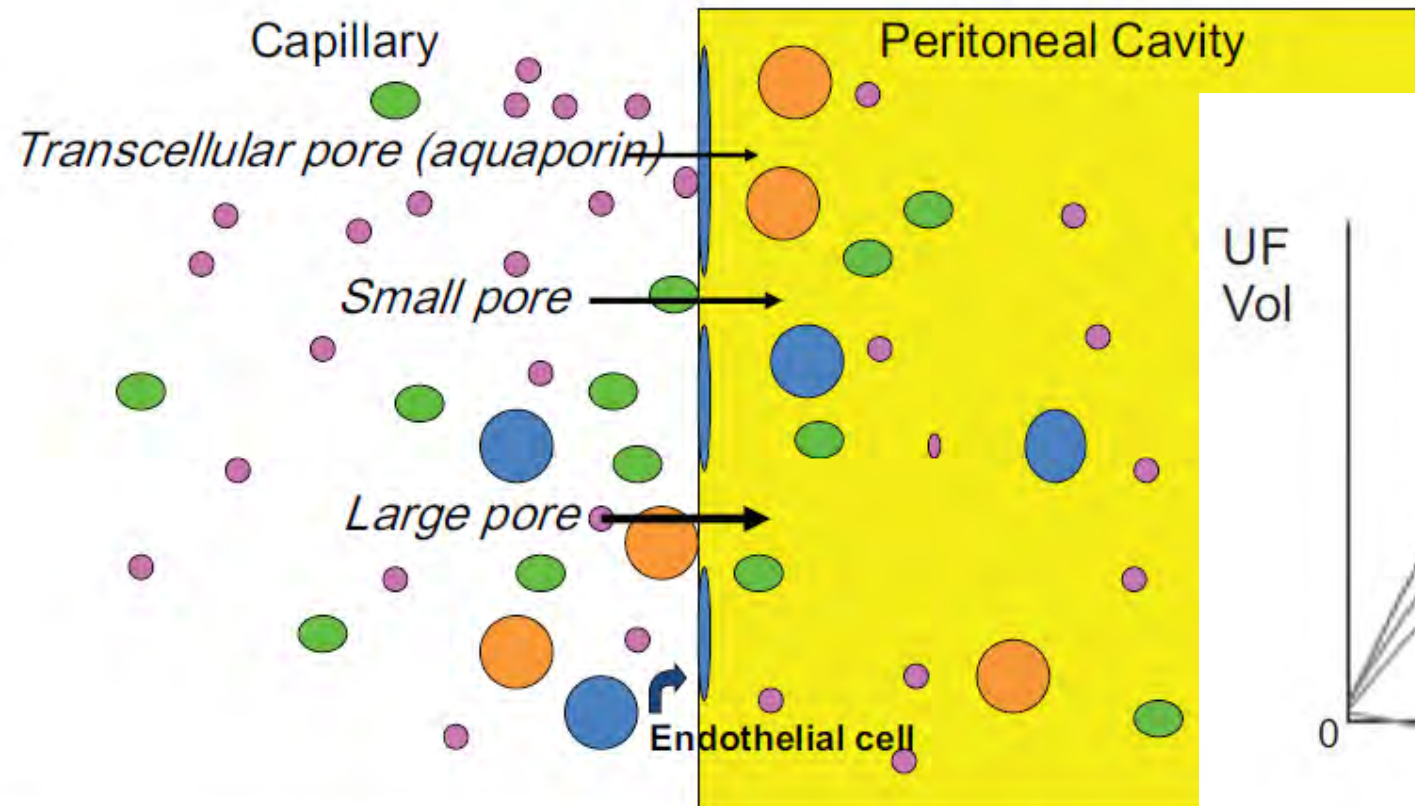
Fig. 2. Solute and water transport occurs across the vascular endot[hel]
peritoneal membrane through 3 pores of varying sizes: large, small, and
ultra-small spores. The large pores (100–200 Å in diameter) represent <1% of
all pores and are the main site of peritoneal protein loss. The small pores
(40–60 Å in diameter) account for over 95% of solute removal. The ultra-
small transcellular pores (4–6 Å in diameter) are composed of aquaporin-1
(AQP1) channels that facilitate free water transport.

Which blood pressure should be used?
- general population: 24 hr ambulatory BP, home BP, unobserved BP
- In dialysis patients, the question of <u>which</u> BP is amplified…

Pre-dialysis blood pressure

Pre-dialysis blood pressure

Inter-dialytic blood pressure

Post-dialysis blood pressure

Post-dialysis blood pressure
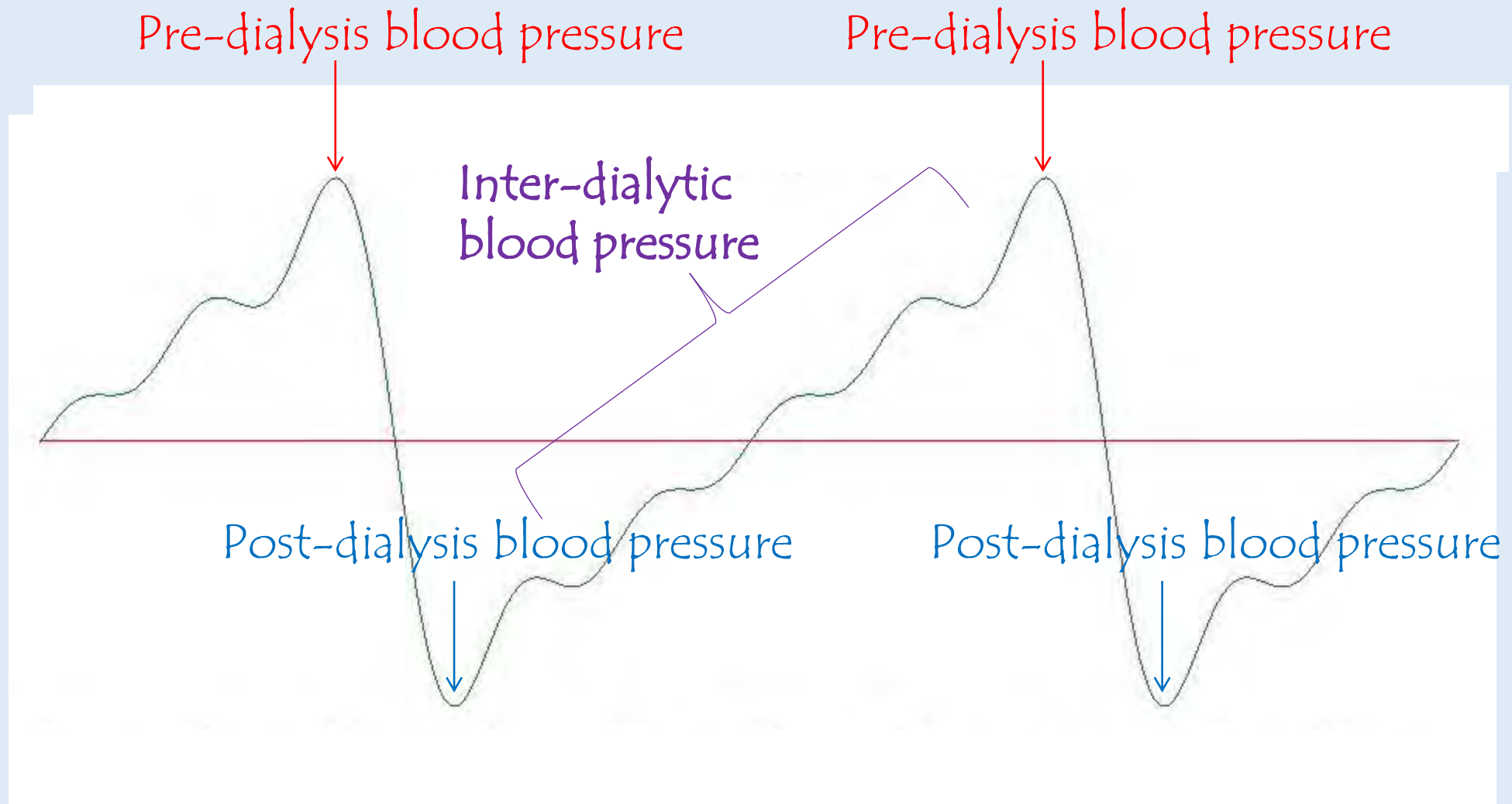
Reverse Epidemiology of Hypertension and Cardiovascular Death in the Hemodialysis Population

The 58th Annual Fall Conference and Scientific Sessions

n= 40,933 DaVita unit patients
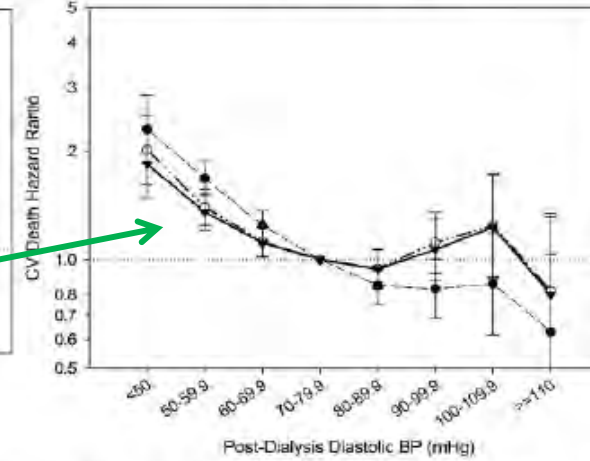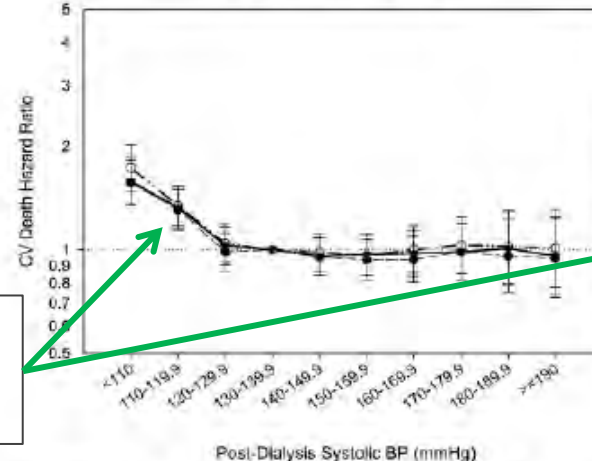From 4/2002 – 6/2003 (15 mo)

Goal BP for general population

Pre-HD

130-140

70-79

Lowest mortality:
Pre-dialysis DBP 90-110

Lowest mortality:
Pre-dialysis SBP 160 –189

Post-HD

Post dialysis mortality:
any blood pressure except low

Association between BP and 15-month CV death in 40 933 MHD patients (95% confidence interval bars are depicted). Note that the unadjusted models also include entry quarter. **MICS-adjusted models also include all covariates in the previous models.

(*Hypertension*. 2005;45[part 2]:811-817.)