Alternatives to conventional hemodialysis: nocturnal incenter, nocturnal home hemodialysis, short daily home hemodialysis, peritoneal dialysis, transplantation: which choice for which patient?

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Objective

1. To assist the dialysis professional and the individual with CKD in making treatment choices, based on evidence supporting the advantages and disadvantages of transplantation, peritoneal dialysis, conventional incenter hemodialysis, nocturnal incenter hemodialysis, short daily hemodialysis, and nocturnal home hemodialysis.

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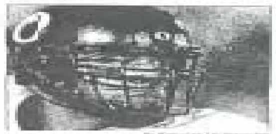


Jeremiah Masoli: Oregon Ducks QB.

Preview of Pac-10: USC's pain in Oregon

■ Trojans hit snags vs. state's two teams in conference, 8C

Laurent: Has a pivotal role in WWII film.

'Basterds' rakes in $37.6M

■ Female form [illegible] Tarantino tale,
■ Meet Christo[illegible] Waltz and Mél[illegible] Laurent, 1D

Health care closeup

Home care: Deb Lustman, 50, passes time with her Maltese Jake as she does dialysis at home in Magnolia, N.J. Lustman dialyzes five days a week and feels better than when she got three treatments a week.

Dialysis treatment in USA: High costs, high death rates

Medicare rules under scrutiny

By Rita Rubin
USA TODAY

Deb Lustman was late getting to work a few days every week, and often felt she wasn't thinking as clearly as she once did.

The reason: Lustman, 50, was spending four hours a day, three days a week, undergoing kidney dialysis at a dialysis center, where a machine filtered toxins and fluids from her blood. Normally, that's the job of the kidneys, but for reasons doctors have never figured out, hers had failed.

Nine months into her treatment, as soon as her doctor raised the possibility of home dialysis, Lustman decided to switch. So, in July 2008, after she and her husband learned the ins-and-outs from a nurse, she began dialyzing five evenings a week at her Magnolia, N.J., home, with her two Maltese, Sophie and Jake often lounging next to her. Now Lustman, an optician, dialyzes on her own schedule, not the center's, and she's not late for work anymore. And, she says, "I'm healthier."

Thanks to more-frequent dialysis, totaling 15 or 16 hours a week, "I feel not only physically better but .... mentally better" and perhaps "happy," she says.

Lustman is a rarity, however: Only 8% of U.S. dialysis patients treat themselves at home. The vast majority of the more than 350,000 Americans on dialysis are treated in centers, where three treatments a week, three or four hours each, is the norm — not because it's optimal but because that's the way it has been done for nearly four decades.

A growing body of evidence suggests that longer and/or more-frequent dialysis treatments, either at home or in a dialysis center, are far superior to the status quo. Although the USA spends more per dial-[illegible]

More than their share

The 2006 costs of an end-stage renal disease patient compared with other Medicare beneficiaries:

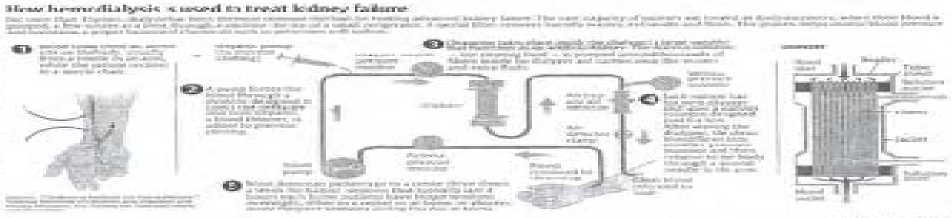
Cover story

Please see COVER STORY page 4A ►

One doctor's opinion: 'It's a broken system, and we need to fix it'

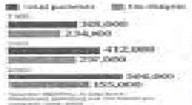
Continued from 1A

How hemodialysis is used to treat kidney failure



Cover story

Growing numbers



Industry dominated by two for-profit chains

Many don't get preventive care

Only the wealthy had dialysis

Longer, more frequent dialysis

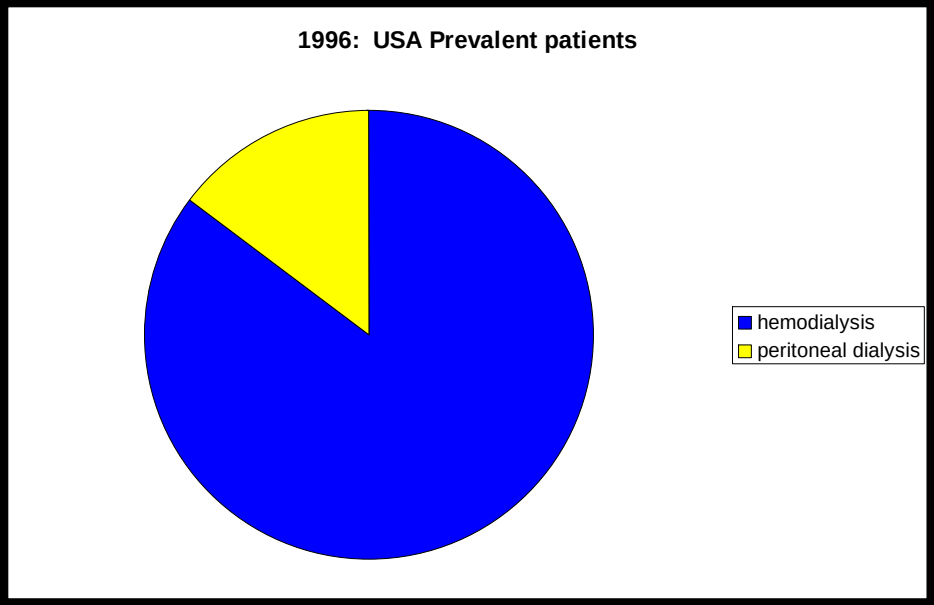
What happens next

Hemodialysis versus transplantation: Lower mortality rate in transplanted patients

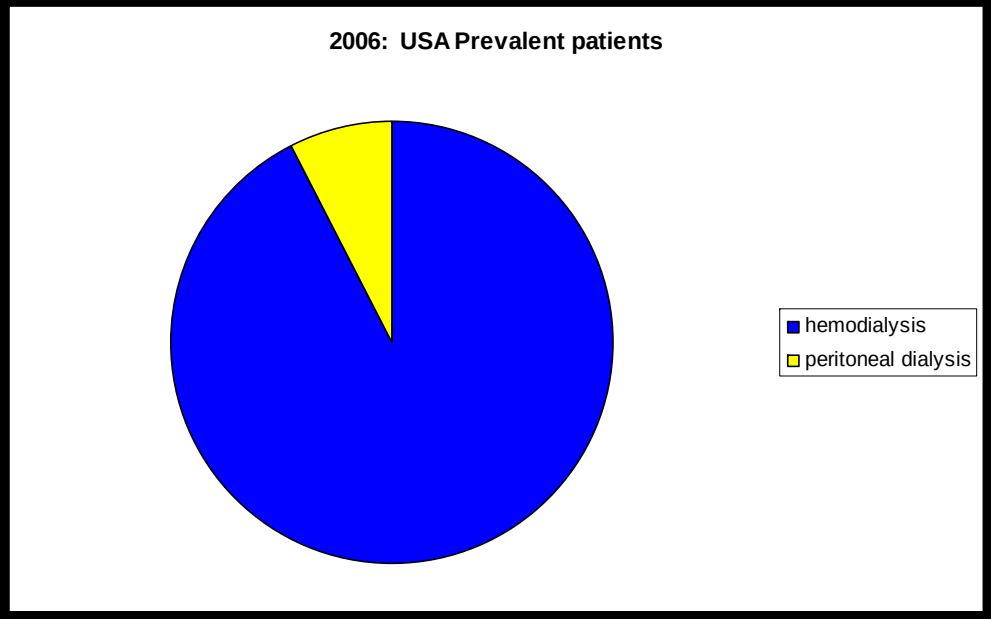
(compared to dialyzed patients on waitlist)

Study	Mortality rate/yr all dialysis pts	waitlisted pts	transplanted pts
Wolfe (USA) NEJM 1999 N = 84713	16.1	6.3	3.8
Oniscu (Scotland) JASN 2005 N = 4532	24.3	9.0	4.1

HD versus PD



The prevalence of PD as
An ESRD modality of therapy
Has dropped from 15 % to 7 %
in the USA from 1996 to
2006.



HD versus PD

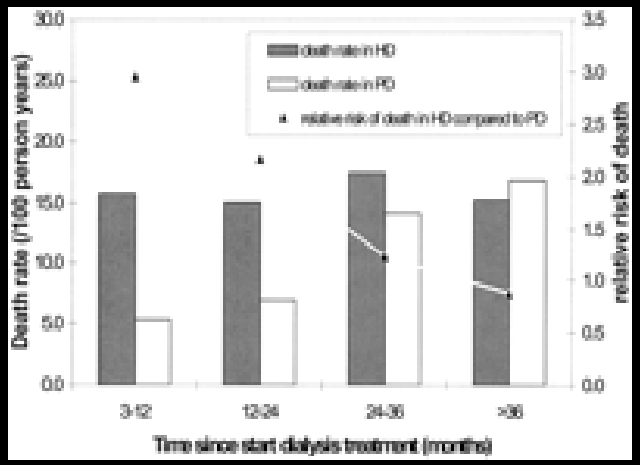
1. No randomized prospective controlled trials comparing the two forms of therapy
2. The only data is based on observational studies, complicated by differences in comorbidities, patient self-selection.
3. Most commonly measured outcome is mortality
4. Some studies use “intention to treat” model: statistically valid but not clinically relevant

CHOICE Study:
(Annals of Internal Medicine 2005): 1041 patients (274 PD, 767 HD) starting dialysis

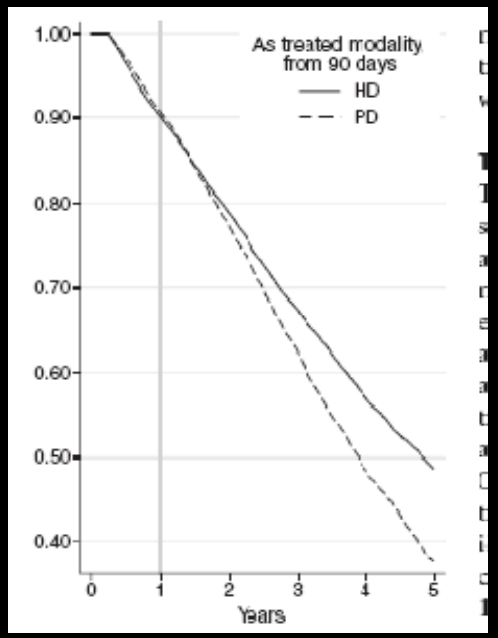
Group	relative risk of death (PD:HD)	significance
All pts	1.35 (0.97 – 1.87)	no
Non-DM	2.78 (1.35 – 5.68)	yes
DM	1.23 (0.79 – 1.94)	no
< 65 yrs	1.67 (1.01 – 2.75)	yes
65 yrs +	1.66 (0.93 – 2.97)	no
Year 1 of Rx	1.39 (0.64 – 3.06)	no
Year 2 of Rx	2.34 (1.19 – 4.59)	yes

HD versus PD: initial survival advantage of PD, disappearing (or favoring HD) after 2 years

Termorshuizen, JASN 2003
1222 pts in the Netherlands



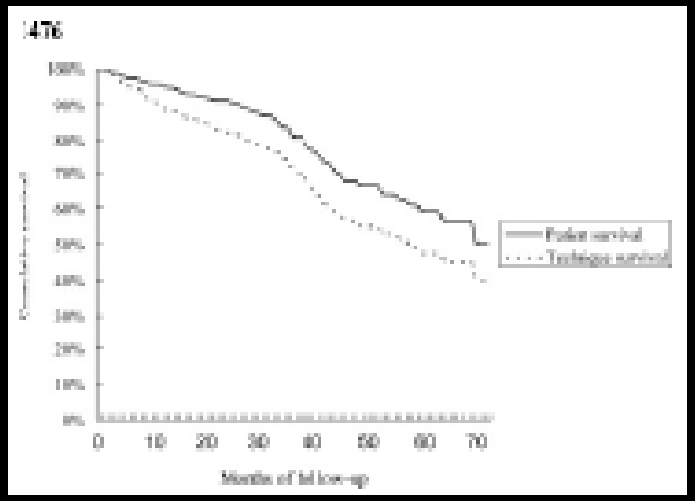
McDonald, JASN 2009
25,000 pts in Australia and New Zealand



Excellent survival with PD in Hong Kong (Prince of Wales Hospital): but body weights very low,

and residual renal function predictive.

Can data be extrapolated to USA?



Li, NDT 2008

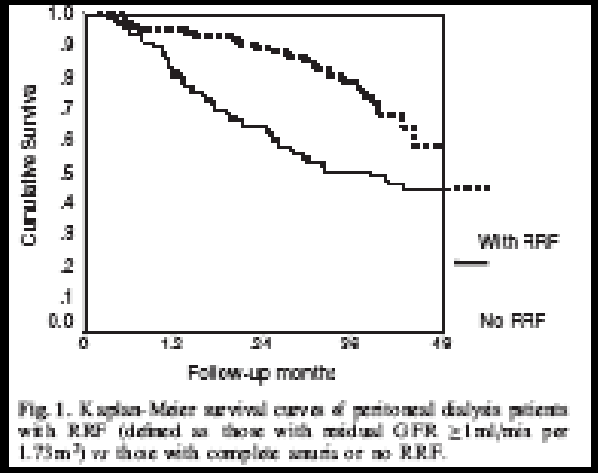


Fig. 1. Kaplan-Meier survival curves of peritoneal dialysis patients with RRF (defined as those with residual GFR ≥1 ml/min per 1.73 m²) vs those with complete anuria or no RRF.

Wang, NDT 2005

Alternatives to Conventional Hemodialysis

	location	duration	frequency
Conventional	**center**	**3 – 5 h**	**3/week**
Home HD	**home**	**3 – 5 h**	**3/week**
Nightly home hemo	**home**	**7 – 10 h**	**5 – 7/week**
Home short daily	**home**	**2 – 3 h**	**5 – 7/week**
Incenter daily	**center**	**2 – 3 h**	**5 – 6/week**
Incenter nocturnal	**center**	**7 – 8 h**	**3/week**
Hemofiltration	**home**	**varies**	**3/week**

Home Hemodialysis (HHD) in New England (ESRD Network 1 report, 2004

	CHD	PD	HHD	Total	%HHD
CT	2710	534	6	3250	0.2 %
MA	4513	405	32	4950	0.6 %
ME	906	76	7	989	0.7 %
NH	615	70	3	688	0.4 %
RI	799	27	3	829	0.3 %
VT	356	19	2	377	0.5 %

Home Hemodialysis (HHD) in New England, ESRD Network 1 report, 2008

	CHD	PD	HHD	Total	%HHD
CT	3036	526	29	3591	0.8 %
MA	4833	432	60	5325	1.1%
ME	976	75	18	1069	1.7 %
NH	666	74	7	747	0.9 %
RI	907	20	2	929	0.2 %
VT	281	17	6	304	2.0 %

Home hemodialysis

3 days/week, 3 – 5 hours/Rx

Schedule/process mimics incenter HD

Home, with self care, assistant, remote monitoring

Number of patients on this therapy not well quantified, but estimates are 150 – 250 patients worldwide

Home vs incenter HD: Bern, Switzerland (Saner, NDT 2005): 58 matched pairs, 2.5 Rx/week, 9.5 hrs/week

	Home HD	incenter HD
Age (yrs)	50	51
Male	67 %	67 %
Married	84 %	70 %
Employed	42 %	35 %
Hospitalizations/year	0.6	1.4 *
Survival at 5 yrs	93 %	64 %*
Survival at 10 yrs	72 %	48 %*

*p < 0.001

Nightly home hemodialysis

5 – 7 nights per week, 7 – 8 hours/Rx:

40 hours per week of HD

Home, with self care, assistant, remote monitoring

Number of patients on this therapy not well quantified, but estimates are 150 – 250 patients worldwide. Biggest centers: Ontario (Pierratos) and Lynchburg, VA (Lockridge)

Nightly home hemodialysis: Until recently, most studies are observational, with small numbers of patients

Recent review (Walsh, KI 2005) of 14 studies:

Outcome	effect (0 to ++++)
Blood pressure control	+++
Left ventricular hypertrophy	+++
Anemia	++
PTH level	+
Phosphorus level	++
Quality of life	+++

Survival among nocturnal home hemodialysis patients compared to renal transplant recipients, Pauly et al, NDT 2009

- Matched cohort study: comparing survival between NHD pts in Canada (177 pts) and deceased donor transplant recipients (531 pts) and living related transplant recipients (531 pts)
- Mean age 46, 40 % female, 14 % diabetic, 1 % with PVD (higher in NHD group) 2 % with coronary artery disease (higher in NHD group)

Nocturnal home hemodialysis: comparable mortality rates When compared to deceased donor kidney transplantation (Pauly, NDT 2009)

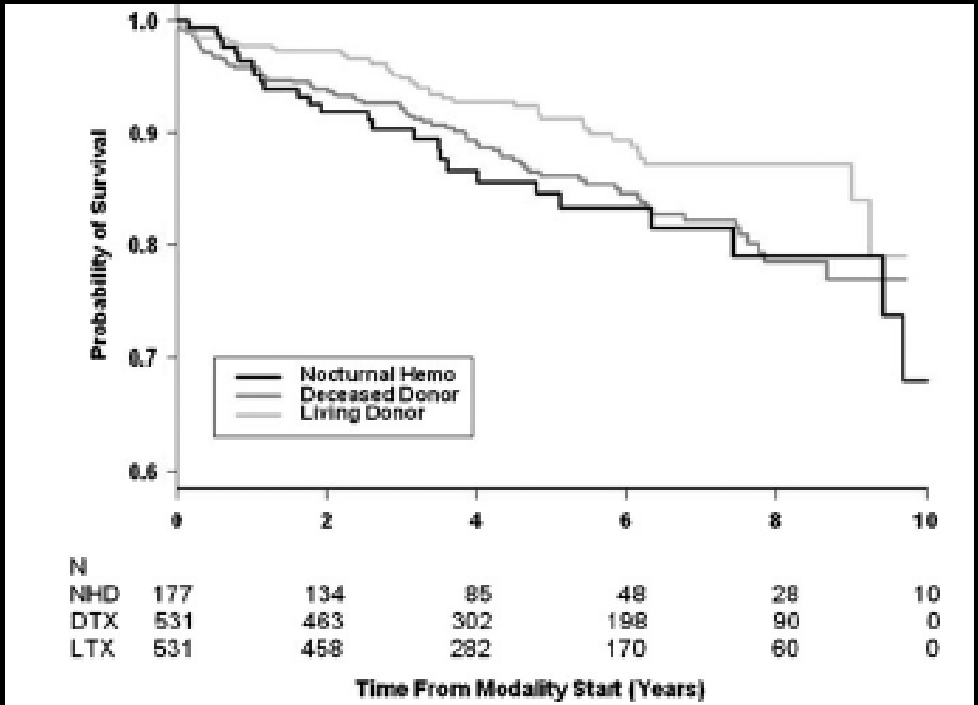


Fig. 1. Time to death in patients treated with nocturnal haemodialysis, deceased and living donor kidney transplantation (log-rank test, $P = 0.03$).

Daily short hemodialysis

- Can be done in HD centers, or at home using conventional equipment or NxStage device
- 1.5 to 2 hours, 5 – 7 times weekly
- 10 to 15 hours of HD per week

Daily Short HD: Kjellstrand, NDT 2008

415 patients (71 % male, 64 % home or self care) in Italy, USA, France, and UK

Mean Rx time: 136 minutes

Mean Rx/week: 5.8

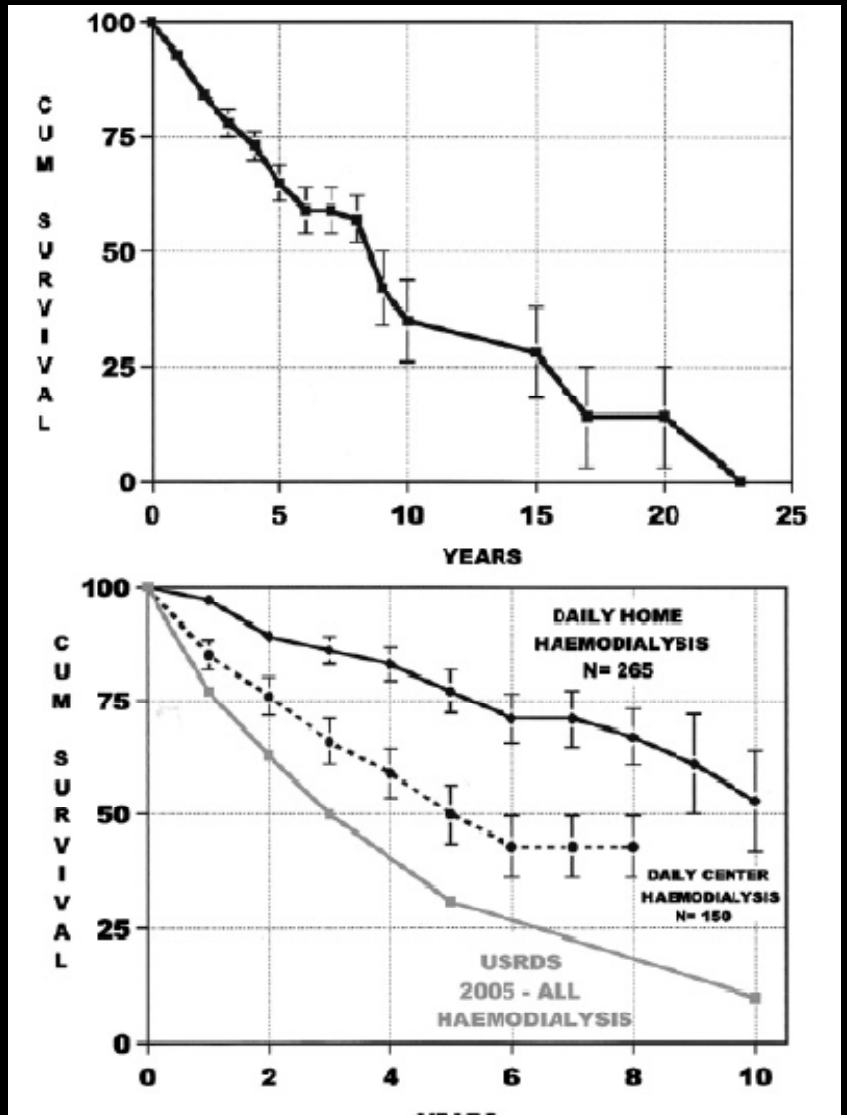
Mean weekly dialysis hours: 13.3

Mean Qb: 375 ml/min, mean Qd: 550 ml/min

Mean spKT/V urea per Rx: 0.77

Mean weekly spKT/V urea: 2.74

Daily hemodialysis: much lower mortality than USRDS data; Home hemodialysis survival better than incenter survival (Kjellstrand, NDT 2008)



NxStage

- Portable machine produced for home HD use only: portable, about 65 lbs
- Most patients dialyze 5 – 7 days per week, about 2 hours per session
- Diaysate initially sipplied in 5 L bags, now processed from tap water, 20 – 30 L dialysate used per session (Qd about 150 – 200 ml/min)
- FREEDOM Study compares outcomes of patients treated with NxStage to controls receiving conventional incenter HD.

NxStage SMR Calculations

Overall and by subgroup

Category	Number of Patients (N)	Number of Deaths	Number of Expected Deaths	SMR	P-Value
All Patients	2553	136	273	0.498	<0.0001
Gender					
Female	927	45	97	0.463	<0.0001
Male	1626	91	175	0.518	<0.0001
Age Category					
0-19	23	0	0.6	N/A	N/A
20-44	714	21	40	0.524	0.00259
45-64	1263	60	131	0.456	<0.0001
65-74	373	24	65	0.372	<0.0001
75+	180	31	36	0.859	0.39871

<0.05 = Statistically significant

SMR of 1=expected; 0.5 = Mortality is 50% lower than expected

NxSTAGE Renal Care, Pure and Simple

Frequent Hemodialysis Network (FHN) trial: outcomes are LV mass and SF-36 score

Incenter trial:

Patients randomized to

1) Conventional HD, 3 Rx/week, minimum eKT/V per Rx > 1.1
2) Daily HD, 6 Rx/week, 1.5 – 2.75 hrs/Rx, minimum eKT/V per Rx > 0.9

Nocturnal trial:

Patients randomized to

1) Conventional HD, 3 Rx/week, minimum eKT/V per Rx > 1.1
2) Nightly home HD, 6 Rx/week, 6 – 8 hrs/Rx, minimum eKT/V per week > 4

Incenter Nocturnal HD

- 3 treatments per week
- Td goal: 7.5 hours/week (range 4 – 7.5 hours)
- Start time: 8 – 10 PM, end time 4 – 5 AM
- Qb 300 ml/min (range 300 – 450 ml/min)
- Qd 500 ml/min
- Optiflux 160 NR dialyzers
- 3.0 mEq/L K+, 2.5 mEq/L Ca++. 35 mEq/L HCO3-
- Two bolus heparin doses at initiation and 3.5 hrs into Rx
- UF volume: 2 – 8.5 L/Rx
- Pts in recliners, lights out at 10:30 pm, everyone is prescribed sedative/hypnotic at night

Prospective controlled study: 224 pts, NHD (8h, 3/wk) vs CHD (4 h,3/wk); Ok, JASN 2008

	NHD	CHD
Rx time	462 min	236 min
Mortality rate	1.29 %	6.03 %
Risk for death	0.22	
Hospitalization days	5.0	19.2
Phosphate binder Rx	72 % decline	
BP med Rx	66 % decline	

Observational study: 20 patients treated with incenter NHD, 20 matched (gender, age, weight, diabetes) patients with conventional HD, Warwick, RI

Mean	NHD	CHD
Age, in years	43	50
% male	85 %	85 %
Weight, in kg	91	91
Rx time	422 min	236 min
URR	85 %	72 %
Albumin (g/dl)	4.1	3.7
PCR	1.17	1.02
PO4 (mg/dL)	5.1	6.0
PTH (ng/ml)	394	336
BP meds (pills/d)	1.8	2.6
PO4 binders (pills/d)	3.4	5.0
Hospitalization days/yr	3.0	7.4

DOPPS: significantly lower mortality rate with Td > 240 minutes/Rx (Saran, KI 2006)

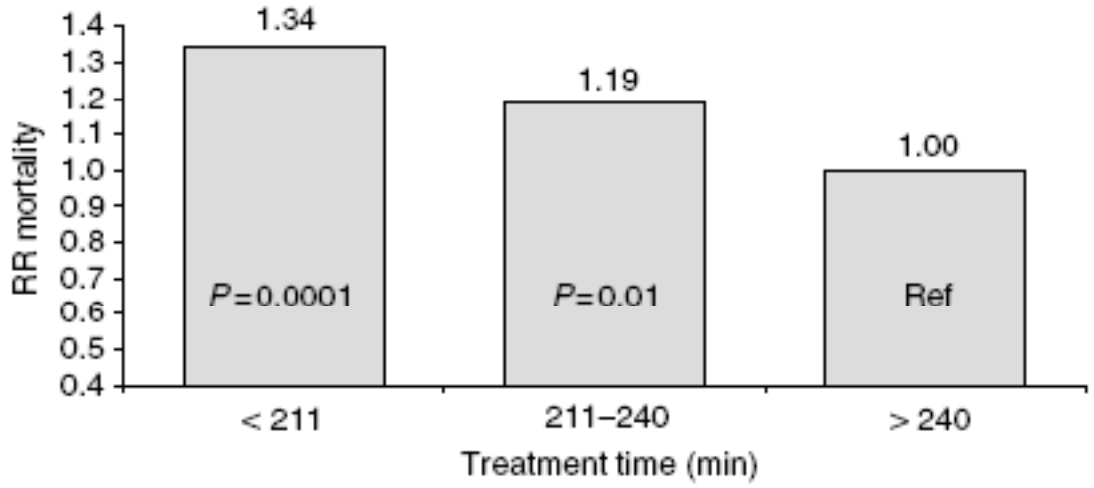
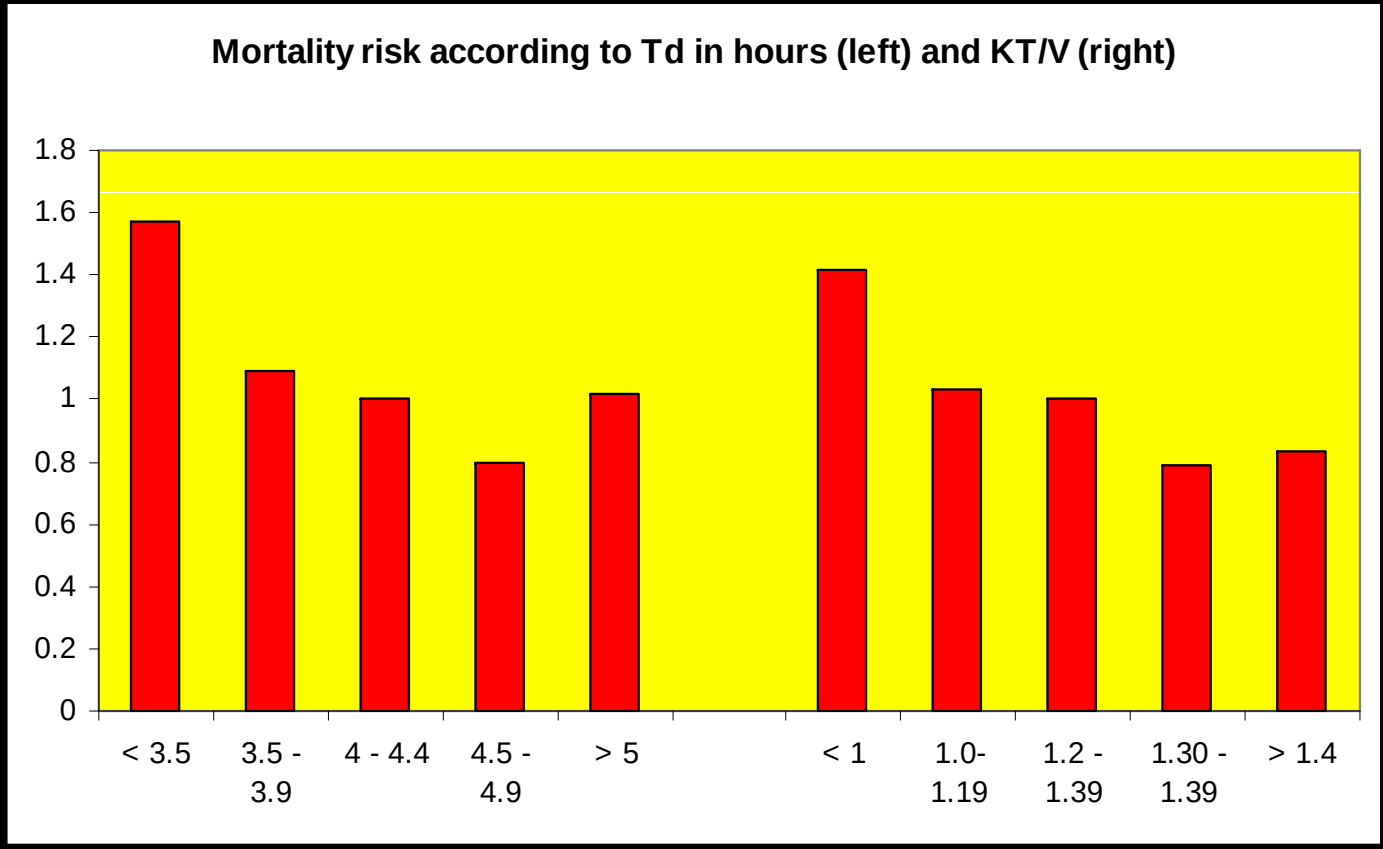


Figure 2 | RR of all-cause mortality, by TT category.
The incremental RR of mortality with decreasing TT categories in all DOPPS regions combined. The referent category is TT > 4 h (240 min).

Associations of HD session length and KT/V urea with mortality risk in 6593 HD patients in Australia and New Zealand, Marshall et al, KI, 2006



Gottschalk report 1967

1. Kidney transplantation preferable to dialysis
2. Home dialysis preferable to center dialysis

In 1967 40 % of dialysis patients were treated at home!

Barriers to home hemodialysis

1. Lack of patient education: when patients are fully informed of options, almost 50 % choose home therapies (Korevaar, KI 2003)
2. Financial disincentives: CMS doesn't encourage home dialysis, lower proportion of home patients in for profit chain units. PD less expensive, but only when PD programs are large. There are big incentives to keep HD units full. Many insurers only reimburse home HD for self care or unpaid partner care HD.
3. Lower MD reimbursement for PD and home HD. Perception that home dialysis patients are time consuming. Limited MD education during fellowship about PD and home HD.

Conclusions

1. In physically active patients without active infection, vascular disease, or cancer, renal transplantation from a living donor is the single best option for ESRD therapy.
2. There are no randomized controlled trials examining the difference between outcomes in HD and PD. Observational studies favor PD. HD is probably a better treatment in patients with higher body weights, who have been on dialysis longer, and who are without residual renal function.
3. Although randomized controlled trials are lacking, observational and retrospective trials are virtually unanimous in showing that the longer the duration of HD treatments, the better. Treatments of more than 4 hours are superior to treatments of less than 4 hours. More than 3 treatments per week is are superior to 3 treatments per week.

Conclusions

In hemodialysis…

- Home treatments better than incenter
- Longer treatments better than shorter
- More treatments better than less