THE DETERMINANTS OF TRAINING AND TECHNIQUE FAILURE IN HOME HEMODIALYSIS

CHRISTOPHER T CHAN MD FRCPC

DIRECTOR – DIV OF NEPHROLOGY – UNIVERSITY HEALTH NETWORK

R FRASER ELLIOTT CHAIR IN HOME DIALYSIS

PROFESSOR OF MEDICINE – UNIVERSITY OF TORONTO

OBJECTIVES

- TO DISCUSS STRATEGIES AND INNOVATION IN MAINTAINING HOME HEMODIALYSIS TECHNIQUE SURVIVAL
  - VASCULAR ACCESS MANAGEMENT
  - TECHNIQUE SURVIVAL
- TO ILLUSTRATE NEW OPPORTUNITIES AND OUTCOME RESEARCH IN HOME HEMODIALYSIS

Determinants of training and technique failure in home hemodialysis

Michael E. SCHACHTER,* Karthik K. TENNANKORE,* Christopher T. CHAN
Division of Nephrology, Department of Medicine, University Health Network, Toronto, Ontario, Canada

Table 2 Social and dialysis-associated factors among incident home hemodialysis patients

Characteristic	Failure ($n = 32$)	Success ($n = 145$)	P value
Social factors			
College/university education, *n* (%)	21 (68)	88 (61)	0.55
Renting current residence, *n* (%)	13 (41)	31 (21)	0.04
Living alone or with dependents, *n* (%)	9 (28)	26 (18)	0.22
Distance from HHD training unit, (median km, IQR)	19 (9–37)	22 (11–45)	0.18
Dialysis factors			
Nephrology follow-up before start of HHD, *n* (%)	27 (84)	140 (97)	0.02
Central venous catheter dialysis access, *n* (%)	22 (69)	71 (49)	0.05
RRT vintage, (median years, IQR)	0.8, 0–8.0	1.5, 0–12.0	0.71
Capacity to perform HHD independently, *n* (%)	26 (81)	101 (70)	0.28

HHD = home hemodialysis; IQR = interquartile range; RRT = renal replacement therapy.

Schachter et al – HDI 2013

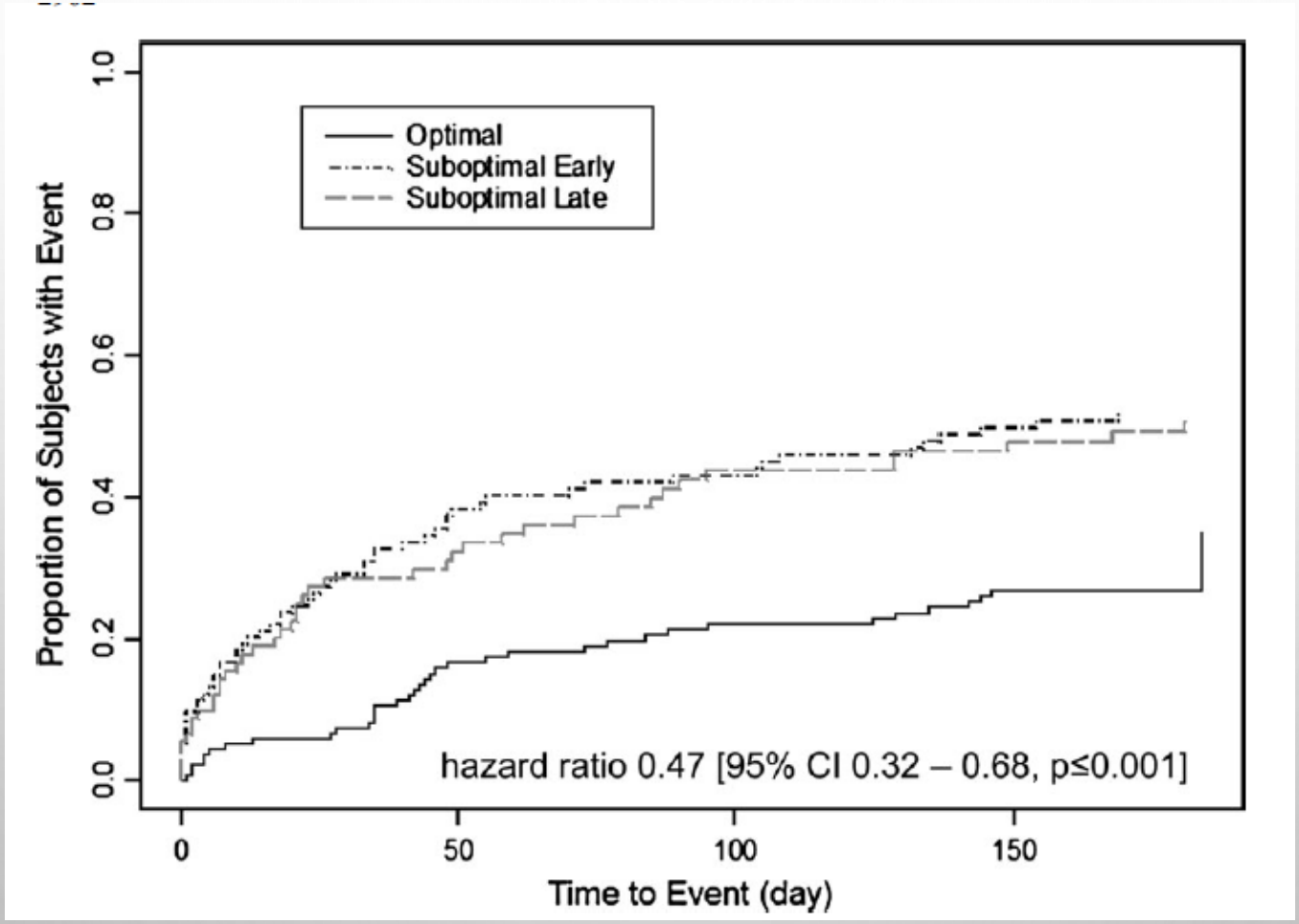
SUBOPTIMAL INITIATION OF HOME HEMODIALYSIS:

DETERMINANTS AND CLINICAL OUTCOMES

BACKGROUND

- TRANSITION FROM CKD TO DIALYSIS IS A CRITICAL PERIOD
  - HIGH MORTALITY
  - HIGH RATE OF HOSPITALIZATIONS
- PATIENTS' PREPAREDNESS TO INITIATE DIALYSIS REMAIN HIGHLY VARIABLE
  - IMPROVED BY PRE-DIALYSIS CLINICS
  - NOT ALWAYS REFERRED
  - NOT ALWAYS COMPLIANT

ADJUSTED KAPLAN MEIER: TIME TO DEATH, HOSPITALIZATION OR TRANSFUSION



Adjusted for age, gender, diabetes

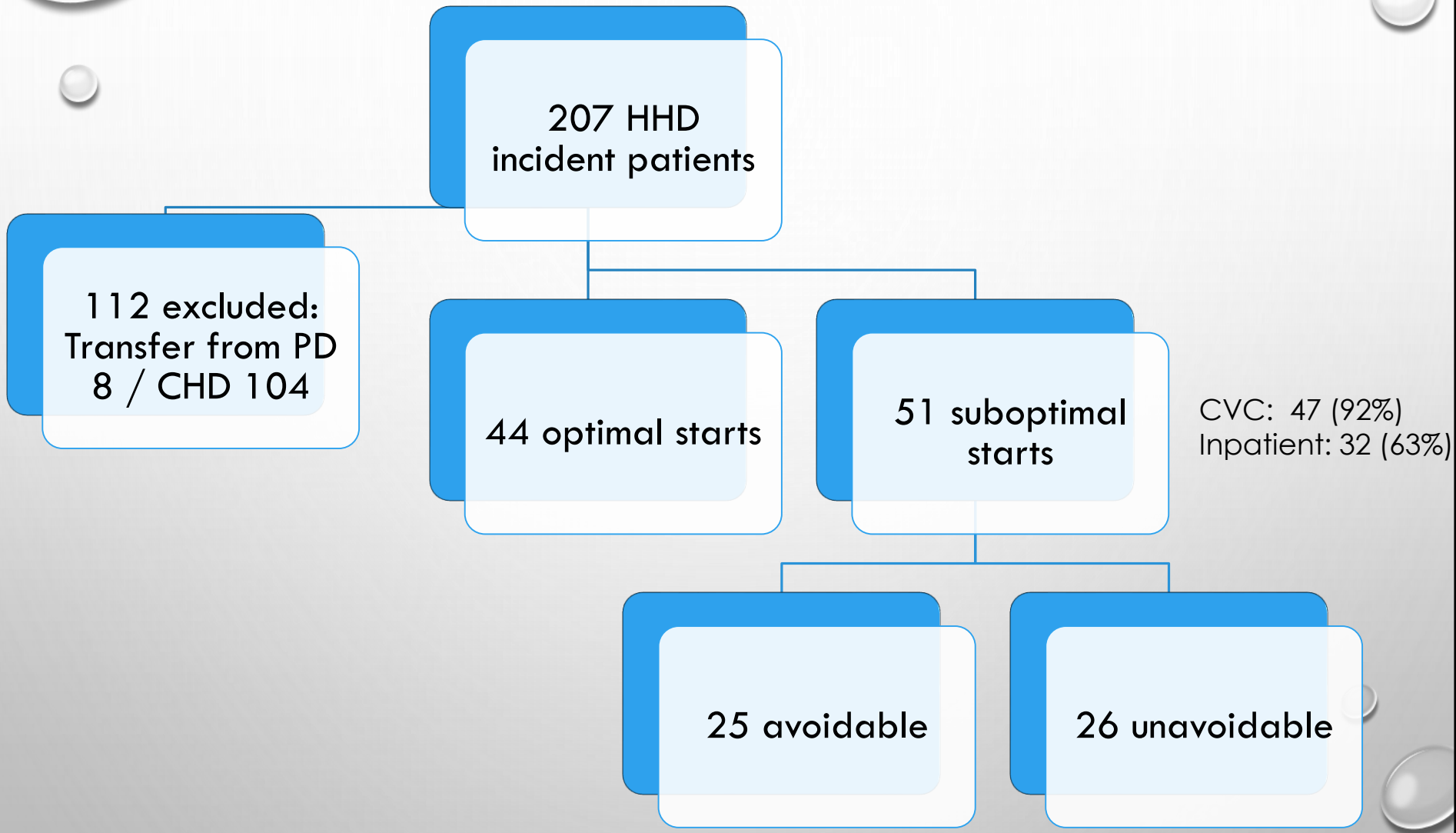
Nephrol Dial Transplant (2011) 26: 2959–2965

METHODOLOGY

- RETROSPECTIVE COHORT STUDY
- SINGLE CENTER (TGH)
- INCIDENT HHD PATIENTS WITH COMPLETED TRAINING
  - JANUARY 1996 – DECEMBER 2011
  - PATIENTS FOLLOWED UNTIL JULY 2012
- INCLUSION:
  - HHD = FIRST RRT OR FIRST AFTER KIDNEY TRANSPLANT
  - PATIENTS WITH TRANSITION THROUGH CHD < 30 DAYS
- EXCLUSION:
  - PATIENTS TRANSFERRED FROM CHD ≥ 30 DAYS
  - PATIENTS TRANSFERRED FROM PD

DEFINITION UNAVOIDABLE SUBOPTIMAL

- ACUTE DECLINE IN KIDNEY FUNCTION (9)
- DOCUMENTED NON-COMPLIANCE TO FOLLOW-UP (6)
- ABSENCE OF NEPHROLOGY FOLLOW-UP (5)
- CONTRAINDICATION (OR FAILURE) TO VASCULAR ACCESS CREATION (3)
- NEPHRECTOMY (BILATERAL OR GRAFT) (3)


207 HHD incident patients
112 excluded: Transfer from PD 8 / CHD 104
44 optimal starts
51 suboptimal starts
CVC: 47 (92%)
Inpatient: 32 (63%)
25 avoidable
26 unavoidable

BASELINE CHARACTERISTICS

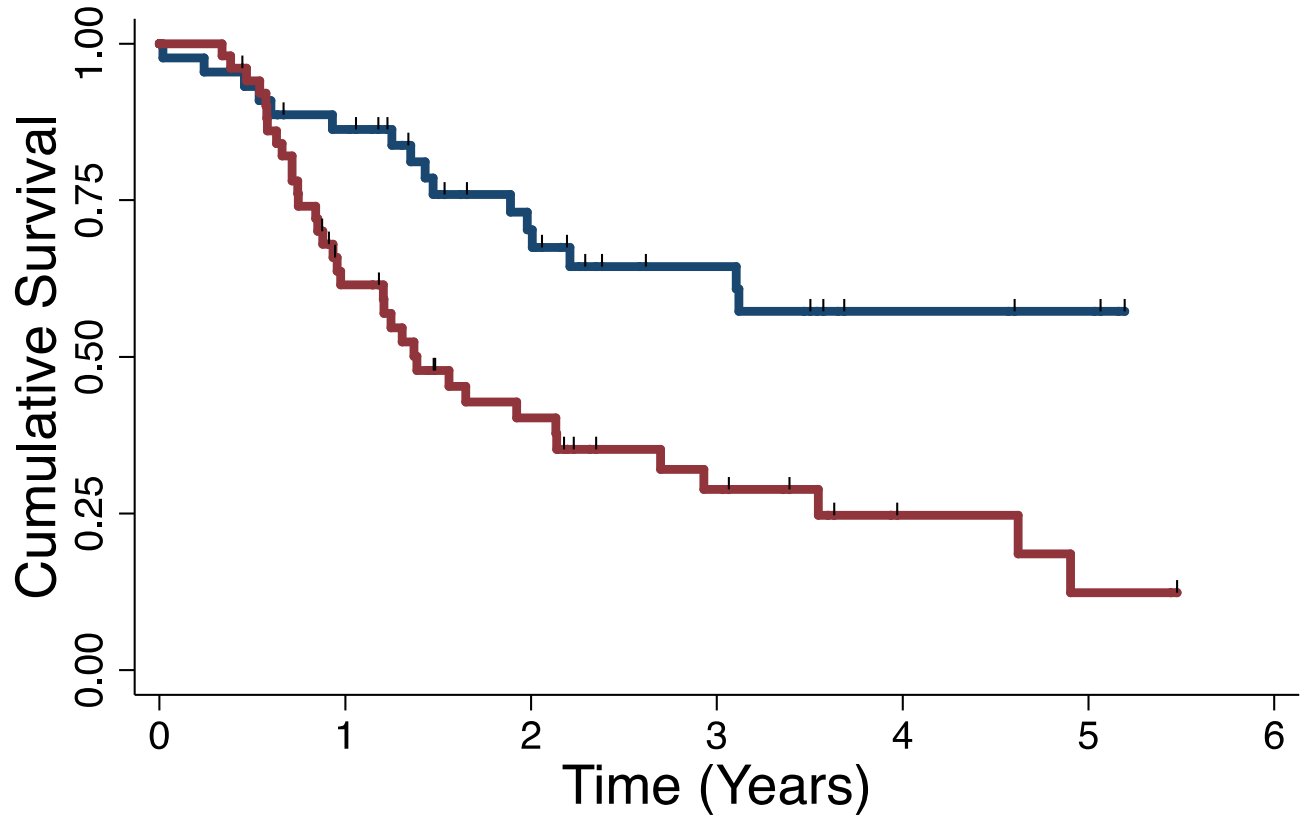
Characteristics, *n (%)*	**Optimal start (n= 44)**	**Suboptimal start (n=51)**	**P**
Age, *mean ± SD*	48.4 ± 14.0	44.0 ± 13.8	0.12
Caucasian	30 (68)	25 (49)	0.07
Male	33 (75)	33 (65)	0.37
ESRD etiology			
Diabetic nephropathy	7 (16)	10 (20)	0.79
Glomerulonephritis	13 (30)	19 (37)	0.52
Comorbidities			
Diabetes	9 (20)	16 (31)	0.25
Coronary arterial disease	3 (7)	6 (12)	0.50
Charlson comorbidity index, *median (IQR)*	2 (2-4)	3 (2-5)	0.03
Nephrology follow-up			0.01
General nephrology clinic	20 (46)	13 (25)	
Transplantation clinic	8 (18)	20 (39)	
Pre-dialysis clinic	16 (36)	13 (26)	
None	0	5 (10)	

PRIMARY OUTCOME EVENTS

- HOSPITALIZATION 52
- TECHNIQUE FAILURE 3
- DEATH 1

Hospitalizations	**Optimal (18)**	**Suboptimal (34)**
Access-related bacteremia	3	9
Access	1	0
Dialysis-related	0	1
Other	14	24

KAPLAN-MEIER SURVIVAL CURVES FOR TIME TO COMPOSITE OUTCOME (HOSPITALIZATION, TECHNIQUE FAILURE OR DEATH)

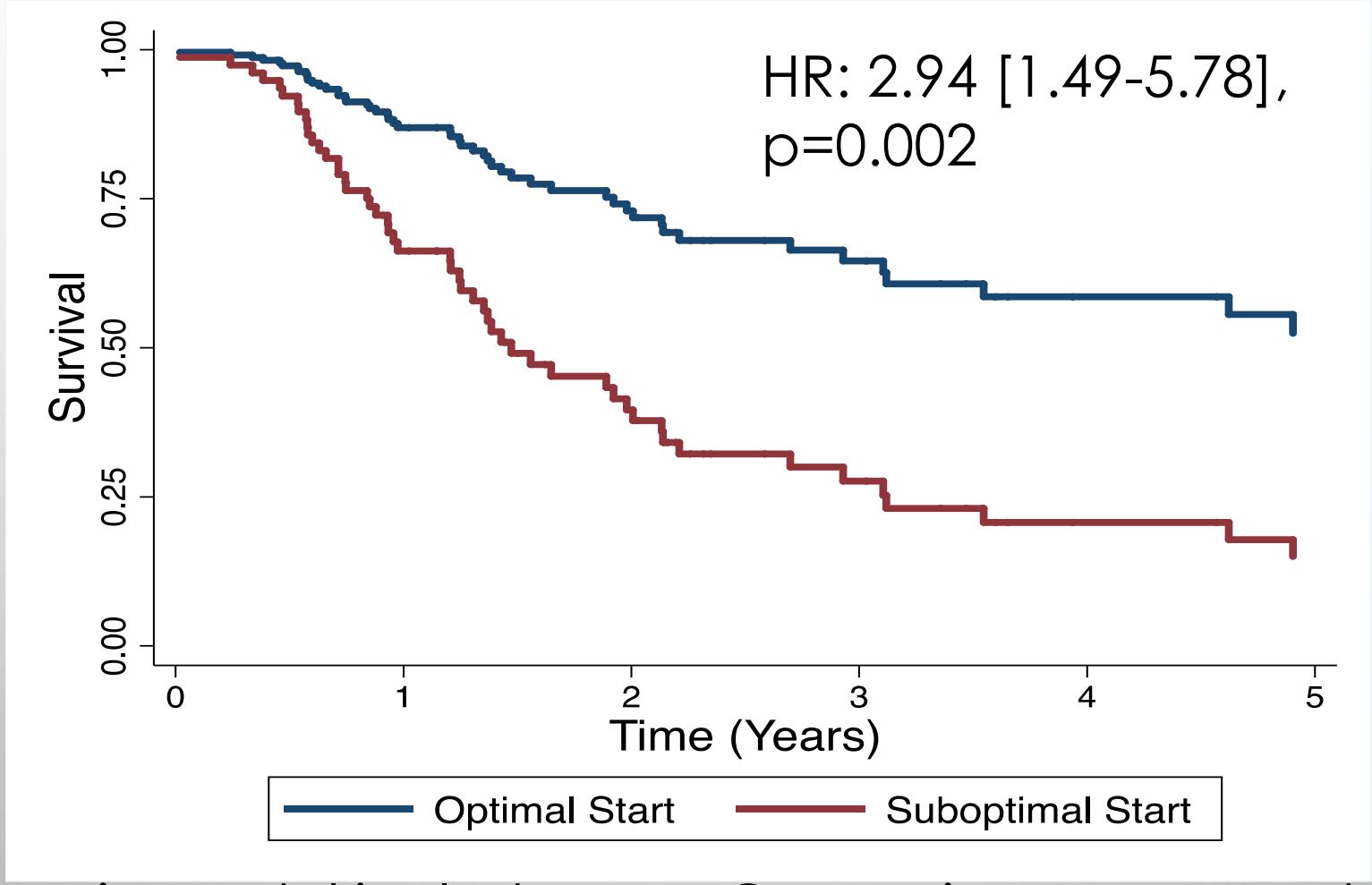


Number at risk							
Optimal	44	37	25	18	13	12	8
Suboptimal	51	28	16	9	4	2	0

Optimal Start — Suboptimal Start

Log Rank p < 0.001

ADJUSTED COX SURVIVAL CURVES FOR TIME TO COMPOSITE OUTCOME



Factors in model include age, Caucasian race, gender, diabetic end-stage renal disease and the CCI

DETERMINANTS OF SUBOPTIMAL START - UNIVARIABLE LOGISTIC REGRESSION

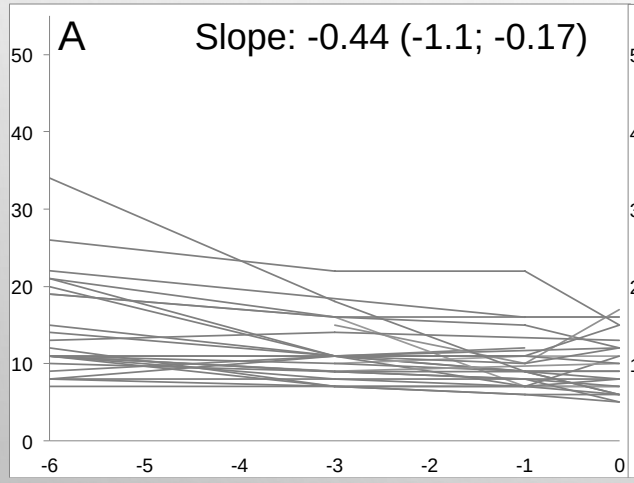
Factor	Odds Ratio	[95% Confidence Interval]	P
Male gender	0.61	[0.25-1.49]	0.28
Caucasian race	0.45	[0.19-1.04]	0.06
Age (per year increase)	0.98	[0.95-1.01]	0.12
CCI (per point increase)	1.29	[1.01-1.63]	0.04
Transplantation clinic follow-up	2.90	[1.12-7.51]	0.03

AVOIDABLE SUBOPTIMAL STARTS & EGFR SLOPES

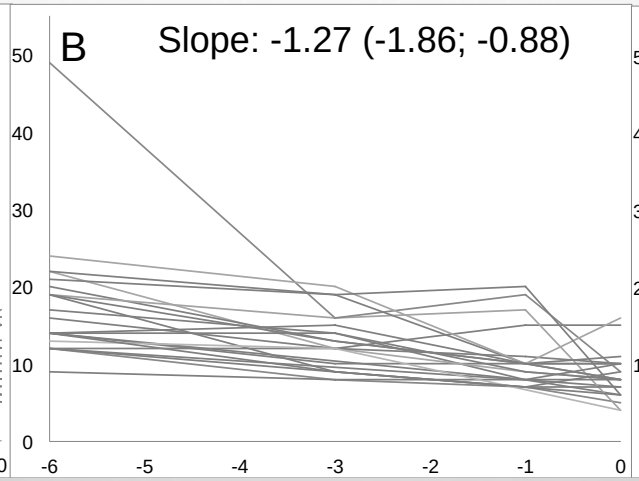
- UNAVOIDABLE IF:
  - ACUTE DECLINE IN KIDNEY FUNCTION (9)
  - DOCUMENTED NON-COMPLIANCE TO FOLLOW-UP (6)
  - ABSENCE OF NEPHROLOGY FOLLOW-UP (5)
  - CONTRAINDICATION (OR FAILURE) TO VASCULAR ACCESS CREATION (3)
  - NEPHRECTOMY (BILATERAL OR GRAFT) (3)
- 51 SUBOPTIMAL STARTS:
  - 26 UNAVOIDABLES SUBOPTIMAL START
  - **25 AVOIDABLES** SUBOPTIMAL START

EGFR 6 MONTHS BEFORE DIALYSIS INITIATION

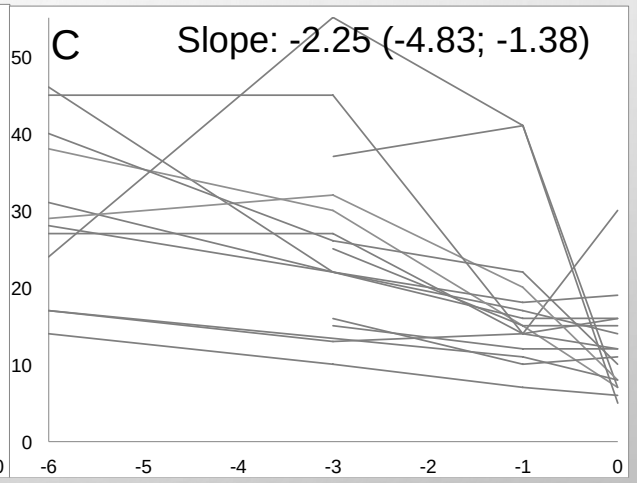
Optimal start



Avoidable suboptimal start



Unavoidable suboptimal start



eGFR at start (ml/min/1.73 m^2):

11 (8-13)

8 (6-10)

10 (7-15)

DISCUSSION

- CONCERNS THAT MORE THAN 50% HHD PATIENTS INITIATE DIALYSIS SUBOPTIMALLY
  - "HEALTHIER"
  - YOUNGER
  - MORE INDEPENDENT
- IN THIS SELECTED COHORT, SUBOPTIMAL START IS ALSO ASSOCIATED WITH ADVERSE OUTCOMES
  - MOSTLY HOSPITALIZATIONS

BUTTONHOLE

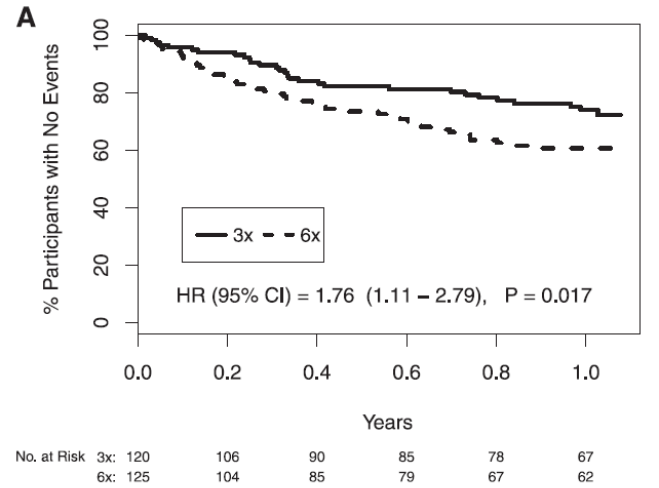
- AKA "CONSTANT-SITE CANNULATION"
- DESCRIBED IN 1977 (HOSPITAL FOR MINERS, POLAND)

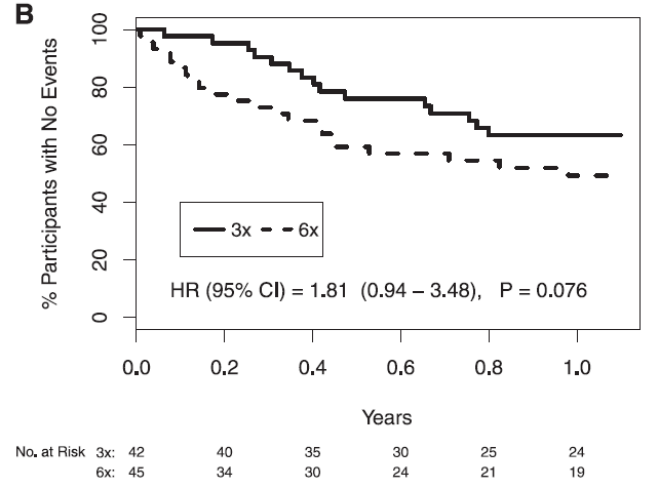
- CANNULATION:
  - SAME SPOT
  - SAME ANGLE
  - SAME DEPTH
  - EVERY TIME

Scar tissue tunnel tract develops

Risk of Vascular Access Complications with Frequent Hemodialysis

Rita S. Suri,* Brett Larive,† Susan Sherer,† Paul Eggers,‡ Jennifer Gassman,† Sam H. James,§ Robert M. Lindsay,* Robert S. Lockridge,‖ Daniel B. Ornt,¶ Michael V. Rocco,** George O. Ting,†† Alan S. Kliger,‡‡ and the Frequent Hemodialysis Network Trial Group





Variable	Daily Trial			Nocturnal Trial		
	Conventional	Daily	HR (95% CI)	Conventional	Nocturnal	HR (95% CI)
AVF/AVG[a]						
Patients (*n*)	106 (79/28)[b]	114 (90/28)[b]		28 (23/6)[b]	32 (29/3)[b]	
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)	
Repairs						
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

J Am Soc Nephrol 24: , 2013. doi: 10.1681/ASN.2012060595

INTEGRATED HOME DIALYSIS

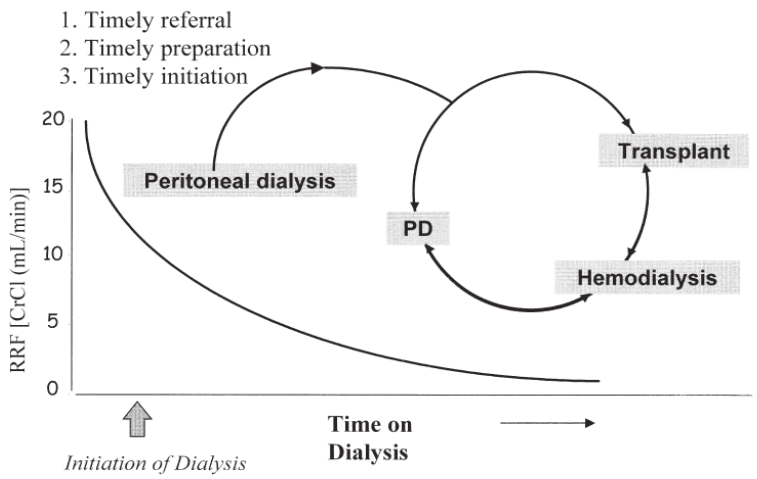


Figure 1 — The integrated care concept [based on Refs. (1), (3), and (4)].

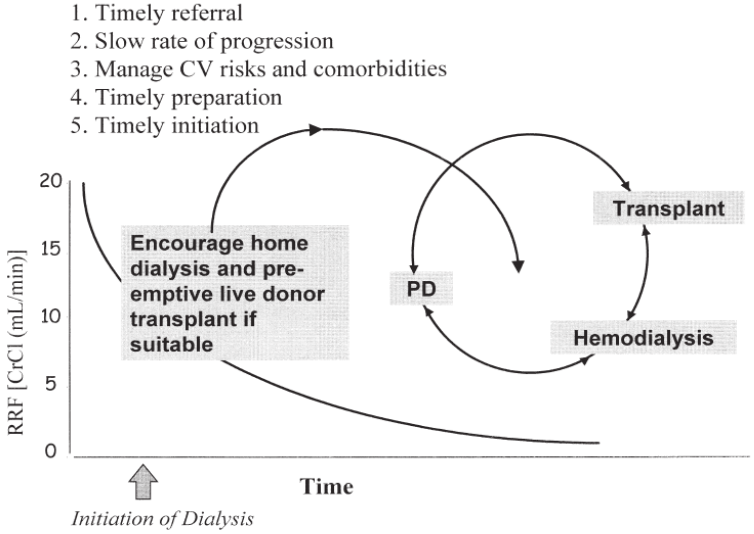
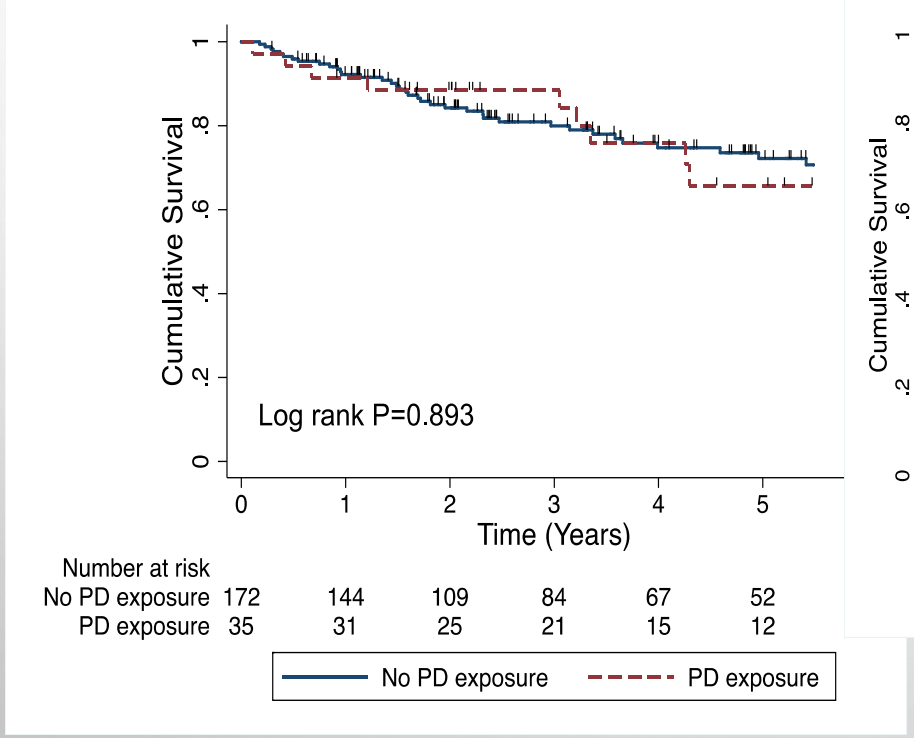
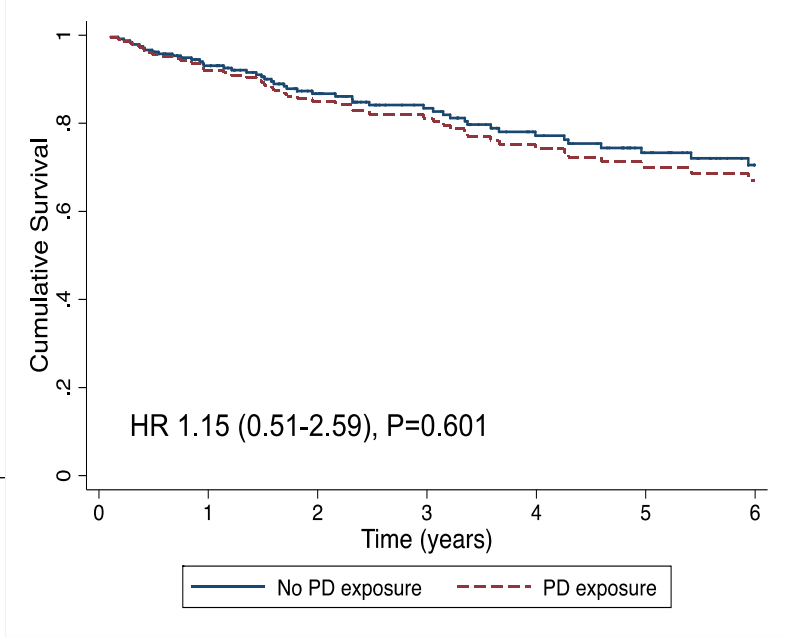


Figure 2 — A broader concept of integrated care.

MENDELSSOHN and PIERRATOS, PDI 2002

CUMULATIVE PATIENT AND TECHNIQUE SURVIVAL : INTEGRATED HOME DIALYSIS SYSTEM





Nadeau-Fredette et al – PDI in press

Procedure-Related Serious Adverse Events Among Home Hemodialysis Patients: A Quality Assurance Perspective

Ben Wong, MD,[1] Deborah Zimmerman, MD,[2] Frances Reintjes, BScN,[3] Mark Courtney, MD,[1] Scott Klarenbach, MD,[1] Graeme Dowling, MD,[4] and Robert P. Pauly, MD, MSc, FRCPC[1]

Table 2. Causes of Adverse Events

Case No.	Human Error(s) or Machine/ Disposable Defects	Immediate Cause of Adverse Event	Details
1	Human error	Blood loss	Ignored machine alarms; improper threading of connections; placement of wetness detectors in incorrect position
2	Human error	Air embolism	Neglected to clamp CVC
3	Possible human error, possible disposable defect	Blood loss	Possible failed integrity of cap; possibly did not correctly thread connections
4	Possible human error, possible disposable defect	Blood loss	Improper placement of clamp; failed integrity of cap
5	Human error	Blood loss	Improper machine setup; neglected to use wetness detectors
6	Human error	Blood loss	Improper threading of connections; placement of wetness detector in incorrect position
7	Human error	Blood loss	Did not follow machine setup protocol specific to local home HD program

Abbreviations: CVC, central venous catheter; HD, hemodialysis.

Wong et al AJKD 2013

The Feasibility of Caregiver-Assisted Home Nocturnal Hemodialysis

Karthik K. Tennankore S. Joseph Kim Christopher T. Chan

University Health Network/Toronto General Hospital, University of Toronto, Toronto, Ont., Canada

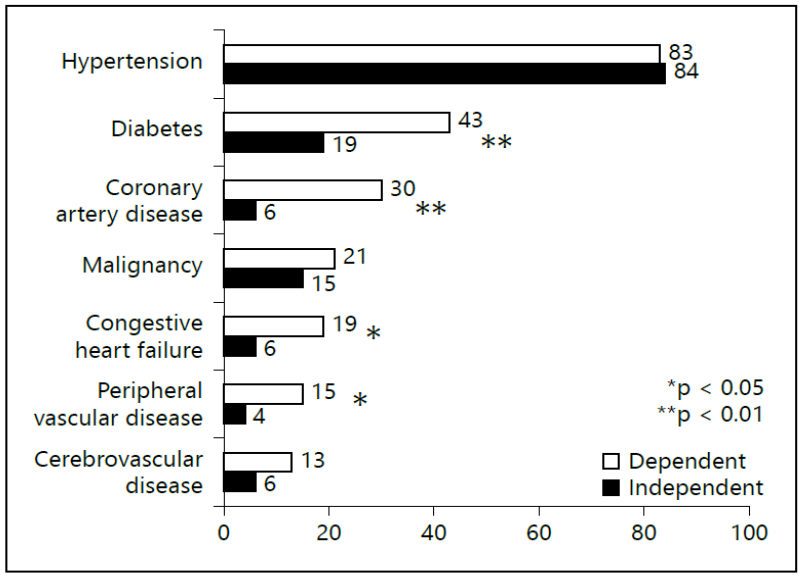
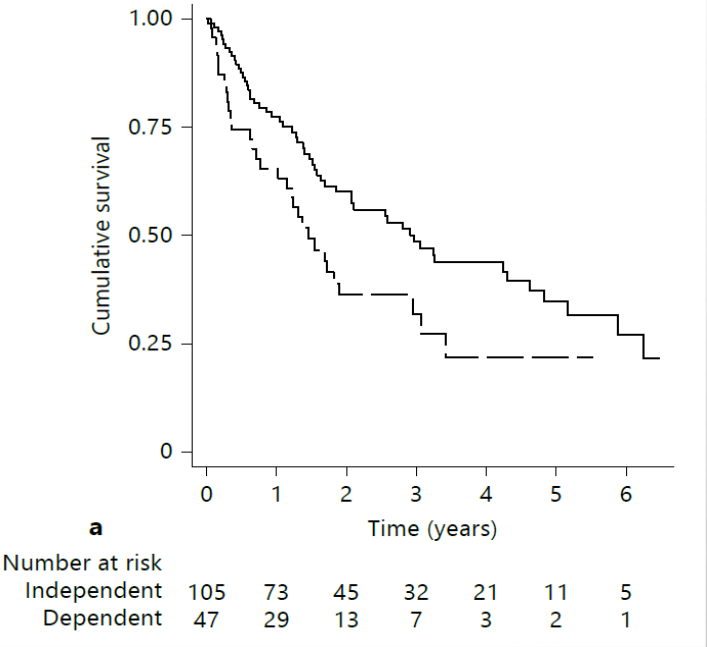


Fig. 2. Baseline comorbidities stratified by dependency status.



Tennankore et al – NCP 2012

CANADIAN HOME DIALYSIS VIRTUAL WARD TEAM

- MULTISITE STUDY (FUNDED THROUGH BAXTER CEC GRANT PROGRAM)
- PROTCOLISED TELEPHONE F/U
- HIGH RISK PATIENTS DURING TRANSITION FROM CARE
  - GRADUATING FROM TRAINING
  - USE OF ANTIBIOTICS
  - AV ACCESS INSTRUMENTATION
  - HOSPITALIZATION

SUMMARY

- THERE IS A RESURGENCE OF INTEREST IN HOME DIALYSIS
- DATA SUGGEST THAT SUBOPTIMAL START IS ASSOCIATED WITH ADVERSE TECHNIQUE SURVIVAL
- ADVERSE SIGNAL
  - DIALYSIS ACCESS
- INTEGRATED HOME DIALYSIS SYSTEM
  - EDUCATION
  - TELEHEALTH STRATEGIES

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