OHIO
KIDNEY DISEASE &
HYPERTENSION CLINIC

Managing dialysis patient. An Internal Medicine Perspective.

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Ohio Kidney Disease & Hypertension Clinic

MU Health Care


مستشفى الملك فيصل التخصصي ومركز الأبحاث
King Faisal Specialist Hospital & Research Centre
Gen. Org. مؤسسة عامة

Important Registries and Guidelines

- USRDS (United States Renal Data System)
- Kidney Dialysis Outcome Quality Initiative (K-DOQI) guidelines
- Kidney Disease Improving Global Outcomes (KDIGO) guidelines

End Stage Renal Disease

- End-stage kidney disease (ESRD) is when the kidneys are no longer able to work at a level needed for day-to-day life:
  - **Sleep Disturbances**
  - **Weight loss**
  - **Poor appetite**
  - **Nauseous**
  - **Persistent itch and neuropathies**
  - **Cramps**
  - **Fluid and electrolyte disturbances**
  - **Metabolic Bone Disorders**
  - **Anemia**

ESRD Treatment Options

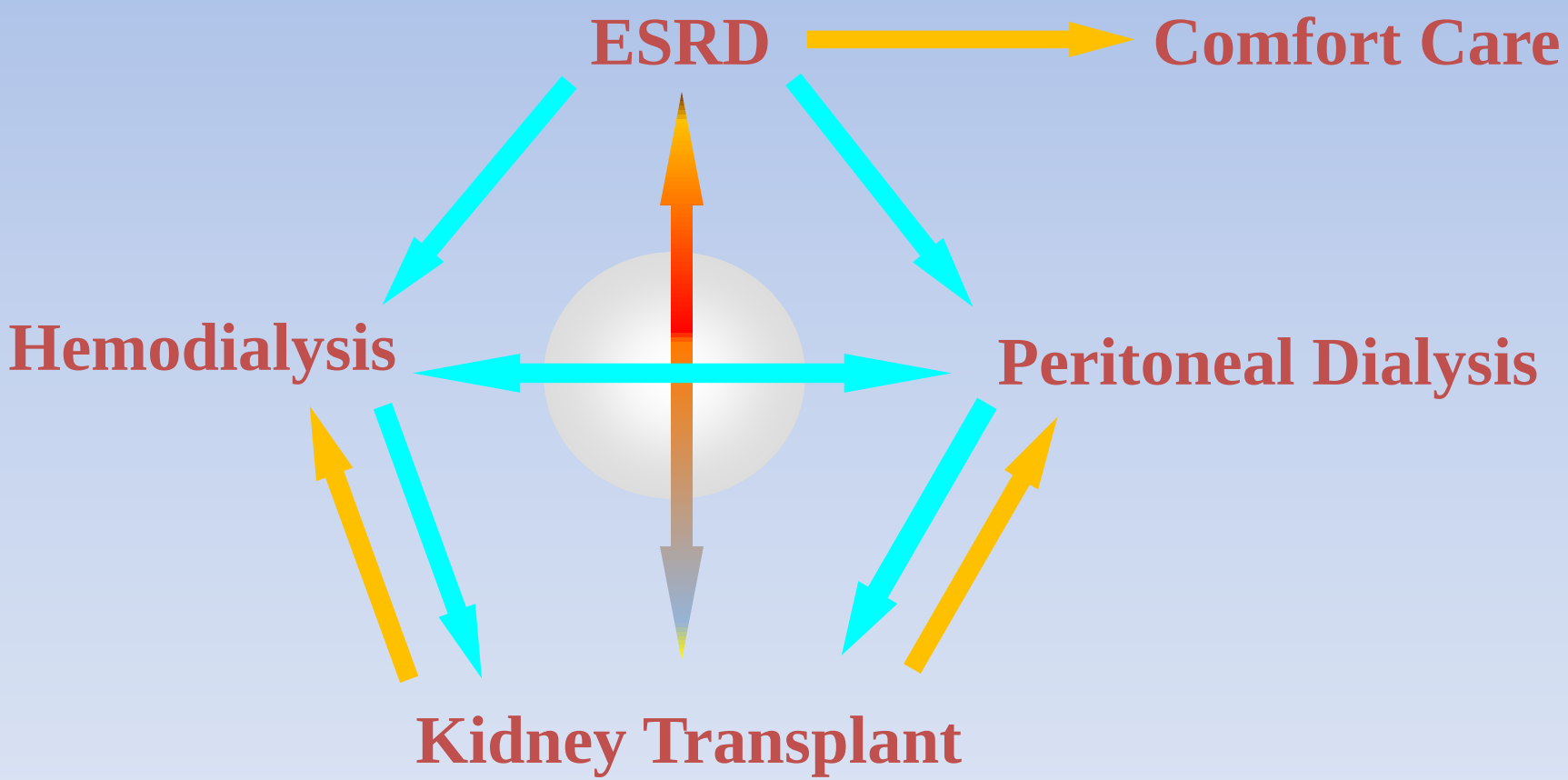
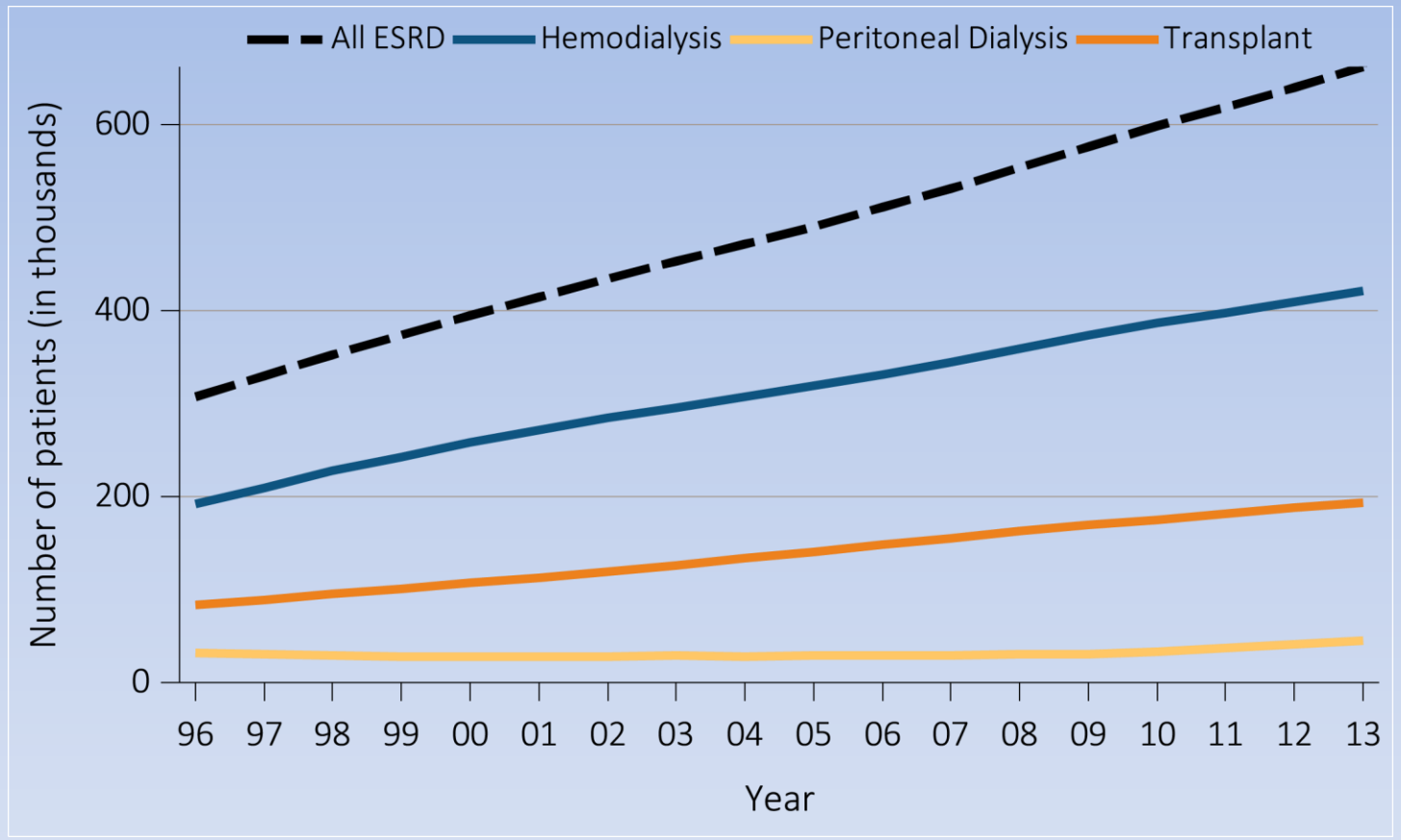


Figure 1.10 Trends in the number of ESRD prevalent cases (in thousands) by modality, in the U.S. population, 1996-2013

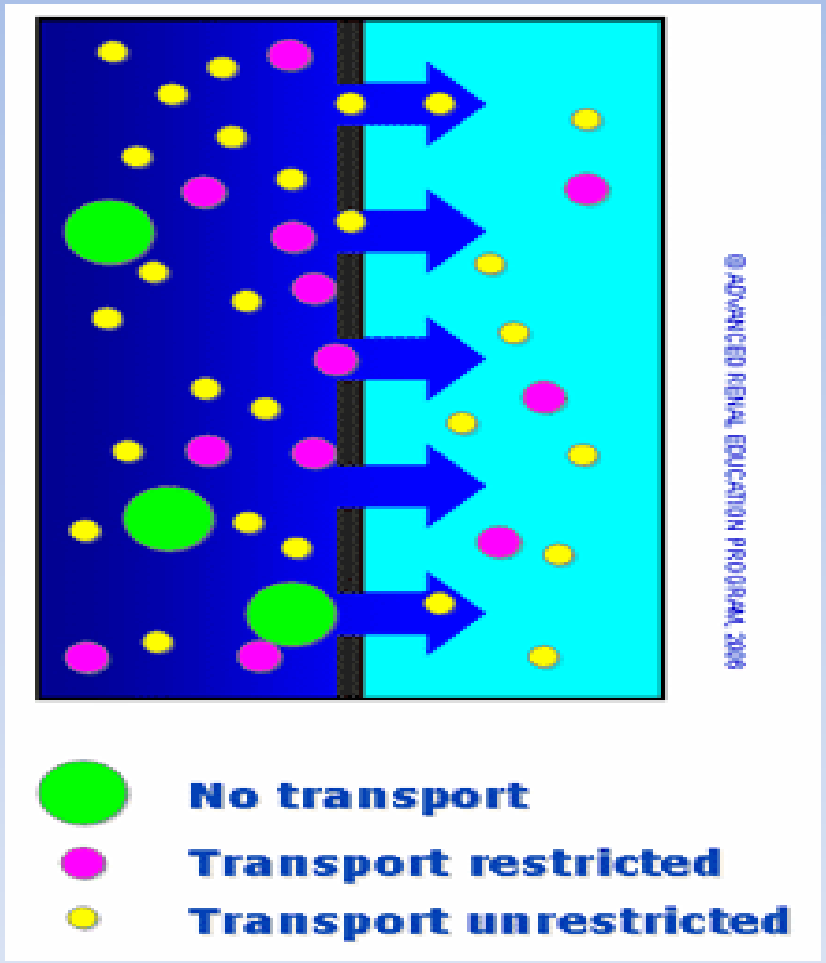


Data Source: Reference Table D.1. Abbreviation: ESRD, end-stage renal disease.

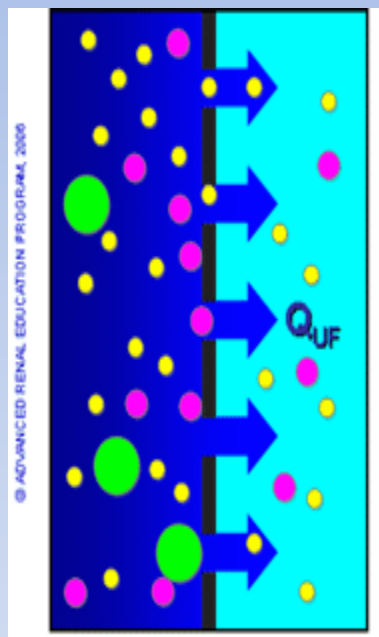
Principles in dialysis

- Diffusion
- Osmosis
- Convective Transport

Diffusion


© ADVANCED RENAL EDUCATION PROGRAM, 2009
No transport
Transport restricted
Transport unrestricted

Convection



Convective clearance:

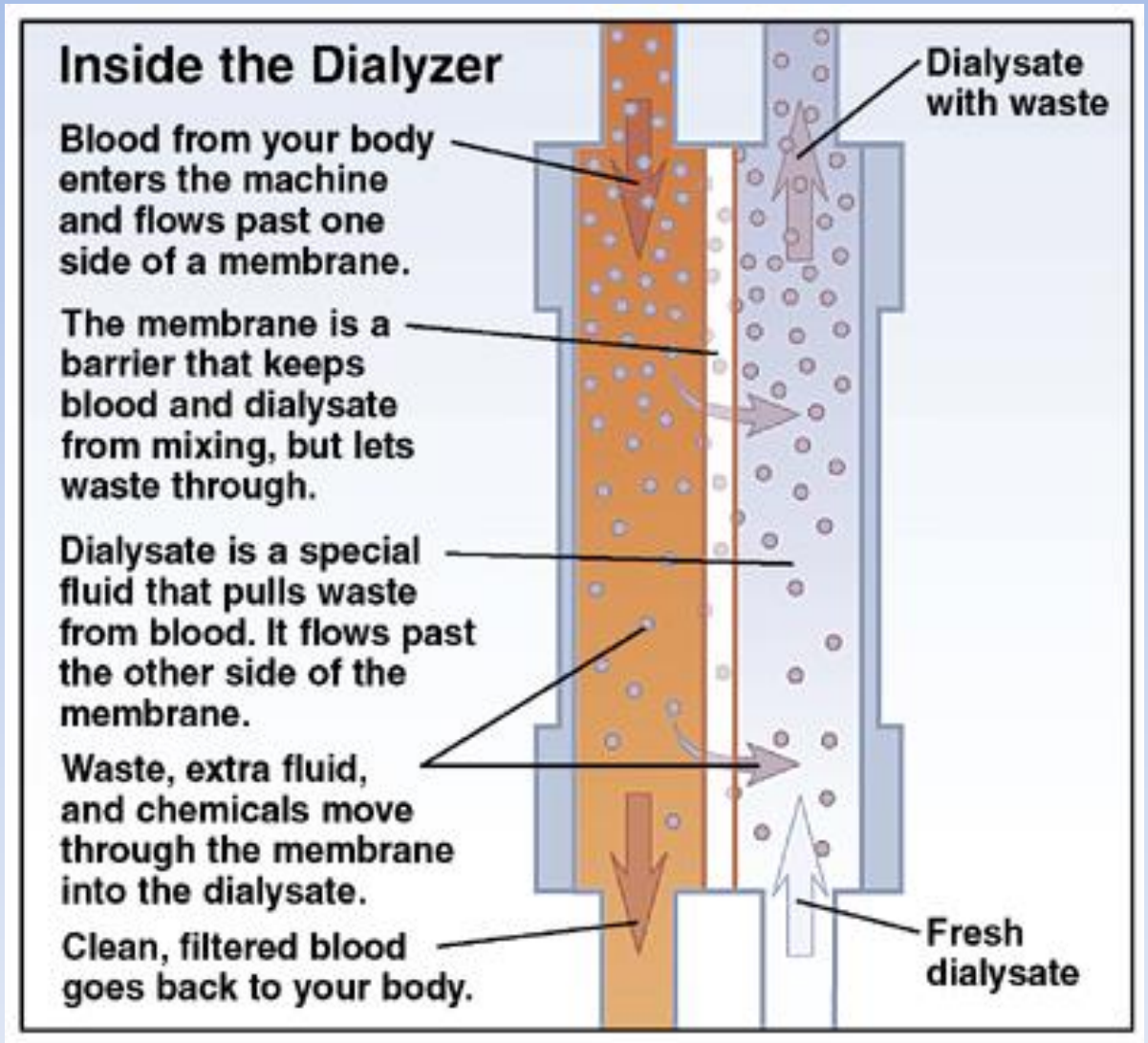
$$K_x = Q_{UF} \cdot S_x$$

K_x	Convective clearance for solute "x"
Q_{UF}	Ultrafiltration flow across membrane
S_x	Membrane sieving coefficient for solute "x"

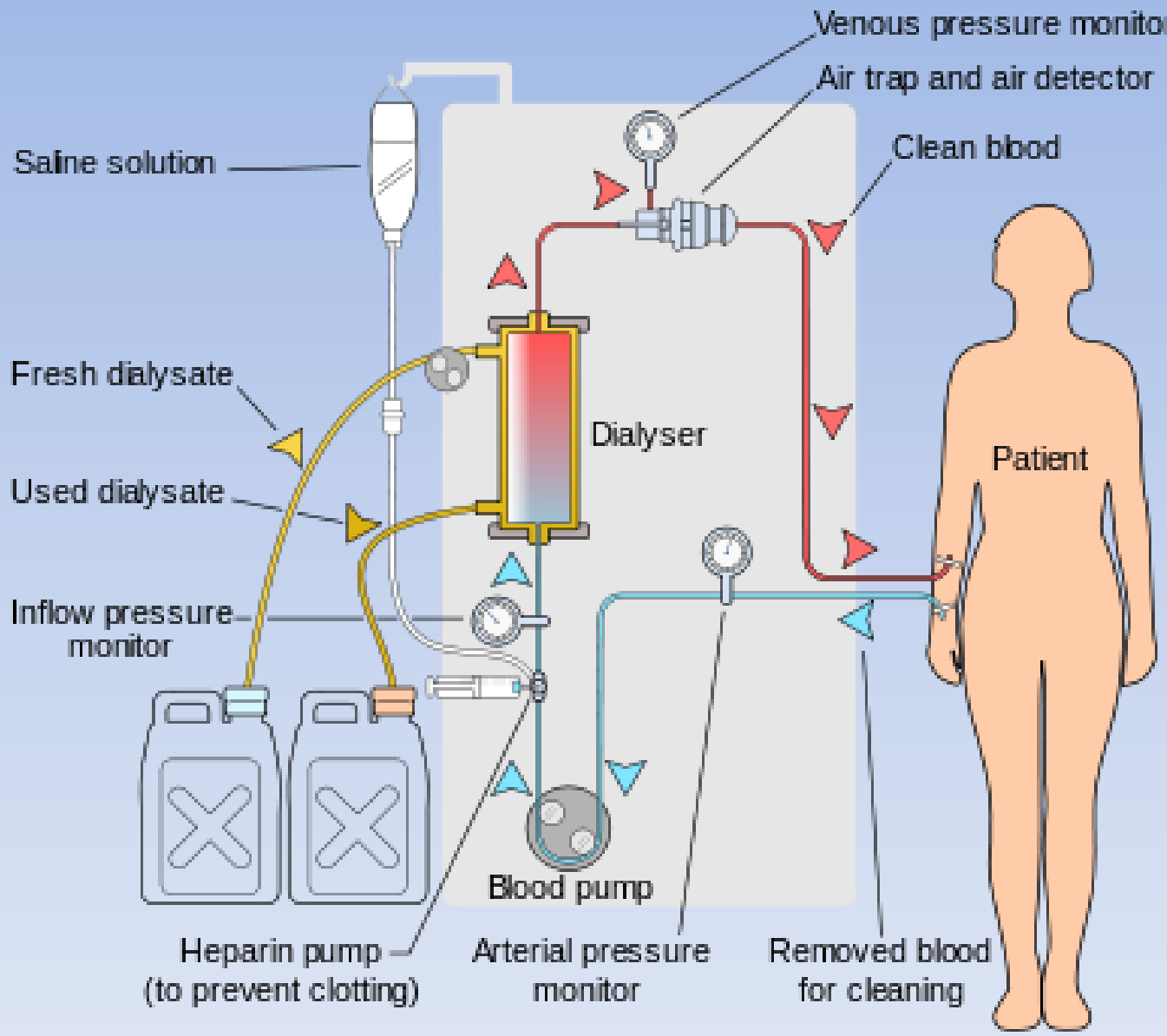
Dimension: volume / time

Units: ml/min, l/h, l/d

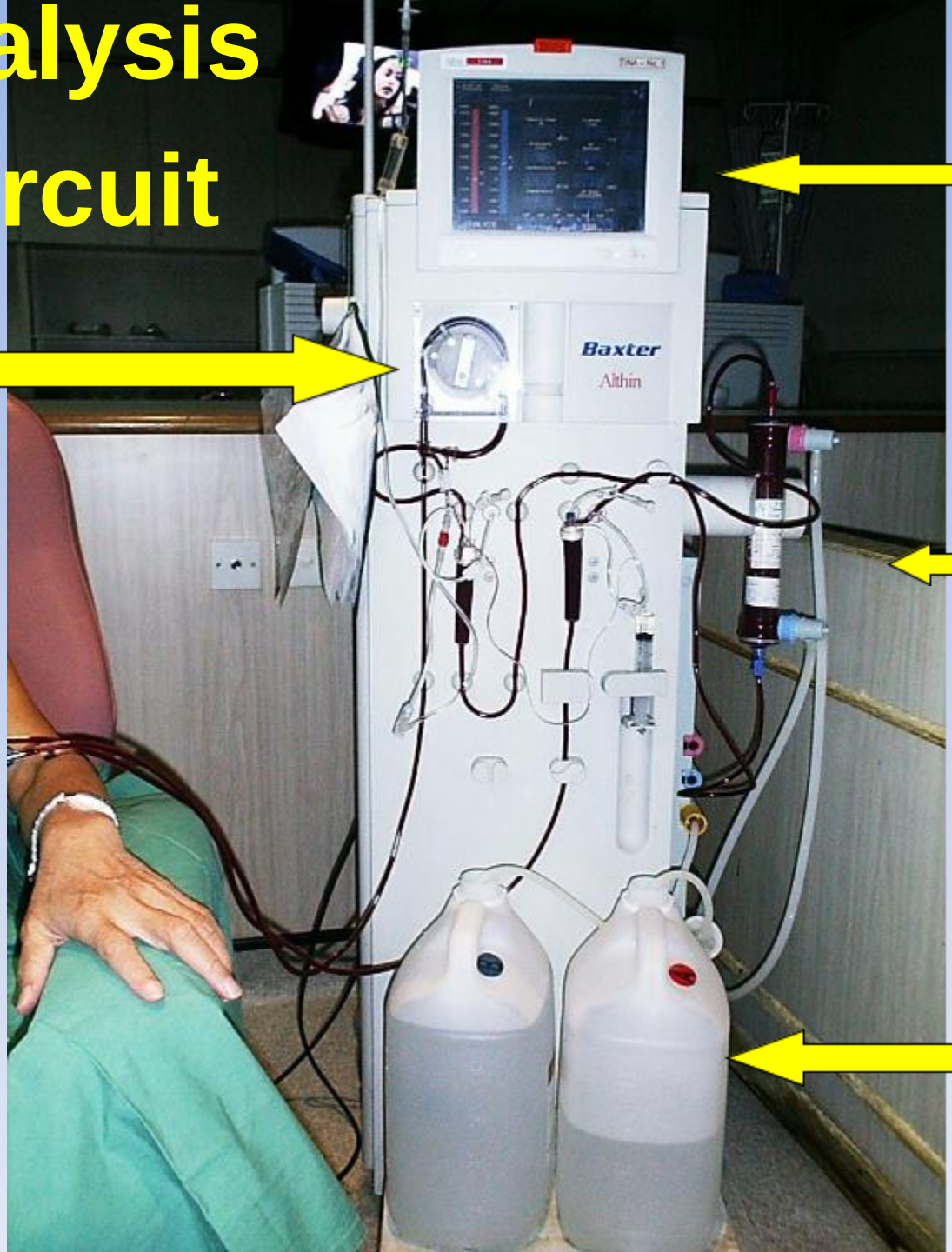
Hemodialysis Filter (Dialyzer)



Hemodialysis Filter (Dialyzer)


Venous pressure monitor
Air trap and air detector
Clean blood
Saline solution
Fresh dialysate
Used dialysate
Dialyser
Patient
Inflow pressure monitor
Blood pump
Heparin pump (to prevent clotting)
Arterial pressure monitor
Removed blood for cleaning

The Dialysis Set Circuit



Blood Pump

Display

Dialyser

Dialysate

The Normal Kidney

History of Dialysis

- 1943- First practical model for hemodialysis, Dr. Kolff.
- 1950- First commercially available dialysis machine
- Early enthusiasm for this new technique was dampened by vascular access problem. Need 350ml/min + flow.

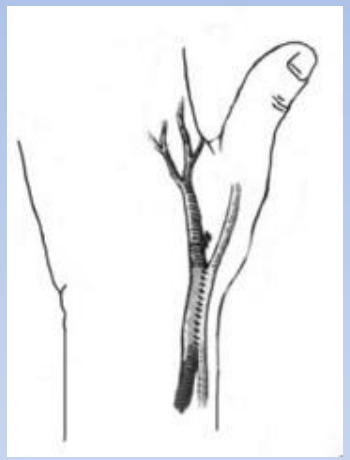
Next Advance

- 1956-Twin coil artificial Kidney.
- Hemodialysis more easily available to more patients.
- Vascular Access still a major problem
- Cut down or by cannulation with large bore needles.

The Next Idea

- 1960-Scribner shunt made chronic dialysis a reality
- Sometimes will work for several weeks without a complication.
- Bleeding, infection, sclerosis of vessel, frequent thrombosis.
- Nephrologists did thrombectomies and taught patients how to do them.

The Great Solution



CHRONIC HEMODIALYSIS USING VENIPUNCTURE AND A SURGICALLY CREATED ARTERIOVENOUS FISTULA*

MICHAEL J. BRESCIA, M.D.,† JAMES E. CIMINO, M.D.,‡ KENNETH APPEL, M.D.,§ AND BARUCH J. HURWICH, M.D.†

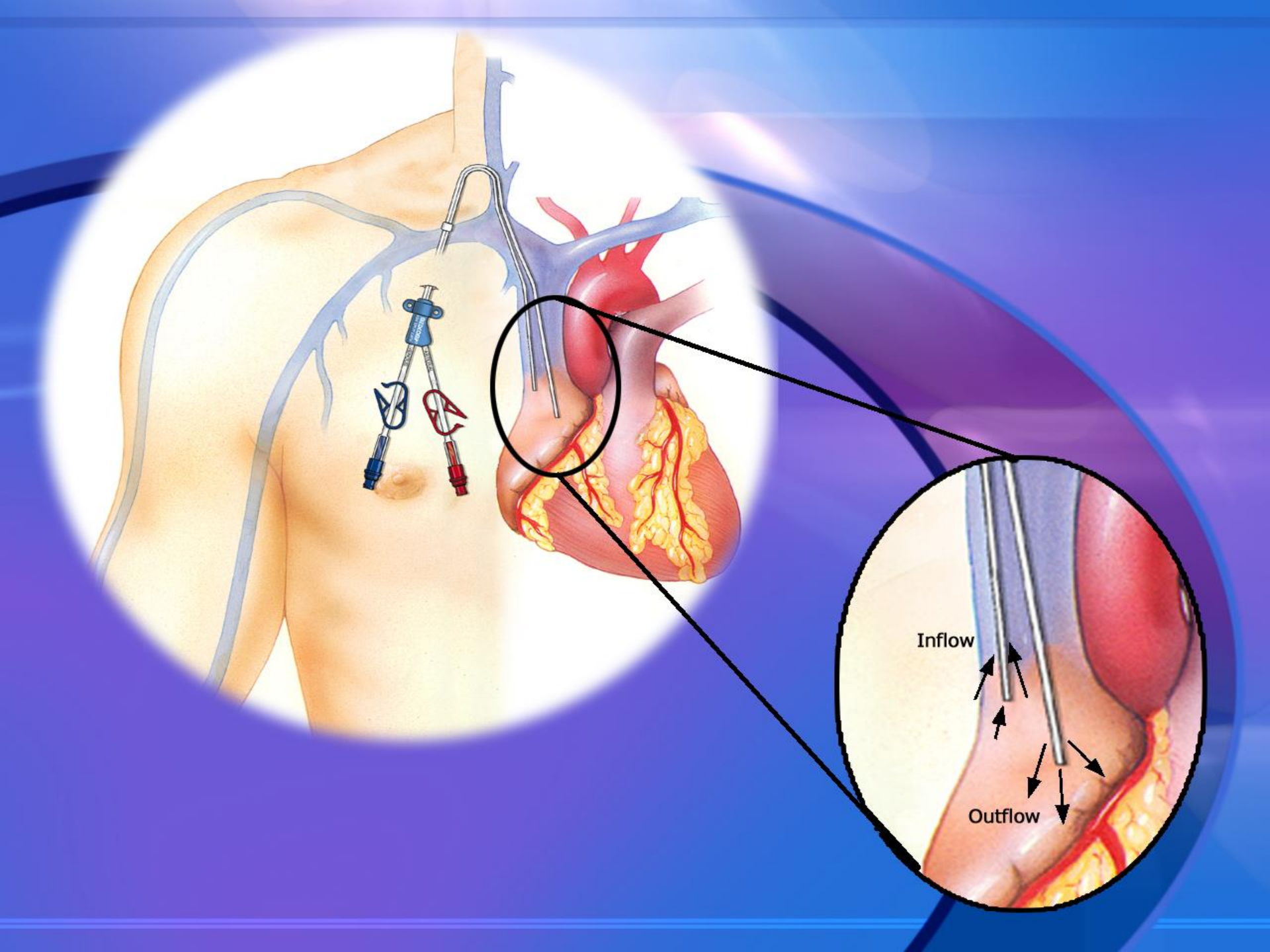
BRONX, NEW YORK

New Engl J Med 1966; 275: 1089

- In 1966, Brescia, Cimino, Appel, and Hurwich introduced the arteriovenous fistula.
- Brescia, Cimino, and Hurwich were from “Renal Service”.

Types of Vascular Access

- Dialysis Catheters
  - Temporary
  - Permanent
- Arteriovenous Fistulas
- Arteriovenous Grafts


Inflow
Outflow

AVF & AVG

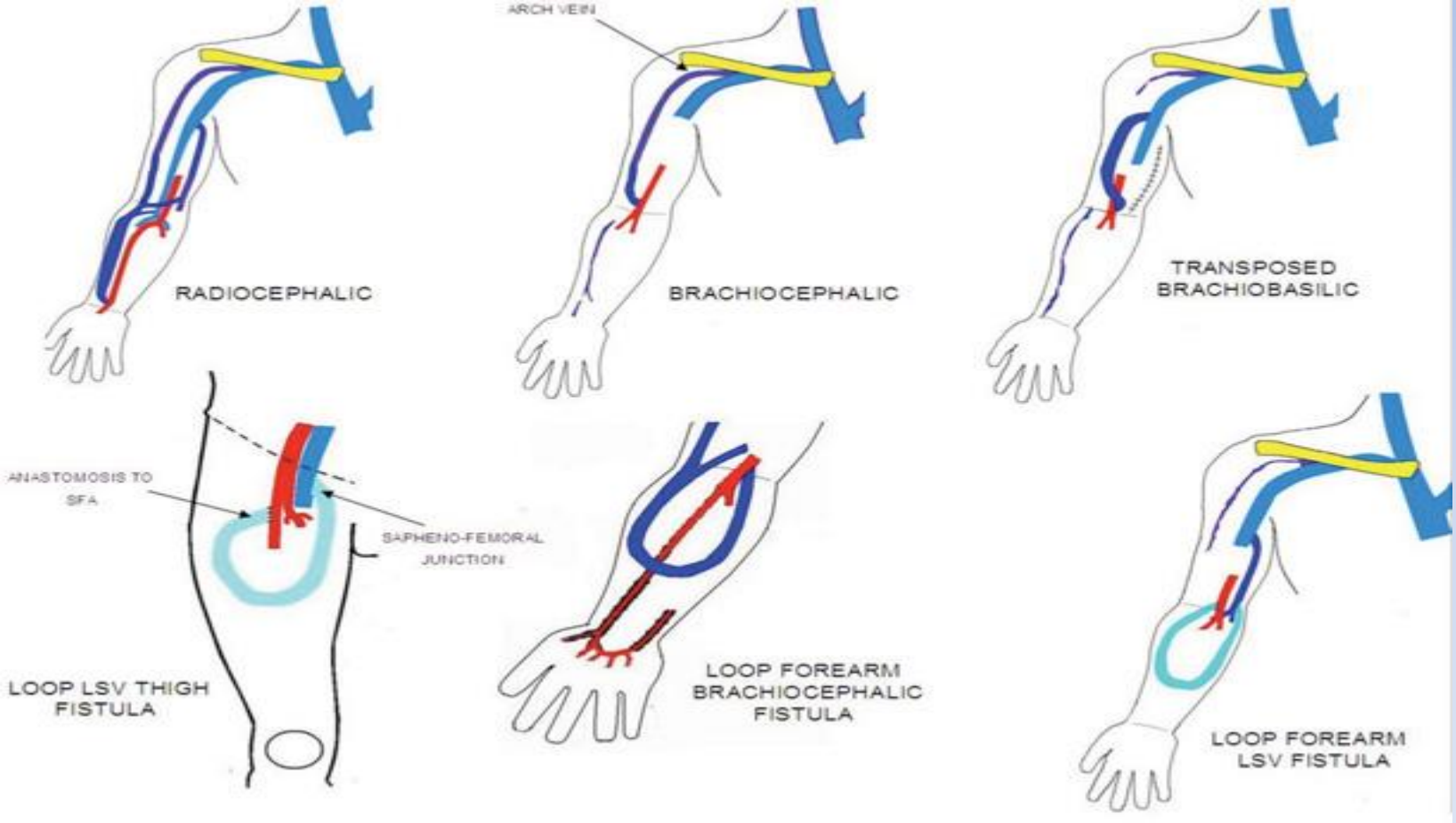
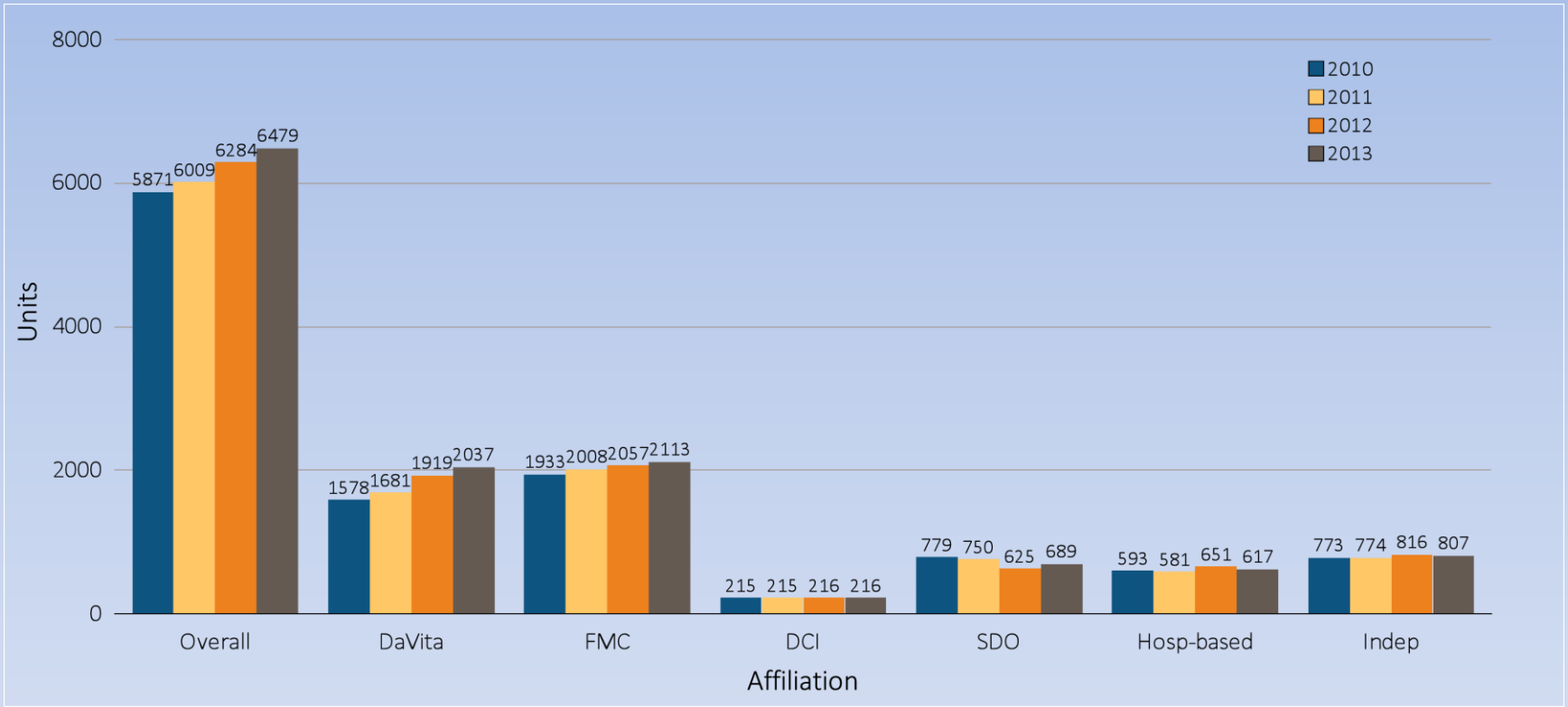

RADIOCEPHALIC
ARCH VEIN
BRACHIOCEPHALIC
TRANSPOSED
BRACHIOBASILIC
ANASTOMOSIS TO
SFA
SAPHENO-FEMORAL
JUNCTION
LOOP LSV THIGH
FISTULA
LOOP FOREARM
BRACHIOCEPHALIC
FISTULA
LOOP FOREARM
LSV FISTULA

Figure 10.1 Dialysis unit counts, by unit affiliation, 2010–2013



Data source: Special analyses, USRDS ESRD Database. Abbreviations: DCI, Dialysis Clinic, Inc.; FMC, Fresenius; Hosp-based, hospital-based dialysis centers; Indep, independent dialysis providers; SDO, small dialysis organizations.

Dialysis options

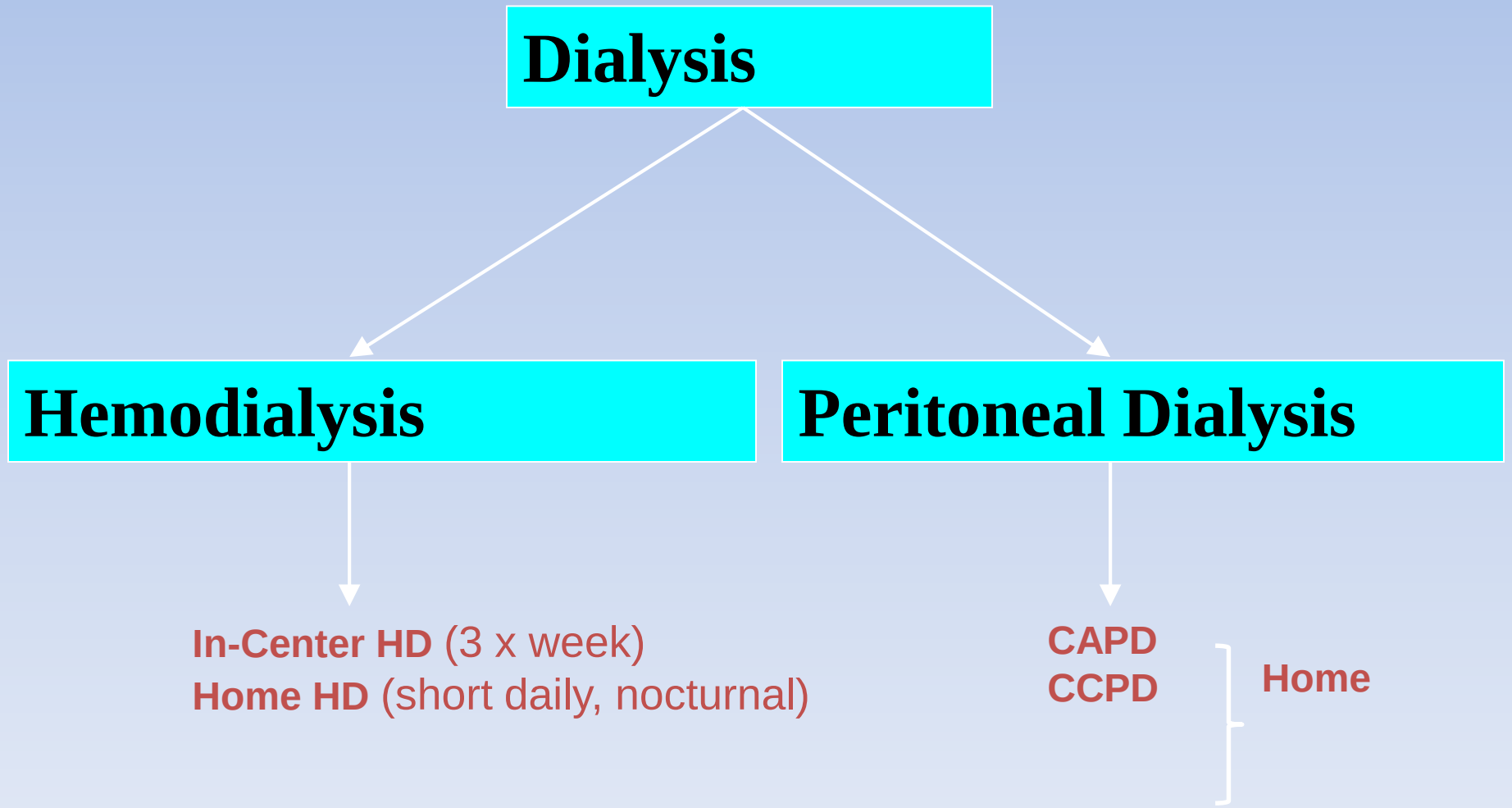
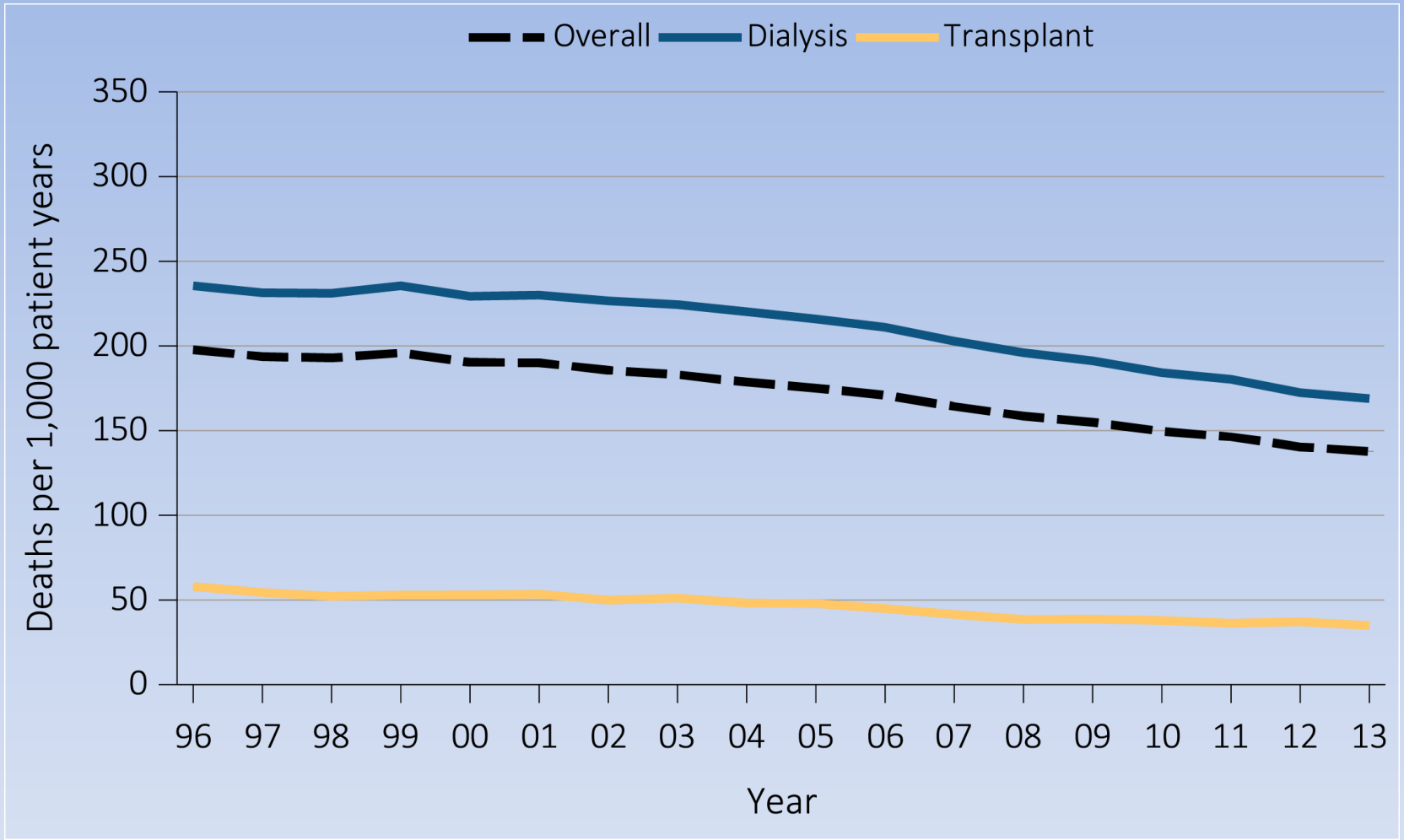
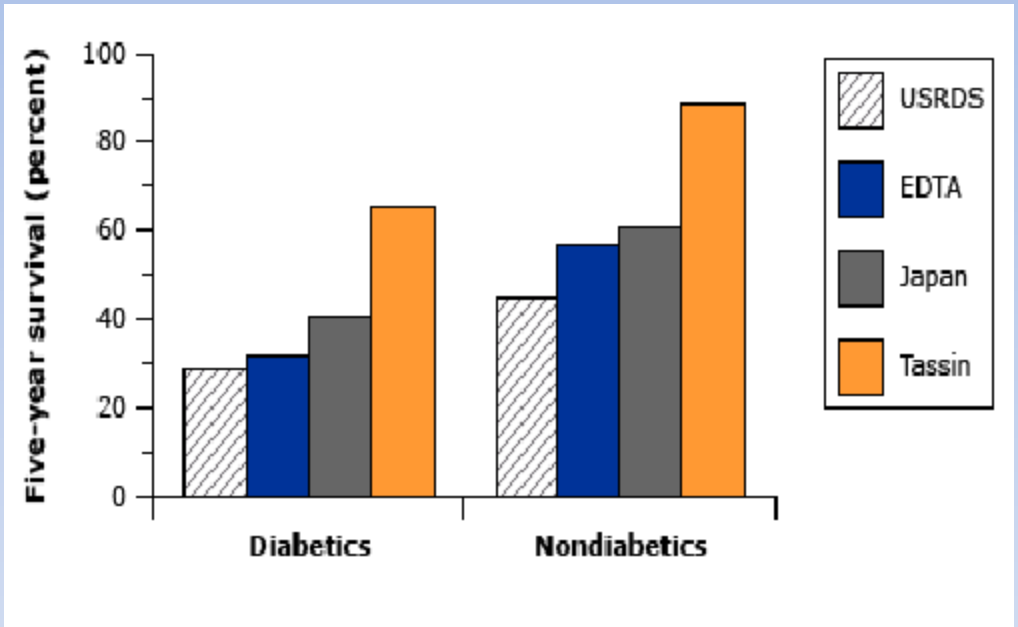


Figure 6.1a Adjusted all-cause mortality (deaths per 1,000 patient-years) by treatment modality: overall, dialysis, and transplant for period-prevalent patients, 1996-2013



Data Source: Reference Tables H.2_adj, H4_adj, H.8_adj, H.9_adj, and H.10_adj; and special analyses, USRDS ESRD Database. Adjusted for age, sex, race, ethnicity, primary diagnosis and vintage. Ref: period prevalent ESRD patients, 2011. Abbreviations: HD, hemodialysis; PD, peritoneal dialysis.

Dialysis Survival



Understanding the dialysis Patient

- Cause of Death
- Cardiovascular disease in ESRD
- Drug Compliance
- Quality of life
  - Symptoms
  - Hospital Visits
  - Depression
- Cancer screening
- Anemia management
- Hypertension goal

Question

- **Who should be responsible for "primary care" of chronic dialysis patients?**

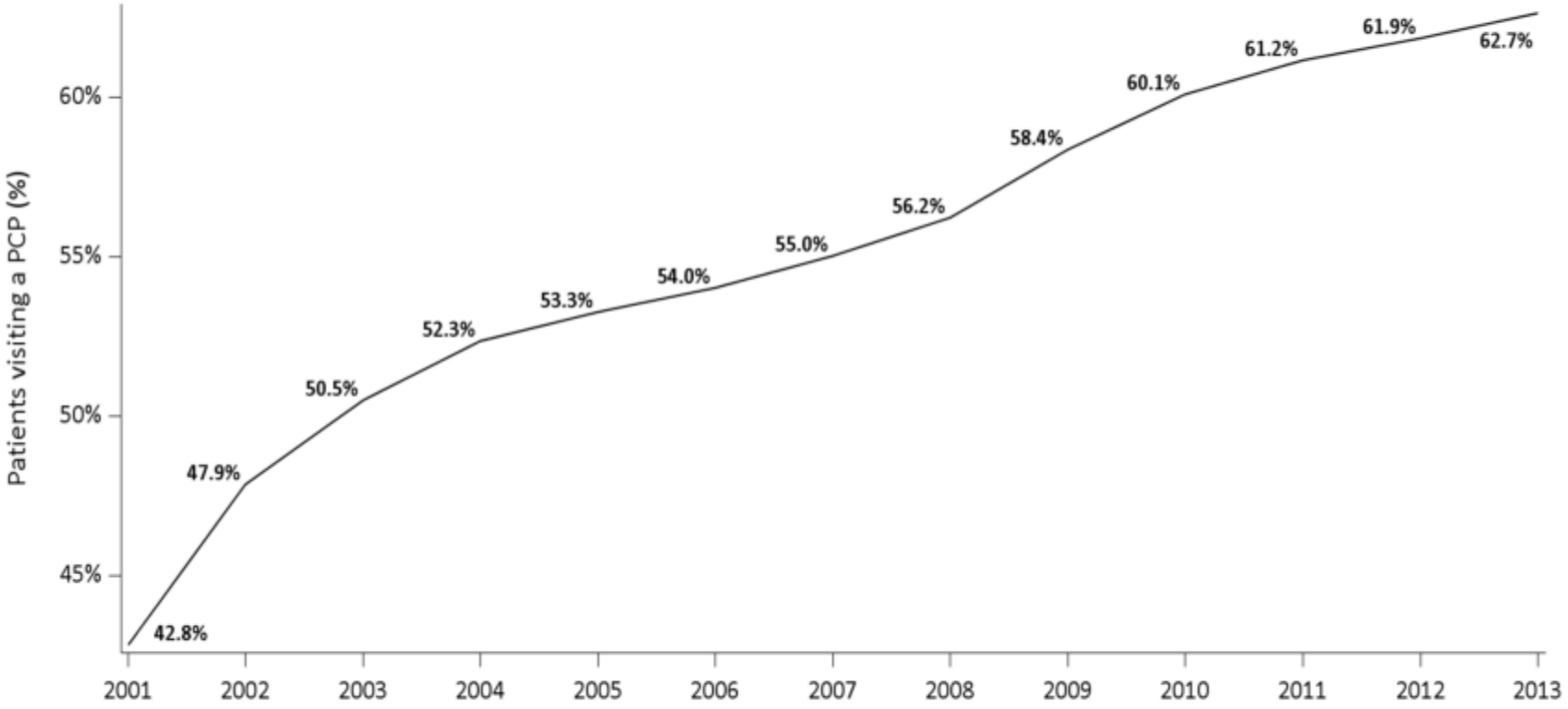
Dialysis-related care	Primary Care
Dialysis Prescription	Care coordination
Access	Preventive care
Anemia	Medication Mgmt
MBD	Other medical issues

Preventive Care

Care area	No PCP visits (n=76,653)	1+ PCP visit (n=118,730)
Vaccination in 2012–13 flu season	63.9	76.2
	No PCP visits (n=26,974)	**1+ PCP visit** (n=53,615)
Diabetes-related care in 2013*		
1+ HbA1C test	79.0	87.1
1+ Lipid test	55.4	67.1
1+ Diabetic eye exam	38.3	47.9
All 3 tests	22.8	32.5

PCP Involvement in the Care of HD Patients in the US

Percentage of dialysis patients visiting a PCP, 2001-2013



Note: Among dialysis patients who were Medicare primary and alive for the entire calendar year.

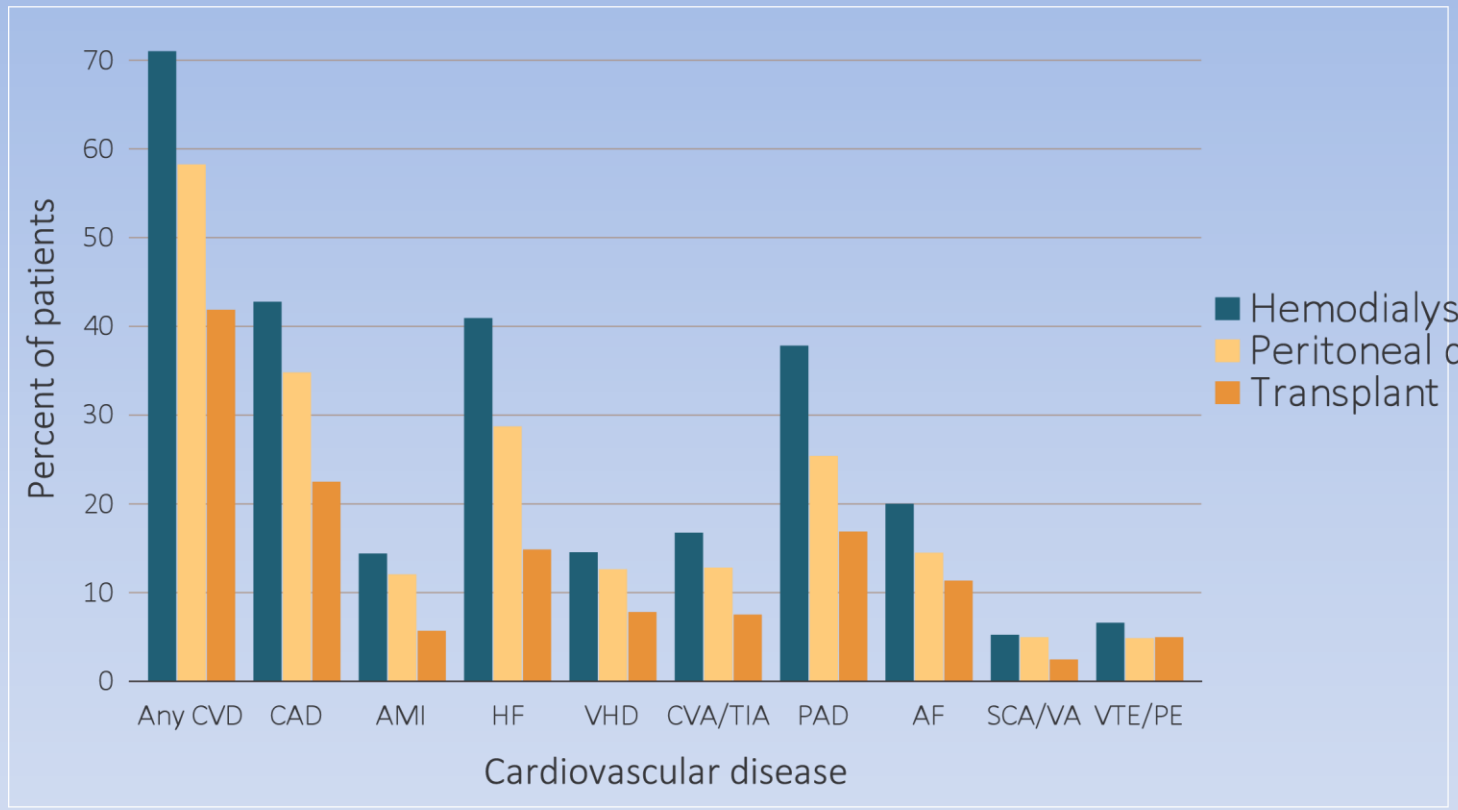
Shahinian V et al. ASN Poster TH-PO-965, 2015.

Cause of Death

Cardiovascular disease accounts for approximately 50 percent of deaths.

Excerpts from the US Renal Data System 2009 Annual Data Report.
Am J Kidney Dis. 2010;55(1 Suppl 1):S1.

vol 2 Figure 8.1 Prevalence of cardiovascular diseases in adult ESRD patients, by treatment modality, 2016

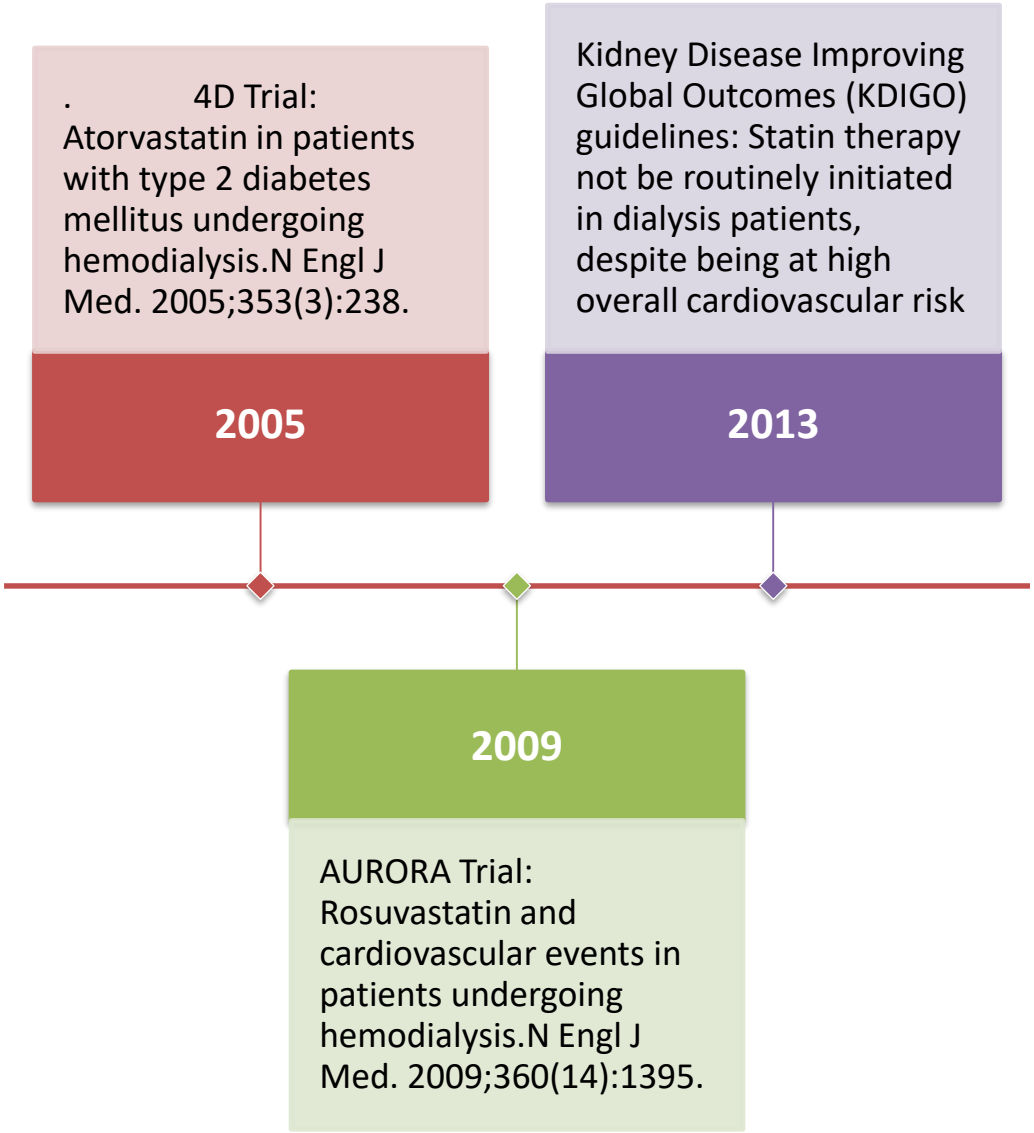


Data Source: Special analyses, USRDS ESRD Database. Point prevalent hemodialysis, peritoneal dialysis, and transplant patients aged 22 and older, who are continuously enrolled in Medicare Parts A and B, and with Medicare as primary payer from January 1, 2016 to December 31, 2016, and ESRD service date is at least 90 days prior to January 1, 2016. Abbreviations: AF, atrial fibrillation; AMI, acute myocardial infarction; CAD, coronary artery disease; CVA/TIA, cerebrovascular accident/transient ischemic attack; CVD, cardiovascular disease; HF, heart failure; PAD, peripheral arterial disease; SCA/VA, sudden cardiac arrest and ventricular arrhythmias; VHD, valvular heart disease; VTE/PE, venous thromboembolism and pulmonary embolism.

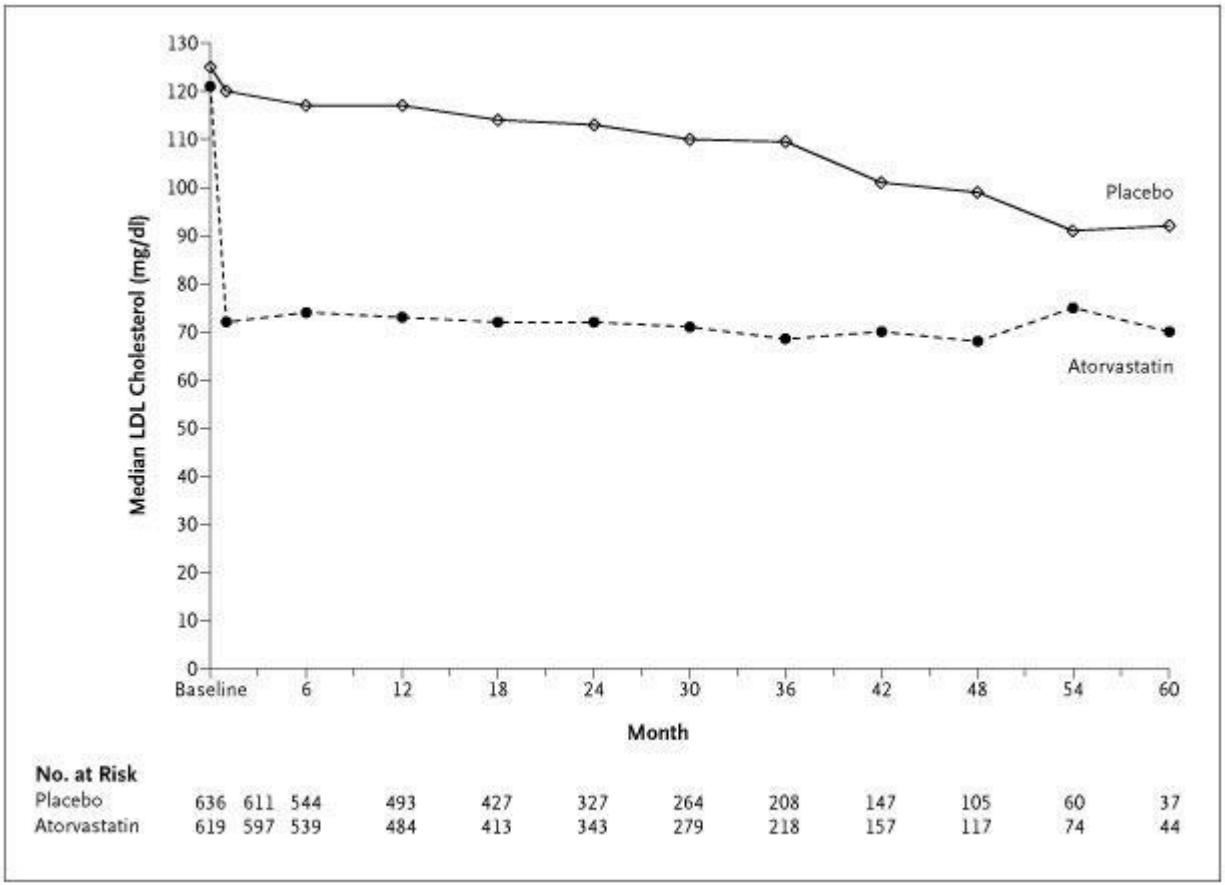
Cause of Cardiovascular Disease

- Cardiac diseases in maintenance hemodialysis patients: results of the HEMO Study. (1846 patients)Kidney Int. 2004;65(6):2380.
  - 80% of patients had cardiac diseases,
  - ischemic heart disease (IHD) (39%),
  - congestive heart failure (40%), arrhythmia (31%), and
  - The HEMO Study identified IHD to be a major cause of cardiac hospitalizations and cardiac deaths.
  - Sudden cardiac death (SCD) in 22-23% of deaths in patients on HD.

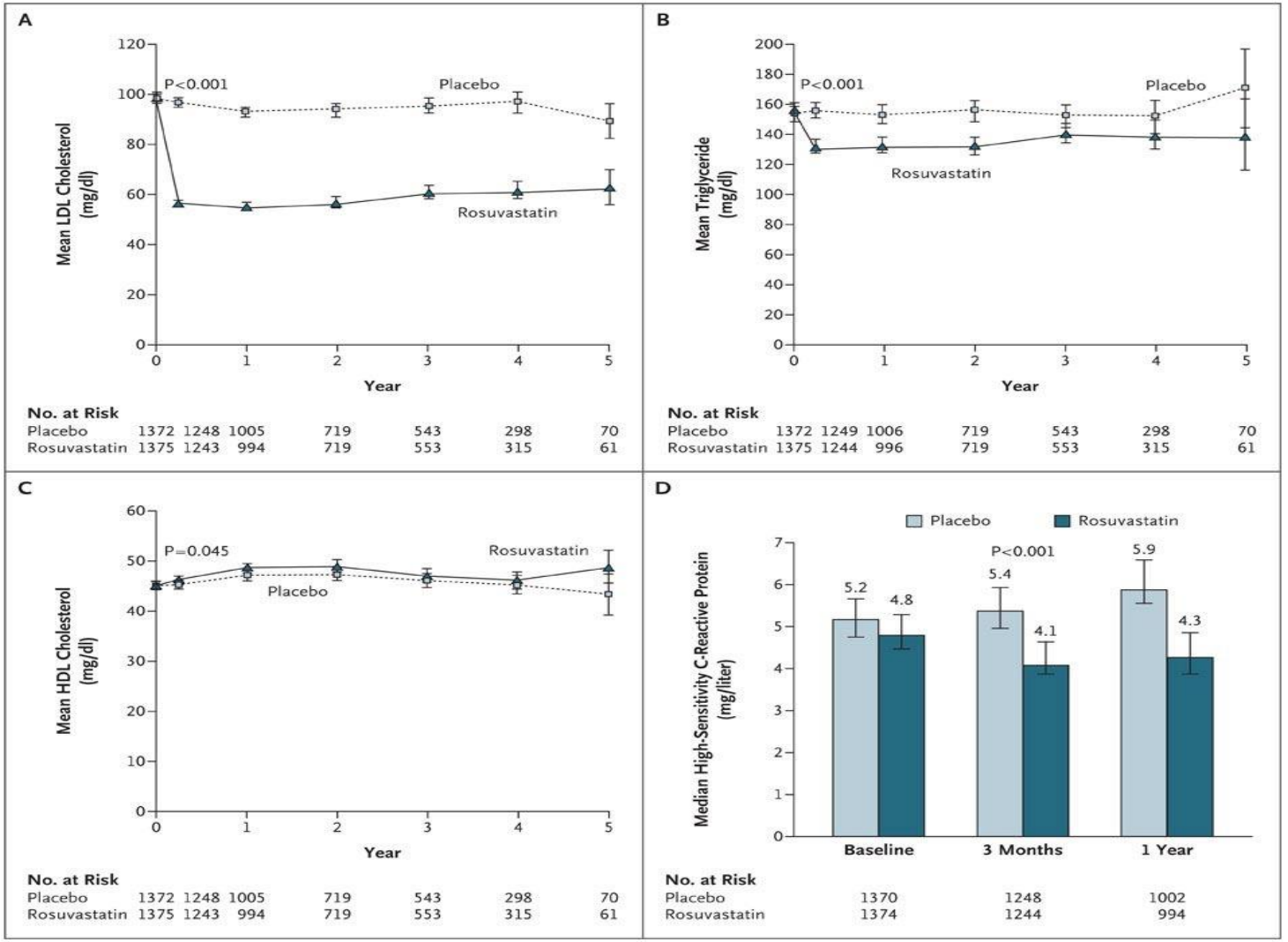
Hypercholestrolemia in ESRD



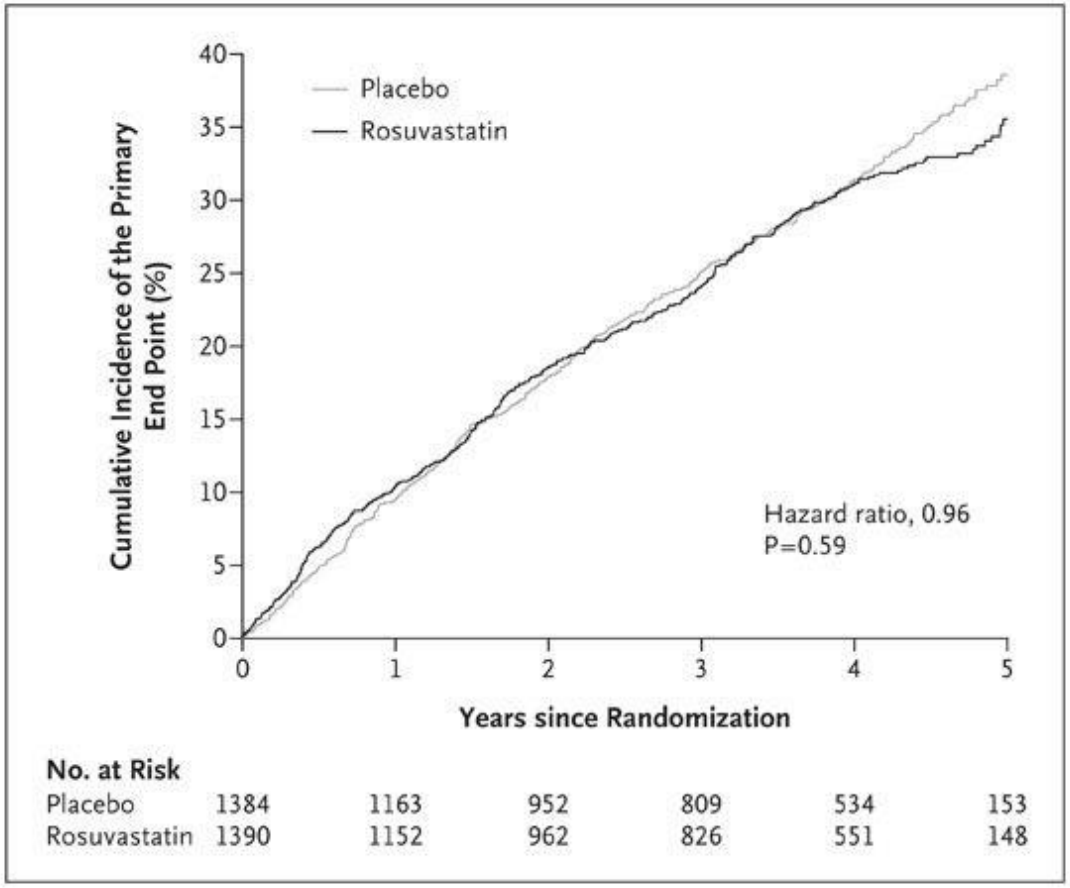
Atorvastatin vs Placebo



AURORA TRIAL



AURORA


Placebo
Rosuvastatin
Cumulative Incidence of the Primary End Point (%)
40
35
30
25
20
15
10
5
0
0
1
2
3
4
5
Years since Randomization
Hazard ratio, 0.96
P=0.59
No. at Risk
Placebo 1384 1163 952 809 534 153
Rosuvastatin 1390 1152 962 826 551 148

Hypertension in ESRD patient

- Pre-Dialysis
- Post-Dialysis
- Non Dialysis Day
- Avoid Hypotension on Dialysis
- Follow patient symptoms
- Pre-dialysis value of <140/90 mmHg and a post-dialysis value of <130/80
- Mean ambulatory BP <135/85 mmHg during the day and <120/80 mmHg at night, is also a reasonable goal.

Blood Pressure in Dialysis (BID) Results of a Pilot Study

METHODS

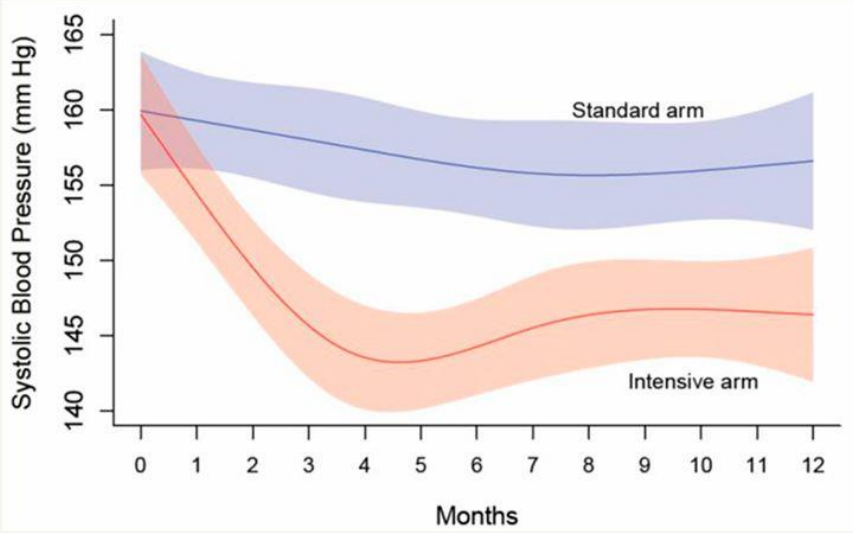
- A pilot RCT to assess feasibility and safety of conducting a full-scale trial of intensive control of hypertension in HD patients.
- Randomized 126 patients to a predialysis standardized SBP of 115-140 or 155-165 mm Hg for one year.

SAE Summary

Event	Hazard Ratio of Recurrent Events (95% CI)	P-value
MACE	0.89 (0.30 – 2.66)	0.84
Hospitalization	1.66 (1.18 – 2.34)	0.004
Vascular access thrombosis	2.80 (1.18 – 6.66)	0.020
Systolic blood pressure <90 mm Hg	1.30 (1.10 – 1.52)	0.002
Cramps	1.16 (1.04 – 1.30)	0.01
Nausea/vomiting	1.41 (1.02 – 1.94)	0.04

RESULTS

- Sustained separation in SBP.
- No significant reduction in MACE.
- Hospitalization, vascular access thrombosis, and intradialytic hypotension were increased in intensive arm.
- No difference in change in left ventricular mass across arms.



CONCLUSIONS

It is feasible to conduct a full-scale RCT. Given the study's small size and short duration the safety signal may not be a definitive result.

doi: 10.1681/ASN.

JASN
JOURNAL OF THE AMERICAN SOCIETY OF NEPHROLOGY

Dana C. Miskulin et al. JASN 2018;29:307-316

JASN

Echocardiography in Dialysis Patients

- Ejection Fraction
- LV Hypertrophy
- Diastolic Dysfunction
- Valvular Heart Disease
- Wall motion abnormalities
- AV access effect on cardiac function
- Pulmonary Hypertension

Uremic Cardiomyopathy — Effect of Hemodialysis on Left Ventricular Function in End-Stage Renal Failure

Joseph Hung, F.R.A.C.P., Philip J. Harris, Ph.D., F.R.A.C.P., Roger F. Uren, F.R.A.C.P., David J. Tiller, F.R.A.C.P., and David T. Kelly, F.R.A.C.P.

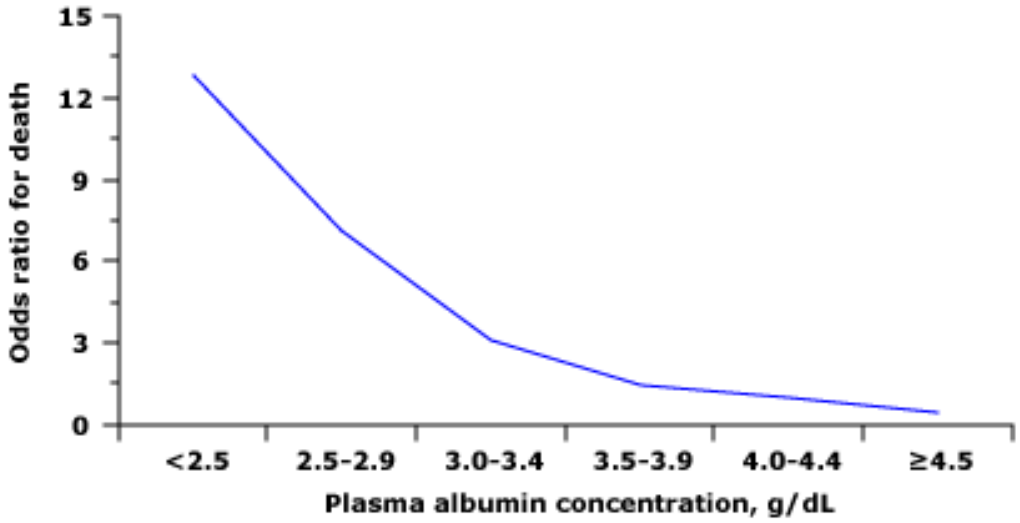
N Engl J Med 1980; 302:547-551March 6, 1980

Ejection fraction and contraction were normal in 15 patients (Group A), six of whom had signs of congestive failure; they were abnormal in five patients (Group B), all of whom were in clinical heart failure. Mean arterial pressure and body weight decreased by a similar amount after dialysis in both groups, and heart rate did not change. In Group A ejection fraction was unchanged by dialysis (0.63±0.06 before vs. 0.62±0.09 after) (mean ±S.D.), but in Group B it was improved significantly (0.32±0.04 before vs. 0.44±0.08 after) ($P<0.01$).

Sudden Cardiac Death (SCD) in ESRD

- Age
- Diabetes,
- Peripheral vascular disease
- Ischemic heart disease
- Low serum creatinine (reflecting decreased muscle mass and poor nutrition)
- An elevated alkaline phosphatase
- Traditional cardiovascular risk factors such as smoking and cholesterol did not
- LV hypertrophy
- Rapid electrolyte shifts during hemodialysis sessions

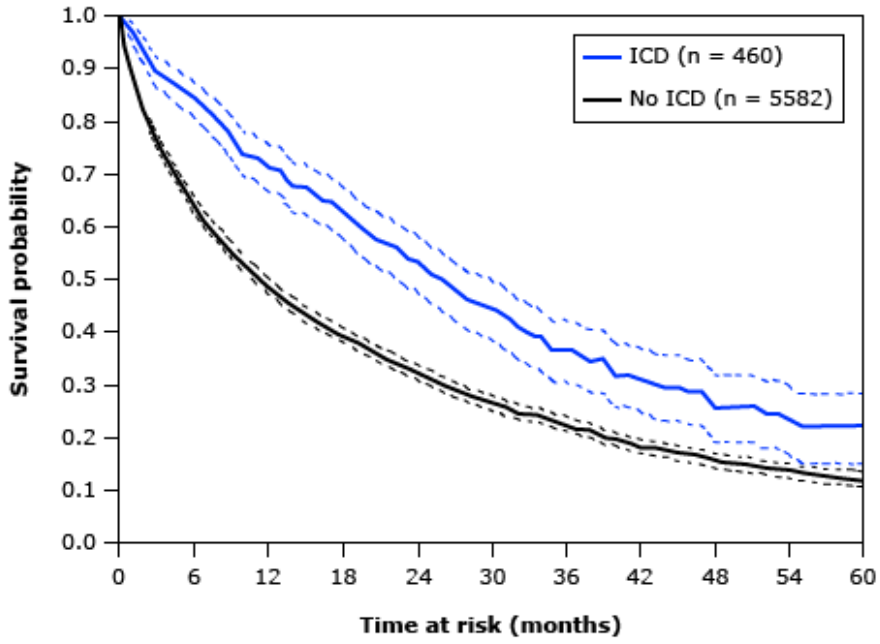
Risk of mortality among hemodialysis patients according to serum albumin during maintenance dialysis



Odds ratio for death, adjusted for age, sex, race, and underlying disease, according to the plasma albumin concentration in patients on maintenance hemodialysis. The likelihood of dying was inversely related to the plasma albumin concentration, being greatest at a plasma albumin concentration below 3.0 g/dL (30 g/L). All values are signficantly different ($p<0.001$ to 0.03) from the odds ratio of 1.0 at a normal plasma albumin concentration of 4.0 to 4.4 g/dL (40 to 44 g/L).

Data from Owen WF Jr, Lew NL, Liu Y, et al. The urea reduction ratio and serum albumin concentration as predictors of mortality in patients undergoing hemodialysis. N Engl J Med 1993; 329:1001.

Estimated unadjusted survival of dialysis patients with and without an implantable cardioverter-defibrillator (ICD)



Number at risk:

No ICD	2239	1149	562	246
ICD	243	136	61	25

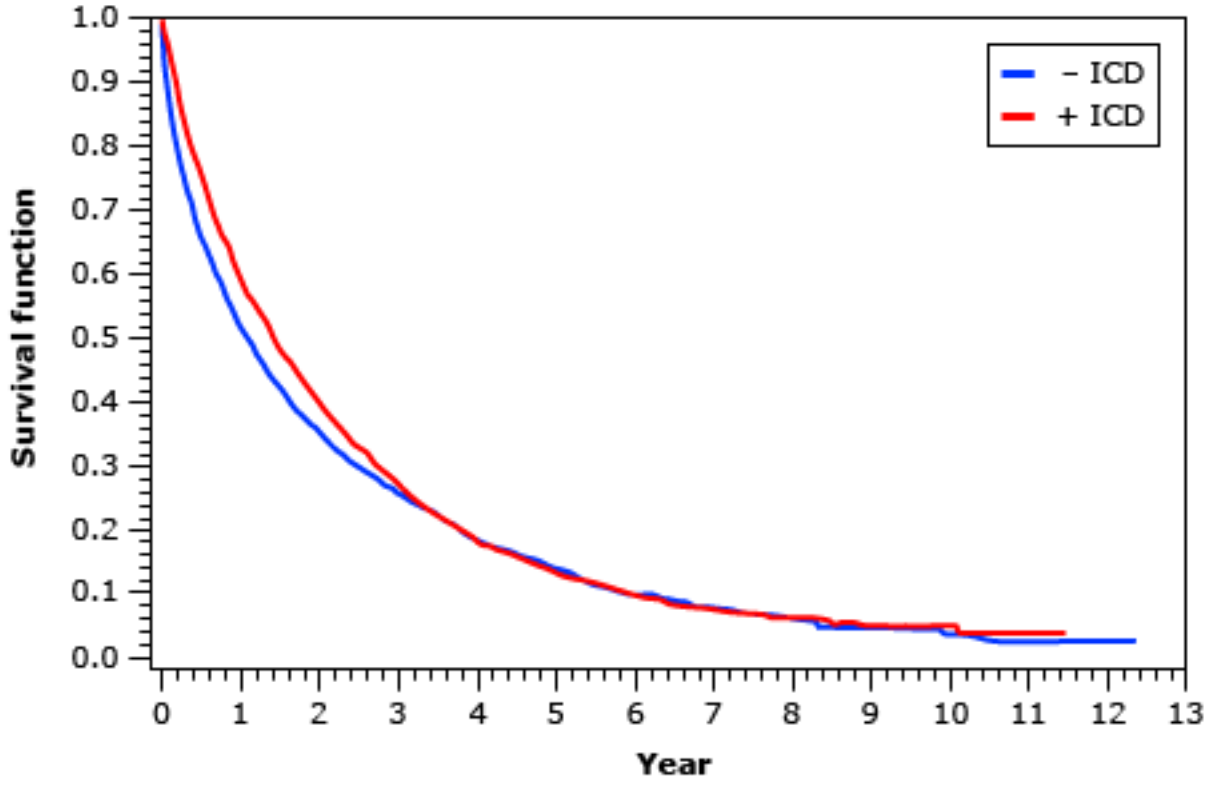
Figure showing probability of survival over time among dialysis patients with a history of sudden cardiac death. At every time point, a higher unadjusted survival is observed in patients with an ICD (blue line) compared with those without an ICD (black line).

ICD: implantable cardioverter-defibrillator.

Data from: Herzog CA, Li S, Weinhandl ED, et al. Survival of dialysis patients after cardiac arrest and the impact of implantable cardioverter defibrillators. Kidney Int 2005; 68:818.

UpToDate®

Survival of dialysis patients who received ICD devices



Survival of patients who received an implantable cardioverter-defibrillator (ICD) for secondary prevention compared with matched controls.

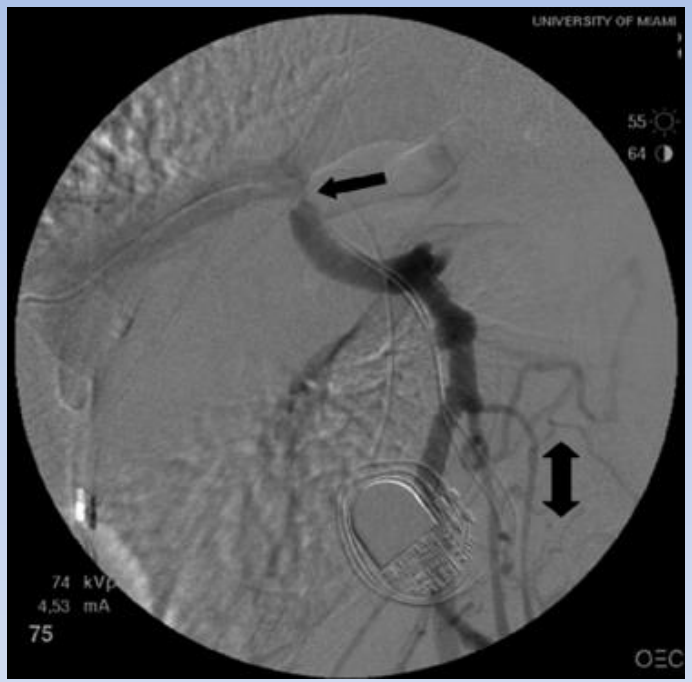
Reproduced from: Charytan DM, Patrick AR, Liu J, et al. Trends in the Use and Outcomes of Implantable Cardioverter-Defibrillators in Patients Undergoing Dialysis in the United States. Am J Kidney Dis 2011; 58:409. Illustration used with the permission of Elsevier Inc. All rights reserved.

AHA Recommendation

"Life-threatening ventricular arrhythmias, especially in patients awaiting renal transplantation, should be treated conventionally, including the use of ICD and pacemaker as required, in patients who are receiving chronic optimal medical therapy and who have reasonable expectation of survival with a good functional status for more than one year."

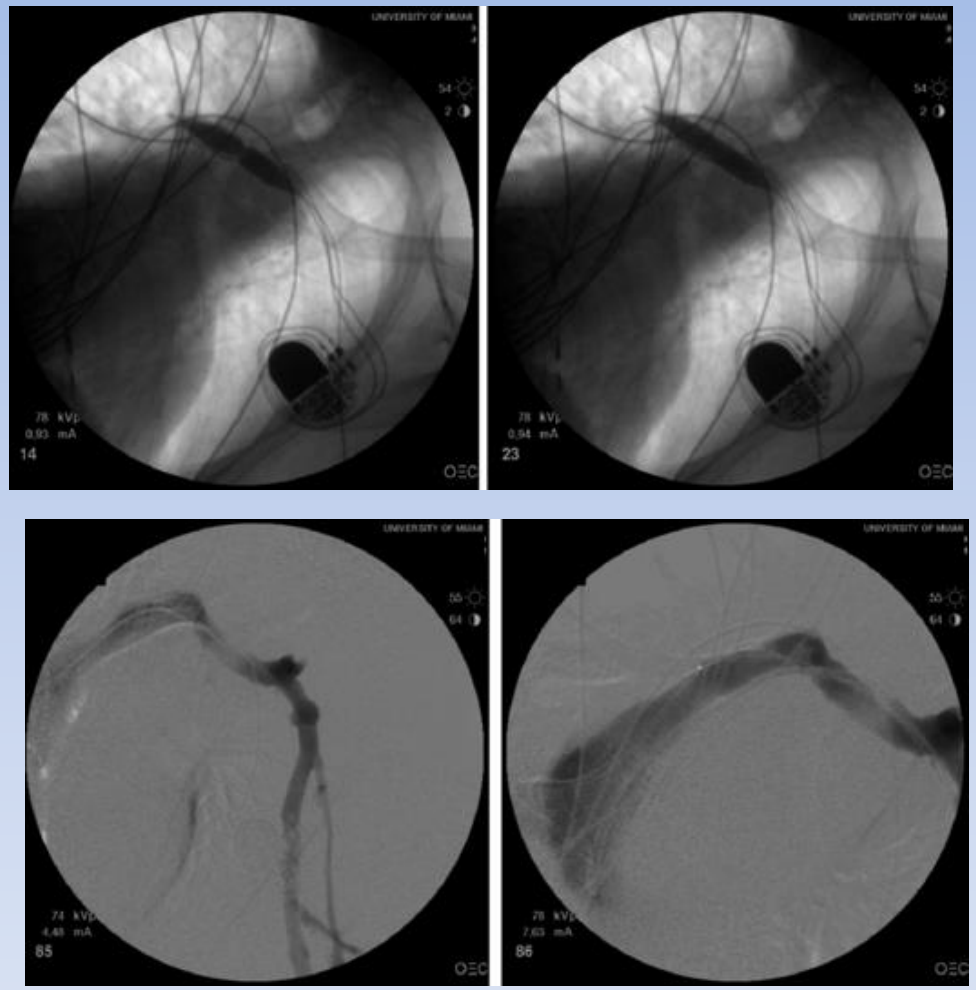
Central Vein Stenosis associated with Pacemaker

Central Vein Stenosis associated with Pacemaker



Seminars in Dialysis
Volume 22, Issue 6, pages 671-676, 2 OCT 2009 DOI: 10.1111/j.1525-139X.2009.00636.x
http://onlinelibrary.wiley.com/doi/10.1111/j.1525-139X.2009.00636.x/full#f3

Central Vein Stenosis associated with Pacemaker



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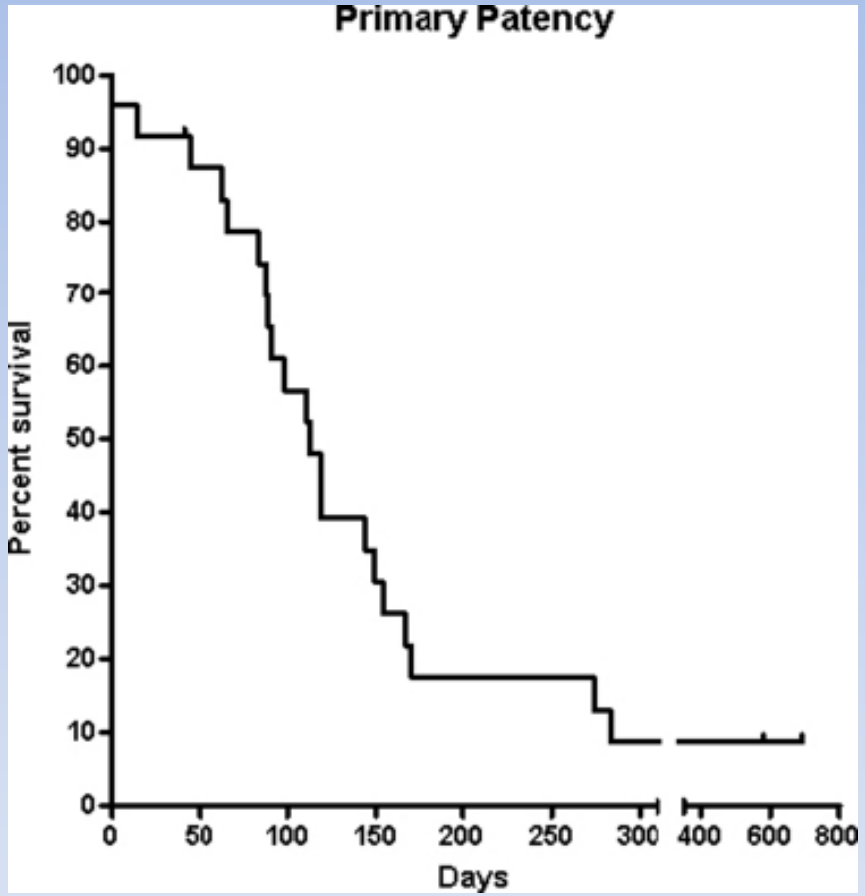
Volume 22, Issue 6, pages 671-676, 2 OCT 2009 DOI: 10.1111/j.1525-139X.2009.00636.x
http://onlinelibrary.wiley.com/doi/10.1111/j.1525-139X.2009.00636.x/full#f5

ASDIN: Patency Rates for Angioplasty in the Treatment of Pacemaker-Induced Central Venous Stenosis in Hemodialysis Patients: Results of a Multi-Center Study



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http://onlinelibrary.wiley.com/doi/10.1111/j.1525-139X.2009.00636.x/full#f1

Atrial Fibrillation in ESRD

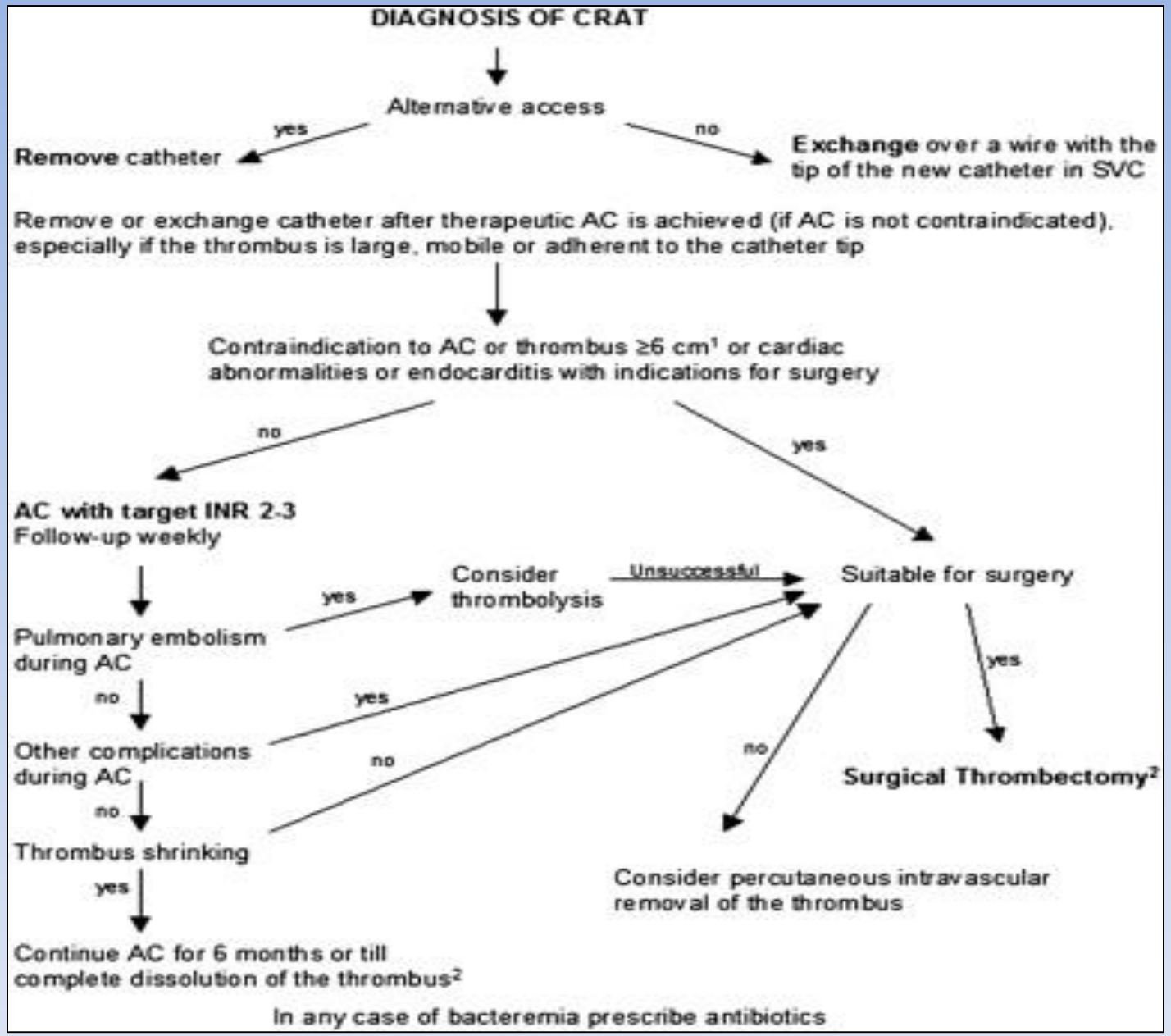
- Warfarin use and the risk for stroke and bleeding in patients with atrial fibrillation undergoing dialysis. Circulation. 2014;129(11):1196.

  CONCLUSIONS: Our results suggest that warfarin use is not beneficial in reducing stroke risk, but it is associated with a higher bleeding risk in patients with AF undergoing dialysis.
- For most AF on dialysis, recommend no anticoagulant therapy (Grade 2C). For patients with known atrial thrombus, valvular/rheumatic valve disease, and previous transient ischemic attack or stroke, we suggest anticoagulation with warfarin(Grade 2C).

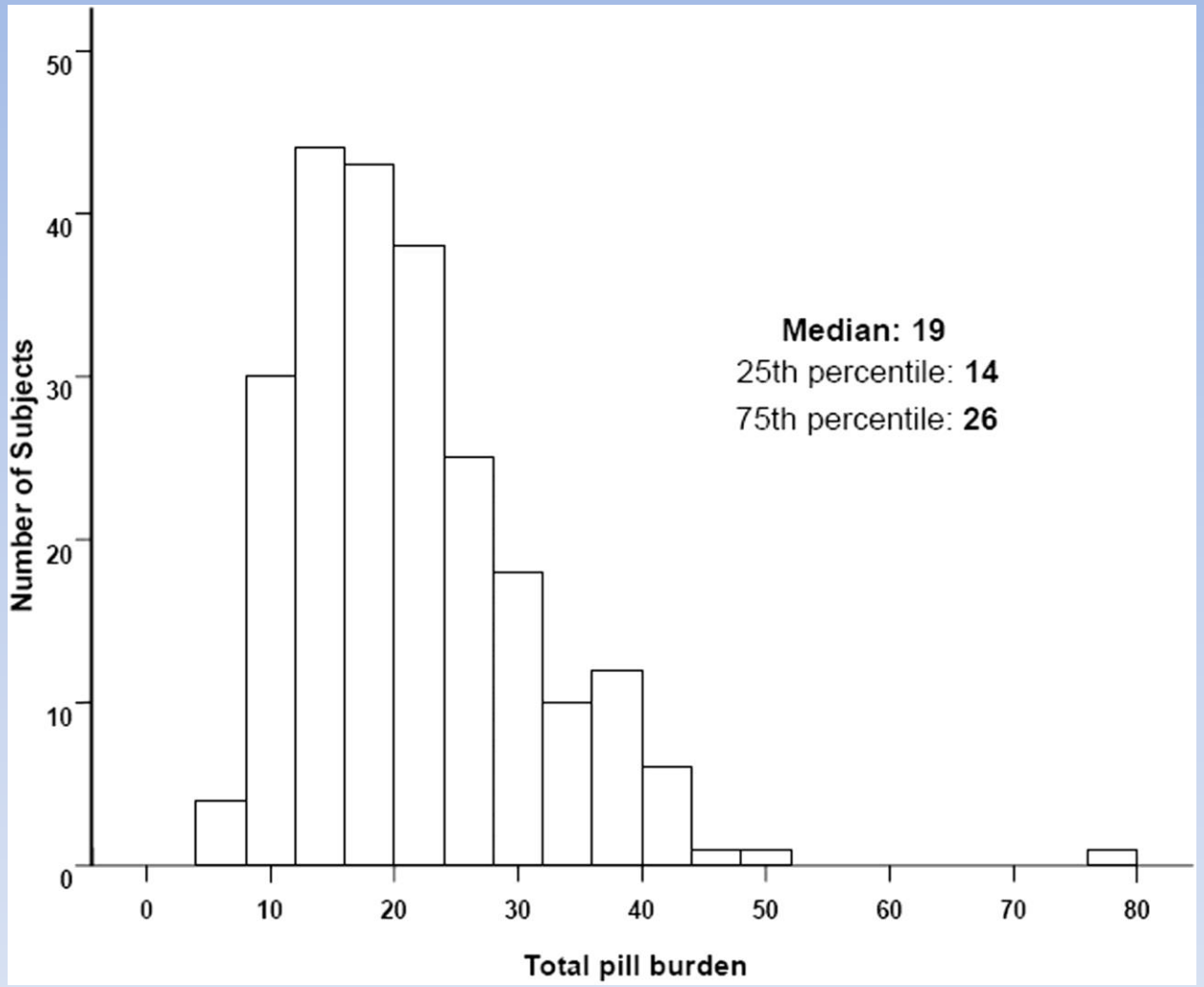
Catheter related Atrial Thrombus (CRAT)

Right atrial thrombi complicating haemodialysis catheters. A meta-analysis of reported cases and a proposal of a management algorithm.
Stavroulopoulos, Aristeidis; Aresti, Vasiliki; Zounis, Christos

Nephrology Dialysis Transplantation. 27(7):2936-2944, July 2012.
DOI: 10.1093/ndt/gfr739


DIAGNOSIS OF CRAT
Alternative access
yes
no
Remove catheter
Exchange over a wire with the tip of the new catheter in SVC
Remove or exchange catheter after therapeutic AC is achieved (if AC is not contraindicated), especially if the thrombus is large, mobile or adherent to the catheter tip
Contraindication to AC or thrombus ≥6 cm[1] or cardiac abnormalities or endocarditis with indications for surgery
no
yes
AC with target INR 2-3
Follow-up weekly
Consider thrombolysis
Unsuccessful
Suitable for surgery
yes
Pulmonary embolism during AC
no
yes
yes
Other complications during AC
no
no
Surgical Thrombectomy[2]
no
Thrombus shrinking
yes
Consider percutaneous intravascular removal of the thrombus
Continue AC for 6 months or till complete dissolution of the thrombus[2]
In any case of bacteremia prescribe antibiotics

Pill burden in Dialysis Patients.



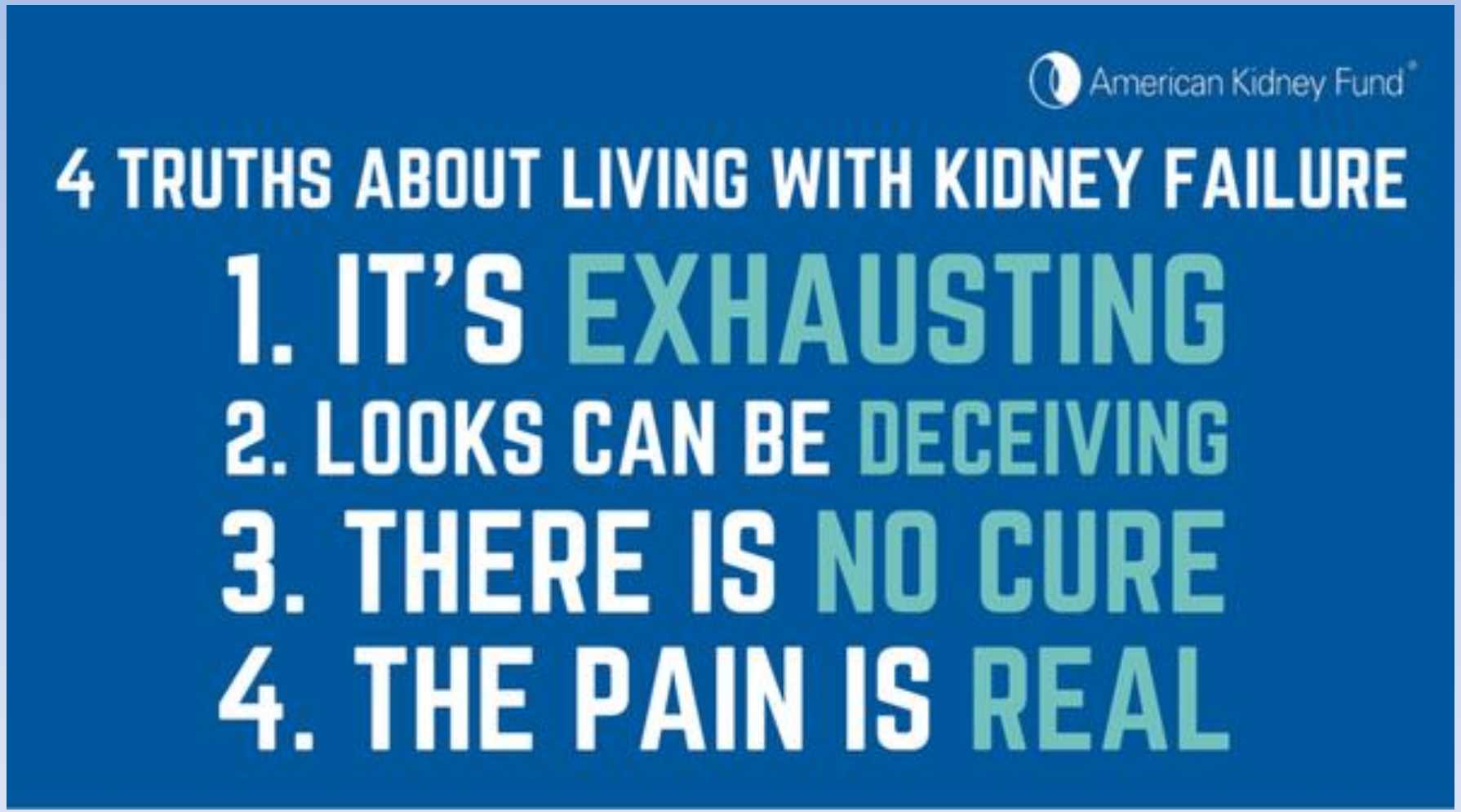
Chiu Y et al. CJASN 2009;4:1089-1096

CJASN

Definition

- QOL can be defined as an individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards, and concerns.
- HRQOL can be defined as the extent to which an individual's usual or expected physical, social, or emotional well-being is affected by a medical condition and/or its treatment.

ESRD: QOL


American Kidney Fund
4 TRUTHS ABOUT LIVING WITH KIDNEY FAILURE
1. IT'S EXHAUSTING
2. LOOKS CAN BE DECEIVING
3. THERE IS NO CURE
4. THE PAIN IS REAL

Assessing and improving the health-related quality of life of patients with ESRD

Fredric O. et al

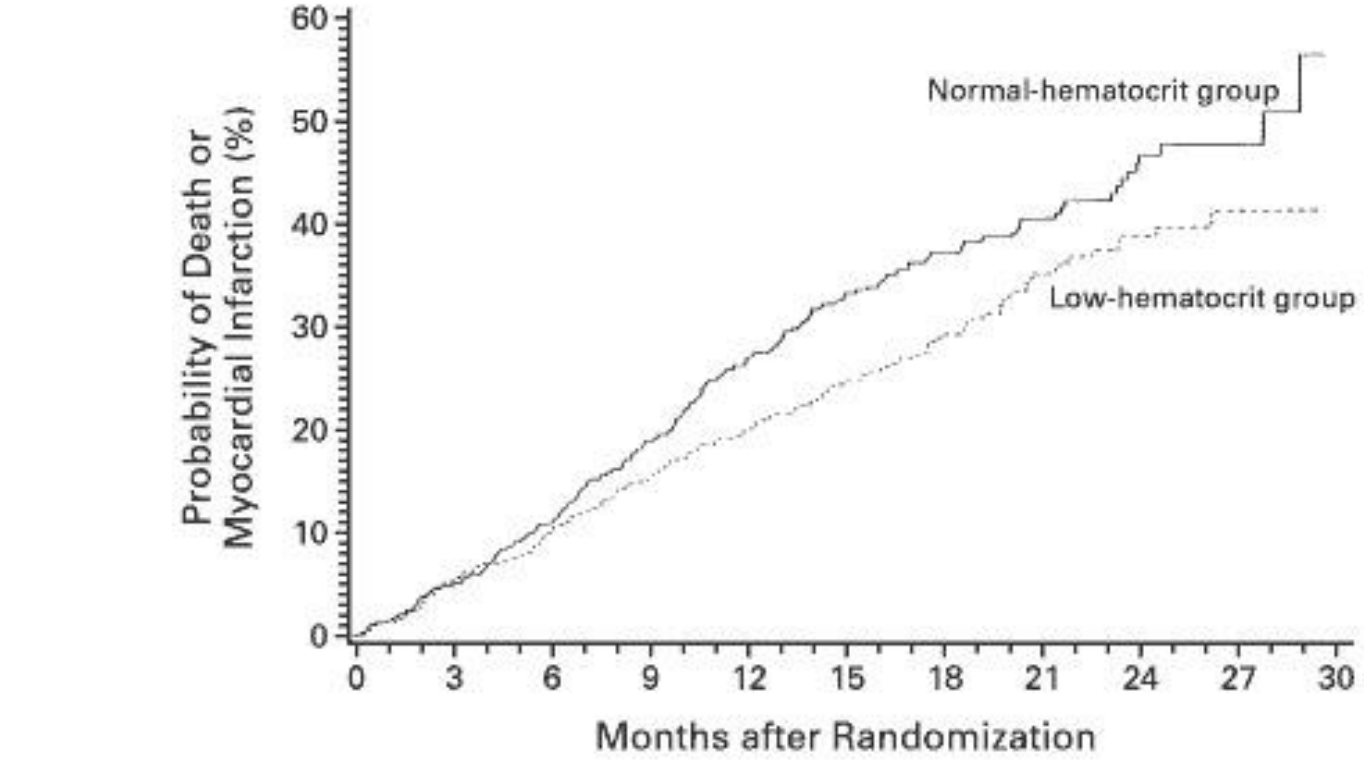
Nature Reviews Nephrology 8, 718-724 (December 2012)

- Physical symptoms (presence, absence and severity), including dry skin, muscle cramps, bone or joint pain, swelling in legs, muscle soreness or weakness, shortness of breath, appetite disturbance and itching
- Depression
- Anxiety
- Sleep disturbances
- Energy and vitality
- Restless legs
- Physical functioning
- Pain
- Sexual functioning
- Marital and family discord
- Social functioning
- Spirituality
- Burden of illness and care
- Satisfaction with care
- Time to recovery after a dialysis session

Anemia Management in ESRD

- The effects of normal as compared with low hematocrit values in patients with cardiac disease who are receiving hemodialysis and epoetin. Besarab et al N Engl J Med. 1998;339(9):584
- Correction of anemia with epoetin alfa in chronic kidney disease. Singh AK, Szczech L, Tang KL, Barnhart H, Sapp S, Wolfson M, Reddan D, CHOIR Investigators. N Engl J Med. 2006;355(20):2085.
- Normalization of hemoglobin level in patients with chronic kidney disease and anemia. Drüeke TB, Locatelli F, Clyne N, Eckardt KU, Macdougall IC, Tsakiris D, Burger HU, Scherhag A, CREATE InvestigatorsN Engl J Med. 2006;355(20):2071
- A trial of darbepoetin alfa in type 2 diabetes and chronic kidney disease. Pfeffer MA, Burdmann EA, Chen CY, Cooper ME, de Zeeuw D, Eckardt KU, Feyzi JM, Ivanovich P, Kewalramani R, Levey AS, Lewis EF, McGill JB, McMurray JJ, Parfrey P, Parving HH, Remuzzi G, Singh AK, Solomon SD, Toto R, TREAT Investigators. N Engl J Med. 2009;361(21):2019.

NHT Trial



No. at Risk

Normal hematocrit	618	540	476	415	353	259	186	124	69	26
Low hematocrit	615	537	485	434	391	292	216	131	80	20

Besarab A, Bolton WK, Browne JK, Egrie JC, Nissenson AR, Okamoto DM, Schwab SJ, Goodkin DA
N Engl J Med. 1998;339(9):584.

Target: 10-11gm/dl

Cancer Screening

- Practice guidelines and/or standards for cancer screening that have been developed in the general population are not necessarily applicable to patients with ESRD.
- Given the limited information about cancer screening that is currently available, routine screening cannot be advocated for all such patients. Routine cancer screening is perhaps most inappropriate in patients with ESRD who are diabetic, white, or ≥65 years of age.
- Cancer-screening protocols are best implemented on an individual patient basis, a setting in which personal risk factors (family history, comorbid diseases, etc) may be considered.
- Patients being considered for renal transplantation should undergo routine cancer screening as part of the transplant evaluation process.

Glycated Hemoglobin and Risk of Death in Diabetic Patients Treated With Hemodialysis: A Meta-analysis

Higher mortality HgbA1C < 5.4% or > 8.4%

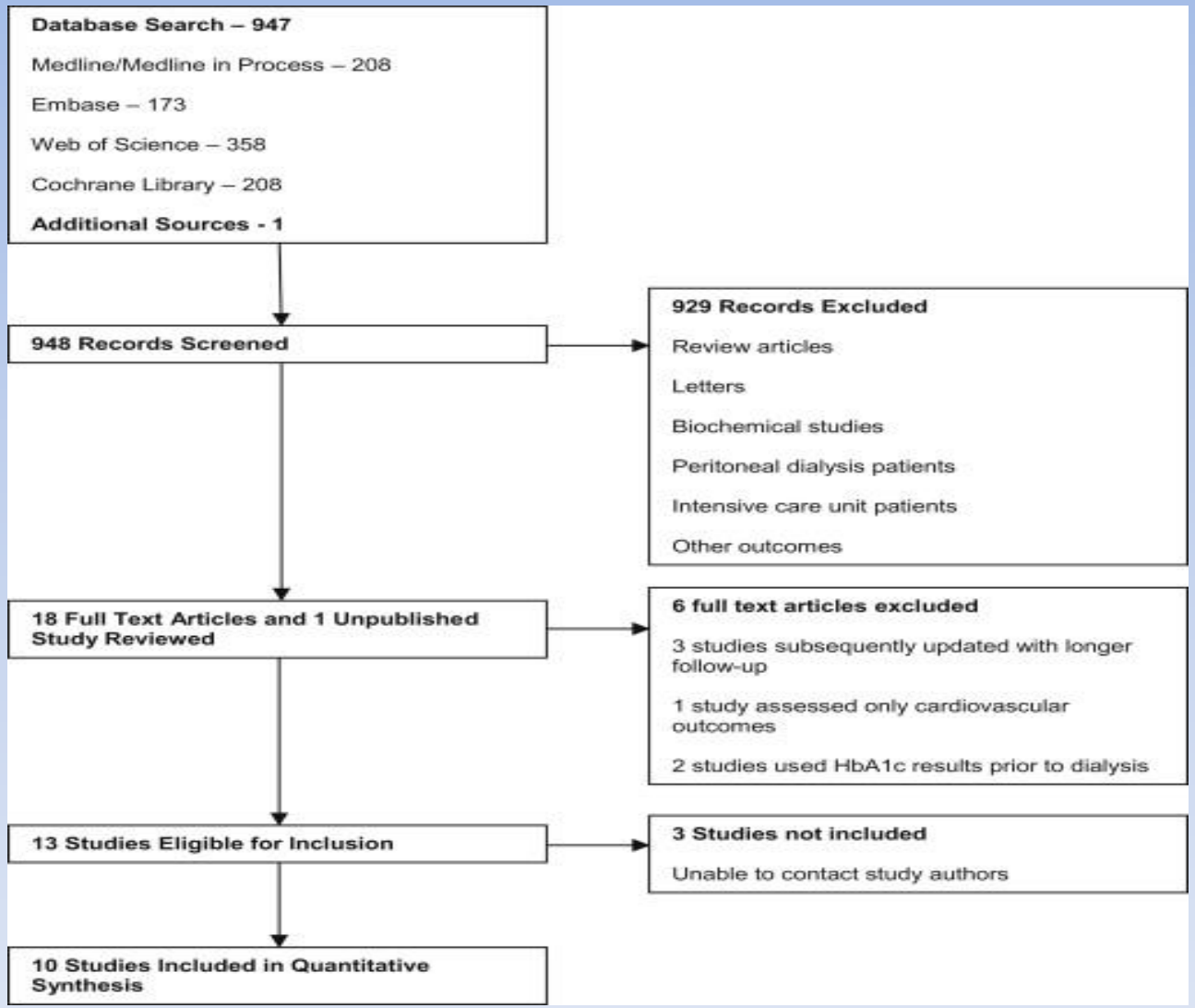
For relatively young (≤50 years) and have no other significant comorbid conditions, recommend using an HbA1c goal of 7 to 7.5, rather than higher values (Grade 2C).

For older patients (ie, >50 years) who have multiple comorbid conditions, we suggest using an HbA1c goal of 7.5 to 8, rather than lower values (Grade 2C).

Christopher J. Hill , Alexander P. Maxwell , Christopher R. Cardwell , Barry I. Freedman , Marcello Tonelli , Masan...

American Journal of Kidney Diseases, Volume 63, Issue 1, 2014, 84 - 94

Glycated Hemoglobin and Risk of Death in Diabetic Patients Treated With Hemodialysis: A Meta-analysis



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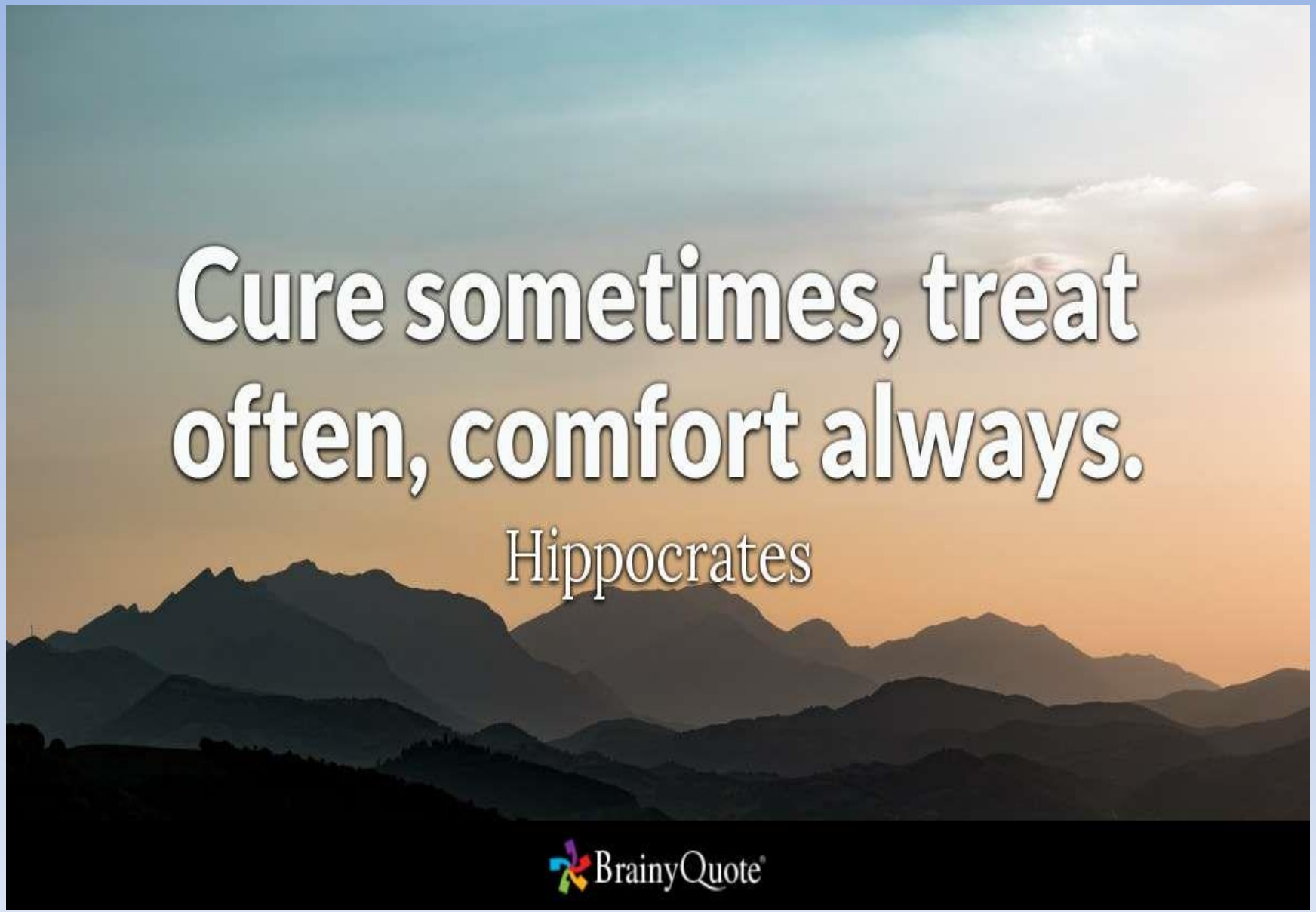
Summary

- Patients with ESRD on HD have unique characteristics
- Studies based on general population may not be applicable to patients with ESRD
- Primary Care Involvement can play an important role in improving care of patients with ESRD
- Offers an interesting challenge with ample opportunity for further research


Cure sometimes, treat often, comfort always.
Hippocrates
BrainyQuote

Thank You