

# Chronic Kidney Disease Medical Management

2021

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# How do you differentiate ARF from CRF.

- What physical exam finding tells you the pt has Chronic Kidney Disease?
- What Would you see on renal Ultrasound for a pt with CKD?

# Lindsey's Nails



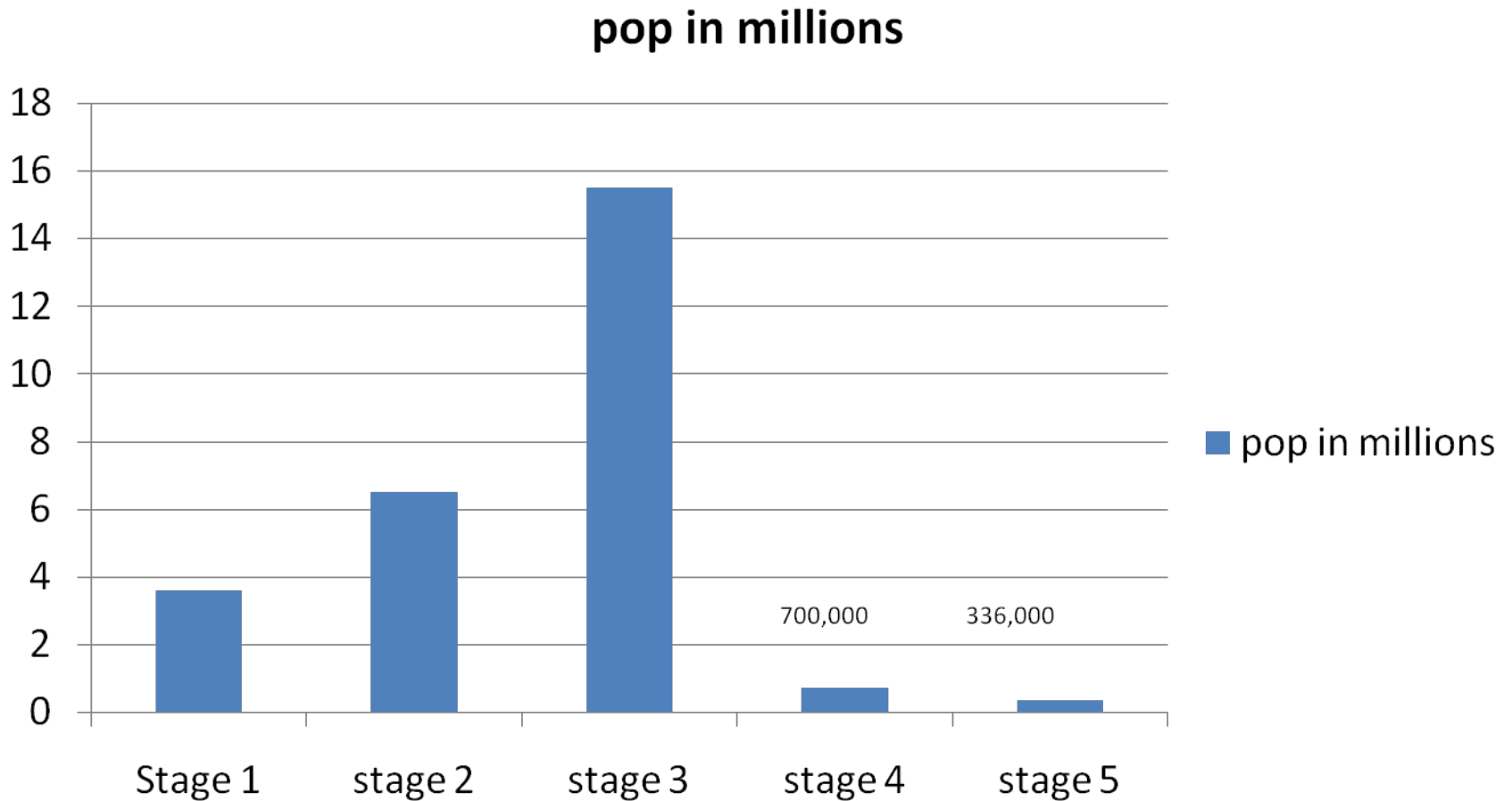
# CKD prevalence in world Populations

• Country	Population	CKD est.
– China	1.298.847.624	35.336.295
– India	1.065.070.607	28.976.185
– Indonesia	238.452.952	6.487.322
– Pakistan	159.196.336	4.331.076
– Phillipines	86.241.697	2.346.281
– Vietnam	82.662.800	2.248.914
• Assumes 2.72 % incidence		

# CKD Stages

- Stage 1. Normal function with known dz
- Stage 2. GFR 60-80
- Stage 3. GFR 30-60
- Stage 4. GFR 15-30.
- Stage 5. GFR less than 15.
- Stage 6. ESRD on dialysis.

# US Population with CKD



Coresh, Selvin, Stevens. Prevalence of CKD in the US. JAMA.2007;298(17)2038.

# US Population with CKD

- Most people will age into Stage 3, and do not have progressive renal disease.
- A subgroup of people do have a progressive kidney disease, and these should be seeing a Nephrologist.
- Some authors assign a Stage 3a and 3b with 3b being those with evidence of renal disease (proteinuria etc)
- Unfortunately, ICD 10 has now divided stage 3 into a (60-45 GFR) and b (45-30)

# Risk factors for progressive CKD

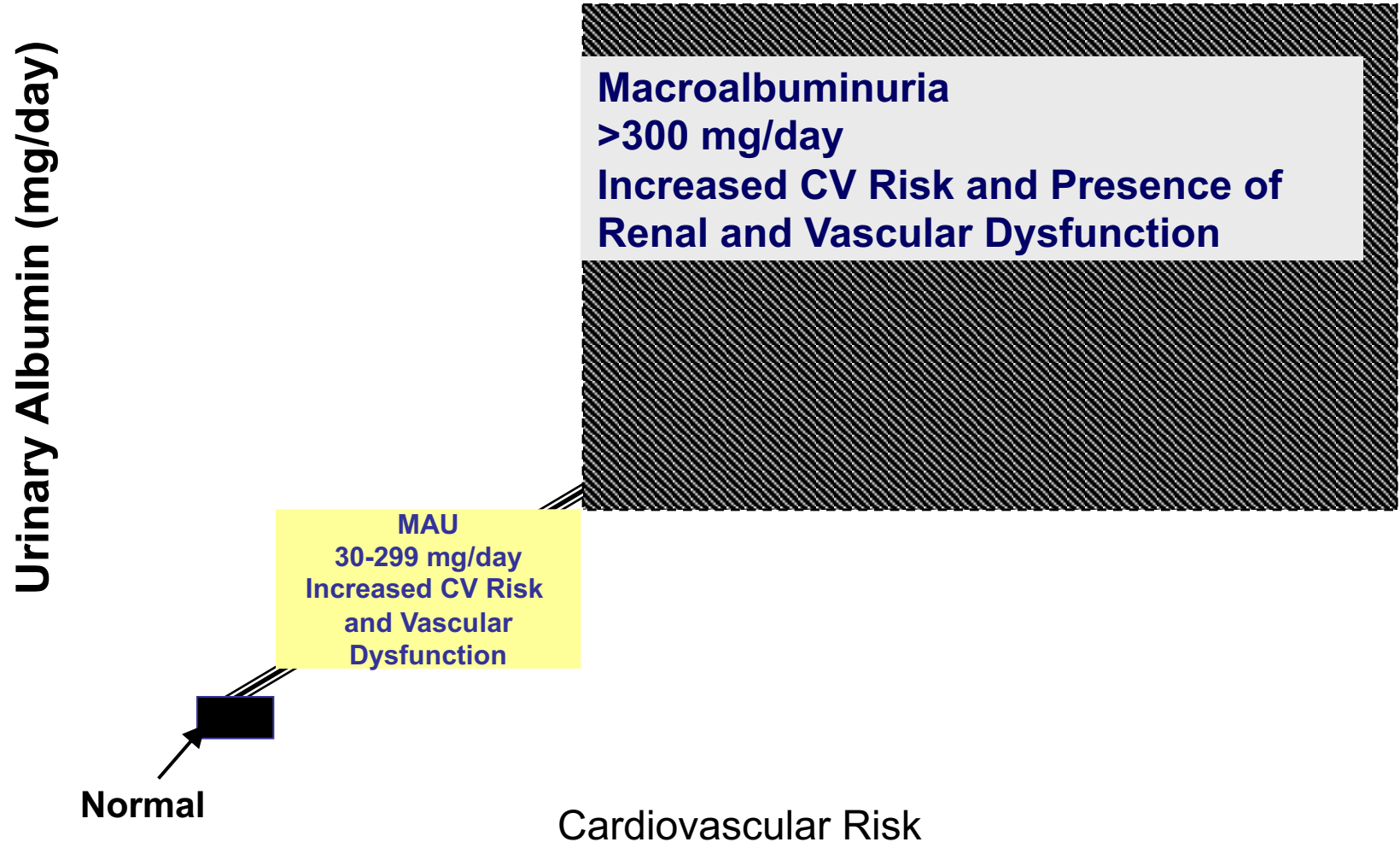
- Presence of a known kidney disease
- Family history of CKD
- Diabetes
- Hypertension
- Elevated creatinine OR presence of metabolic acidosis.
- Proteinuria/ albuminuria
- Cancer
- Prior COVID infection.
- Heart disease



# Metabolic Acidosis and Adverse Renal Outcomes

- Bicarb less than 20
- For CKD 3a
- CKD 3b
- CKD 4
- CKD 5
- This is observational and retrospective
- MA was more assoc with DM, HTN, PVD and CAD.
- Acidosis vs normal
- 39 vs 12 %
- 43 vs 16%
- 59 vs 33%
- 87 vs 82 %
- Risk for progression.

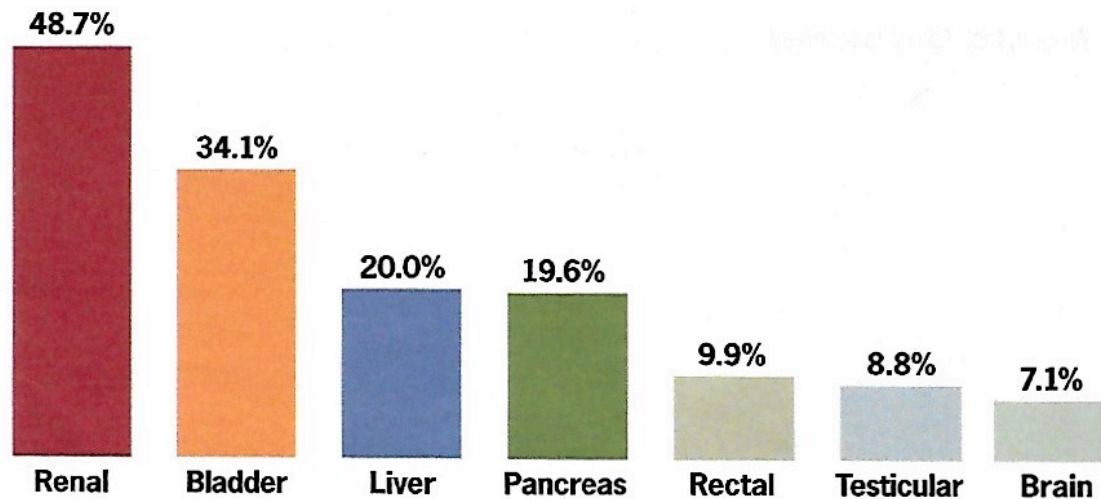
# Presence of MAU Indicates a Potential Increased Risk for CV Events



# Cancer and CKD

## CKD in Patients With Cancer

A study by investigators in Romania found that the prevalence of chronic kidney disease (CKD) among patients with cancer is higher than that of the general population, and the prevalence varies by cancer type, as shown below.



**Source:** Ciorean M, Chisavu L, Gadalean F, et al. Chronic kidney disease in neoplasia patients, the analysis of a large cancer database. Presented at: 58th ERA-EDTA 2021 virtual congress. Abstract MO525.

# Effect of COVID on renal function

- AKI as high as 47% of admitted cases
- Mortality in COVID patients with AKI ranges from 35-80%
- RRT in COVID assoc with 68% mortality
- Among Survivors, 54% continue dialysis after discharge
- Even asymptomatic and nonhospitalized patients had higher risk for CKD and unexplained AKI than controls.
- Kidney Outcomes in long COVID. JASN 2021-06-0734-81. 25 Jul 2021. Bowe, Benjamin. VA St Louis.

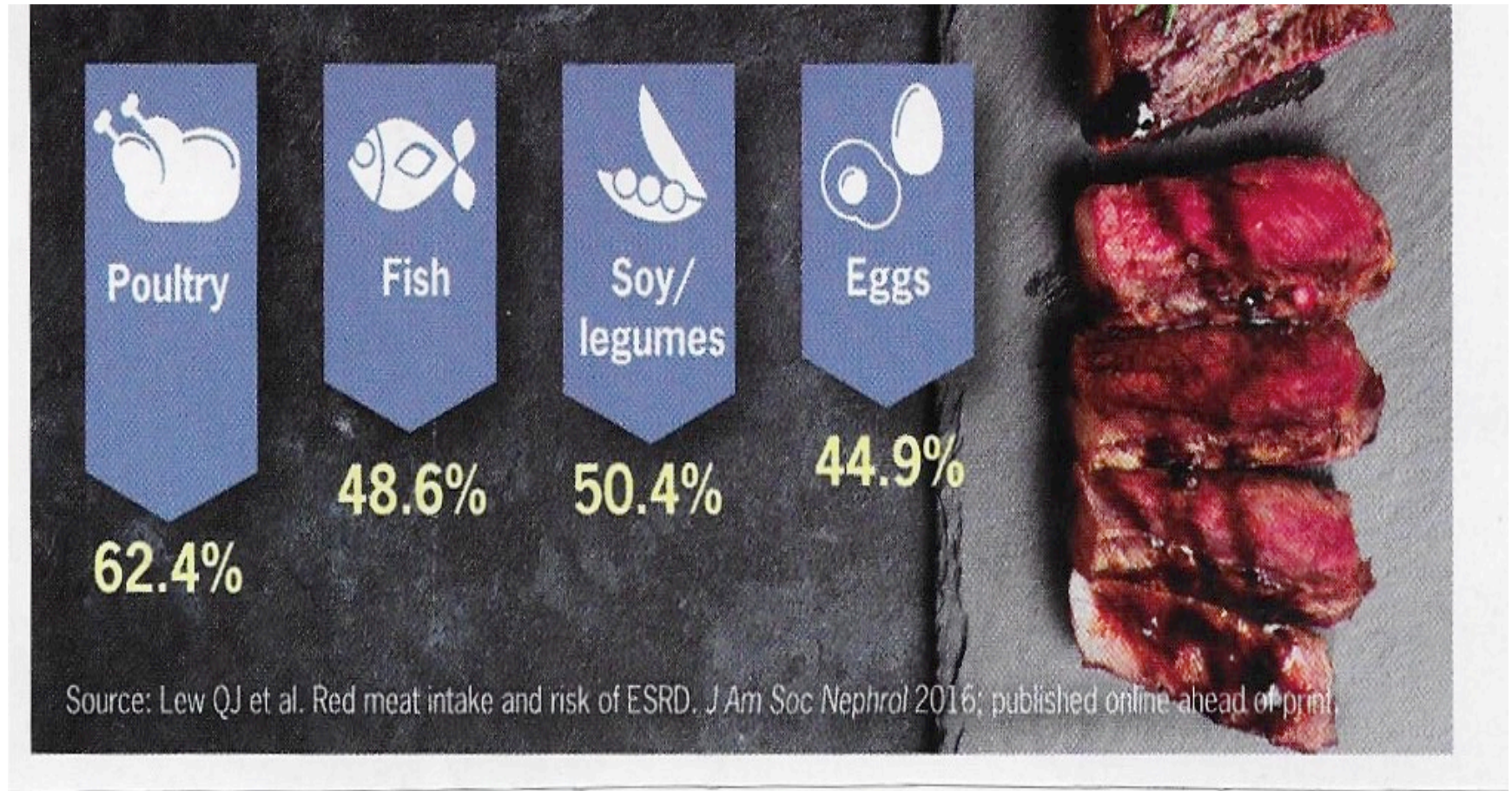
# Measures to slow progression

- Physical Activity
- Low Protein Diet
- Early Referral to Nephrology
- Control of DM
- Control of HTN with preferential use of ACE/ARB or other agents\*
- Use of SGLT2i even in nondiabetics
- Chitosan

# Measures to slow progression

- Physical Activity
  - Measured by PASE score
  - Score > 90 (moderate physical activity like walking more than 90 min/week) had lower prevalence of CKD, lower mortality, but no impact on risk for falls.
- Canadian Frailty Observation and Intervention Trial (CanFIT). Am J KD 2021;78(3):391-398

# Dietary Changes May Lower Risk



ESRD Risk Reductions by replacing 1 Serving of red meat per day

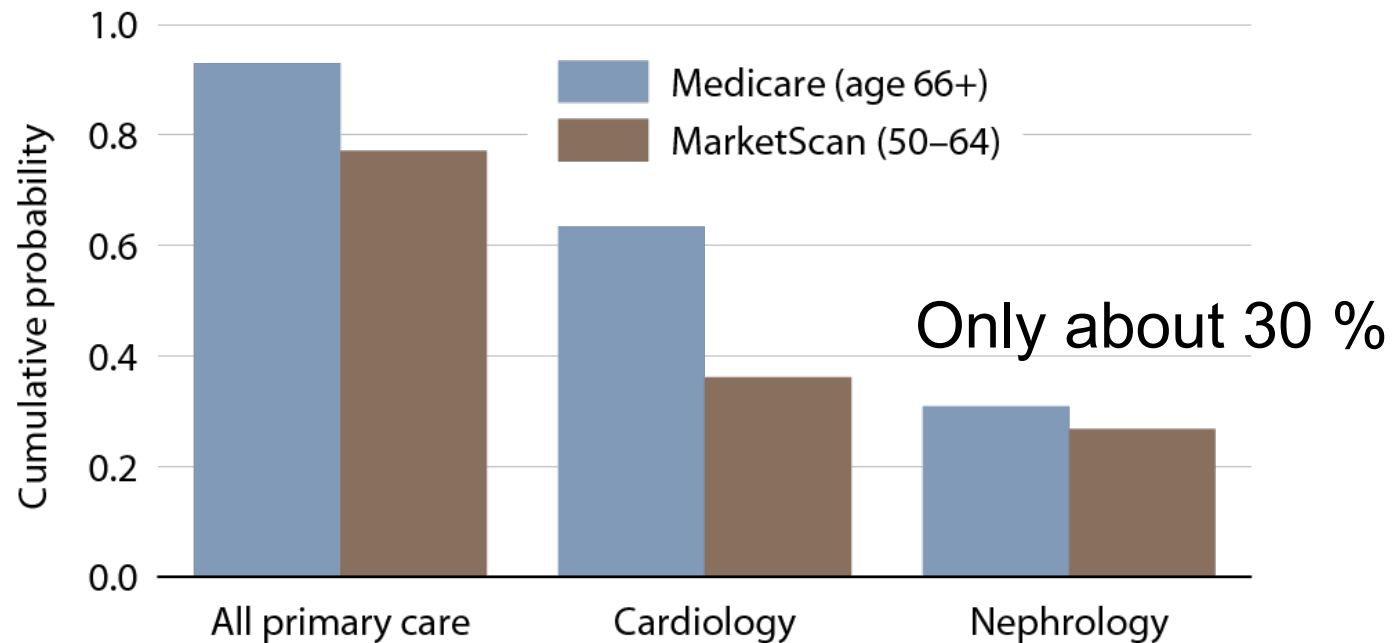
- Previous slide:
  - Lew QJ et al. Red Meat intake and risk of ESRD. J Am Soc Nephrol (JASN) 2016.
  - Published online ahead of print.
  - As seen in Renal and Urology News December 6 2016
  - [www.renalandurologynews.com](http://www.renalandurologynews.com)



# Nephrology Referral

# Cumulative probability of a physician visit in the year following CKD diagnosis by physician specialty & dataset

Figure 2.10 (Volume 1)



Patients alive and eligible all of 2008, CKD diagnosis represents date of first CKD claim during 2008, physician claims searched during 12months following that date.

# How to improve CV Morbidity in CKD?

1. Early referral to Nephrology
2. Consider a patient with CKD 4 , 5, and ESRD as having the same risk as a patient who HAS ALREADY HAD THEIR FIRST HEART ATTACK.

Beta Blocker

Aspirin

Statin

restart ACE inhibitor or ARB  
once pt on dialysis

To prevent a vessel wall thrombus

# Hall Thrombus



# Medical treatment in CKD

## How the Nephrologist can Help

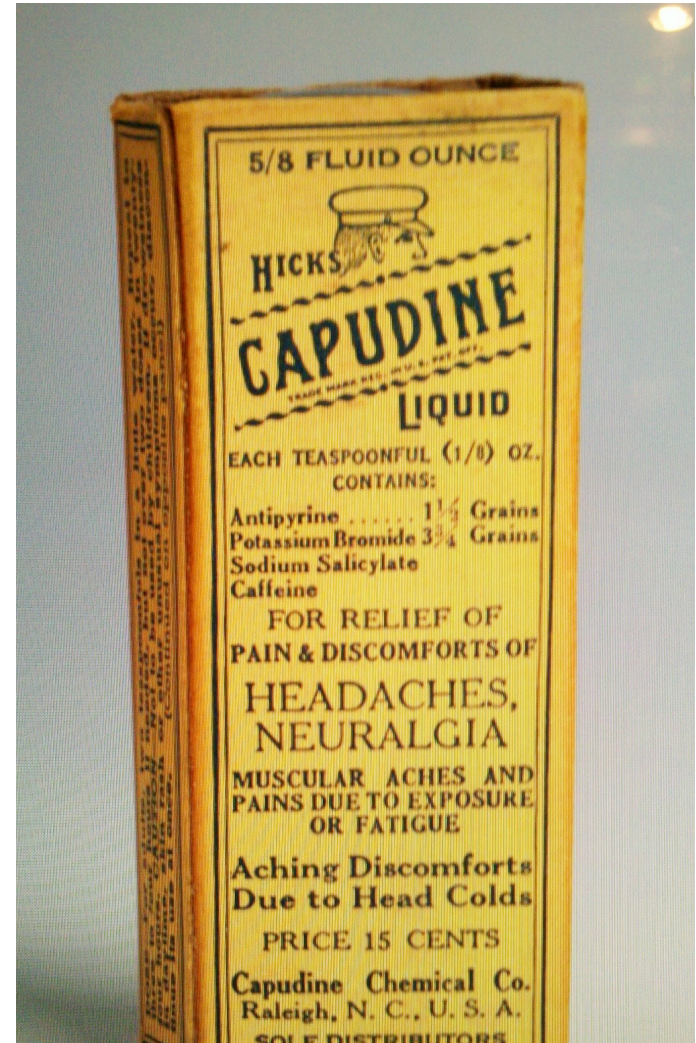
Which drugs

To avoid,

and

Which drugs

Work for HTN



# What Drugs to Avoid

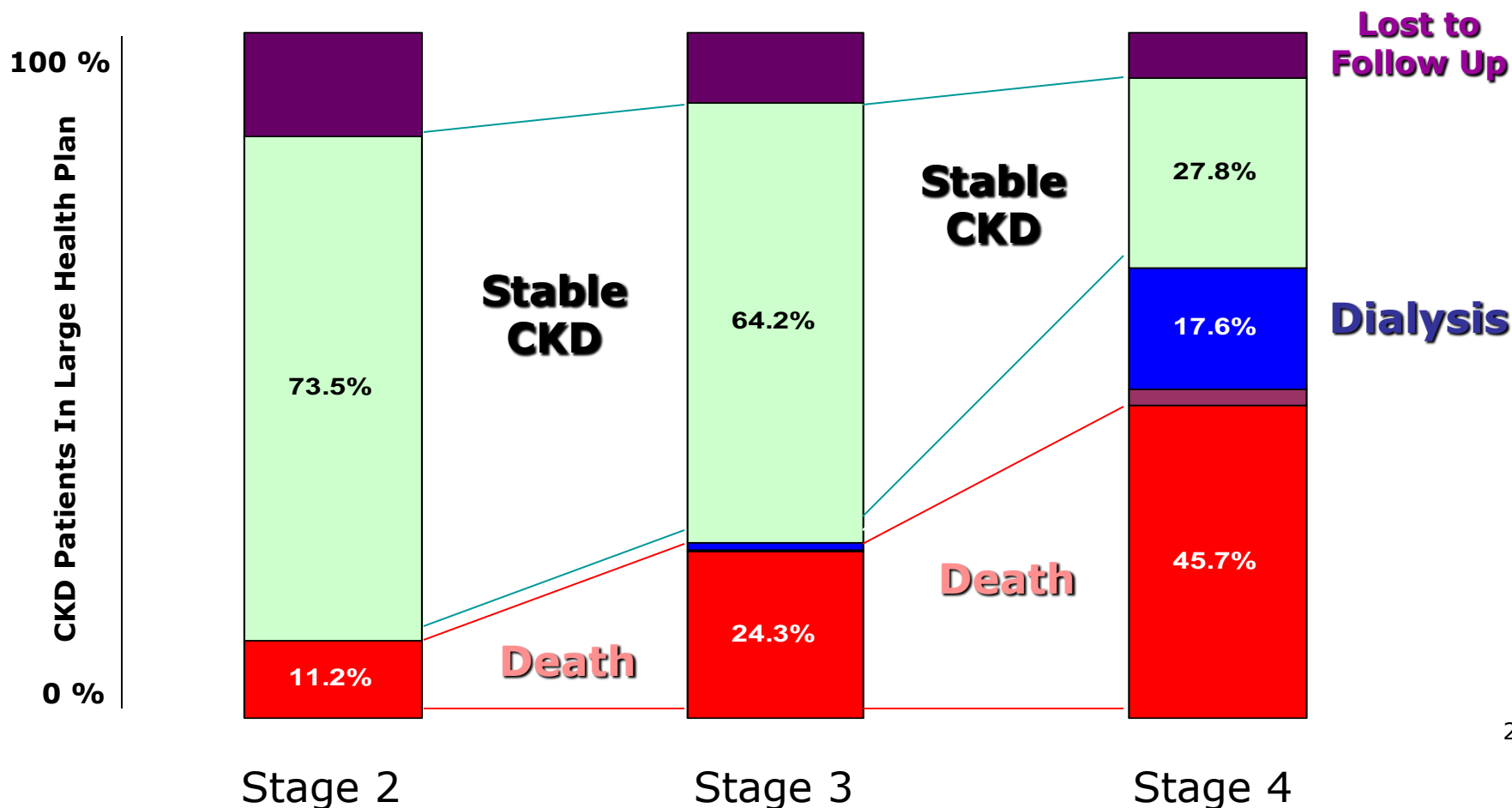
- Drugs to avoid when GFR is less than 40:
  - NSAID's
  - Bactrim
  - IV Contrast
  - Fleets Enemas
  - Metformin, Xarelto
- For GFR less than 30, need to be careful with combinations of drugs like ACE and Spironolactone.



# Why Do CKD Patients Need Special Care?

## CKD “*Death Before Dialysis*” is Prominent

- Early recognition of CKD risk and early intervention for CKD can prevent early death before dialysis
- CKD patients in a large HMO were more likely to die than reach Renal Replacement Therapy



# Why Do CKD Patients Need Special Care?

- Effective Primary Care Can Improve Renal Patient Outcomes:
  - Expect to see eGFR reported
  - Note the significance of the eGFR
  - Make the diagnosis of CKD as indicated
  - Identify the CKD stage
  - Context Sensitive Interventions based on eGFR
    - Co-management of DM, HTN, underlying diseases
    - Intervention for Anemia, HPT, Nutrition and Psychosocial impact of kidney disease
    - Referral at 30 ml/min eGFR
    - Vascular Access and Modality Prep at 20 ml/min eGFR
    - Renal Replacement at 10 ml/min eGFR



# Coordinated Roles in the Total Care of the CKD Patient

## ■ Primary Care Provider

- Early identification of CKD patients
- Focused & Structured evaluation and management
- Referral and co-management with nephrologist
- Co-Management of Co-Morbid Diseases

## ■ Nephrologist and the Renal Care Team

- Focused assistance in management of co-morbidities
  - Diabetes, Hypertension, cardiovascular disease
  - Anemia, Mineral Metabolism, Nutrition & Volume management
  - Vascular Access Preparation & Management
  - Education on ESRD treatment options & modality selection
- Co-management of Medications, Family and Social Issues of Renal Disease

# Impact of Early Intervention

- Slower progression to ESRD
- Increased functional status
- Decreased Morbidity and Mortality from
  - Hospitalizations
  - CVD events
  - Urgent Care & Emergency Visits
  - Medication Management
- Decreased costs from fewer urgent complications

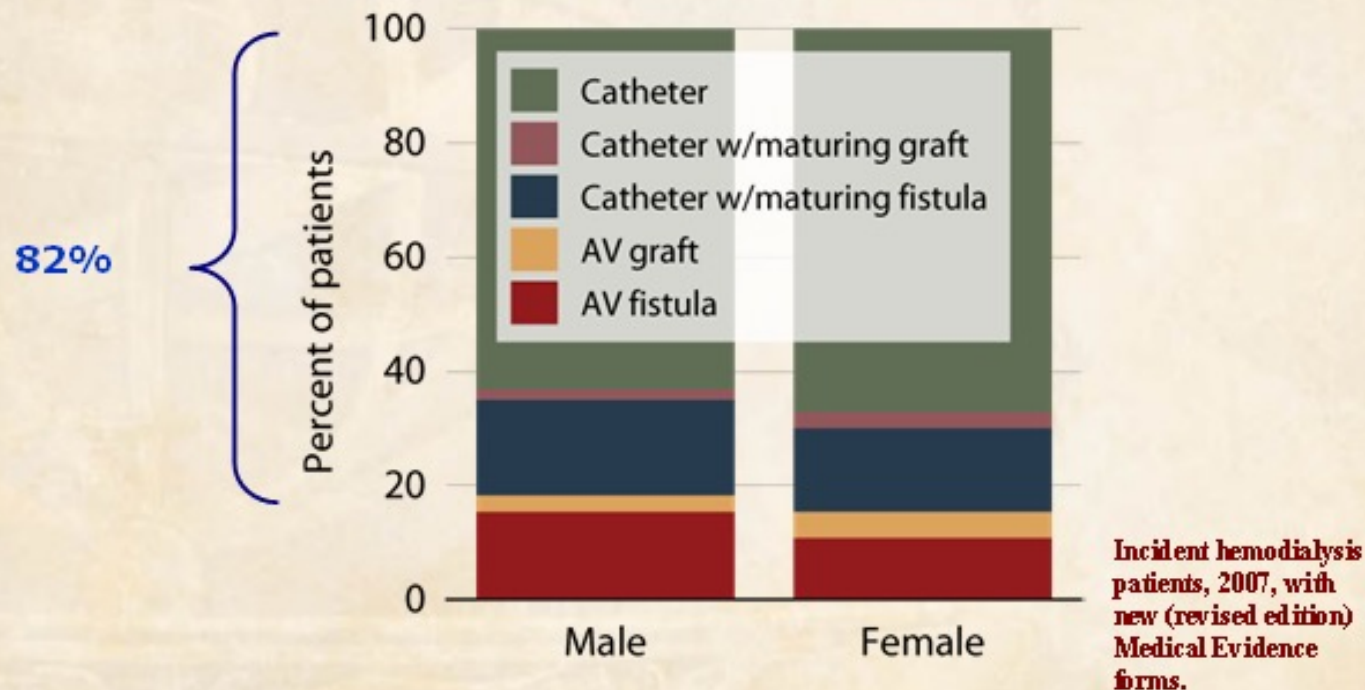
# Referral Related Realities

- 30-40% of referrals to nephrologists occur less than 120 days prior to starting dialysis
- Referral to nephrology <4 months before starting dialysis is considered a “Late Referral” by Medicare and other Payers
- 82% of patients having to begin Dialysis start with a catheter
- First year mortality of Dialysis patients is annualized at ~40%

# High Catheter Use At Initiation Of Dialysis is the Primary Cause of Early Morbidity and Mortality

## Vascular access use at initiation, by gender, 2007

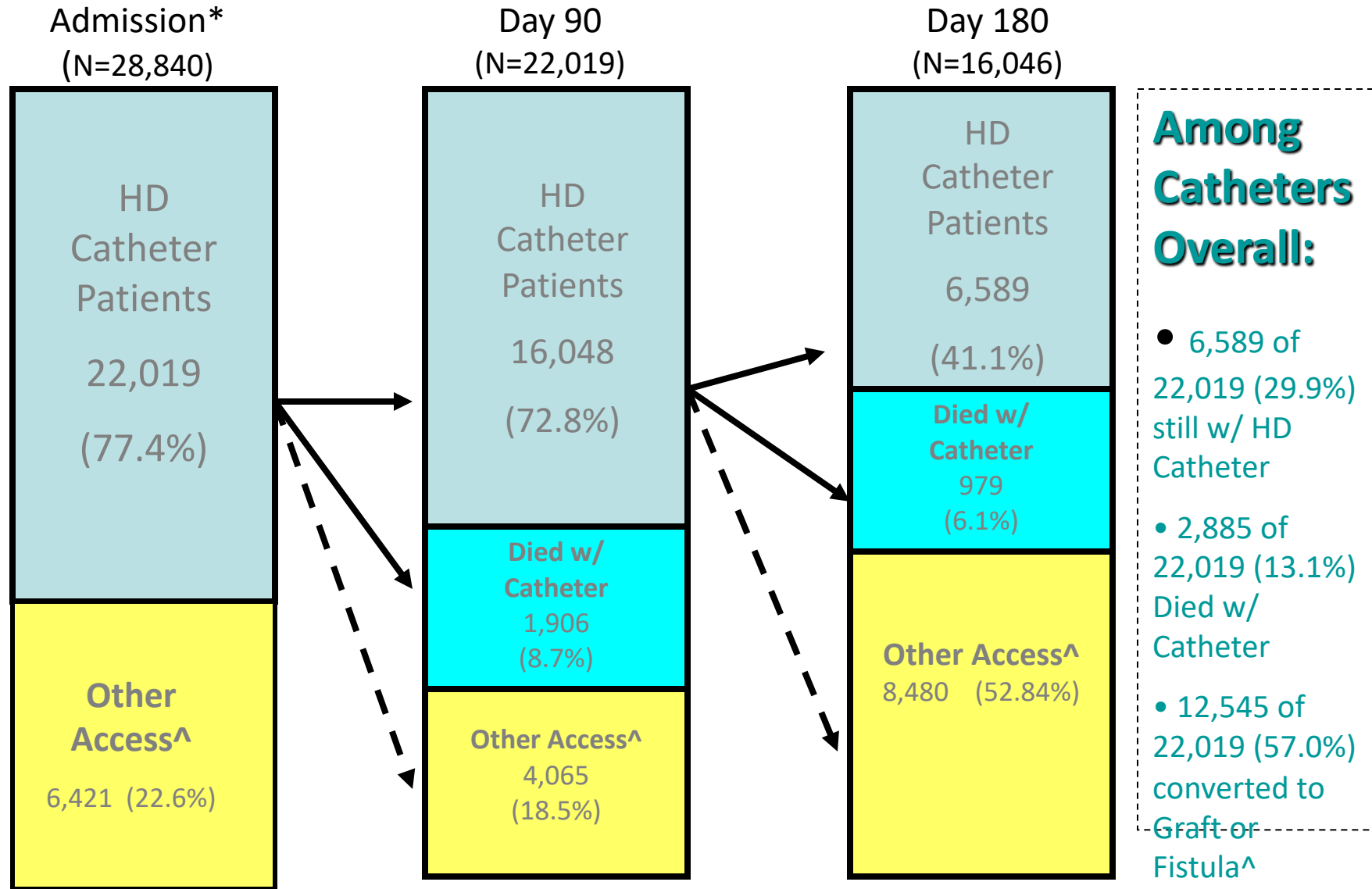
Figure p.10 (Volume 2)



USRDS 2009 ADR

USRDS

# Fate of Catheters From First Dialysis Through 180 days

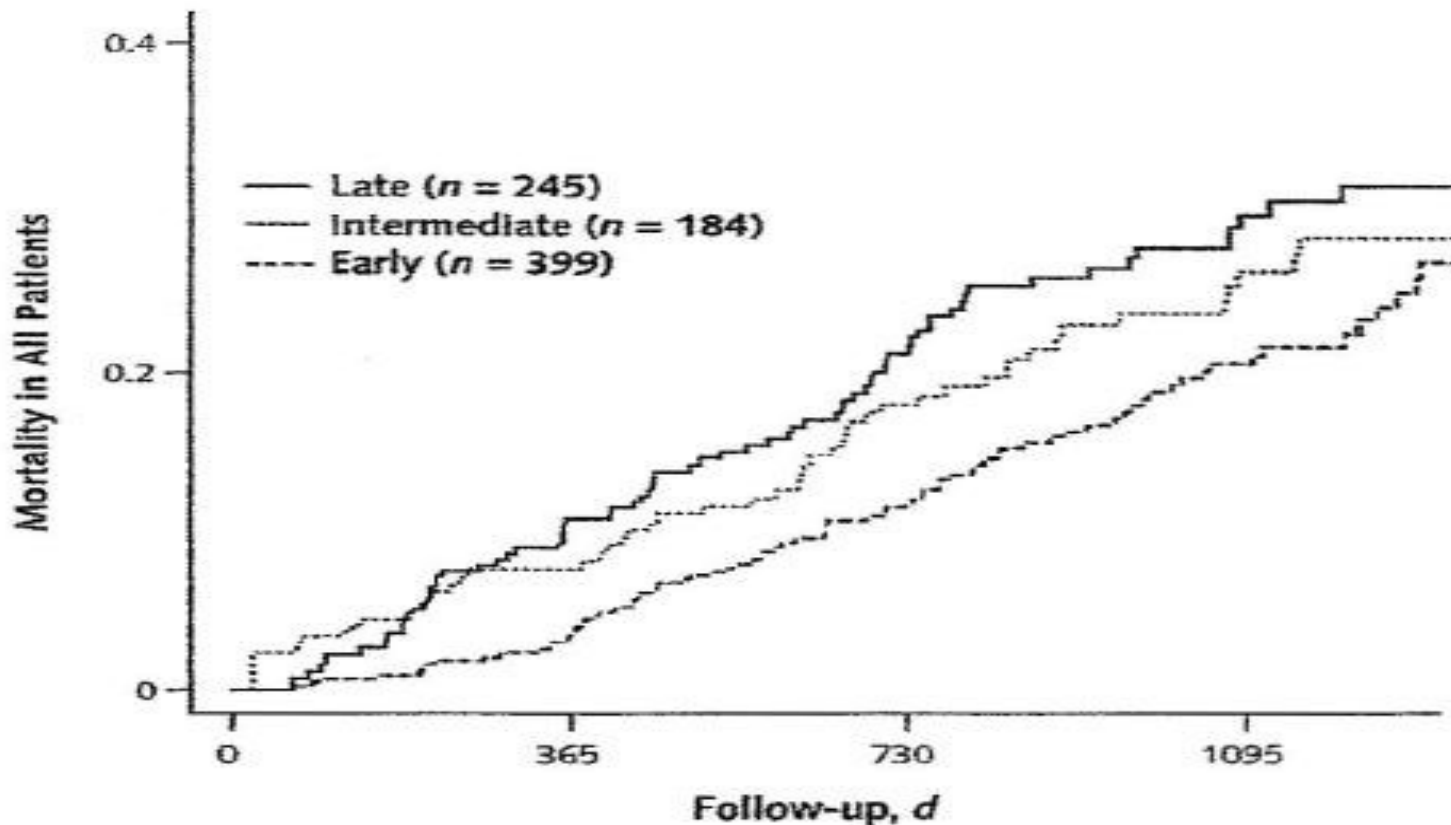


\* Total of 28,440 HD patients admitted within 15 days of first dialysis (ever) during 2008.

<sup>^</sup> Some of the patients with grafts or fistula may have failed and reverted to catheters after 90-180 days (Not Counted).

# Timely Referral: Mortality

- In the CHOICE Study Late Referral is associated with an increased RISK OF DEATH

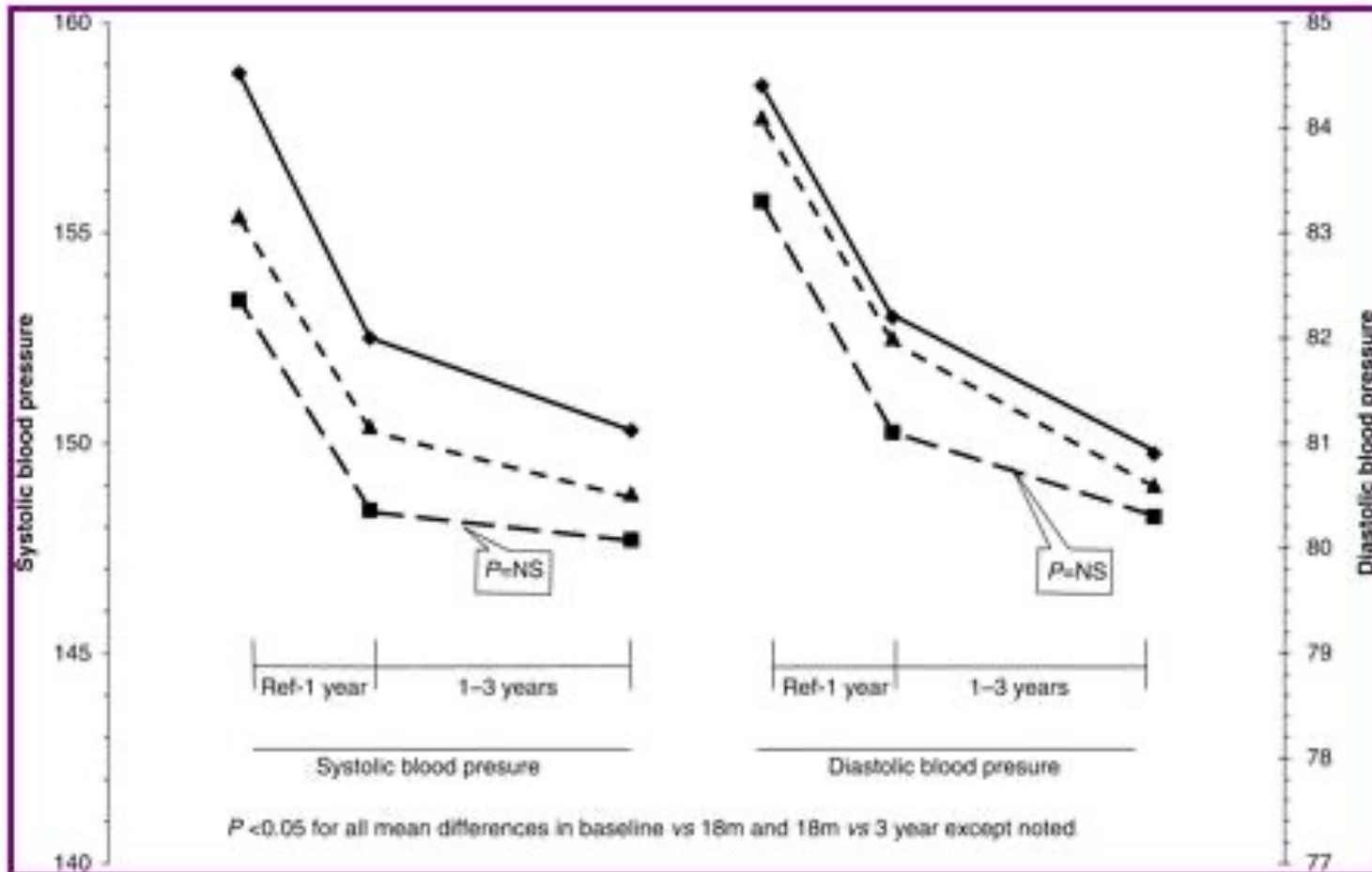


# Timely Referral: Mortality

- For patients with AKI, who need dialysis, follow up with a nephrologist is associated with 24% reduction in risk of death.
  - Nephrology Times Jan 2019
- In the REACH trial, a pharmacist could identify patients with CKD and facilitate referral to nephrology.
  - This was associated with improved glycemic control, improved BP and lipid control
  - 5 year risk of progressing to ESRD dropped from 8.9 % to 3.4 %
  - Estimated cardiovascular risk reduced by 20% within 3 months!
  - Am J Kid Dis 2018,71(1): 42-51.

# Timely Referral and Hypertension

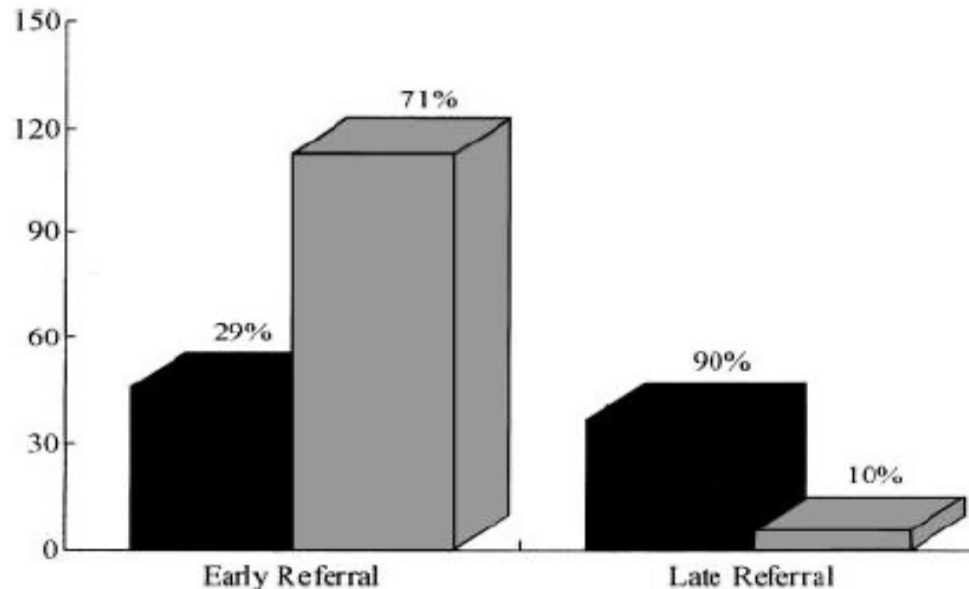
- Nephrology support improves BP control





# Timely Referral: Emergent Dialysis

- Timely Referral reduces the occurrence of emergent first dialysis



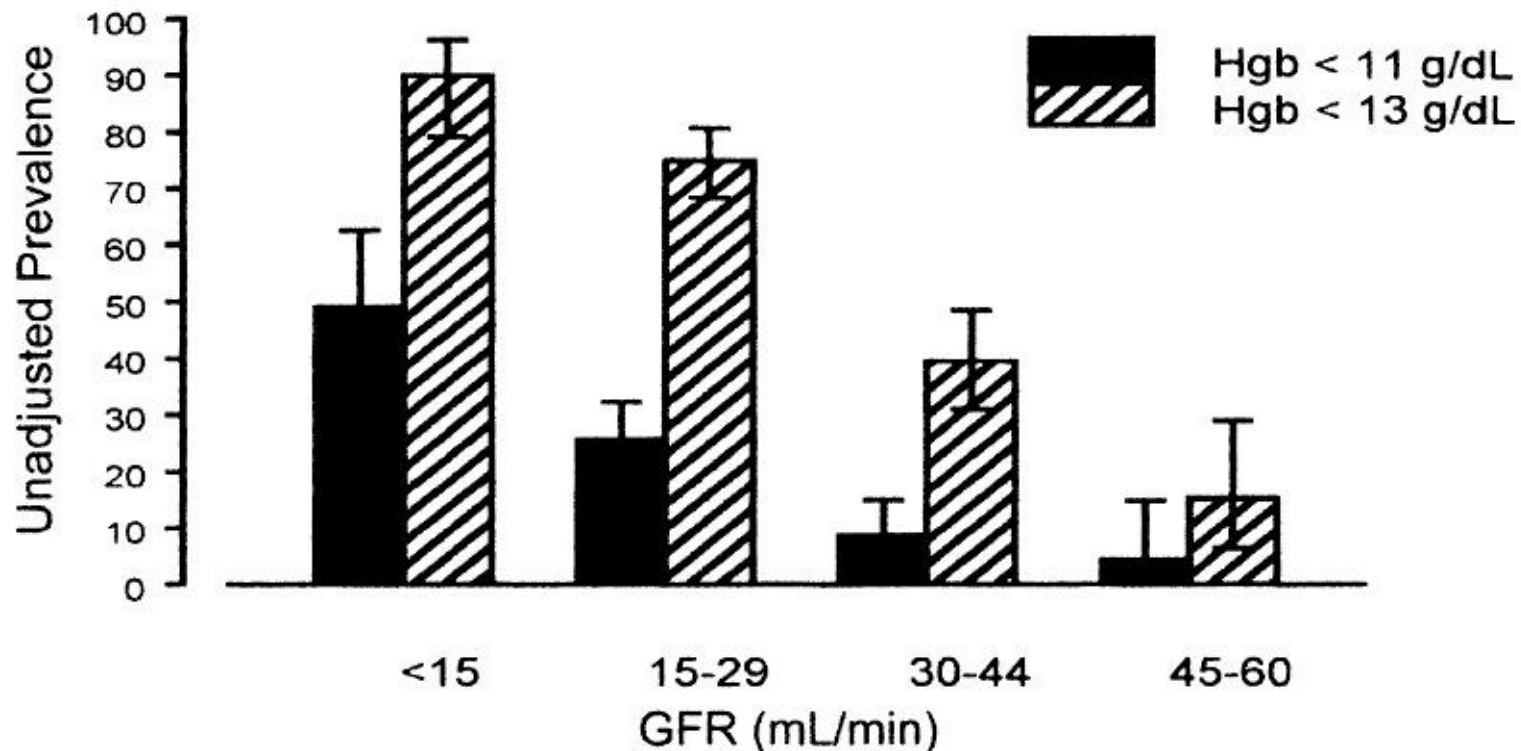
**Fig 1. Early v late referral and the incidence of emergent hemodialysis (HD) ( $P < 0.0001$ ).** The x-axis shows the percentage of early v late referred patients who received emergent HD. ■, Emergent HD-yes; ▒ emergent HD-no. The y-axis reflects the actual number of patients studied.

# Timely Referral: Modality and Access

- Patient Education and Preparation associated with Early Referral are critical for:
  - Timely vascular access placement
  - Reduced use of dialysis catheters
  - Modality Choice for Patients
    - Home Therapies
      - Peritoneal Dialysis
      - Home Hemodialysis
    - Transplantation
    - In-Center Hemodialysis
    - Palliative or End of Life Care

# Timely Referral: Anemia

- Complications of anemia may occur early in CKD
- Evaluation and treatment of anemia with Erythropoietin is improved with Timely Referral



# Timely Referral: Nutrition and Bone Disease

- Early Nutritional Counseling
  - Avoid protein malnutrition
  - Avoidance of volume overload and hyperkalemia which might lead to emergent dialysis
- Bone Disease and derangements of Calcium/Phosphorus metabolism occur early in CKD. Treatment and dietary counseling are necessary to prevent complications.

# Timely Referral: Quality of Life

- Timely Referral improves  
Quality of Life in CKD patients
  - First dialysis is a planned event avoiding a “Crash” into Dialysis
  - Dialysis Access is established
  - Families and Patients are prepared
  - Appropriate use of Erythropoeisis-Stimulating Agent (ESA) therapy for treating anemia

# Timely Referral: Healthcare Costs

- Timely Referral → Lower Healthcare Costs
  - Reduced Hospitalizations
  - Improved management of co-morbidities
  - Reduced complications from cardiovascular disease
  - Delayed deterioration of residual renal function and the need to start Renal Replacement Therapy
  - Enhances patient choices for treatment modalities
  - Next up: DM

# Treatment of DM to slow progression.

- Prevent GEP formation in the early stages!  
Time is kidney!
- Attack High blood pressure
- Keep blood sugar normal as possible.
- Stage III with microalbuminuria is still reversible - Stage IV too late.
- Can reduce rate of decline by 5-6 ml/min/year<sup>2</sup>

# Proof that Diabetic Nephropathy is reversible.

- 1. Correction of microalbuminuria with treatment using ACEi / ARBs
- 2. Renal Transplant case - 37 y.o. diabetic donor kidney with proteinuria and normal renal function. biopsy of the allograft kidney showing extensive sclerosis which resolved within 6 months in normal recipient.
  - (Abouna et al. Lancet 1983; 2: 1274-6.)



# Treatment Guidelines

- **Primary Prevention:**
- Control BP aggressively - Target 140/80 or LESS
- Control Blood Sugars - DCCT<sup>3</sup>
- Target HgA1c <8.0 Correlates with  
accuchecks 80-150
- Used insulin pump
- Hypoglycemia 2/week accepted as the  
» price of doing business
- Achieved 50% reduction in retinopathy and  
microalbuminuria.

# Treatment Guidelines

- **Secondary Prevention:** After Microalbuminuria detected
  - Protein restricted diet
  - 0.8 gm/kg/day
    - (easiest way is to minimize red meat in diet)
  - Add or switch to ACE inhibitors<sup>4</sup>,
  - or Cardizem or Coreg if hyperkalemic
  - or possibly Amlodipine
  - not short acting nifedipine.
  - Add Angiotensin Receptor Blocker too! <sup>7</sup>

# Treatment Guidelines

- Overt Nephropathy not reversible, but progression can be slowed by BP control and glycemic control.
- Refer to nephrologist as early as possible to allow for dialysis education and preparation<sup>5</sup>.
- Try to Avoid oral hypoglycemic agents once the creatinine is over 3.0
- Glimepiride, Januvia may be used safely with close monitoring
- Glipizide, Actos, Avandia, and others also have been used and can be done safely if careful
- Anticipate reduced requirement for insulin
  - (average 10-20 units/day once pt on dialysis)
- Avoid Metformin in creatinine over 2.0, or GFR less than 30 ml/min

# SGLT-2 Inhibitors

- sodium-glucose cotransporter 2 (SGLT2) inhibition leads to elimination of glucose—about 80 g/day—from the body by the kidney. Removal of glucose, salt, and water results in positive effects on the heart and the circulatory system, and prominent reductions in cardiovascular and all-cause mortality.

# SGLT-2 Inhibitors

- EMPA-REG OUTCOME study 2015
- Improved risk for development or reduction in macroalbuminuria,
- Reduced rate of doubling of serum creatinine,
- Reduced need for renal replacement therapy, or dialysis.
- The relative risk for this composite was reduced by 39% in patients receiving empagliflozin

# SGLT-2 i reduce CV risk

**Table. Summary of cardiovascular and kidney outcomes in randomized clinical trials of SGLT-2 inhibitors**

Study	N	Inclusion criteria	Intervention	Follow-up	Main outcomes
EMPA-REG OUTCOME <sup>6</sup>	7,020	Patients with T2DM and established CV disease	Empagliflozin (10 mg/dL or 25 mg/dL) vs. placebo	3.1 years	<ul style="list-style-type: none"> <li>• CV death, non-fatal MI or stroke</li> <li>• Hospitalization for HF</li> <li>• Doubling of SCr, dialysis or kidney death</li> </ul>
CANVAS <sup>7</sup>	10,142	Patients with T2DM, age at least 30 years with established CV disease or age at least 50 years with at least two additional CV risk factors	Canagliflozin (100 mg/dL or 300 mg/dL) vs. placebo	2.4 years	<ul style="list-style-type: none"> <li>• CV death, non-fatal MI or stroke</li> <li>• Hospitalization for HF</li> <li>• At least 40% eGFR decline, dialysis or kidney death</li> </ul>
DECLARE-TIMI-58 <sup>8</sup>	17,160	Patients with T2DM, age at least 40 years with established CV disease or age at least 55 years (men) or at least 60 years (women) with at least one additional CV risk factor	Dapagliflozin (10 mg/dL) vs. placebo	4.2 years	<ul style="list-style-type: none"> <li>• CV death, non-fatal MI or stroke</li> <li>• Hospitalization for HF</li> <li>• At least 40% eGFR decline, dialysis or kidney death</li> </ul>
CREDESCENCE <sup>10</sup>	4,401	Patients with T2DM, age at least 30 years and overt nephropathy defined as eGFR of 30 ml/min/1.73m <sup>2</sup> to 90 ml/min/1.73m <sup>2</sup> and UACR at least 300 mg/g	Canagliflozin (100 mg/dL) vs. placebo	2.6 years	<ul style="list-style-type: none"> <li>• Doubling of SCr, dialysis or death from CV or kidney causes</li> <li>• CV death, non fatal MI or stroke</li> <li>• Hospitalization for HF</li> </ul>

**Abbreviations:** CI=confidence interval; CV=cardiovascular; eGFR=estimated glomerular filtration rate; HF=heart failure; MI=myocardial infarction; SCr=serum creatinine; T2DM=type 2 diabetes mellitus; UACR=urinary albumin-to-creatinine-ratio

Source: Panagiotis I, Georgiannos, MD, PhD; Rajiv Agarwal, MD, MS

# SGLT2 inhibitors may reduce risk for AKI

- Meta-analysis of 18 studies
- SGLT2i had lower risk for AKI than placebo
  - OR 0.76
- SGLT2i had lower risk for AKI than
  - GLP-IRAs (OR 0.79)
  - DPP-4inhibitors. (OR 0.68)
    - Zhao M et al. Clin J Am Soc Nephro 2020 10.2215

# Gliflozin info

- Dapagliflozin may decrease risk for progression of FSGS, and also reduced risk for cardiovascular events and mortality in FSGS patients.
  - ERA-EDTA 58<sup>th</sup> congress, data from the DAPA-CKD trial
- Renoprotective effect of the Gliflozins due to reduced volume, and can be measured by increases in hematocrit.
  - Data from EMPA-REG outcome study.



# Semaglutide for Diabetic Kidney disease

- Study presented at the ERA-EDTA 58<sup>th</sup> congress in 2021.
- Monitored 122 patients with GFR 15-60, or proteinuria.
- Over 12 months, semaglutide reduced albuminuria by 50% and renal function remained stable.
- Drug discontinued in 5% of patients mainly due to GI side effects.

# Treat Hypertension

- Preferential use of ACE inhibitors and/or Angiotensin Receptor blockers (ARB)
- These drugs can lead to hyperkalemia, which can be treated with agents to lower potassium and allow more time on the ACE/ ARB
  - Kayexalate, Lokelma, Veltassa are potassium exchange agents

# Treat Hypertension

- Resistant Hypertension becomes more common as the nephropathy progresses:
  - No albuminuria: 1.2%
  - Microalbuminuria 4.7%
  - Macroalbuminuria 28.1%
  - Dialysis patient 36.6%
  - After transplant 26.3%
  - RENAAL, study, IDNT study

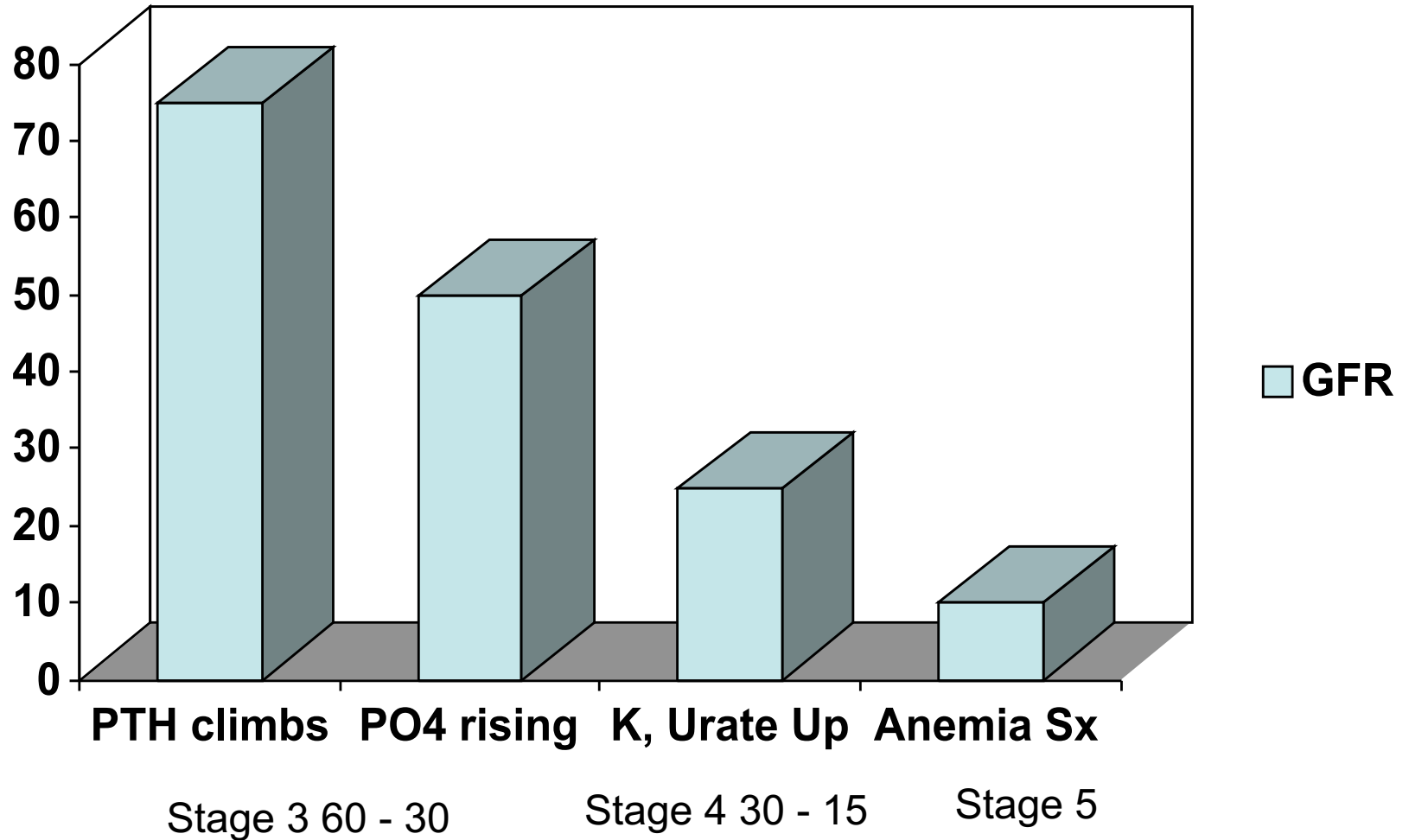
# Chitosan

- This is the supplement your nephrologist won't tell you about!
- In the weight loss aisle of health food stores.
- Solublizes Collagen in the glomeruli and can reduce proteinuria and rate of progression of CKD
- Safe with Coumadin and other drugs.
- Main side effect is nausea/ appetite suppression.
- Bardoxalone is chemically modified version in studies showing improvement in GFR!

# New markers that impact renal disease progression

- Diabetes Care May 2019
  - Pyruvate Kinase M2 (PKM2) is much more prevalent in glomeruli and plasma of patients who do not develop diabetic kidney disease.
  - Amyloid Precursor Protein (APP) also much more prevalent, but this is also assoc with higher risk for Alzheimer's.
    - From medscape May 30 2019.

# Progression of CRF



# Preparation of the Patient

- Manage CRF
- Control BP
- Control glucose
  - Adjust meds for GFR!
- Prevent Hyper PTH
  - Vit D
  - Calcium acetate
  - Phosphate binder
- Diet Education

# Preparation of the Patient

## Most of this will be in Stage 4

- Manage Fluids
- Dialysis education
- Access Placement
- Prevent anemia
- Prevent Malnutrition
- Start ACE?
- metolazone
- NKF program
- AV fistula, PD cath
- Epogen, Iron
- This can get tricky
- Stop ACE?



# Diuretics

- The creatinine tells you how often a patient should see the nephrologist in a given year.
- The creatinine times 40 = expected Lasix dose for that level of CKD.
- Creatinine level = expected Bumex dose.
- If your patient needs less, they are probably doing a good job limiting salt.
- If they are on much more than expected, they may be eating too much salt, or they may have nephrotic syndrome, which makes them resistant.

# Diuretic use in CKD

- Lasix dosing:
  - House of God :  $\text{BUN} + \text{Age} = \text{lasix dose}$
  - $\text{Creatinine} \times 40 \text{ mg} = \text{lasix dose}$
  - $\text{Creatinine} = \text{Bumex dose in mg}$
  - Maximum dose of lasix is about 400 mg/day
  - For refractory patients
    - we use drip rates of 20-40 mg Lasix /hour (= close to 1000 mg/day)
    - Bumex drip rate 0.5 to 1 mg bumex/hour

# Diuretic use in CKD

- If lasix /loop diuretic is not enough:
  - Add a long acting diuretic based on pts potassium:
    - Potassium normal or high: Metolazone
    - Potassium low or needs a lot of potassium supplement: spironolactone
  - Do you Need to give metolazone 30 min prior to the loop diuretic?

# Diuretic use in CKD

- Need to give metolazone 30 min prior to the loop diuretic? --- MYTH



lasix Lasix Lasix

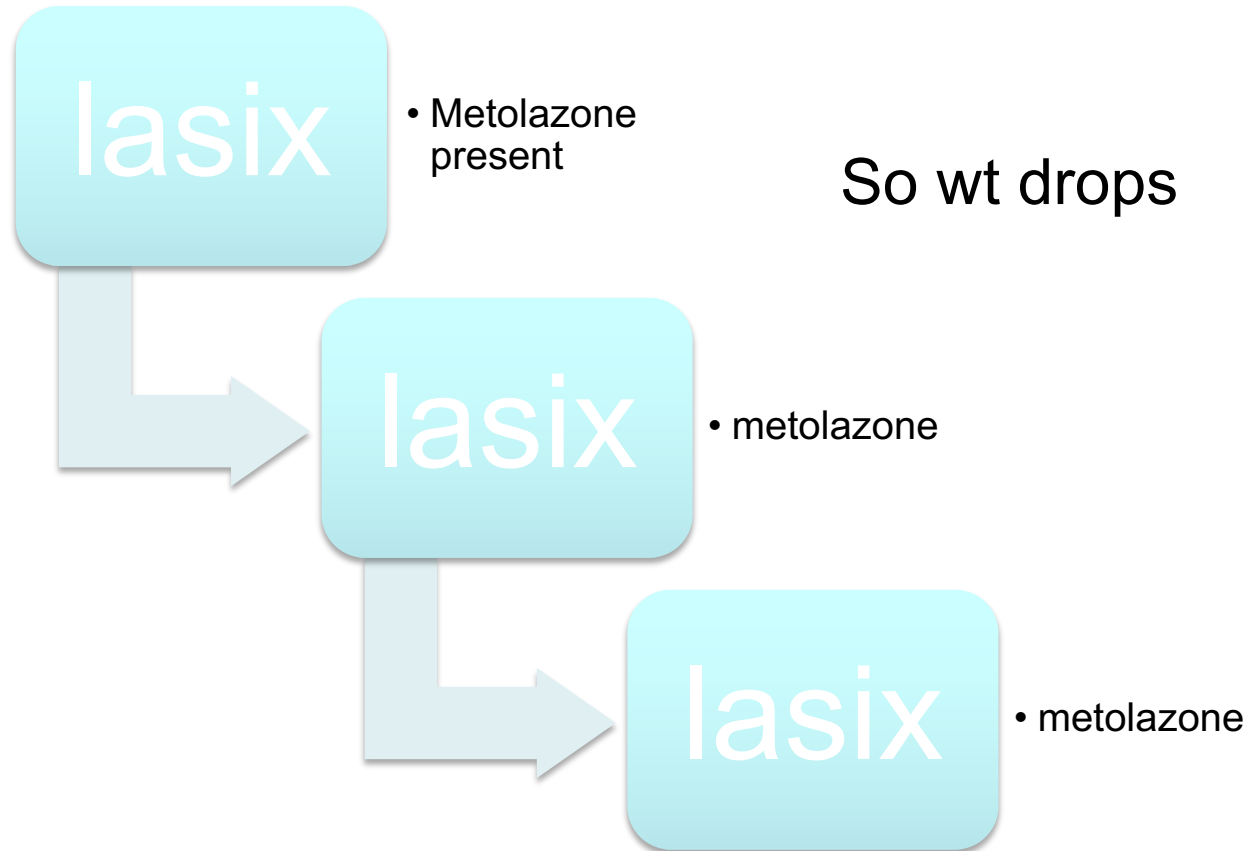
Metolazone  $T_{1/2}$  = 72 hours

Spironolactone half-life: 16 hrs\*

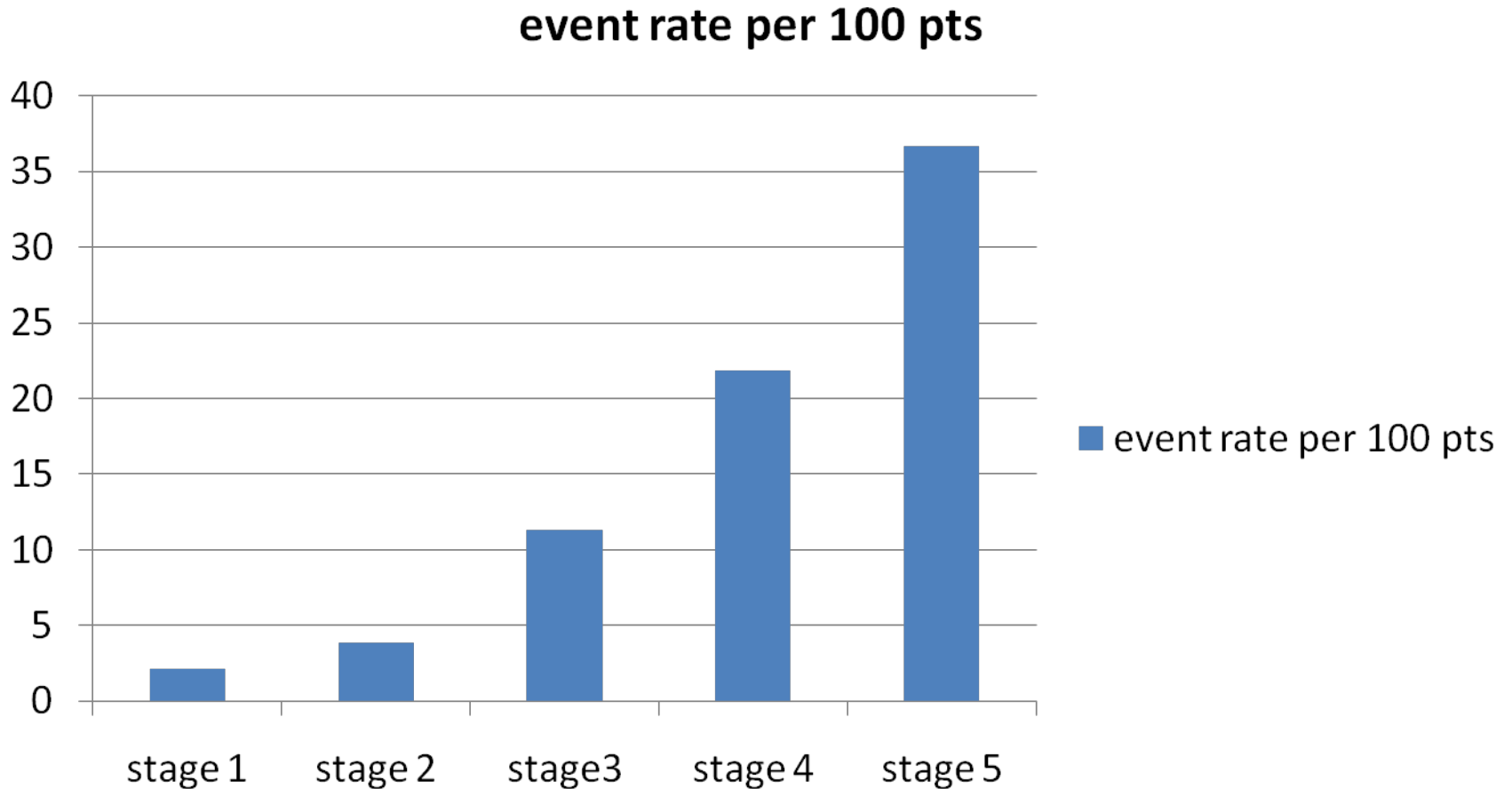
Weight will vary around a mean

# Actual mechanism for Metolazone – loop combo

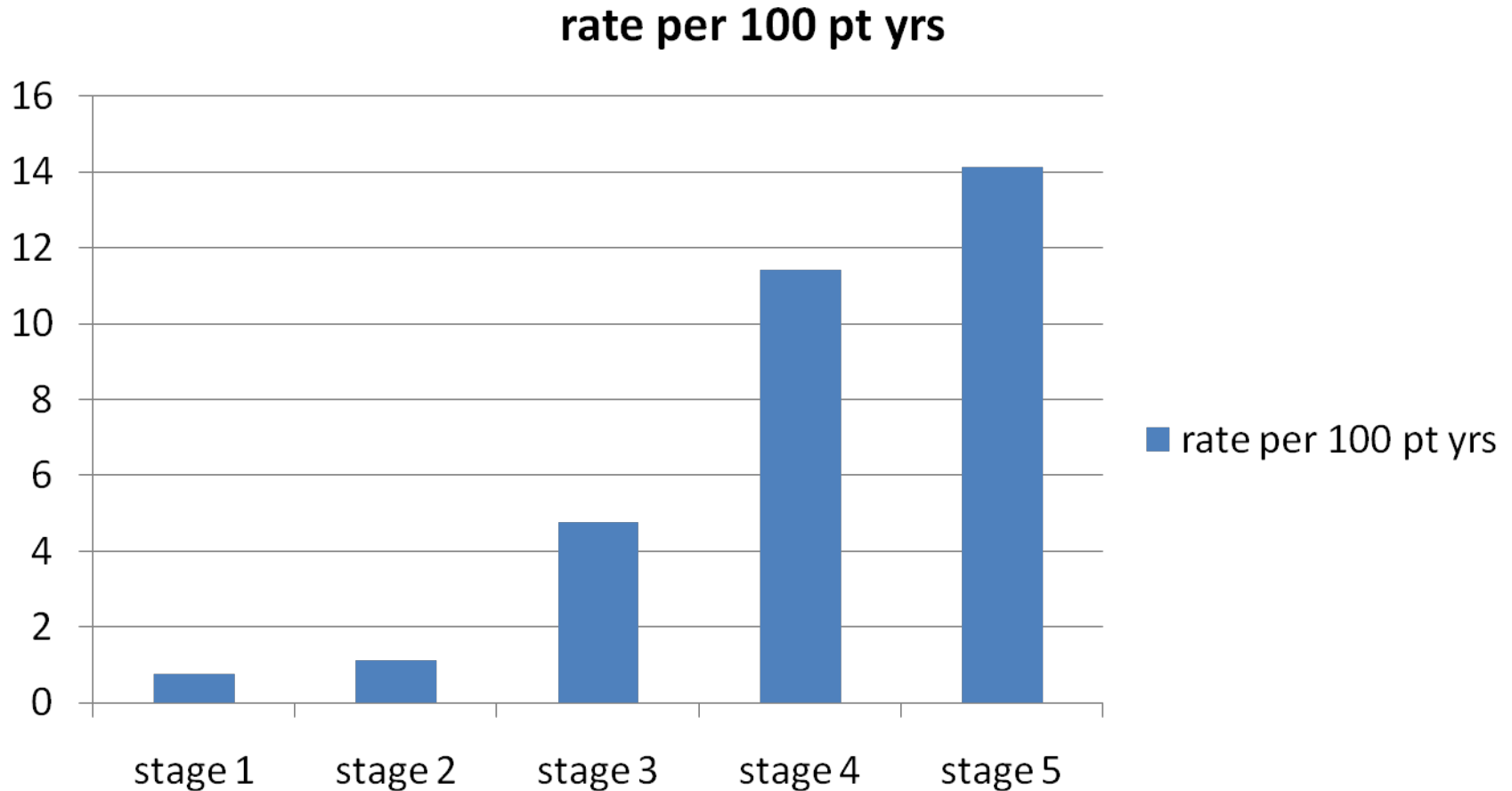
- The long acting agents prevent aldosterone mediated fluid retention between doses of lasix:



# Cardiovascular events by Stage of CKD



# All Cause Mortality By Stage of CKD



# Causes of Outpatient Mortality in patients with advanced CKD

- Cardiovascular events
  - GI bleed
  - Infection
- 
- One of the problems we face is cardiology is reluctant to take CKD patients to cardiac Cath due to the contrast.



# Inpatient Mortality in patients with AKI or advanced CKD

- Sepsis/Infection
- Cardiovascular events
- GI bleed

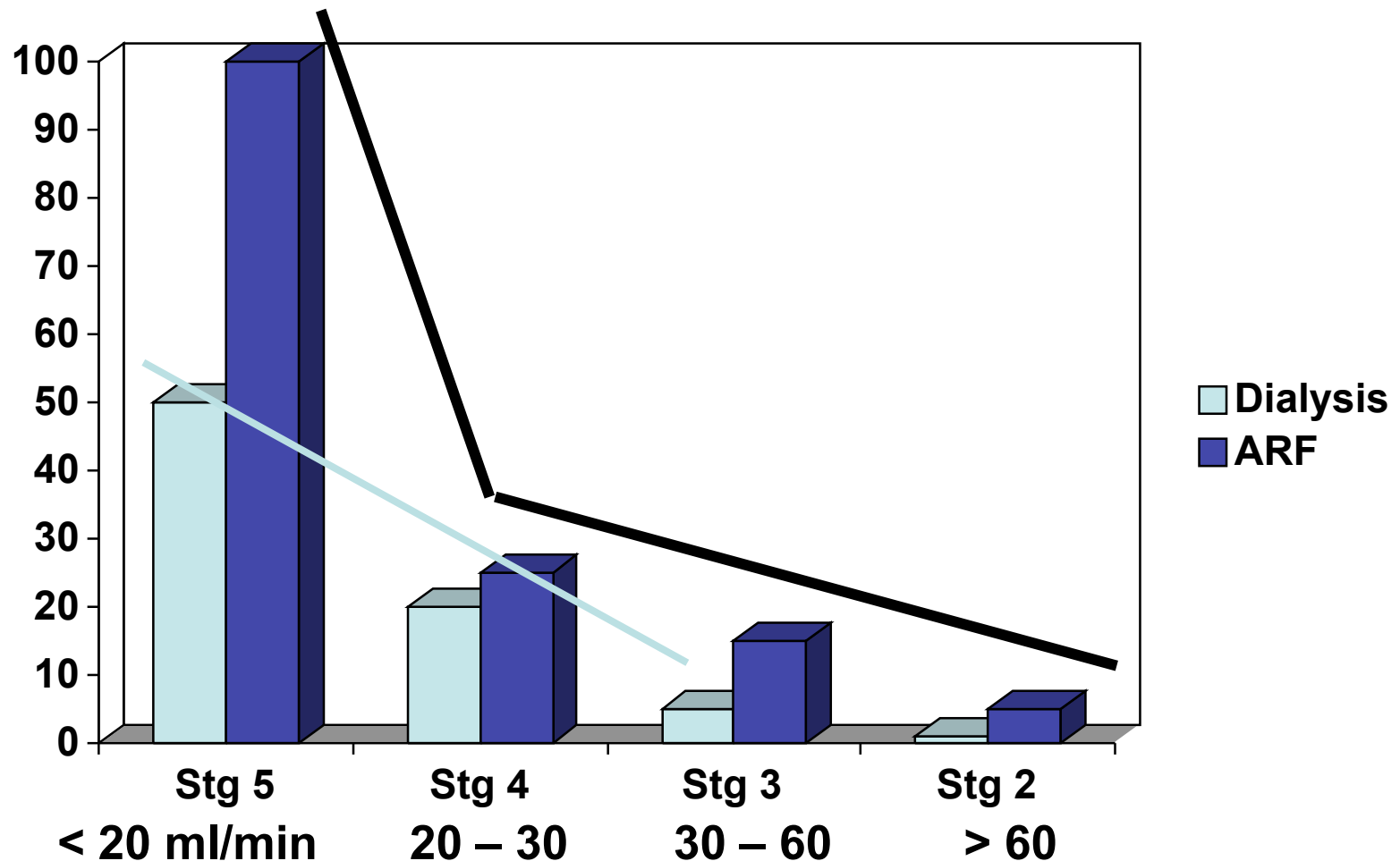
# Cardiovascular Risk of Patients with CKD

- Treat them as if they have already had their first MI.
- Should be on B-Blocker, ASA, Statin, and ACE or ARB.
- May need to stop the ACE/ARB as renal function declines
- Think about restarting it once they are on dialysis.
- Be careful about writing “no ACE/ARB or Contrast” in these pts.

# Risk Factors for Contrast Nephropathy

- Age over 60
- Diabetes
- Pre-Renal States
  - CHF
  - NSAIDS, ACE Inhibitors, Diuretics
- Proteinuria Includes, but not limited to Myeloma.
- Pre-existing Renal Disease

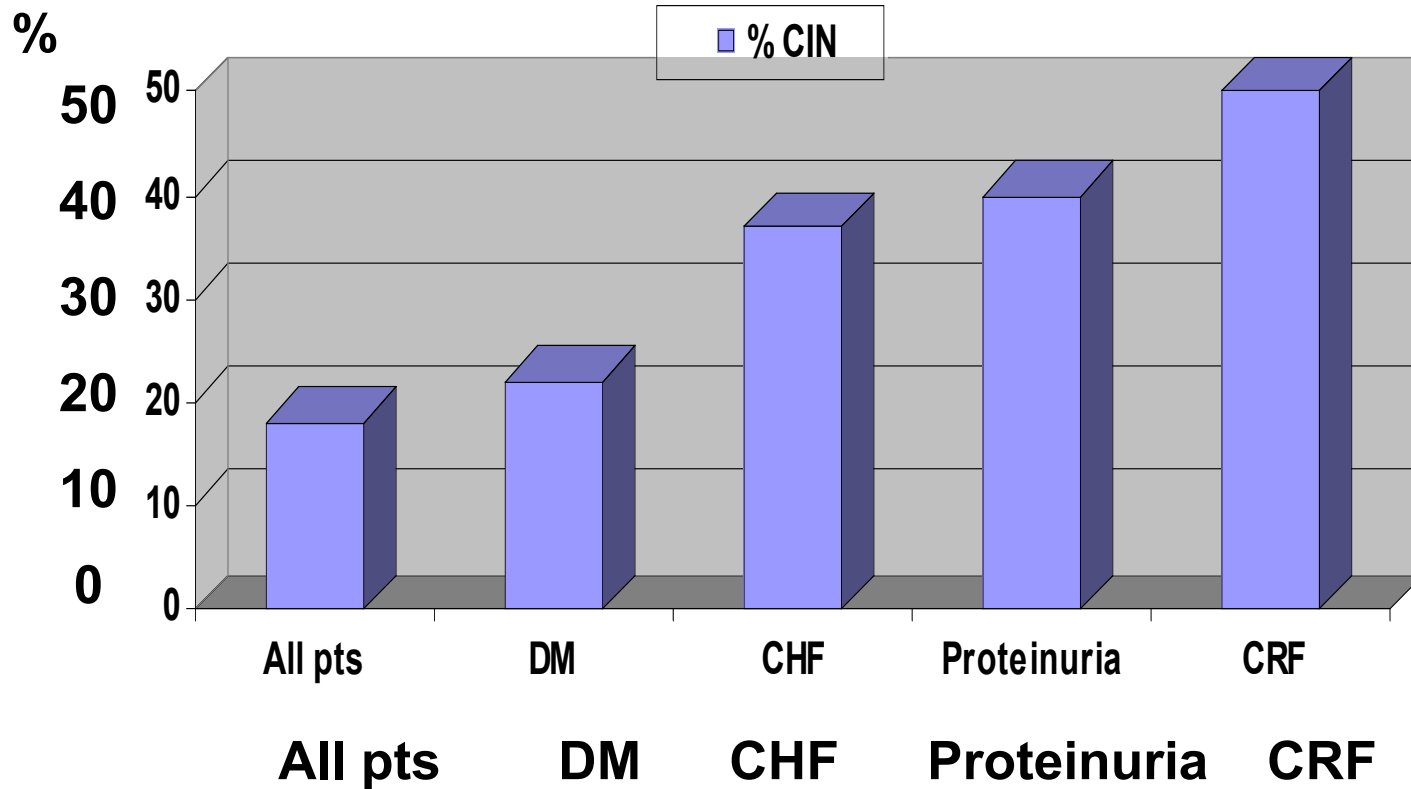
# Risk of CN By Stage of CKD



# Incidence of CN

- Nationally 4%
- GVH 2005 18%
- GVH 2006 5
- DHH 4%

# Contrast Nephropathy at GVH 2005



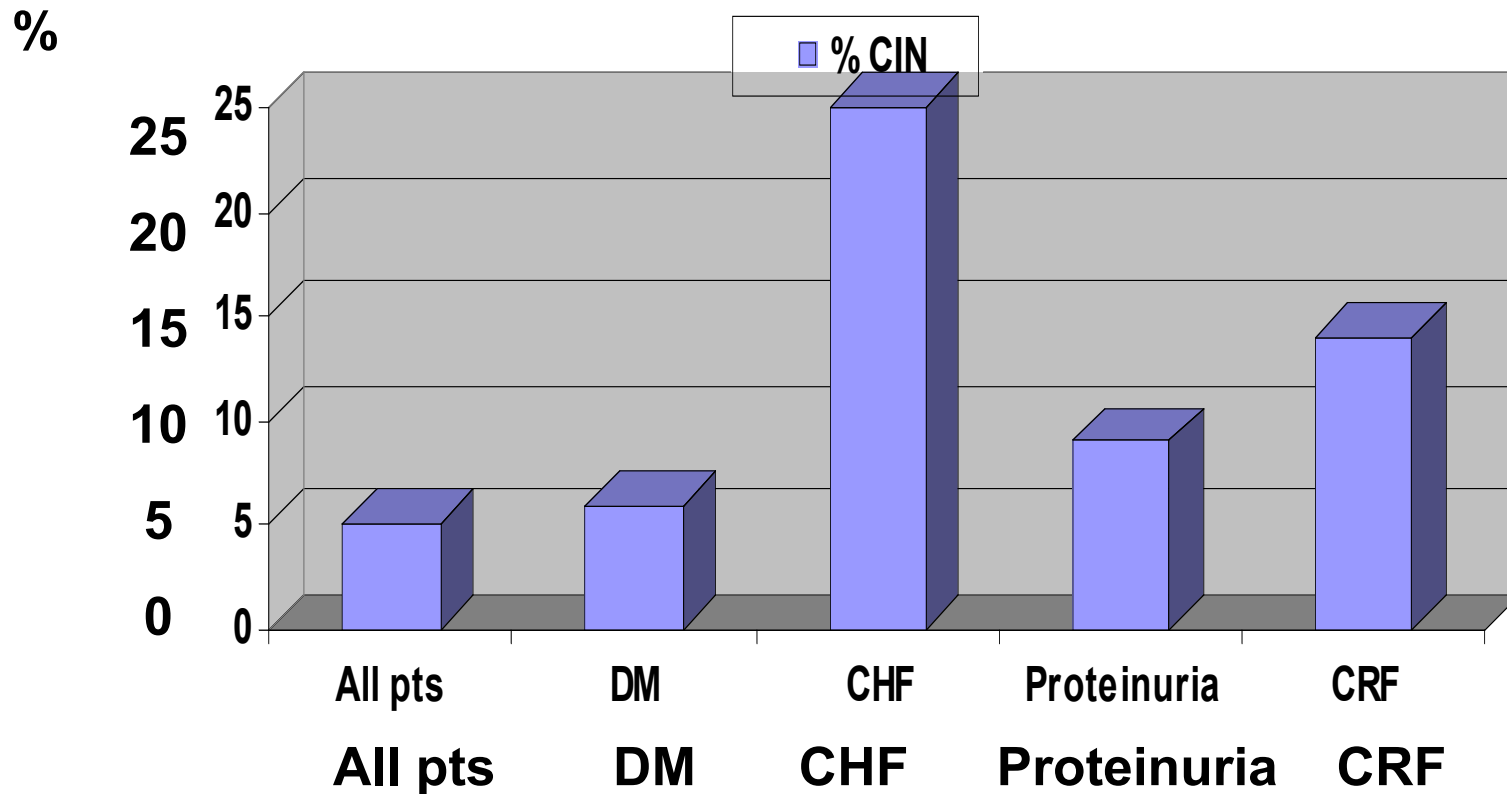
# Policy / Recommendations

- Stop ACE/ ARB, NSAIDs, Diuretics day before procedure
- IVF for everyone
  - NS for low risk pts
  - Bicarb for high risk pts?
- Urinalysis for all pts/ calculate Creat Clear for all pts.
  - Proteinuria or creat clear  $< 40$  considered High risk.
- Mucomyst for High risk pts
- Limit volume of contrast in High Risk Pts.
- Consider Nephrology consult if considering Mannitol, Corlepan, or identified as high risk.

# Contrast Nephropathy    GVH

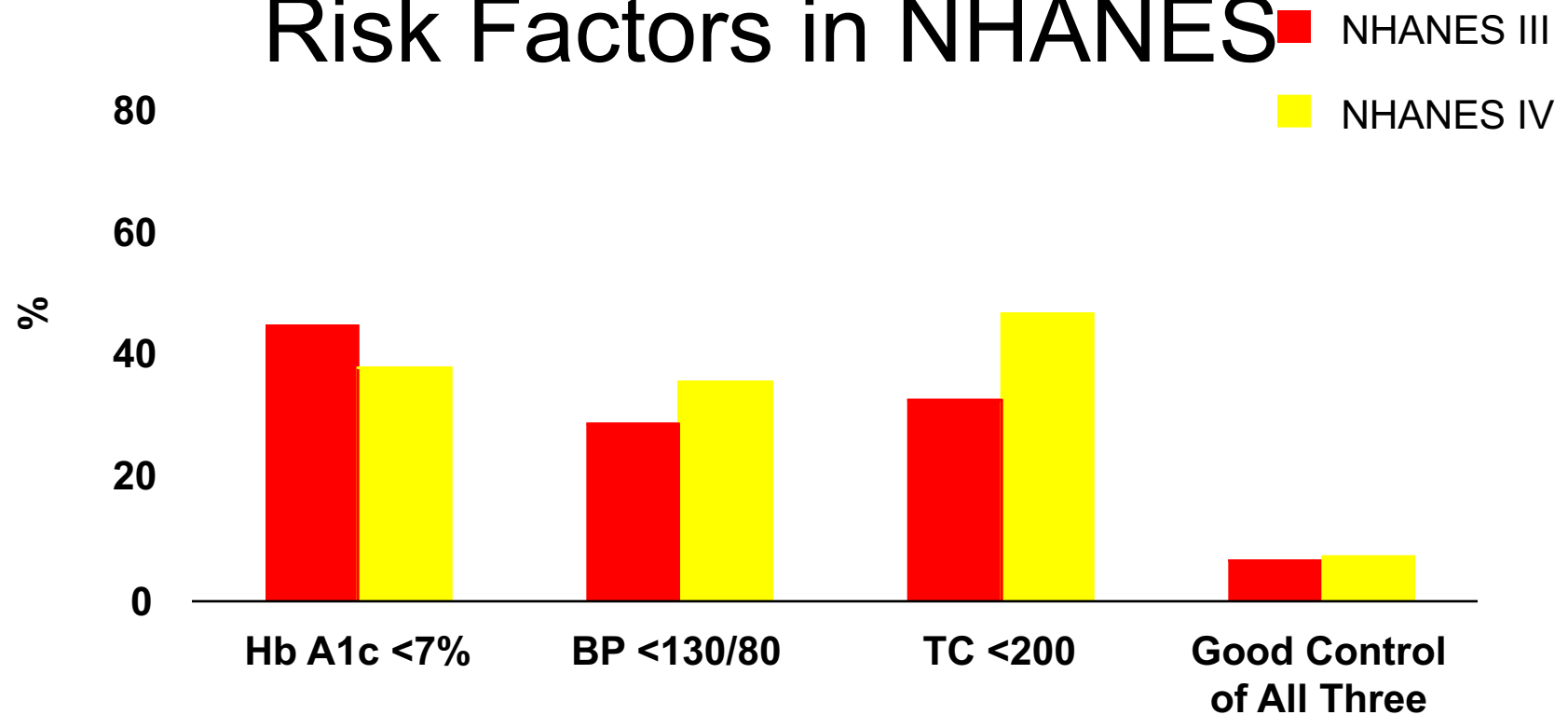
## 2006

- After Implementation of Policy





# Percentage of Adults With Diabetes Who Achieved Recommended Levels of Vascular Risk Factors in NHANES



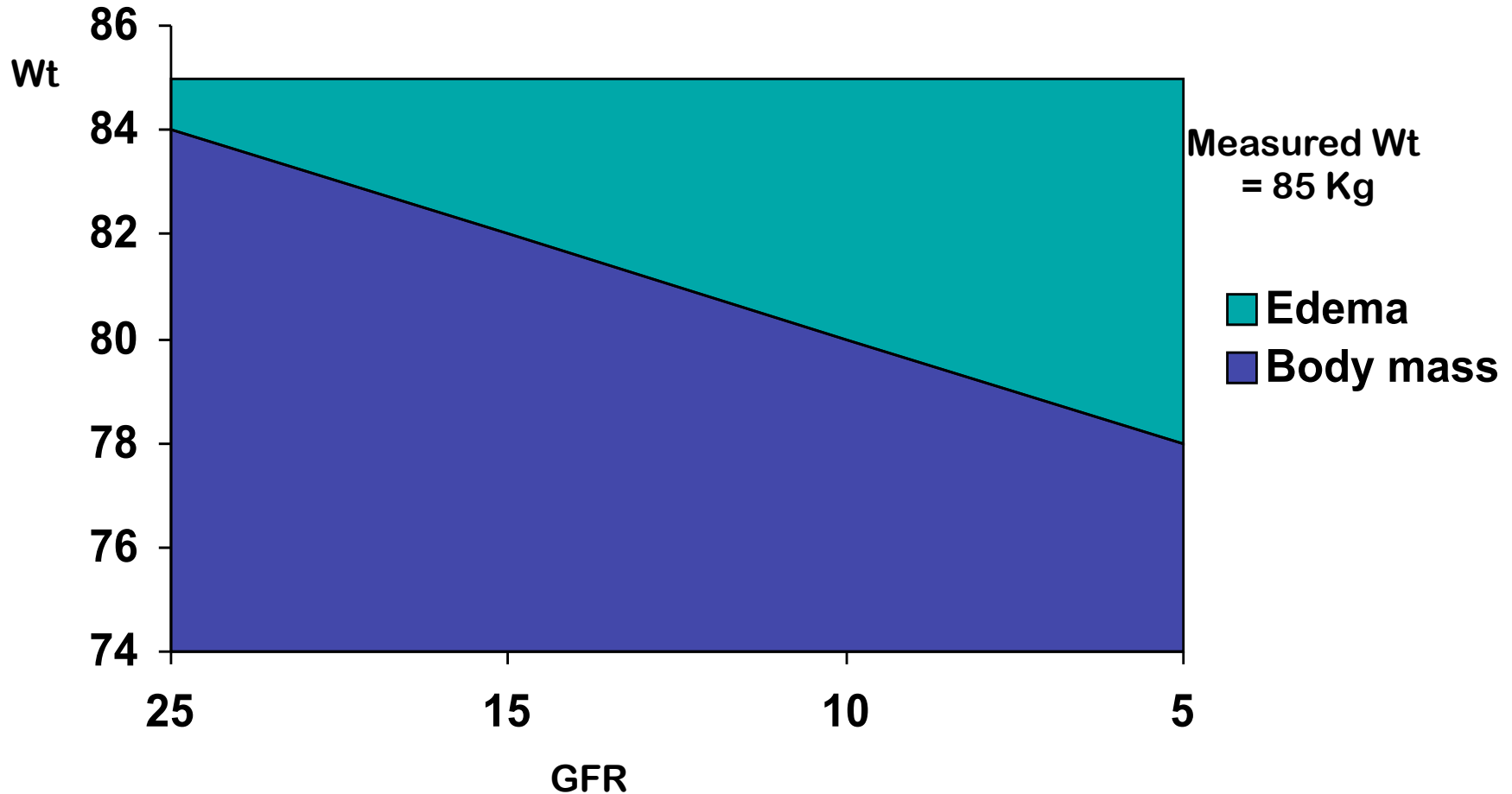
# Correction of Anemia in Diabetic CHF

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- Diabetic patients with Hb less than 12.5 g% treated with erythropoetin and IV iron
  - NYHA class improved by 36.8%
  - Dyspnea improved by 69.7% on Visual Analogue Scale
  - EF improved by 7.6%
  - Hospitalizations decreased by 96.6%

# Transition to End Stage

## Effect of Malnutrition



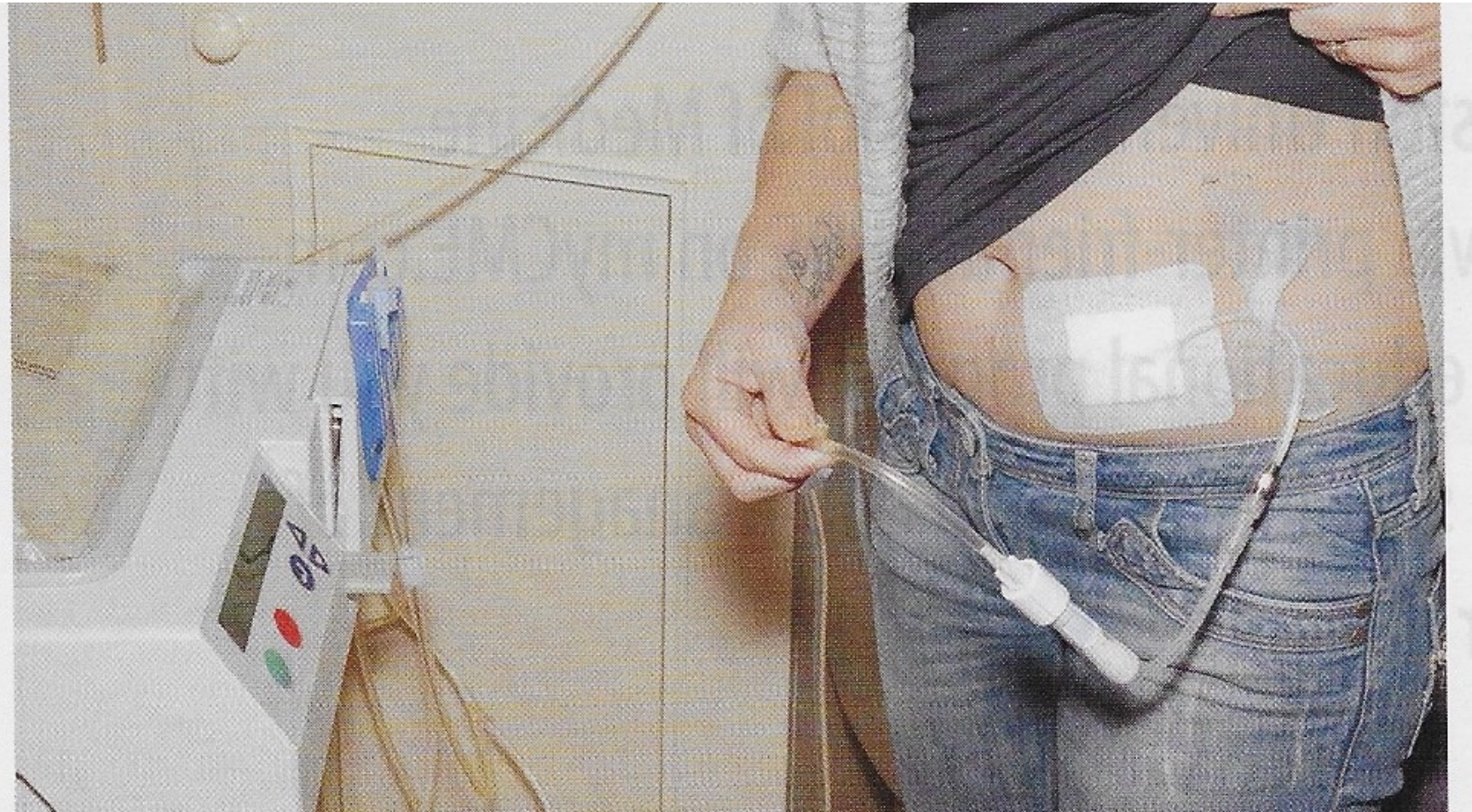
# Indications for Dialysis

- A acidosis
- E electrolyte abnormalities
- I intoxication/poisoning
- O fluid overload
- U uremia symptoms/complications

# Dialysis for Intoxications

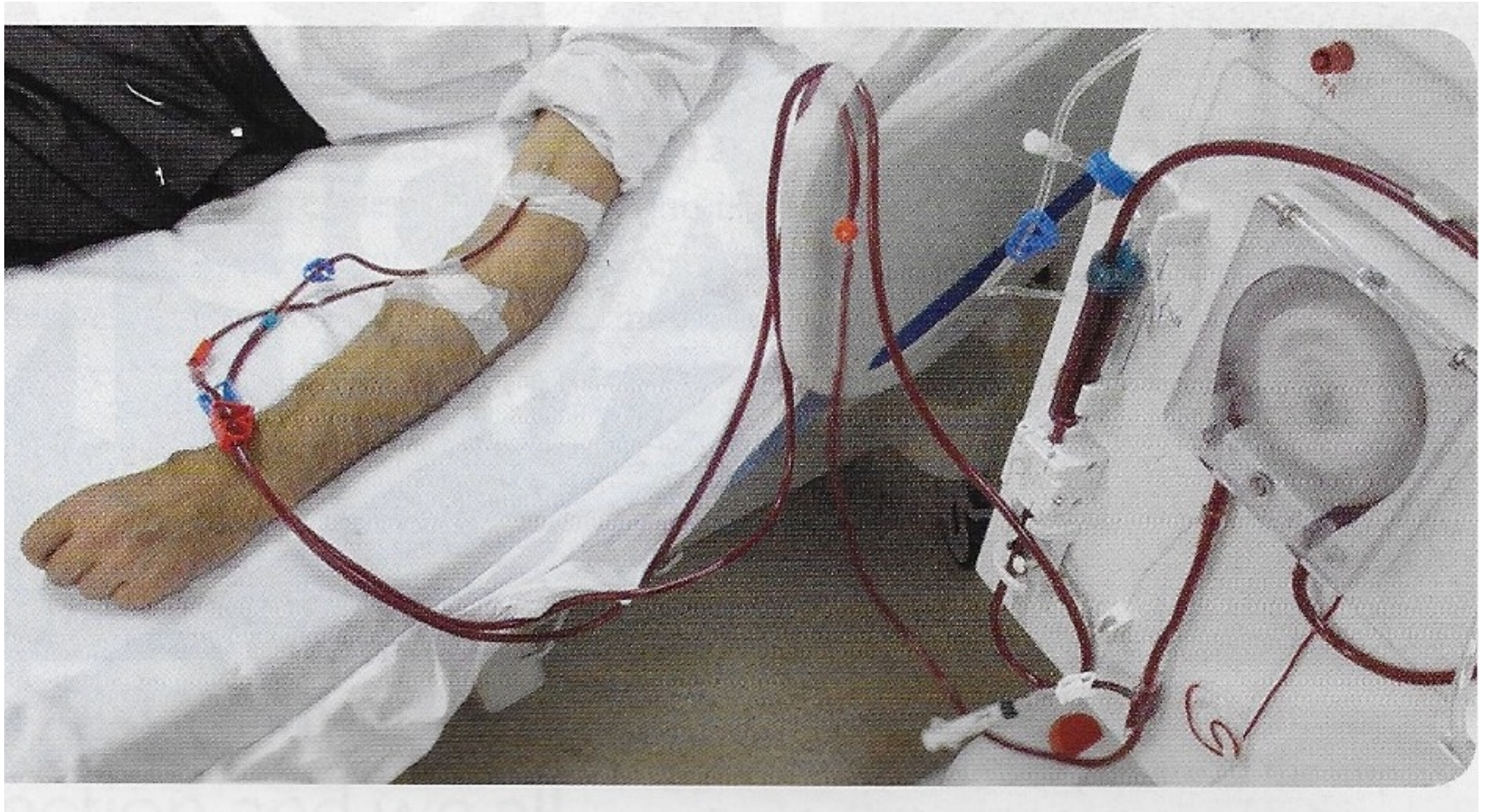
- T theophylline
- A aspirin
- B barbiturates
- L lithium
- E ethylene glycol, methanol
- M Metformin

# PD cyclor and catheter





# Hemodialysis using AV fistula





# Kidney Transplant in right pelvic fossa





## Peritoneal Dialysis Catheters

Two types of peritoneal dialysis catheters, pigtail curled catheters in short-term use and straight catheters for long-term use are available. Both are made of medical-grade silicone.

Two types of implantable cuffs are used for catheter placement.

**t** - Minimizes kinking;  
used with dialysis treatment.



Available in Pigtail or Straight

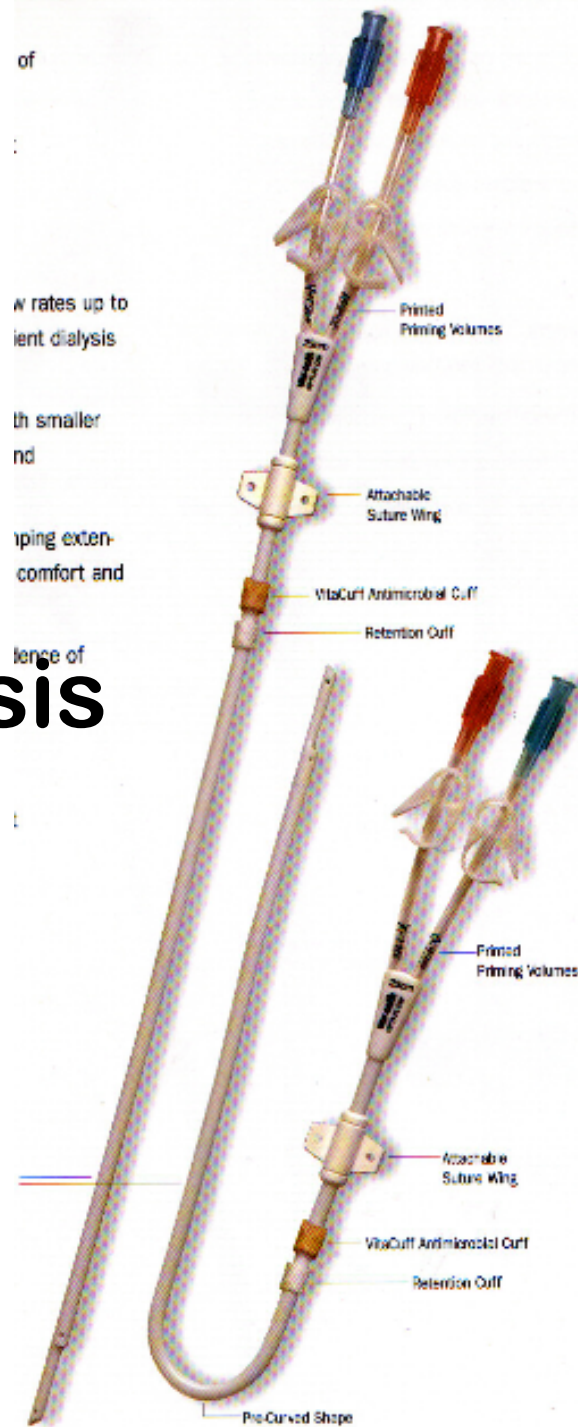
VitaCuff

One or Two  
Implantable Cuffs

One or Two  
Implantable C

Polyurethane or Silicone

# Cuffed Tunnelled Hemodialysis Catheters.



# Relative Contraindications

- Alzheimer' s disease
- Multi-infarct Dementia
- Hepatorenal syndrome
- Advanced cirrhosis with encephalopathy
- Advanced malignancy
- HIV with dementia

# Pain Meds

- HD patients usually require fewer narcotics than other patients
- Typically, a patient will have an order for morphine 2-4 mg q 2-4 hours
- Alternative choices
  - Dilaudid
  - Fentanyl



# Pain Meds

- If the dose is inadequate, you can always give more.
- Giving more narcotics is always easier than treating with a narcan drip and pressors
- Avoid demerol if possible
  - its metabolite normeperidine can cause seizures if it accumulates

# Pain Meds

- If a patient has residual renal function, try to avoid NSAID's
- Remember that overdosing NSAIDS can lead to salicylate toxicity
- Pts present with tinnitus, headache, nausea, and fever
- HD patients have a narrow therapeutic range and develop salicylism with less drug

# Diabetics

- As kidney function declines and ceases, insulin is not cleared as quickly.
- The insulin and oral agent's effects last longer
  - Sulfonylureas
  - Avoid Metformin once GFR is less than 40 ml/min

# Diabetics

- The patient's response to insulin and oral agents is a marker of getting close to dialysis
- Patients think their DM is doing great
  - needs less insulin to control blood sugars.





# Diabetics

- What really happens is:
- The patient is uremic and loses his appetite
- He eats less
- The insulin hangs around
- Now the blood sugars look great and the patient needed a fistula last month

# Hemostasis

- Uremic plasma factors lead to abnormal platelet aggregation and adhesion
- Dialysis removes these factors
- Unfortunately, the dialysis membrane alters the platelet membrane receptors for vWF and fibrinogen

# Hemostasis

- Manifestation of this platelet dysfunction can range from oozing at a venipuncture site to GI hemorrhage
- If a patient is bleeding after a simple procedure, start with the simple treatments

# Hemostasis



- DDAVP may be used if the bleeding cannot be controlled
- Use 0.3mcg/kg IV over about 20 minutes
  - 15 mcg in 50 cc NS over 15 min.
- DDAVP stimulates release of vWF
  - increases GPIIb platelet adhesion factor expression

# Reminders

- When you evaluate a patient keep in mind that HD patients are different
- These patients need the same workup for the same complaints
- Your differential will be the same
- Your treatment may be modified

# Hypotension

- Treat the HD patient with IV fluids
- 0.9% saline, 250cc bolus
- Albumin / Hespan
- Check for response
- You have treated the HD patients like the other patients
- All you changed was the amount of fluid

# Meds to Consider

- Demerol
- Morphine
- NSAID's
- ACEI / ARBS
- Glucophage
- Antibiotics

# Meds to Avoid/Think About

- Contrast- IV contrast can be given in dialysis patients
- Keep in mind that the osmotic effects of contrast can shift fluid into the intravascular space and cause pulmonary edema
- MRI contrast (Gadolinium etc) should be avoided over creat of 2.0 or GFR less than 40 ml/min



# Advancing Kidney Health Initiative (AKHI) 2019

- Background from the USRDS:
  - US Renal Data System – [www.usrds.org](http://www.usrds.org)
- Mortality among ESRD patients is no longer decreasing
- Vast majority of new dialysis patients start with a catheter (80%)
- Use of home therapies PD, Home HD are lower in US than in other countries
- Kidney disease is Expensive (\$114 Billion/year)
- AKI is major risk factor for CKD

# Advancing Kidney Health Initiative (AKHI) 2019

- Reduce development of ESRD by 25%
- Target 80% of ESRD pts receive home dialysis or preemptive transplant by 2025.
- Double number of kidneys available for transplant by 2030
  - Including removing financial barriers for living donors
- Encourage development of artificial kidneys
- Incentivize disease prevention, Home dialysis, and transplant.

# AKHI 2019

- This will require a lot of infrastructure
- First phase will see increased use of acute peritoneal dialysis in the ICU.
- Will require education and culture change in Nephrologists, Surgeons, hospital staff, Nursing

# Advances in Artificial Kidneys

- Membraneless artificial kidney
  - Uses fluid layer in microtubule for solute exchange
  - Worn on arm, connected to avf continuously
  - The fluid layer collects wastes and is exchanged periodically
  - Infoscitex Inc and Columbia University
  - KidneyX prize advancing research on renal replacement and transplant, including Xenotransplantation.

# Wearable Artificial Kidney

- Miniaturized dialysis machine worn around waist. Wt 5 lbs.
- Utilizes a unique battery powered pump for blood and dialysate
- Sorbent cartridge based dialysate
- Already proven for SCUF in CHF pts.
- UCLA Victor Gura, MD

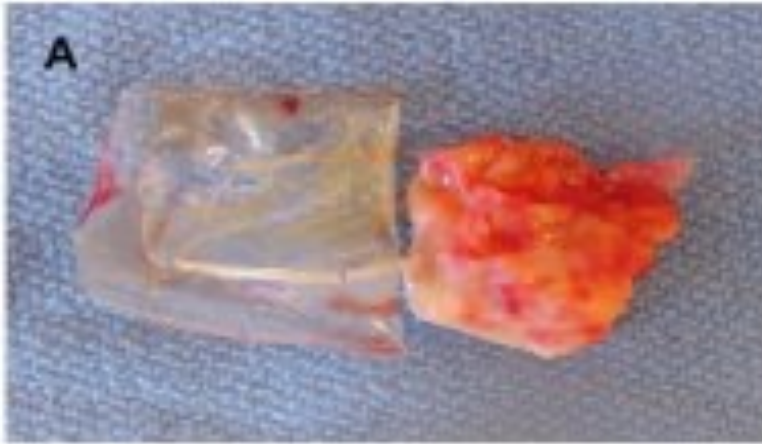
# Wearable artificial Kidney



# Human Nephron Filter

- Nanomembrane technology
- May be able to tailor dialysis
- Would lend itself to wearable, continuous modalities
- Philtre, Alan Nissenson, MD

# Cloning Kidney Tissue

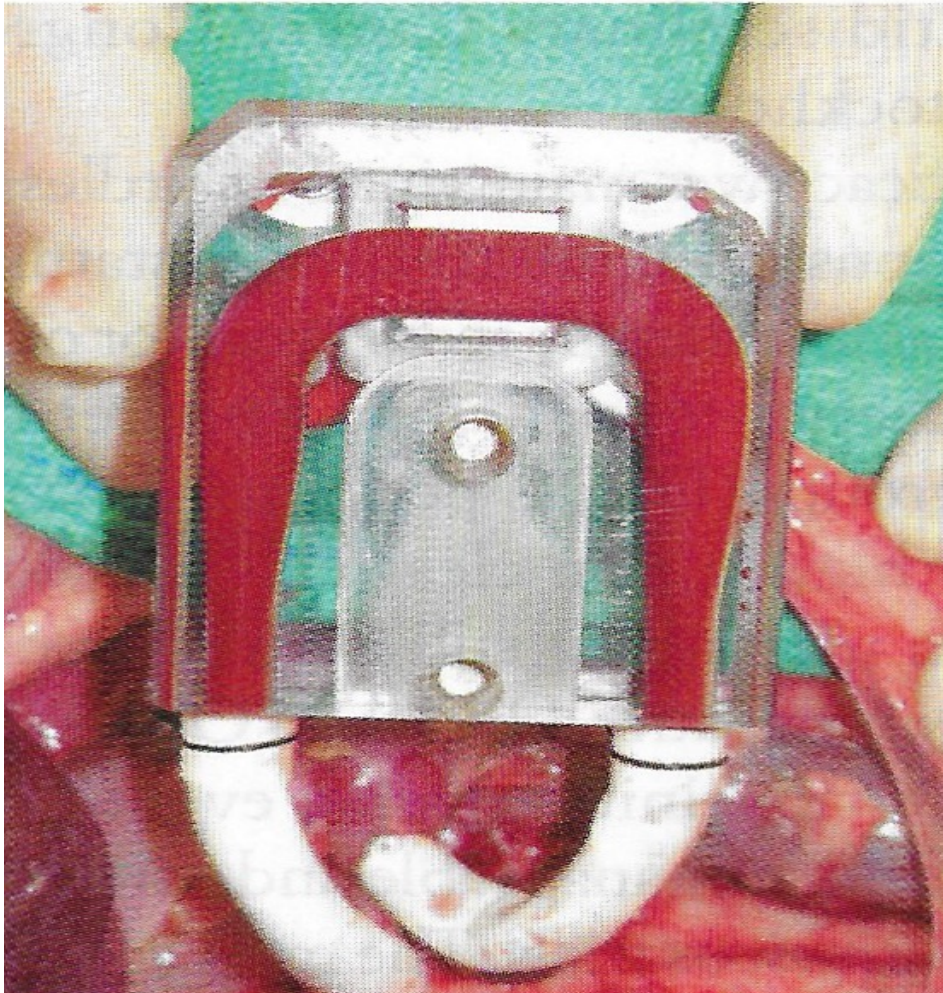




# Bioartificial Kidney

- Uses cloned renal tubular cells from unusable donor kidneys
- Cells line capillary tubules in a kidney similar to conventional dialysis kidney
- Renal Assist Device can assume endocrine and metabolic functions
- In phase II study reduced mortality in ICU ARF pts from 61 to 34 %.
- University of Michigan David Humes, MD

# Implantable Artificial Kidney



Fissell et al. Cleveland Clinic Glickman Urology Institute 2017

# Summary

- CKD is a common disease and comorbid condition with DM, HTN and heart disease
- Markers for risk of progression
- Nonpharmacologic measures to delay progression
- Pharmacologic measures
- Management of CKD
- Pitfalls to watch out for
- New innovations in treatment of CKD