

**NUTRITION CONSIDERATIONS FOR
PATIENTS WITH DIABETES AND
ADVANCED KIDNEY DISEASE**

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CONFLICTS OF INTEREST

In compliance with the accrediting board policies, the American Diabetes Association requires the following disclosure to the participants:

Becca Wallschlaeger, MS RDN:

Disclosed no conflict of interest



OBJECTIVES

- Recognize kidney disease is a growing epidemic, much like diabetes, and obesity
- Understand relationship between diabetes and kidney function
- Identify nutrition changes for people living with diabetes and advanced kidney disease
- Understand kidney replacement options and the nutrition implications of each



OVERVIEW

- Background
- Anatomy and Physiology of Renal Organ System
- Diabetic Kidney Disease
- Nutrition Implications and Changes in Advanced Kidney Disease
- Kidney Replacement Options
- Nutrition and Diabetes in Kidney Replacement

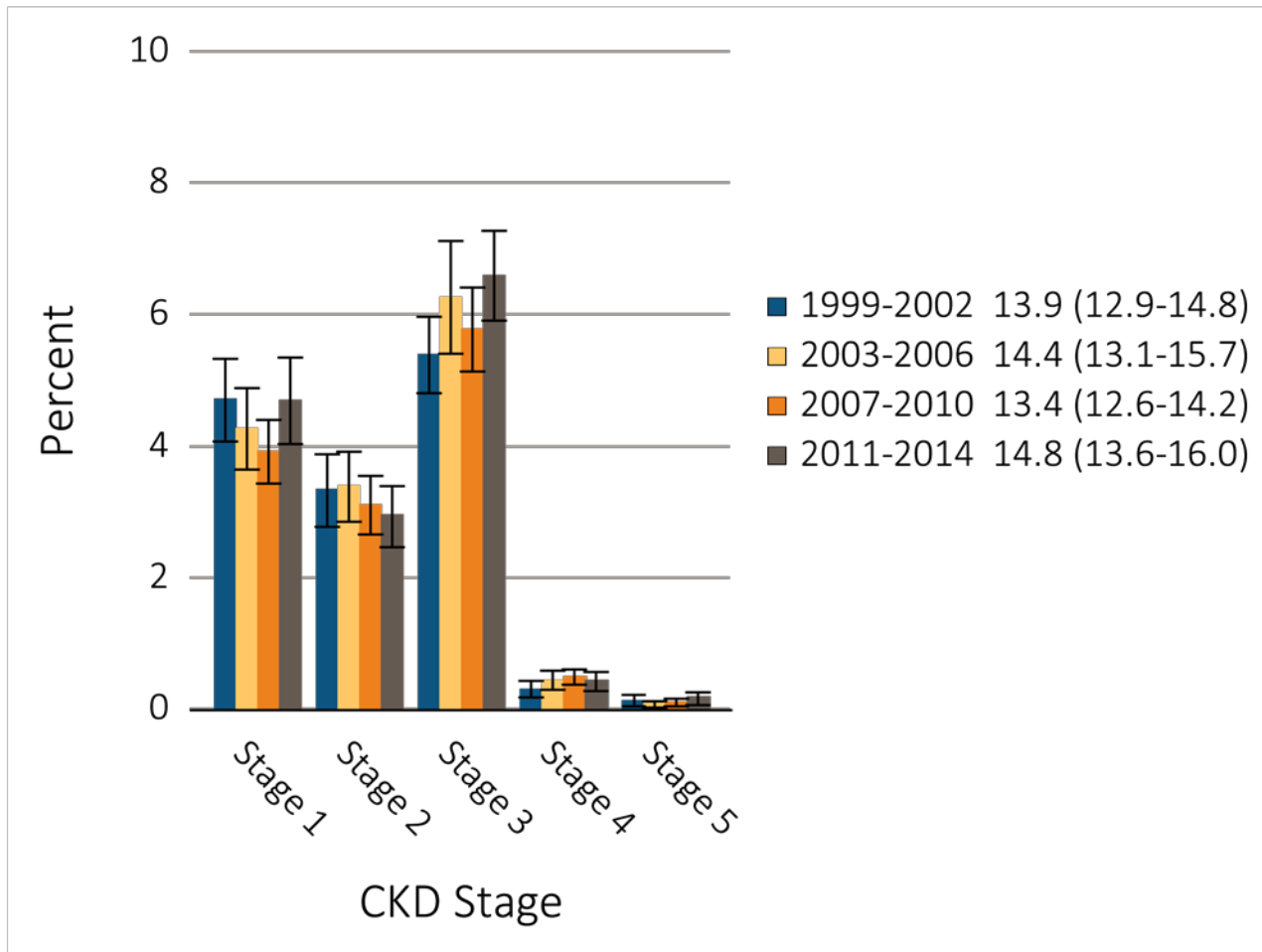


KIDNEY DISEASE FACTS

- More than 20 million (or more than 10%) US adults are estimated to have CKD and most are undiagnosed
- Kidney disease is the 9th leading cause of death in US
- In the US, diabetes and hypertension are the leading causes of kidney failure, accounting for 72% or about $\frac{3}{4}$ of new cases
- The number of kidney failure cases in the US population has more than tripled since 1990



Figure 1.1 Prevalence of CKD by stage among NHANES participants, 1999-2014

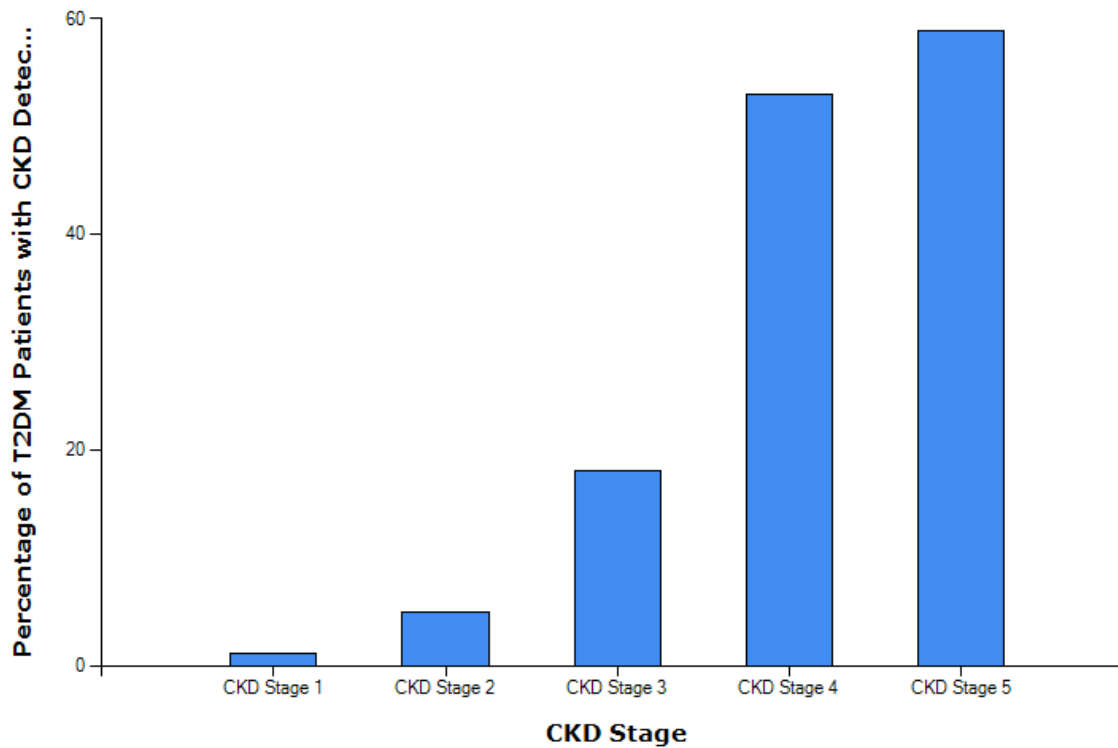


Data Source: National Health and Nutrition Examination Survey (NHANES), 1999-2002, 2003-2006, 2007-2010 & 2011-2014 participants aged 20 & older. Whisker lines indicate 95% confidence intervals. Abbreviations: CKD, chronic kidney disease.

DETECTION OF CKD IN DIABETICS

Primary Care Detection of CKD in Patients with Type 2 Diabetes Mellitus by CKD Stage 2012

ADD-CKD Cohort

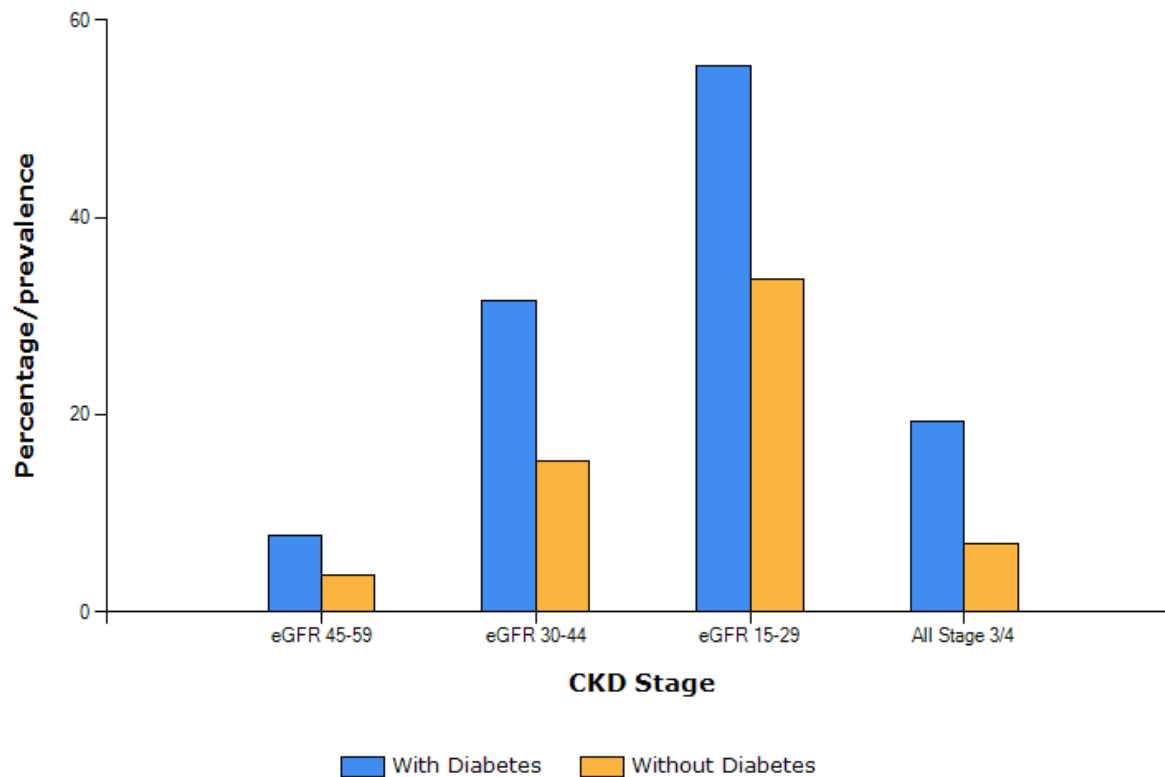


Centers for Disease Control and Prevention. Chronic Kidney Disease Surveillance System—United States. website. <http://nccd.cdc.gov/CKD>.

DIAGNOSIS COMMUNICATION

Percentage with CKD Stage 3 or 4 Who Were Aware of Their Disease by CKD Stage and Diabetes 1999-2012

National Health and Nutrition Examination Survey



Centers for Disease Control and Prevention. Chronic Kidney Disease Surveillance System—United States. website. <http://nccd.cdc.gov/CKD>.

Centers for Disease Control and Prevention, CKD Initiative, 2015

HEALTHY PEOPLE 2020—DM & CKD

- Goal: Reduce the disease burden of DM and improve the quality of life for all people who have, or are at risk for, DM
- 16 Objectives
 - <https://www.healthypeople.gov/2020/topics-objectives/topic/diabetes/objectives>
- Goal: Reduce new cases of CKD and its complications, disability, death, and economic costs
 - Nearly 25% of the Medicare budget is used to treat people with CKD and ESRD.
- 14 Objectives
 - <https://www.healthypeople.gov/2020/topics-objectives/topic/chronic-kidney-disease/objectives>



Table 2.2 HP2020 D-12 Increase the proportion of persons with diagnosed diabetes who obtain an annual urinary microalbumin measurement: Target 37.0%

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
All	15.3	18.1	21.2	25.5	28.5	31.0	33.3	35.3	36.9	38.6	40.5	42.3	44.9	46.2
Race/Ethnicity														
American Indian or Alaska Native	11.4	12.1	13.1	15.5	18.9	20.1	20.9	21.2	24.1	23.0	24.5	24.1	27.1	27.8
Asian	16.8	20.6	23.9	28.9	30.5	33.4	34.9	37.3	39.5	41.7	43.8	47.3	49.4	50.4
Black/African American	13.1	15.6	18.5	23.5	26.4	29.0	31.5	33.3	35.3	36.9	39.0	40.5	43.0	43.9
White	15.5	18.5	21.6	25.7	28.7	31.2	33.5	35.5	37.1	38.6	40.6	42.3	44.9	46.3
Hispanic or Latino	15.3	17.8	20.7	25.5	29.6	31.3	33.2	35.1	37.5	40.2	42.3	44.3	47.8	48.7
Sex														
Male	14.8	17.6	20.7	24.7	27.8	30.2	32.4	34.4	36.2	37.7	39.6	41.5	44.0	45.2
Female	15.9	18.8	21.9	26.5	29.4	32.0	34.5	36.4	37.9	39.5	41.6	43.3	46.1	47.4
Age														
65-74	18.2	21.2	24.7	29.4	32.6	35.1	37.7	39.9	41.8	43.3	45.3	47.2	49.6	50.7
75-84	13.7	16.7	19.6	23.8	26.8	29.6	31.8	33.7	35.3	37.1	39.1	41.0	44.4	45.8
85+	7.2	9.0	10.9	13.9	16.1	18.1	20.5	22.2	23.5	25.0	26.7	28.0	31.4	32.6

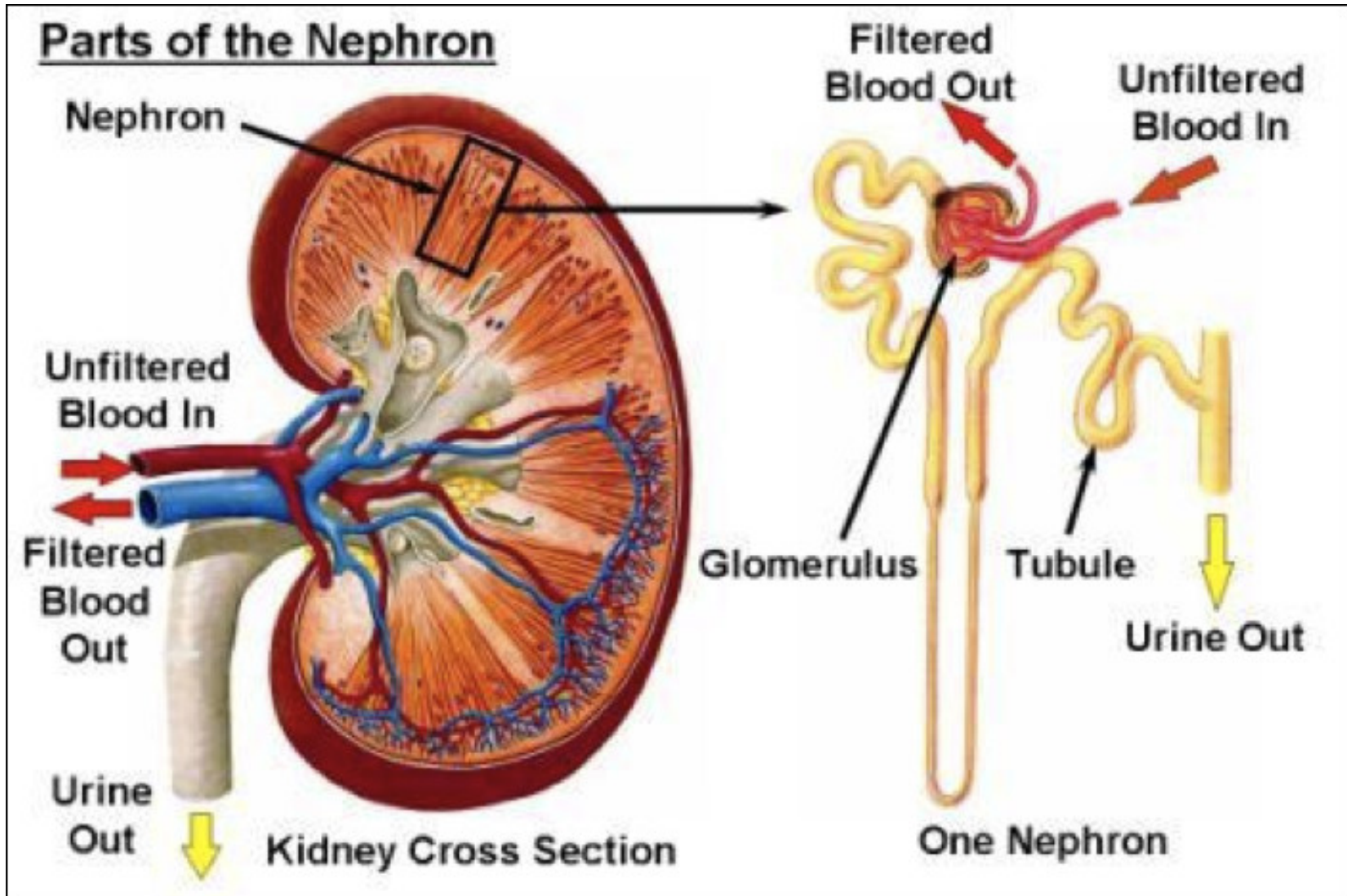
Data Source: Special analyses, Medicare 5 percent sample. Medicare patients with diabetes mellitus, aged 65 & older. Abbreviations: D, diabetes mellitus.

KIDNEY PHYSIOLOGY

- Filters Blood
 - Glomerular Filtration
 - Tubule Secretion
 - Tubule Resorption
- Removes Toxins
- Regulates Extracellular Homeostasis
 - Acid/base
 - Electrolytes
 - Fluids
- Blood Pressure Control
- Makes Erythropoietin
- Vitamin D Metabolism



KIDNEY ANATOMY



STAGES OF CKD

- Stage 1: eGFR ≥ 90 ml/min/1.73m² and ACR ≥ 30 mg/g
- Stage 2: eGFR 60-89 ml/min/1.73m² and ACR ≥ 30 mg/g
- Stage 3: eGFR 30-59 ml/min/1.73m²
- Stage 4: eGFR 15-29 ml/min/1.73m²
- Stage 5: eGFR < 15 ml/min/1.73m²

ADVANCED KIDNEY DISEASE

- Stage 4 or GFR <30 mL/min
- Quality vs quantity –clearance
- Symptoms
 - Fluid build up
 - Loss of appetite
 - Changes in sleep
 - Changes in concentration
- Monitoring
 - Urine
 - Blood



DIABETES AND PROGRESSION OF KIDNEY DISEASE

- Hyperglycemia
- ↑ Filtration rate
- Leaking
- Loss of protein
 - Microalbuminuria (early stages)
 - Macroalbuminuria (nearing ESRD)
- Loss of filtering
- Waste build up
- Dialysis/Transplant



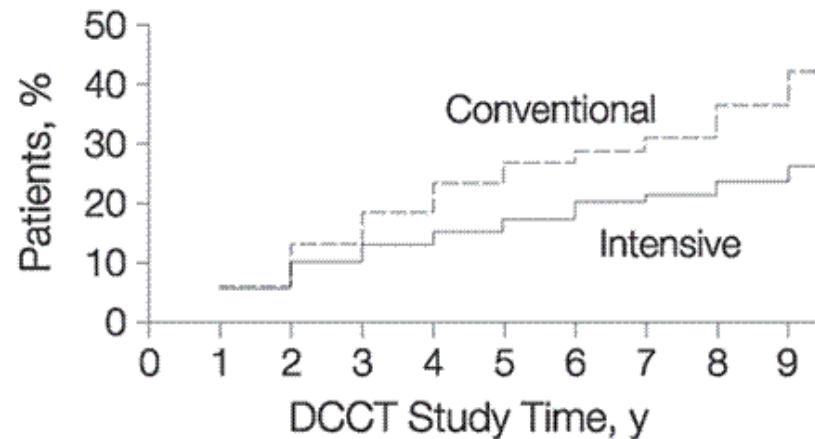
GLUCOSE CONTROL AND MICROALBUMINURIA

- KDOQI Guideline 2
- “Intensive treatment of hyperglycemia prevents elevated albuminuria or delays its progression”
- Recommend: HbA1c of ~ 7% to prevent or delay progression of microvascular complications of diabetes (Diabetes Control and Complications Trial)
- Recommend: Not treating to HbA1c <7% in patients at risk of hypoglycemia
- ADVANCE Trial



DIABETES CONTROL AND COMPLICATIONS TRIAL

B Cumulative Incidence of Microalbuminuria



No. Evaluated

Conventional	352	351	348	349	346	345	262	171	103	79
Intensive	363	361	358	354	352	351	276	186	106	91

Modified from The DCCT Research Group.⁹ Cumulative incidence of sustained 3-step progression of 2 cohorts of the Diabetes Control and Complications Trial (DCCT). A, The Early Treatment Diabetic Retinopathy Study scale cohort (conventional vs intensive, $P < .001$). B, The development of microalbuminuria cohort (conventional vs intensive, $P = .001$).

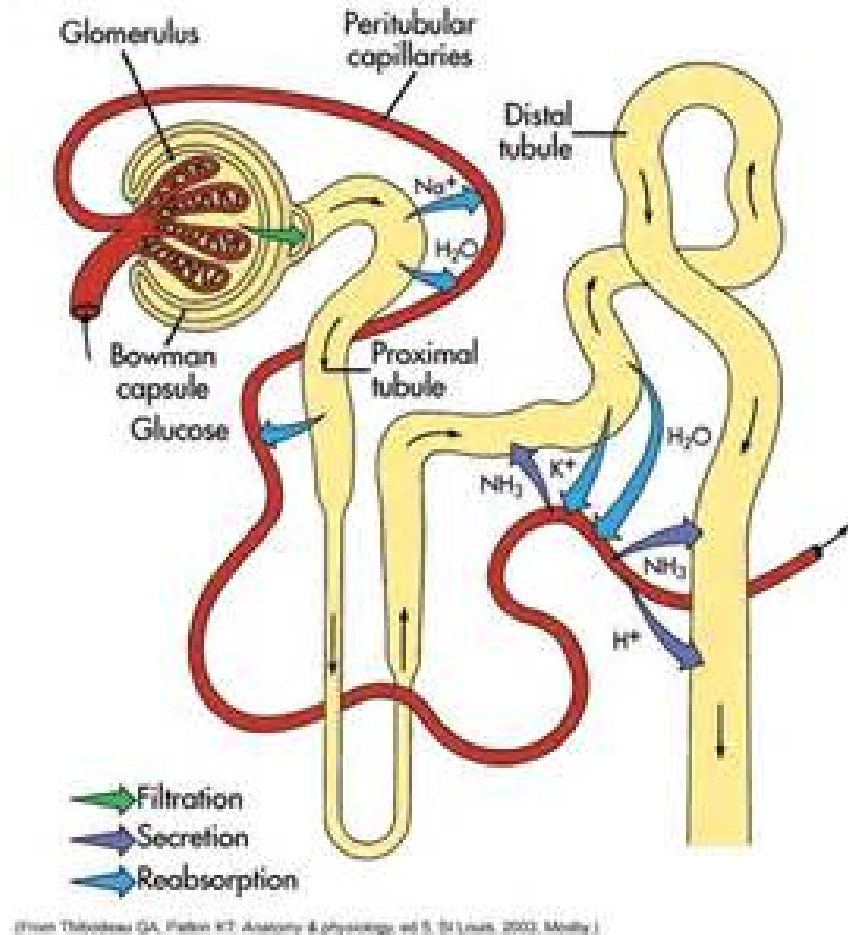
ADVANCE TRIAL

- 11,140 participants
- Randomly assigned
 - Intensive glucose-lowering strategy
 - Standard glucose control
- Measures
 - ESRD Risk
 - Microalbuminuria
 - Macroalbuminuria
- Results:
 - HbA1c level was 6.5% in intensive group, and 7.3% in standard group
 - Significant reduction in ESRD risk by 65%, microalbuminuria in intensive group
 - Significant reduction in microalbuminuria by 9%
 - Significant reduction in macroalbuminuria by 30%



RENAL INSUFFICIENCY & DIABETIC CHANGES

- Insulin metabolism
 - Glomerulus
 - Peritubular Capillaries
- Impaired renal function=impaired insulin metabolism
- Prolonged half-life of circulating insulin



RENAL DIET

- KDOQI guidelines
- Academy of Nutrition and Dietetics Position
- DASH Diet
- Diabetic Diet
- Typical Concerns
 - Sodium
 - Potassium
 - Phosphorus
 - Calcium
 - Protein



ACADEMY OF NUTRITION AND DIETETICS

- Evidence Analysis Library
- CKD Guideline
- CKD Toolkit
- Based on KDOQI Guidelines
- Medical Nutrition Therapy



DASH DIET

- 1,500-2,300 mg sodium/day
- Grains: 6-8 servings/day whole grains or sweet potatoes
- Vegetables: 4-5 servings/day
- Fruit: 4-5 servings/day
- Dairy: 2-3 servings/day (Low- or Non-Fat)
- Lean Protein: \leq 6 oz/day
- Nuts, Seeds, Beans: 4-5 servings/**week**
- Fats & Oils: 2-3 servings/day (unsaturated)
- Sweets: \leq 5/**week**



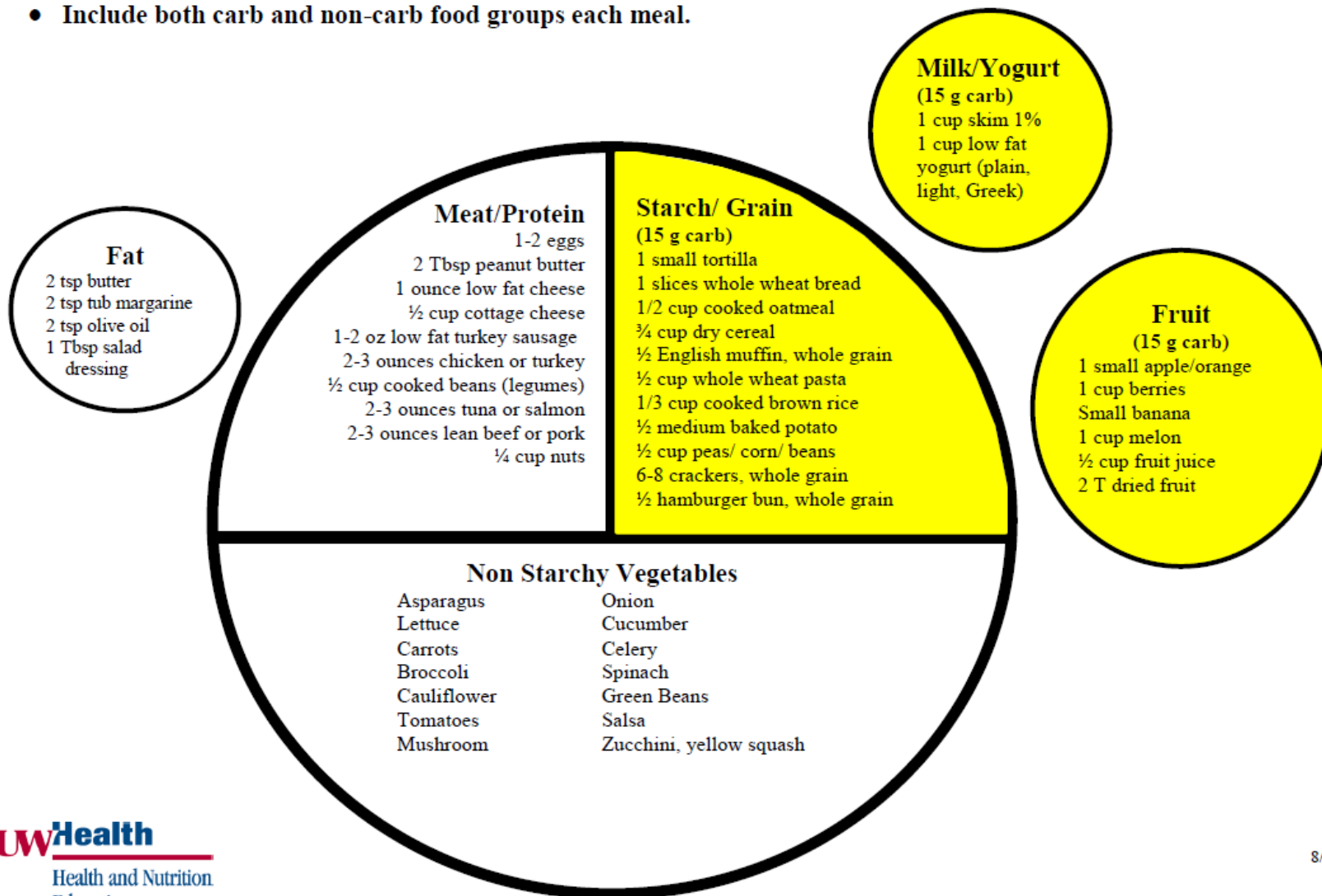
DIABETIC DIET

- Consistent meal times; avoid skipping meals
- Reduce sugar and sweets
- Consistent meal composition
 - My Plate
- Include a lean protein source at meals and snacks
- Choose high-fiber foods
- Eat less fat



Meal Planning- Plate Method

- Eat 3 meals and 0-2 snacks daily.
- Choose at least 3-4 food groups at meals and up to 1-2 food groups at snacks.
- **Yellow** groups are carbohydrate. Carbohydrate gives energy and raises blood sugar.
- Include both carb and non-carb food groups each meal.




KDOQI GUIDELINES: PROTEIN

- GFR < 50 mL/min per 1.73 m²
 - 0.8 gram protein/kg/day (IBW if BMI > 30 kg/m²)
 - Ensure adequate caloric intake to prevent malnutrition
- GFR < 20 mL/min per 1.73 m²
 - 0.2-0.5 gram protein/kg/day (IBW if BMI > 30 kg/m²)
 - Keto acid analogs
 - Vitamin/Mineral supplementation
- Diabetic Nephropathy
 - 0.8-0.9 gram protein/kg/day (IBW if BMI > 30 kg/m²)
 - Prevent hypoalbuminemia
- Dialysis
 - 1.2 gram protein/kg/day (IBW if BMI > 30 kg/m²)



RESTRICTING DIETARY PROTEIN

Chronic kidney disease progression: a retrospective analysis of 3-year adherence to a low protein diet

Felipe Rizzetto, Viviane de Oliveira Leal , Leonardo Soares Bastos, Denis Fouque & Denise Mafra


Pages 357-362 | Received 15 Mar 2016, Accepted 09 Jan 2017, Published online: 02 Feb 2017

- 321 enrolled patients; 2008-2013
- Provided with KDOQI guidelines
- Followed every 3 months by RD
- Diet records with analysis
- Adherence defined 90-110% of diet prescription
 - Motivation additionally self-measured by patient
 - Excellent, very good, fair, poor
- 4 groups
 - DM adhered
 - DM did not adhere
 - Non-DM adhered
 - Non-DM did not adhere



RESTRICTING DIETARY PROTEIN, CONT.

Chronic kidney disease progression: a retrospective analysis of 3-year adherence to a low protein diet

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○ Results:

- Adherence: 49.2% (25% DM 23% non-DM)
- Significant improvement in fasting glucose in group 1
- Creatinine levels decreased significantly in adherent groups
- E-GFR increased significantly year-to-year in adherent groups with albumin in normal range (>3.8 mg/dL)
- No protein-energy wasting found
- Limitation: did not evaluate blood pressure or proteinuria



KDOQI GUIDELINES: POTASSIUM (K)

- No restrictions until K is > 5.5 mg/dL
 - < 2.4 gram/day if hyperkalemic
- Restrict K intake to 3-4 g/day CKD
- Restrict K intake to 2-3 g/day ESRD
- Misc: multivitamins, sports drinks, salt alternatives, diuretics/blood pressure medications
- Common Sources
 - Dairy
 - Nuts
 - Produce
 - Dried fruits
 - Processed foods

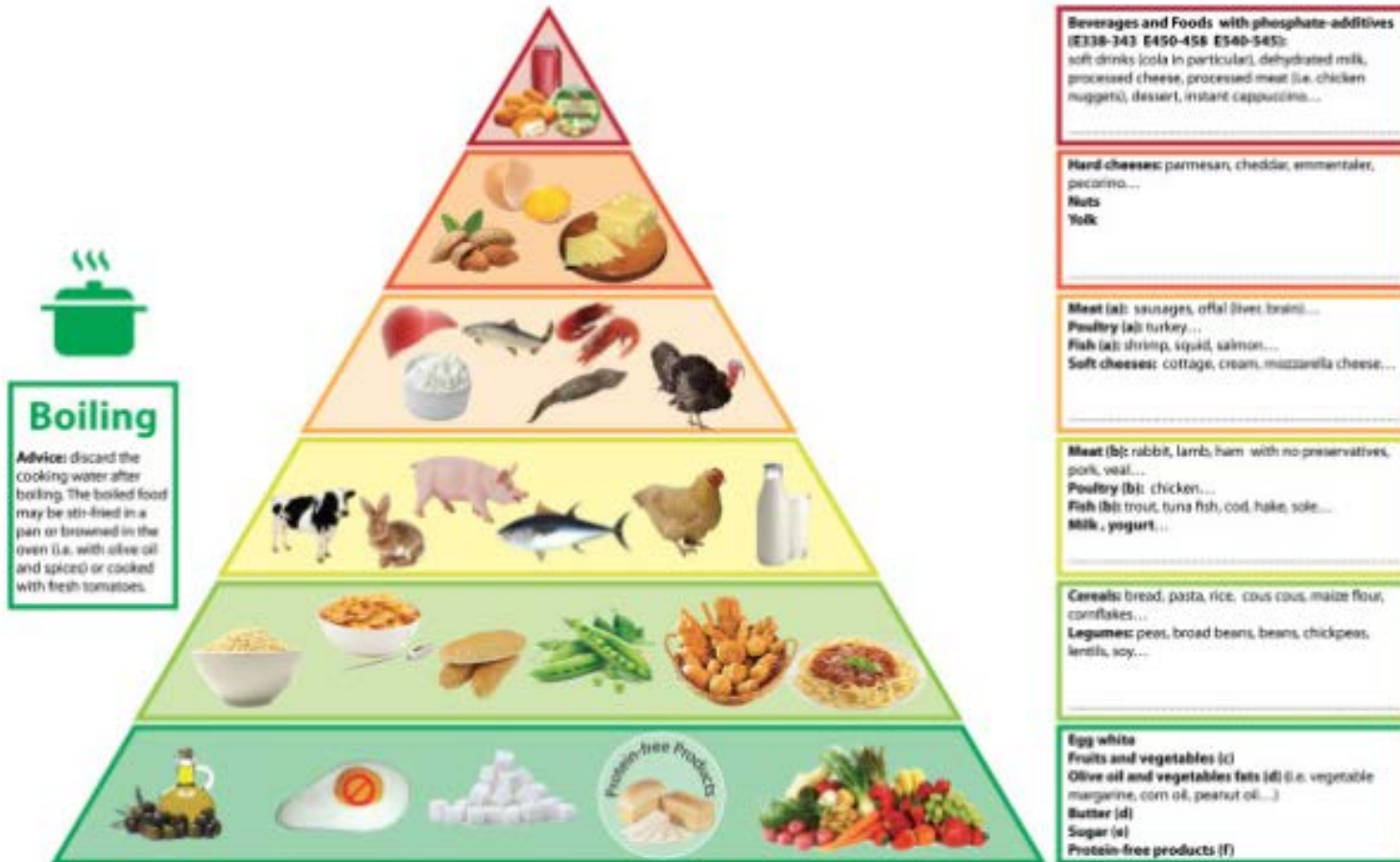


KDOQI GUIDELINES: PHOSPHORUS

- Restrict if serum level is > 4.6 mg/dL
- 800-1,000 mg/day
- RDA healthy population: 700-1250 mg/day
- Average intake: 1400-2000 mg/day
- Common sources:
 - Dairy
 - Meats/Eggs
 - Nuts
 - Whole grains
 - Processed foods



THE PHOSPHORUS PYRAMID



PHOSPHATE BINDERS

Table 1. Non-calcium based binders*

Brand Name	Generic Name	Available Dosage Forms	Maximum Dose per Day
Renagel	Sevelamer hydrochloride	800 mg tablet	16 tablets (12,800 mg)
Renvela	Sevelamer carbonate	800 mg tablet 800 mg powder packet 2.4 gram powder packet	16 tablets (12,800 mg)
Fosrenol	Lanthanum	(Chewable tablets) 500 mg 750 mg 1000 mg	4500 mg
Velphoro	Sucroferic oxyhydroxide	500 mg chewable tablet	6 tablets (3000 mg)
<u>Auryxia</u>	Ferric citrate	210 mg tablet	12 tablets (2520 mg)

*Currently none are available as generic

Table 2. Calcium content of calcium-based binders

Brand Name	Elemental Calcium	Pill Dose	Maximum dose per day
Calcium acetate (PhosLo, Eliphos)	167 mg	667 mg	9 tabs (6003 mg or 1503 mg of elemental calcium)
Calcium carbonate	250 mg	650 mg	1500 mg of elemental calcium
	500 mg	1250 mg	
Tums	200 mg	500 mg	
Tums EX	300 mg	750 mg	
Tums Ultra	400 mg	1000 mg	
<u>OsCal 500</u>	500 mg	1250 mg	
Caltrate 600	600 mg	1500 mg	



SODIUM & FLUIDS

○ Sodium

- Based upon blood pressure and fluid balance
- Stages 1-5 < 2.4 gram/day
- Dialysis \leq 2.0 gram/day

○ Fluids

- No restrictions Stages 1-3
- Stage 4: output +1000 mL
- HD: 1.5-2 L, depending on output and ID gains
- PD: 1-3 L/day



DIALYSIS

- Kidney replacement therapy
- Access Types
 - Fistula: artery-vein connection in arm
 - Graft: use of plastic tube to join artery-vein in arm
 - Catheter: plastic tube inserted into large vein in neck
- Dialysis Modalities
 - Hemodialysis
 - In Center
 - Home
 - Peritoneal Dialysis
 - CAPD
 - Cyclic PD
- RD Assessment monthly-CMS requirement
 - Additional assessments “Care Conferences”



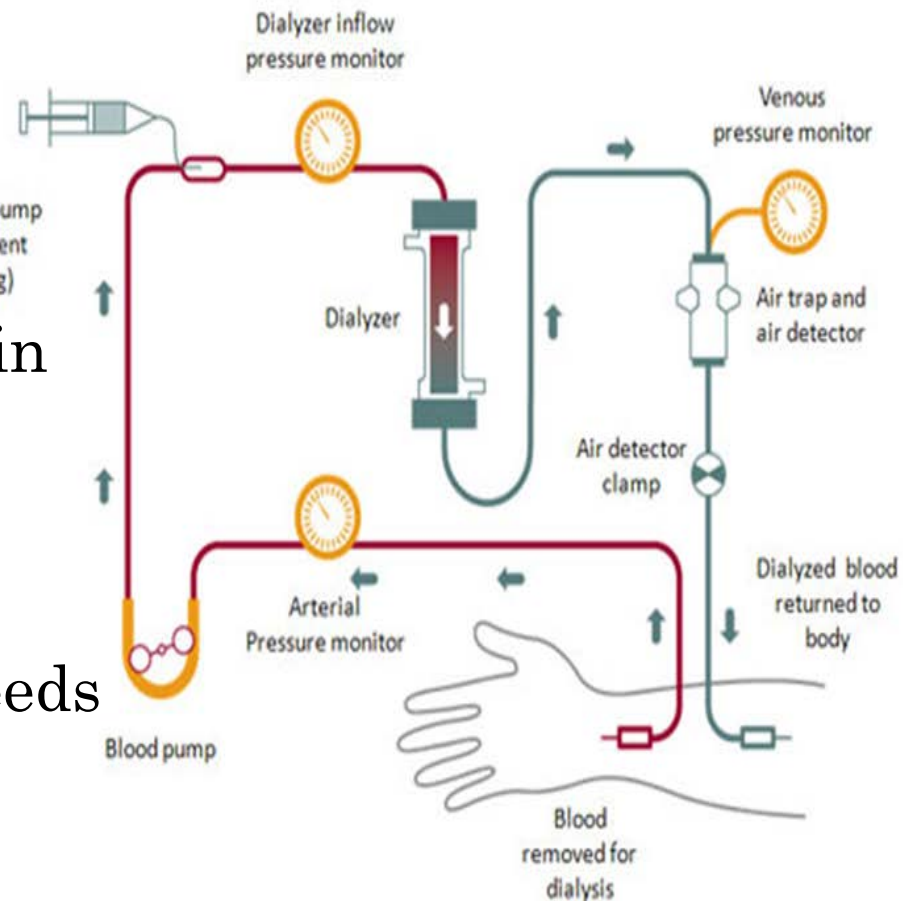
COMMON MEDICATIONS AND SUPPLEMENTS

- No herbal supplements!!!
- Phosphate Binders
 - Calcium-Based
 - Iron-Based
 - Aluminum-Based
 - Aluminum-Free
 - Magnesium-Based
- B-12/Folic Acid
 - MCV > 100 ng/mL
 - Serum levels < normal
- Vitamin D
 - Serum 25-hydroxy < 30 ng/mL (75 nmol/L)—ergocalciferol or cholecalciferol
 - iPTH > 600 pg/mL—Calcitriol
- Iron
 - Serum ferritin < 100 ng/mL
 - TSAT < 20%



HEMODIALYSIS

- In-Center vs Home
- 3 days/week vs 5 days/week
- 3-4 hour sessions
- Increased variation in fluid shifts
- Typically more restrictive diet
- Increased protein needs



PERITONEAL DIALYSIS

- At home, usually while sleeping (cyclic) or ambulatory
- Daily
- 9-10 hour sessions
- Less variations in fluid retention
- Dextrose can cause unwanted weight gain
- Diet usually more liberal than HD
- Increased infection risk
- Increased protein needs
- Changes in appetite



EXERCISE RECOMMENDATIONS

- Diabetic vascular disease
- Minimizes catabolic effects of protein restrictions in CKD
- #1 cause of death in dialysis and transplant patients is CVD
- Increased risk of frailty in chronic illness and aging
- American Heart Association Recommendations
 - 150 min/week cardiovascular
 - 2 days/week strength building



TRANSPLANT OPTIONS FOR DIABETICS

- Pancreas
- Islet Cell
- Simultaneous Pancreas Kidney
- Kidney



UW TRANSPLANT WAITING TIMES

Simultaneous Pancreas-Kidney (SPK)

ABO	Median Waiting Time (in days)
A	72
AB	97
B	53
O	63

Solitary Pancreas

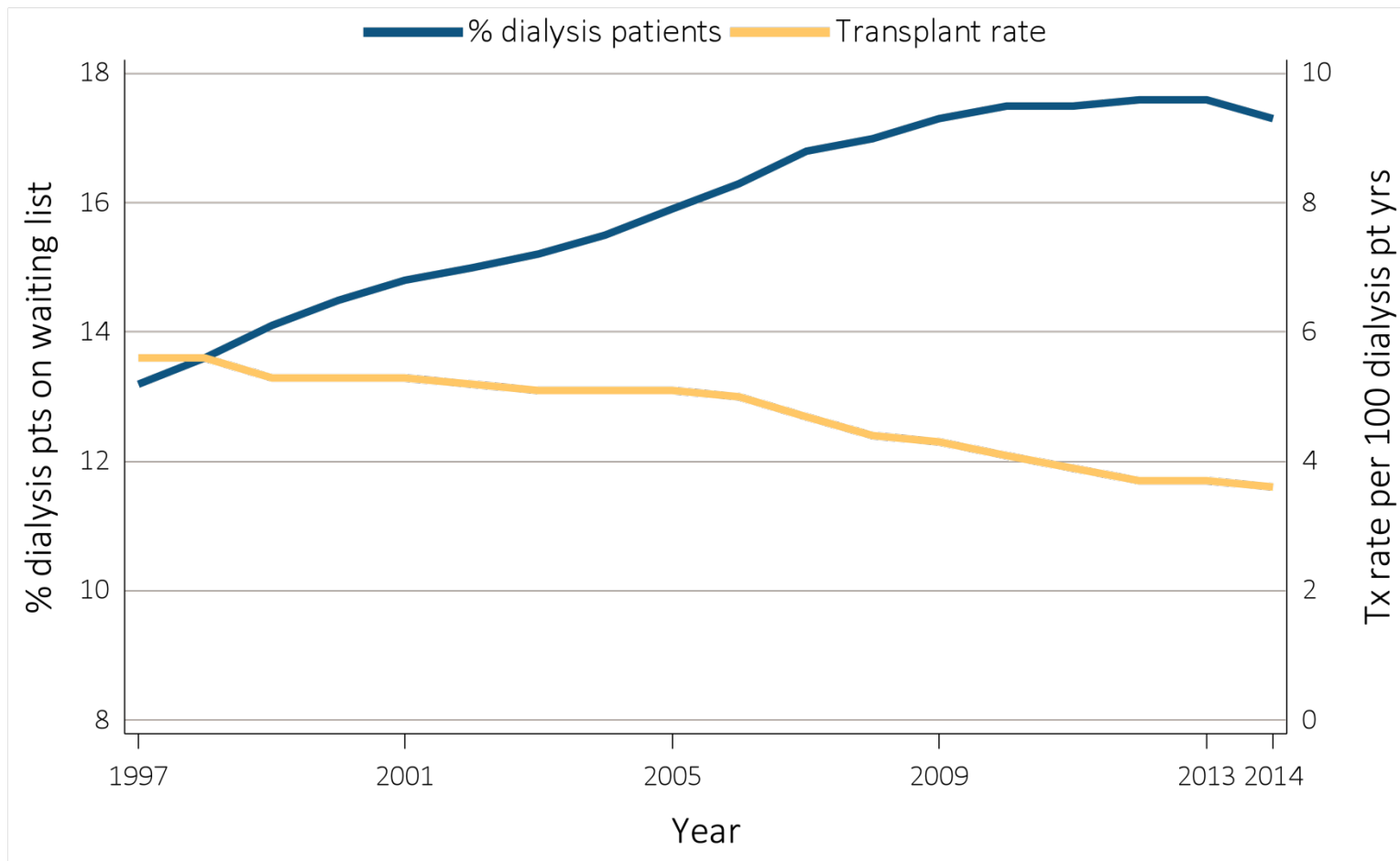
ABO	Median Waiting Time (in days)
A	45
AB	NA
B	58
O	91

Kidney

ABO	Median Waiting Time (in days)
A	931
AB	609
B	1847
O	1975



Figure 7.1 Percentage of dialysis patients wait-listed and unadjusted kidney transplant rates, 1997-2014



Data Source: Reference Tables E4 and E9. Percentage of dialysis patients on the kidney waiting list is for all dialysis patients. Unadjusted transplant rates are for all dialysis patients. Abbreviations: Tx, transplant; pt yrs, patient years.

NUTRITION CONSIDERATIONS PRE-TRANSPLANT

- BMI
 - Pancreas < 30 kg/m²
 - SPK < 30 kg/m²
 - Kidney < 35 kg/m²
- Weight History
- Diet Restrictions
- Biochemical Data
- Activity level
 - Frailty Assessments
- Contraindications: BMI >30-35 kg/m², A1c >/= 10%



FRAILTY ASSESSMENT

- Fried, et al

- Gait Speed : timed 4 meter walk
- Grip Strength: hand dynamometer
- Exhaustion: patient questionnaire
- Physical Activity: Minnesota Leisure Activity
- Weight change: within past year



NUTRITION CONCERNS FOLLOWING TRANSPLANT

- Hyperglycemia
- Hypophosphatemia
- Hyperkalemia
- GI upset
- Food Safety
- Hypertension
- Dyslipidemia
- Weight management



QUESTIONS & DISCUSSION



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