Chronic Kidney Disease Associated With Type 2 Diabetes

March 2022. MA-PF-CAR-US-0050-2

Definition of Chronic Kidney Disease

Chronic Kidney Disease (CKD)[1]

- Persistent change in either or both of the following for >3 months:
  - Reduced estimated glomerular filtration rate (eGFR) <60 mL/min/1.73 m^2
  - Elevated urine albumin excretion ≥30 mg/g (3 mg/mmol) creatinine
    - UACR is the preferred test for evaluation of albuminuria[2]

Severe Global Glomerulosclerosis with Patchy Interstitial Fibrosis and Tubular Atrophy[3]

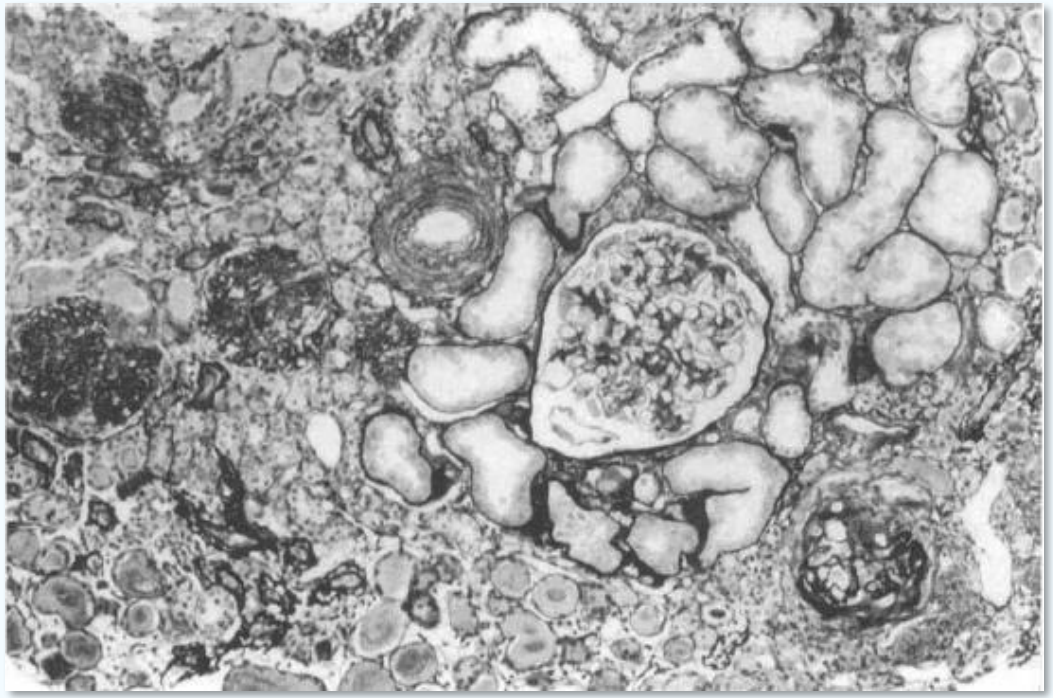


Figure reprinted with permission of The International Society of Nephrology: Fogo A, et al. *Kidney Int*. 1997;51:244-252.

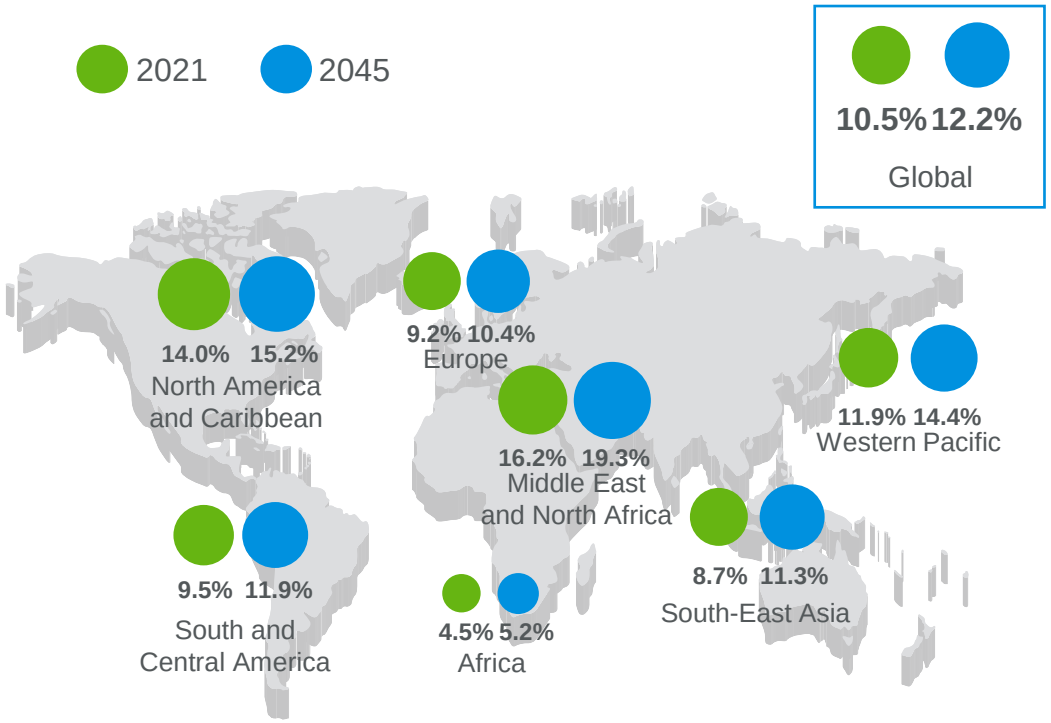
UACR, urine albumin-to-creatinine ratio.

1. Kidney Disease Improving Global Outcomes Diabetes Work Group. *Kidney Int*. 2020;98(4S):S1-S115. **2.** Kidney Disease Improving Global Outcomes. *Kidney Int Suppl*. 2013;3:1-150. **3.** Fogo A, et al. *Kidney Int*. 1997;51:244-252.

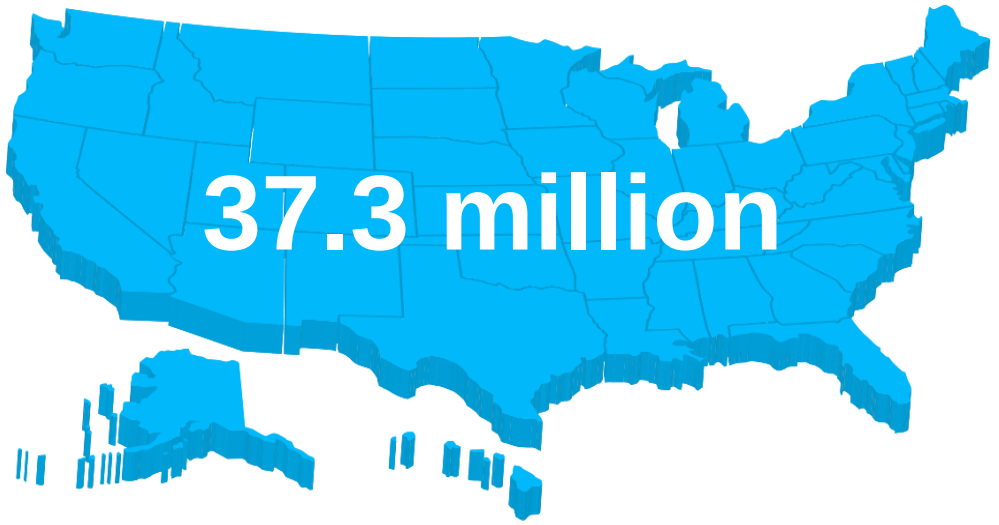
Diabetes Prevalence Is Projected to Increase

Global Prevalence of Diabetes Is Rising[1]

Estimated percentage of people 20-79 years old with diabetes by region in 2021 and 2045



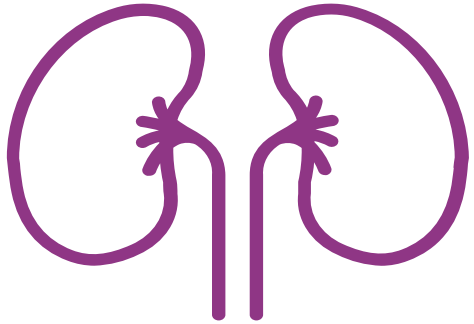
In 2019, 37.3 million Americans had diabetes (28.7 million diagnosed, 8.5 million undiagnosed)[2]



- 1.4 million Americans are diagnosed with diabetes every year[2]
- In 2019, 96 million Americans age 18 and older had prediabetes[2]

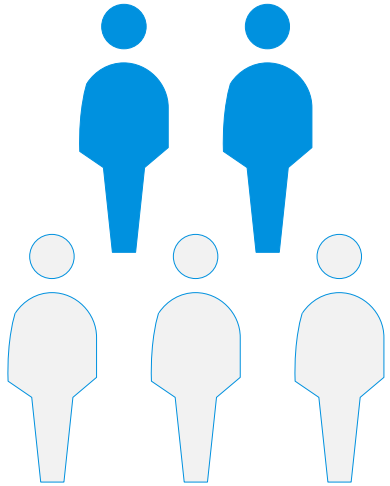
1. International Diabetes Foundation. IDF Diabetes Atlas, 10th ed. Brussels, Belgium; 2021. **2.** American Diabetes Association: Statistics about diabetes. 2022. www.diabetes.org/diabetes-basics/statistics/. Accessed February 15, 2022.

Increase in Prevalence of Diabetes Has a Major Impact on the Development of CKD[1]



Diabetes is a leading cause of **CKD** and end-stage kidney disease in the United States[2]

~40%



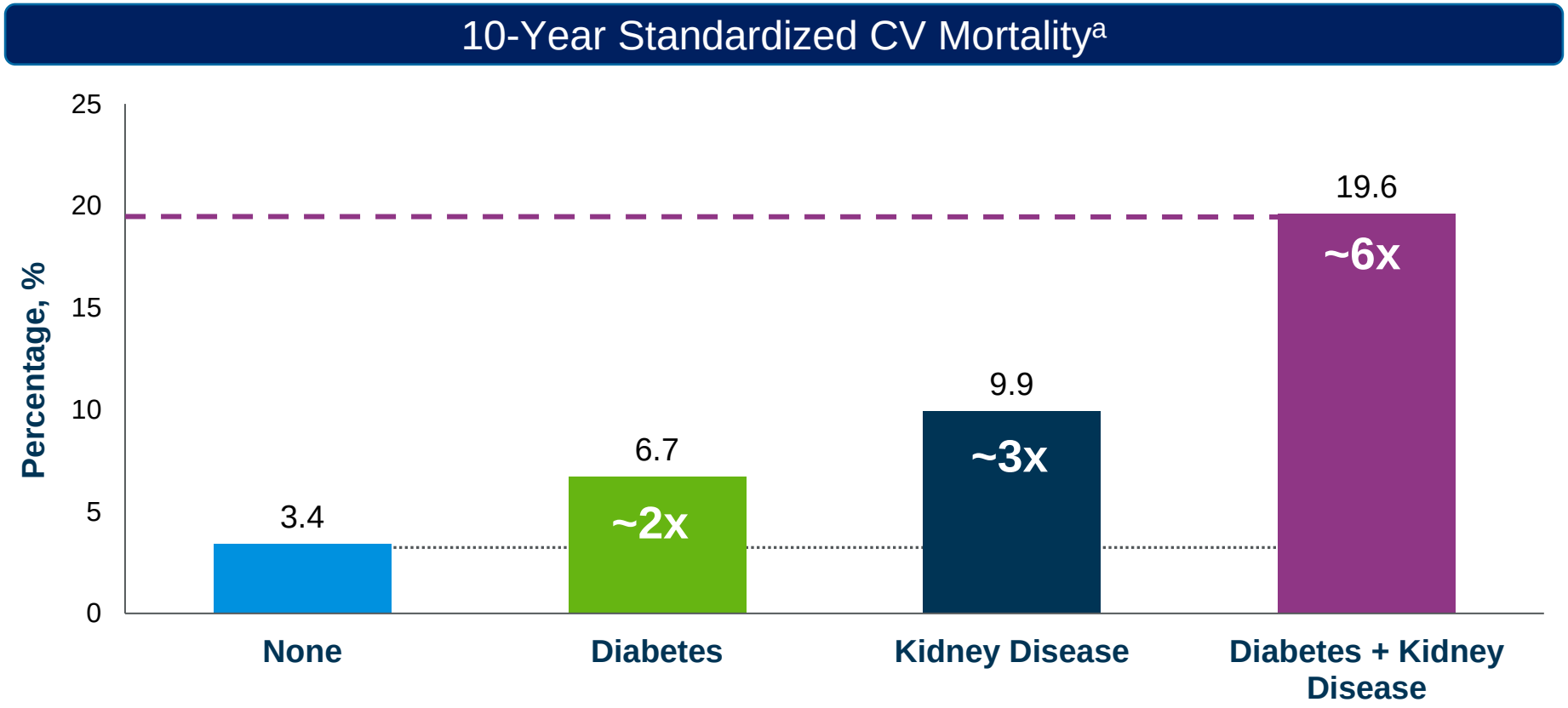
of patients with **T2D** in the United States develop CKD[3]

Patients with CKD associated with **T2D** are at **increased risk** for overall mortality and **CV-related death**[4]

CKD, chronic kidney disease; CV, cardiovascular; T2D, type 2 diabetes.

1. Kidney Disease Improving Global Outcomes Diabetes Work Group. *Kidney Int*. 2020;98(4S):S1-S115. **2.** Duru OK, et al. *Curr Diab Rep*. 2018;18:14.
3. Bailey RA, et al. *BMC Research Notes*. 2014;7:415. **4.** Afkarian M, et al. *J Am Soc Nephrol.* 2013;24(2):302-308.

Kidney Disease Approximately Triples the Risk of CV Mortality in Patients With Diabetes



Data from the NHANES III[b] study suggested that excess risk for CV mortality among patients with DM was concentrated in patients with kidney disease (defined as albuminuria, impaired eGFR, or both)

[a]N=15,046. [b]NHANES III was conducted between 1988 and 1994; this study uses data from NHANES III participants aged ≥20 years who had follow-up mortality data through 2006.

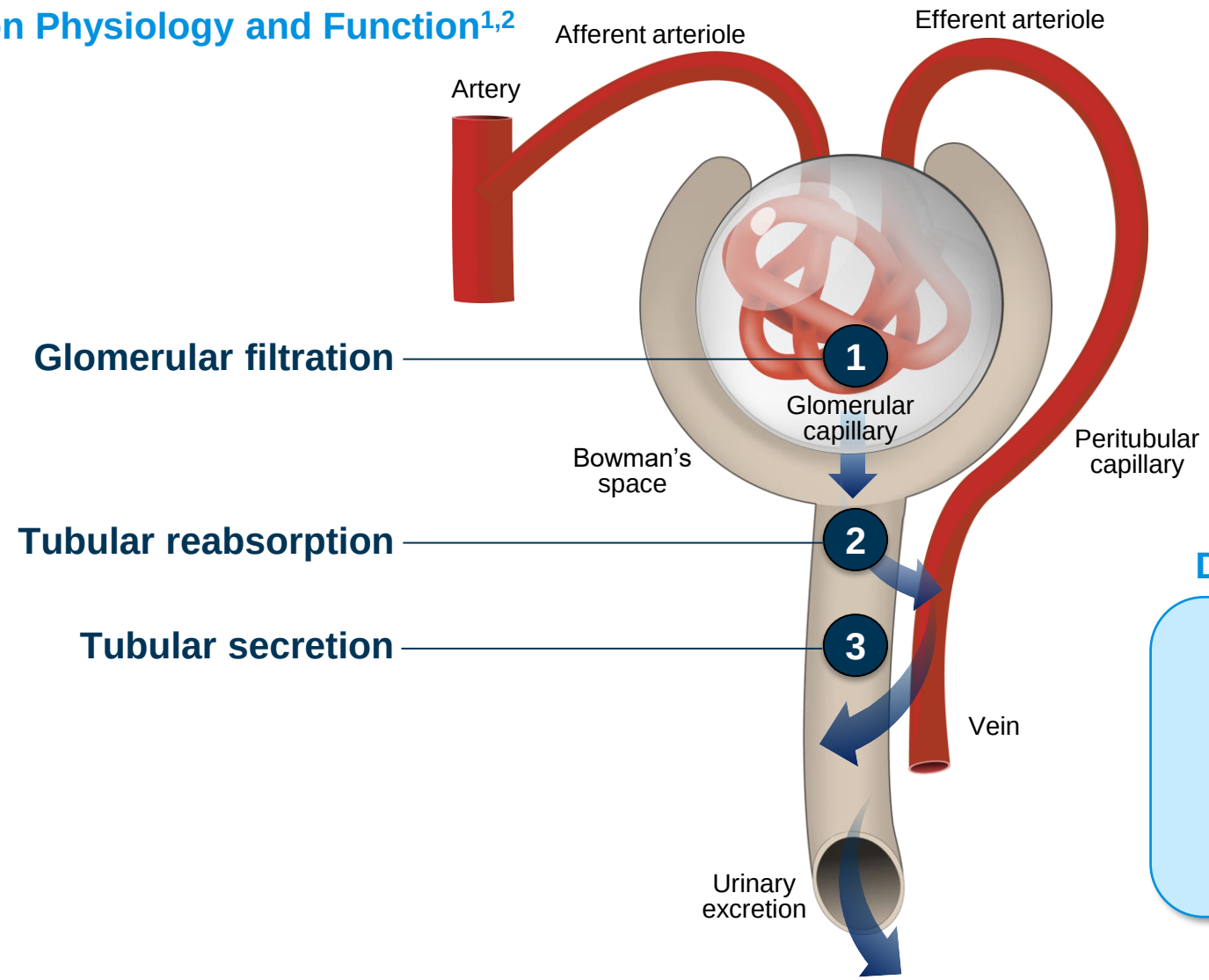
CV, cardiovascular; DM, diabetes mellitus; eGFR, estimated glomerular filtration rate; NHANES III; Third National Health and Nutritional Examination Survey.

Afkarian M, et al. *J Am Soc Nephrol*. 2013;24:302-308.

Normal Renal Function and Pathophysiology

Basic Renal Filtration Processes

Nephron Physiology and Function[1,2]



Determining Excretion Amounts[3]

Amount of substance excreted =

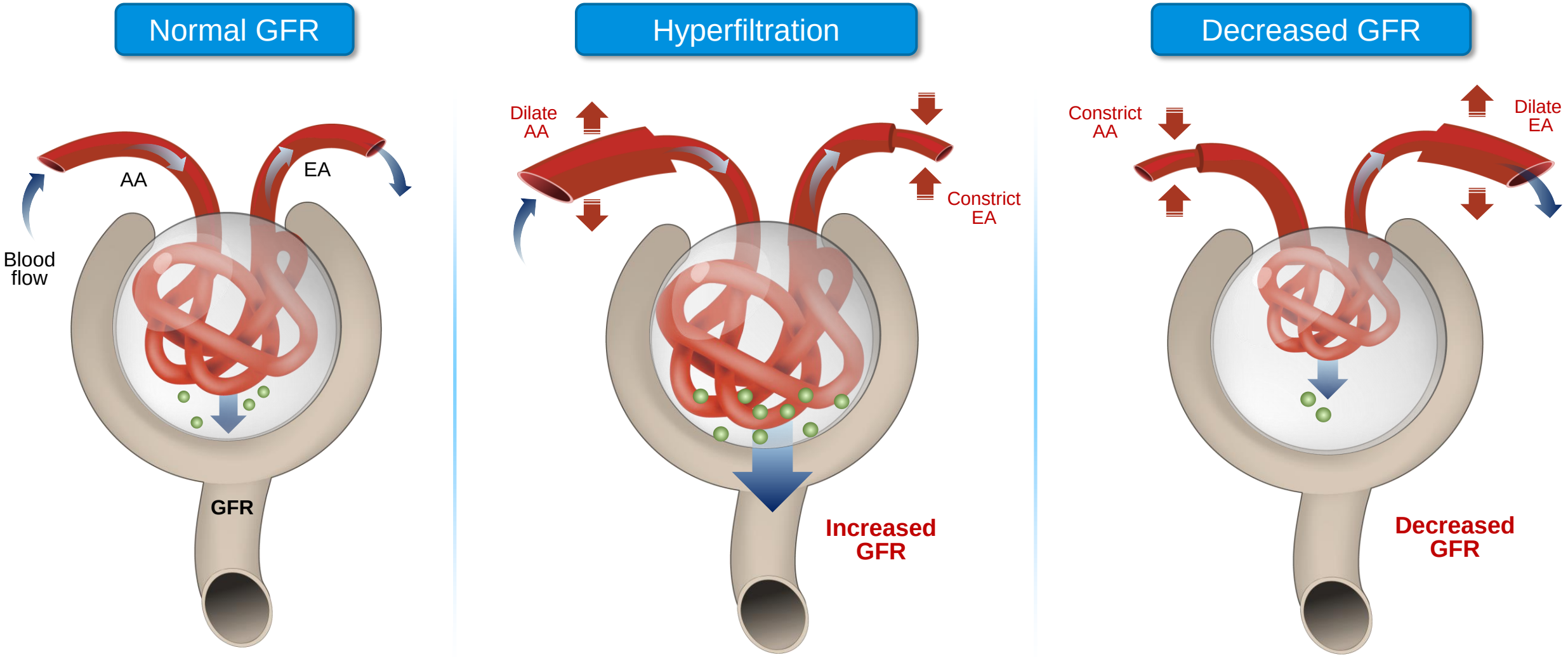
Amount filtered

– Amount reabsorbed

+ Amount secreted

1. Ogobuiro I, Tuma F. Physiology, Renal. Treasure Island (FL): StatPearls Publishing; 2021. https://www.ncbi.nlm.nih.gov/books/NBK538339/. Accessed February 15, 2022.
2. Costantini F, Kopan R. *Dev Cell*. 2010;18(5):698-712. **3.** Inker LA, et al. *Adv Chronic Kidney Dis*. 2018;25(1):67-75.

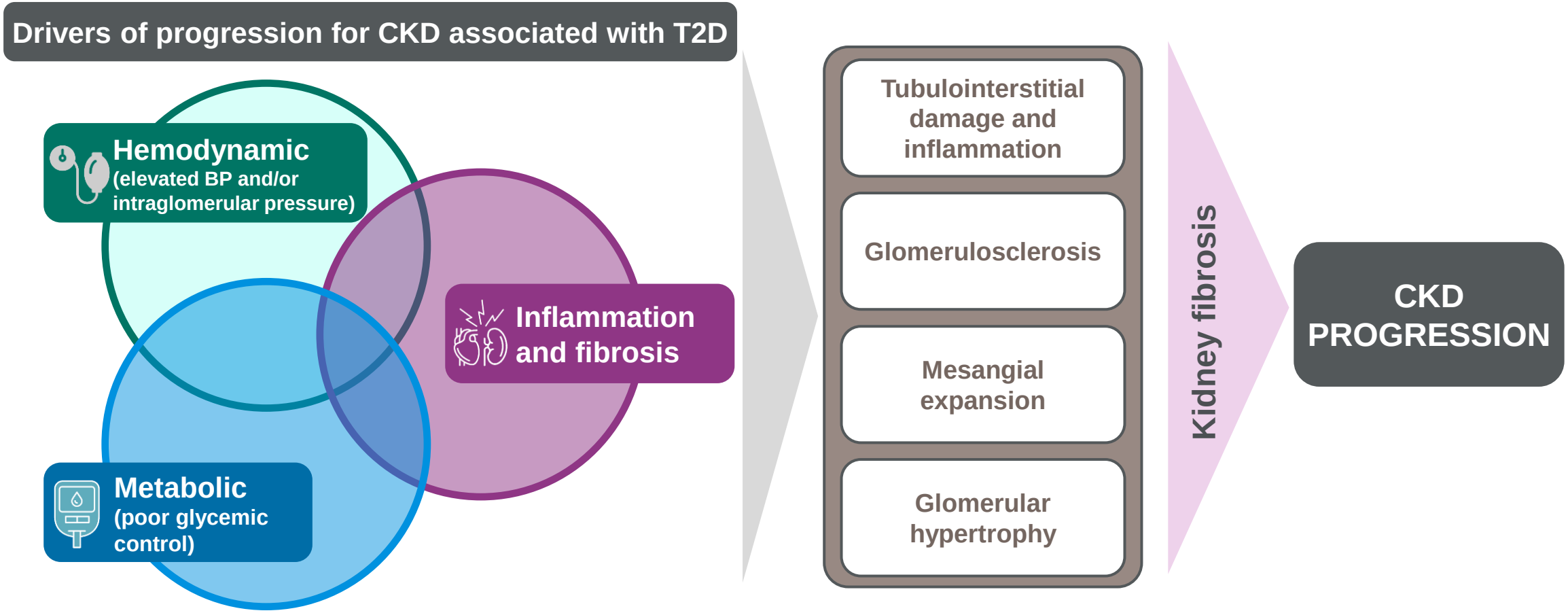
Glomerular Filtration Rate in CKD Associated With Diabetes[1,2]



AA, afferent arteriole; CKD, chronic kidney disease; EA, efferent arteriole; GFR, glomerular filtration rate.

1. Tonneijck L, et al. *J Am Soc Nephrol.* 2017;28:1023-1039. **2.** Dalal R, et al. Physiology, Renal Blood Flow and Filtration. Treasure Island (FL): StatPearls Publishing; 2021. https://www.ncbi.nlm.nih.gov/books/NBK482248/. Accessed February 15, 2022.

CKD Progression in T2D Is Driven by the Combined Effects of Metabolic, Hemodynamic, and Inflammatory and Fibrotic Factors



BP, blood pressure; CKD, chronic kidney disease; T2D, type 2 diabetes.

Alicic RZ, et al. *Clin J Am Soc Nephrol.* 2017;12:2032-2045.

Pathophysiology of Proteinuria in the Progression of CKD[1]

Renal injury/reduced nephron mass

↓

Increased glomerular capillary pressure

↓

Podocyte dysfunction/loss

↓

Increased glomerular permeability to macromolecules

↓

Increased filtration of plasma proteins

↓

Excessive tubular reabsorption

↓

Release of vasoactive and inflammatory proteins

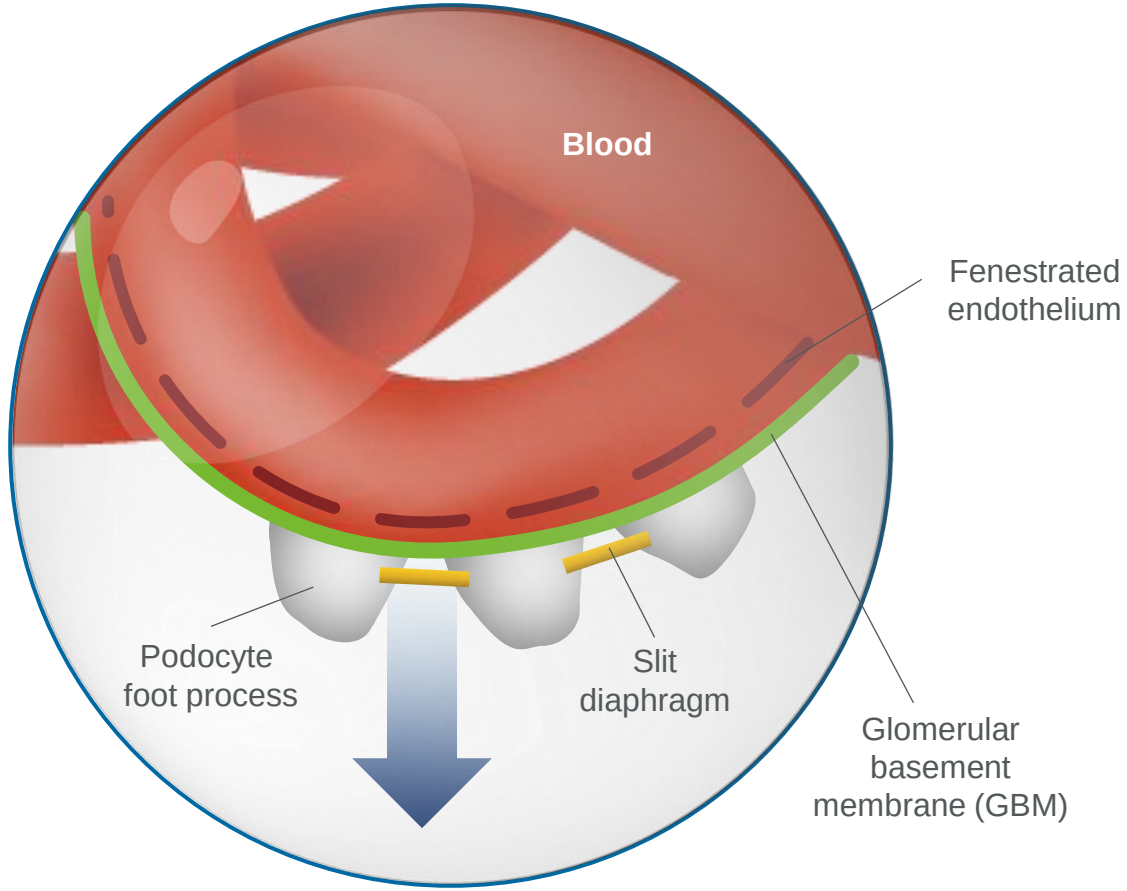
↓

Tubular cell apoptosis, monocyte infiltration, accumulation in the interstitium of extracellular matrix

↓

Scarring/GFR loss

Glomerular Filtration Barrier[2,a]



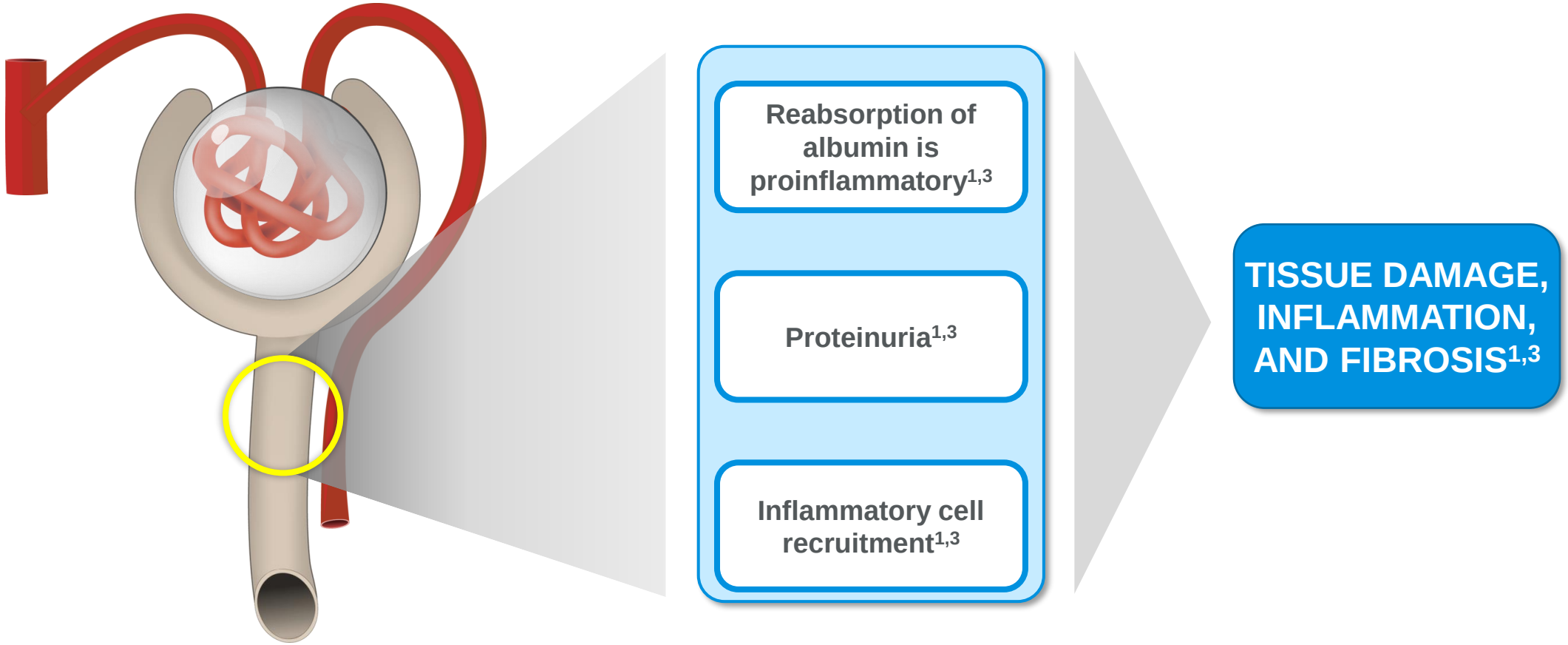
[a]Glomerular capillaries are lined by fenestrated endothelium and the GBM; on the urinary side of the GBM are podocytes with foot processes that wrap around the glomerular capillaries. The glomerular filtration barrier is a specialized molecular sieve, with properties that aid filtration of small molecules from the blood to the urine, while limiting the passage of macromolecules such as albumin.[2]

CKD, chronic kidney disease; GBM, glomerular basement membrane; GFR, glomerular filtration rate.

1. Cravedi P, Remuzzi G. *Br J Clin Pharmacol*. 2013;76(4):516-523. **2.** Kitching AR, Hutton HL. *Clin J Am Soc Nephrol.* 2016;11:1664-1674.

Albuminuria (Proteinuria) Contributes to Pathogenesis of Inflammation and Fibrosis[1]

Albuminuria Is a Marker for Early Progressive Structural Kidney Damage in Patients With T2D[2]



T2D, type 2 diabetes.

1. Abbate M, et al. *J Am Soc Nephrol*. 2006;17:2974-2984. **2.** Looker HC, et al. *J Am Soc Nephrol*. 2019;30:1049-1059. **3.** Perico N, et al. *Nat Rev Drug Discov*. 2008;7(11):936-953.

Albuminuria and CKD Disease Progression

Conceptual Model of Changes in GFR and Albuminuria Over Time in Patients with CKD Associated With Diabetes[1,2]

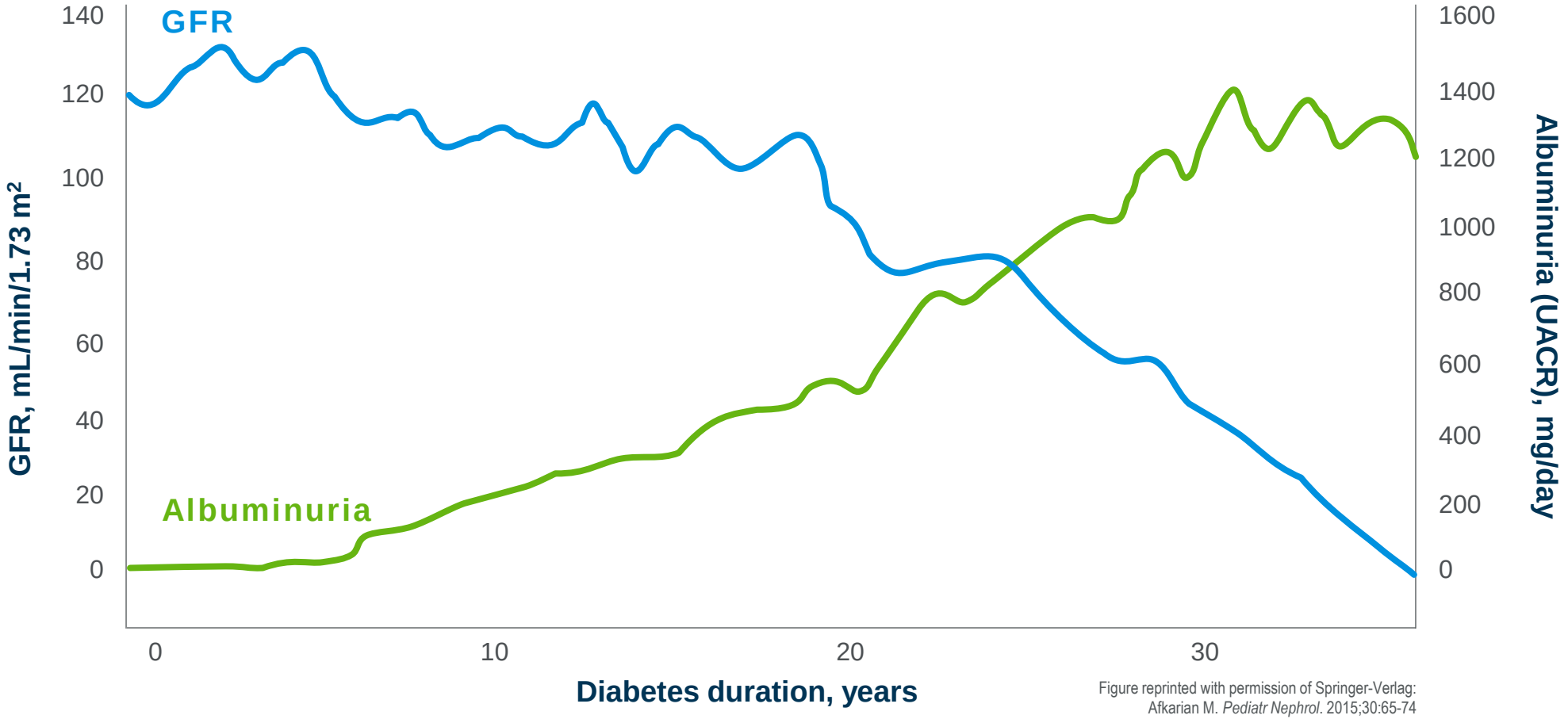


Figure reprinted with permission of Springer-Verlag: Afkarian M. *Pediatr Nephrol*. 2015;30:65-74

CKD, chronic kidney disease; GFR, glomerular filtration rate; UACR, urine albumin-to-creatinine ratio.

1. Afkarian M. *Pediatr Nephrol*. 2015;30:65-74. **2.** Pugliese G. *Acta Diabetol*. 2014;51(6):905-915.

Conceptual Model of Changes in GFR and Albuminuria Over Time in Patients with CKD Associated With Diabetes[1,2]

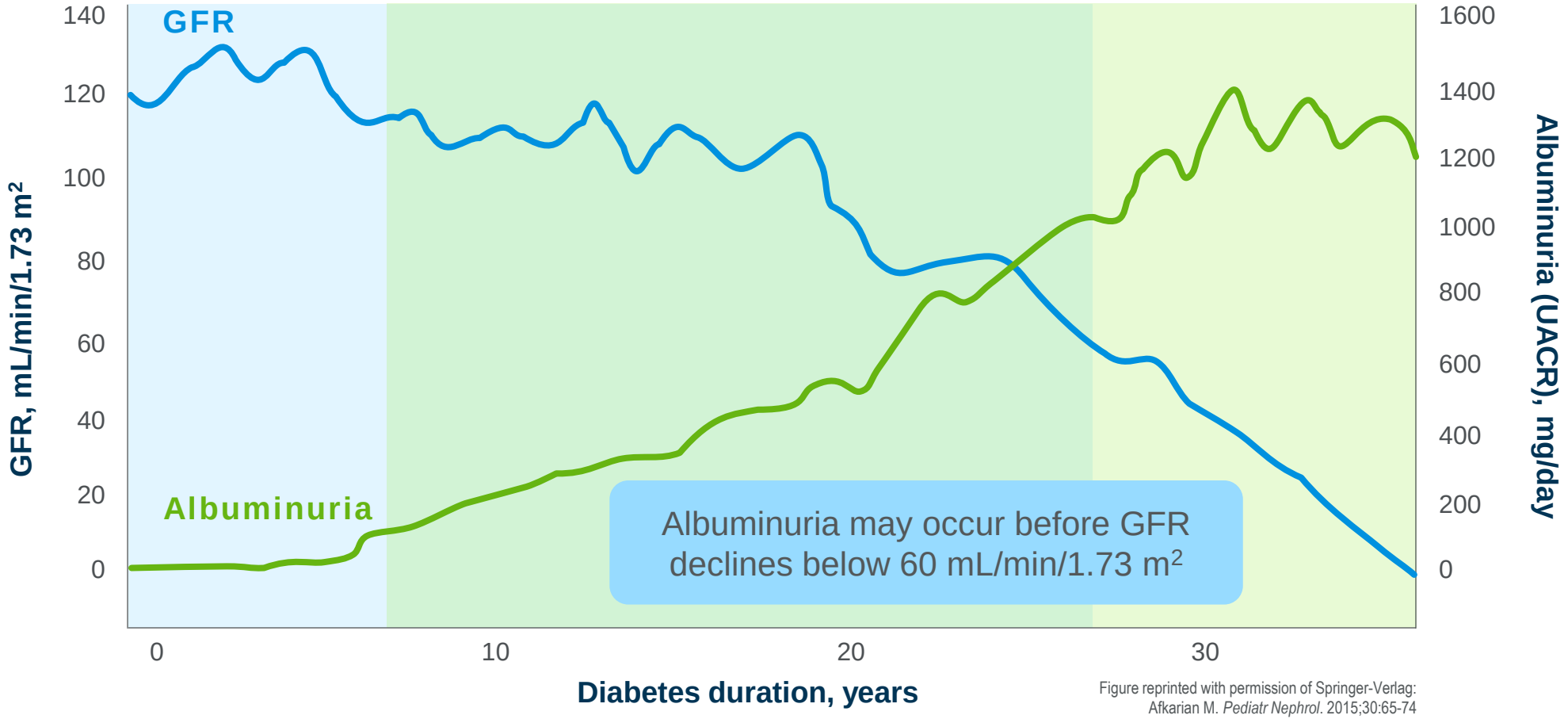


Figure reprinted with permission of Springer-Verlag: Afkarian M. *Pediatr Nephrol*. 2015;30:65-74

CKD, chronic kidney disease; GFR, glomerular filtration rate; UACR, urine albumin-to-creatinine ratio.

1. Afkarian M. *Pediatr Nephrol*. 2015;30:65-74. **2.** Pugliese G. *Acta Diabetol*. 2014;51(6):905-915.

Conceptual Model of Natural History of CKD Associated With Diabetes

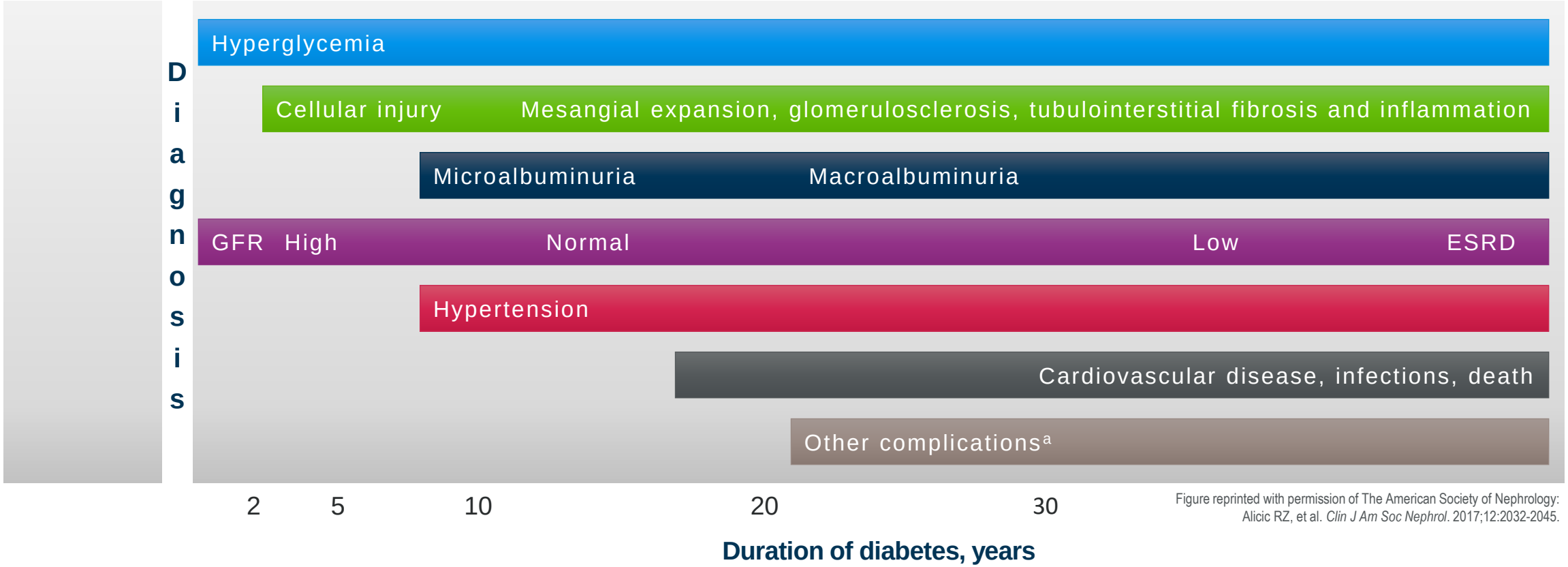


Figure reprinted with permission of The American Society of Nephrology: Alicic RZ, et al. *Clin J Am Soc Nephrol*. 2017;12:2032-2045.

Timeline is well characterized for T1D; for T2D, timeline may depart from the illustration due to the variable timing of the onset of hyperglycemia.

[a]Kidney complications: anemia, bone and mineral metabolism, retinopathy, and neuropathy.

CKD, chronic kidney disease; ESRD, end-stage renal disease; GFR, glomerular filtration rate; T1D, type 1 diabetes; T2D, type 2 diabetes.

Alicic RZ, et al. *Clin J Am Soc Nephrol*. 2017;12:2032-2045.

UACR Is an Independent Predictor of All-Cause Mortality From eGFR

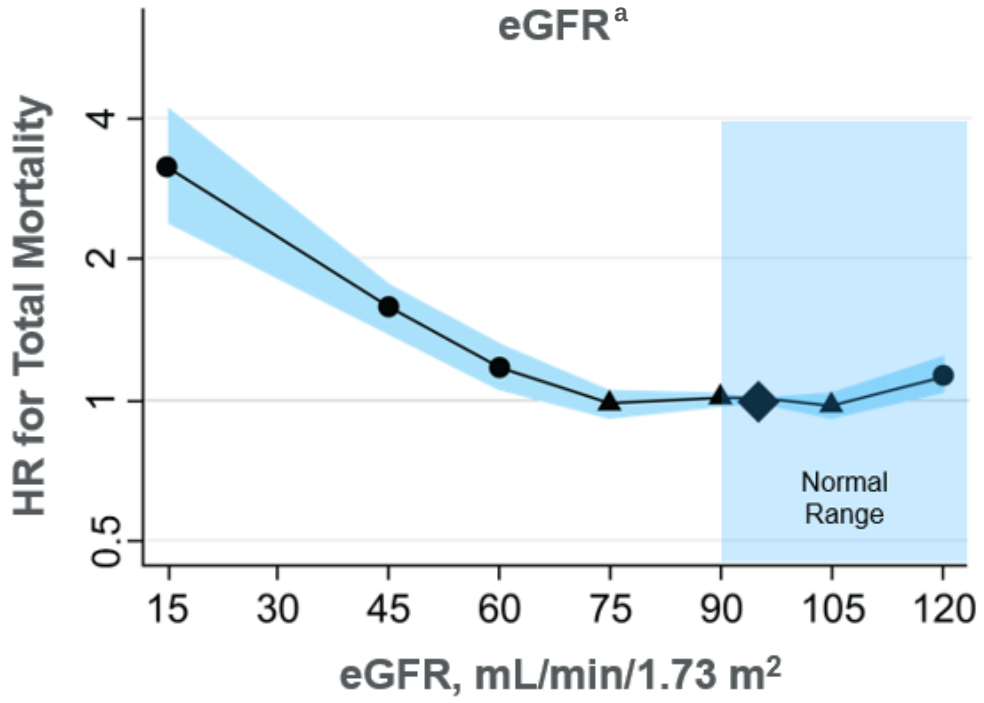


Figure reprinted with permission of Elsevier: Matsushita K, et al. *Lancet.* 2010;375:2073-2081.

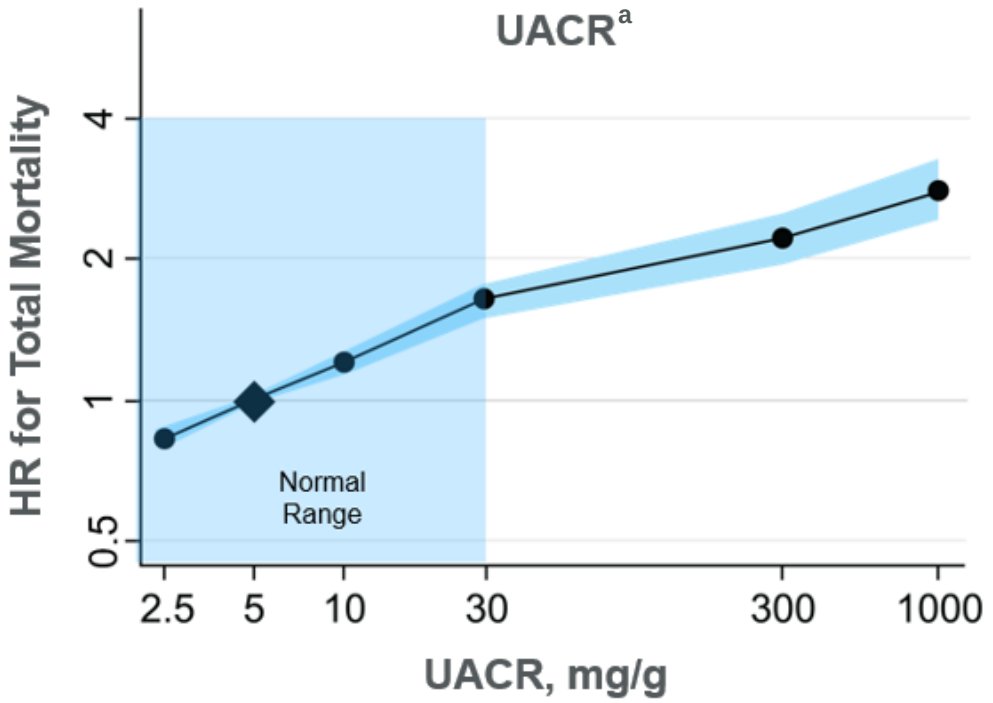
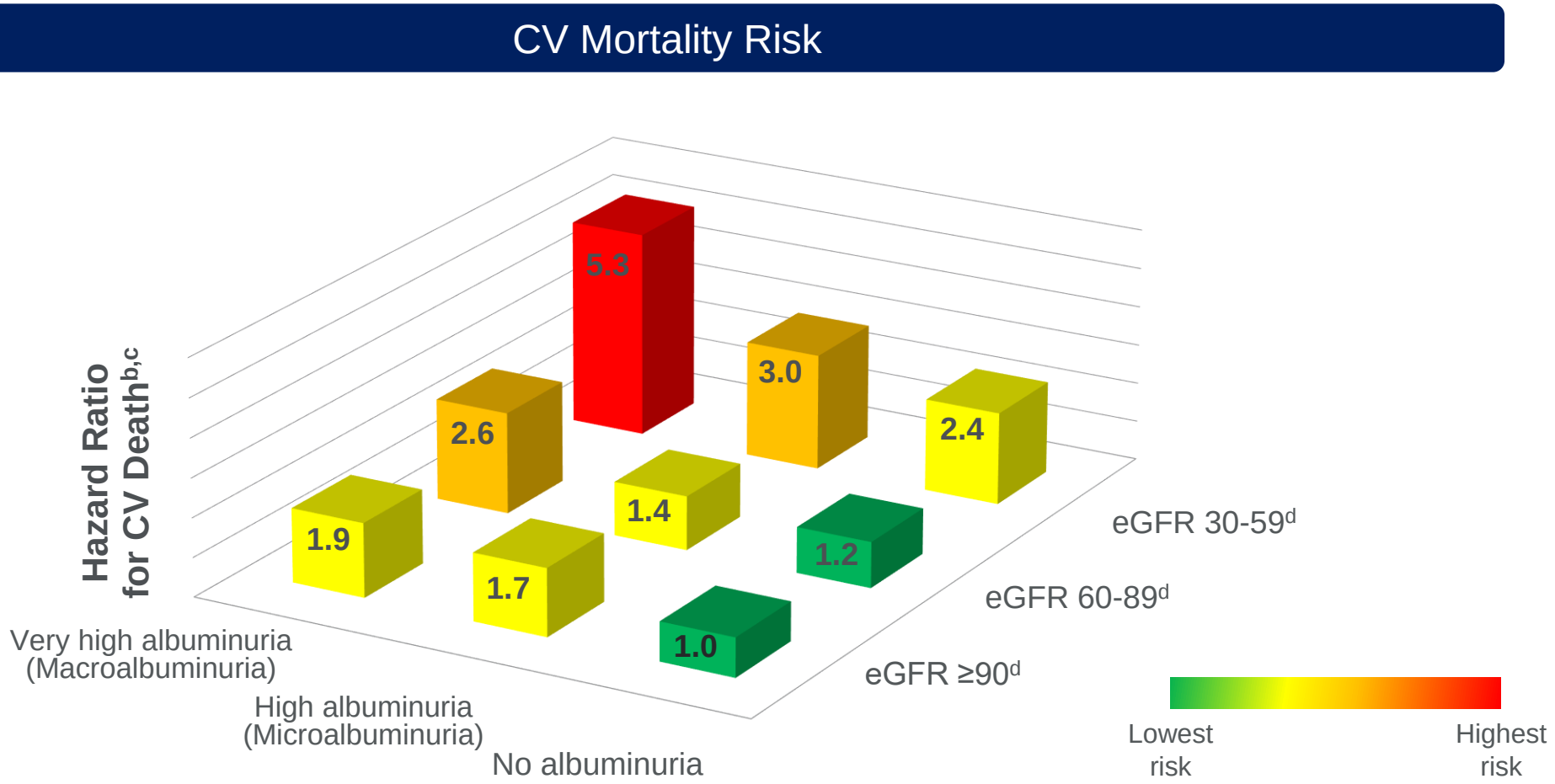


Figure reprinted with permission of Elsevier: Matsushita K, et al. *Lancet.* 2010;375:2073-2081.

Independent of each other and traditional risk factors, UACR ≥10 mg/g and eGFR <60 mL/min/1.73 m^2 were significantly associated with increased all-cause mortality

[a]Adjusted for each other (UACR or eGFR), age, gender, race, CVD history, systolic blood pressure, diabetes, smoking, and total cholesterol.
Circles represent statistically significant and triangles represent not significant.
CVD, cardiovascular disease; eGFR, estimated glomerular filtration rate; HR, hazard ratio; UACR, urine albumin-to-creatinine ratio.
Matsushita K, et al. *Lancet.* 2010;375:2073-2081.

CV Mortality Risk by Albuminuria and eGFR Status in Patients With T2D[a]



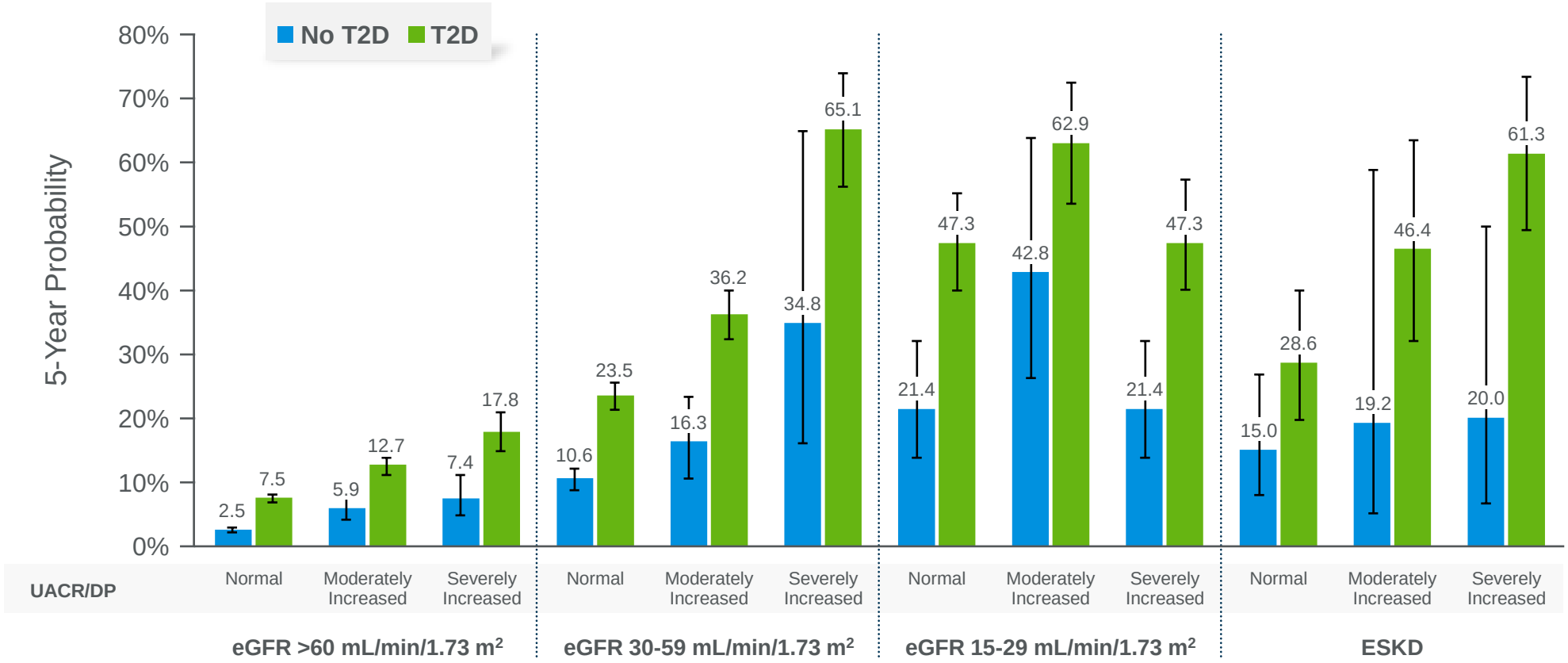
[a]N=9795. [b]Reference group has eGFR ≥90 and no albuminuria. [c]Baseline adjustment for age, sex, duration of diabetes, smoking, body mass index, systolic blood pressure, HbA1c, HDL-cholesterol, LDL-cholesterol, triacylglycerol, retinopathy, RAAS inhibition and treatment group. [d]In mL/min/1.73 m^2.

CV, cardiovascular; eGFR, estimated glomerular filtration rate; HDL, high-density lipoprotein; LDL, low-density lipoprotein; HbA1c, glycated hemoglobin; RAAS, renin–angiotensin–aldosterone system; T2D, type 2 diabetes.

Drury PL, et al. *Diabetologia.* 2011;54:32-43.

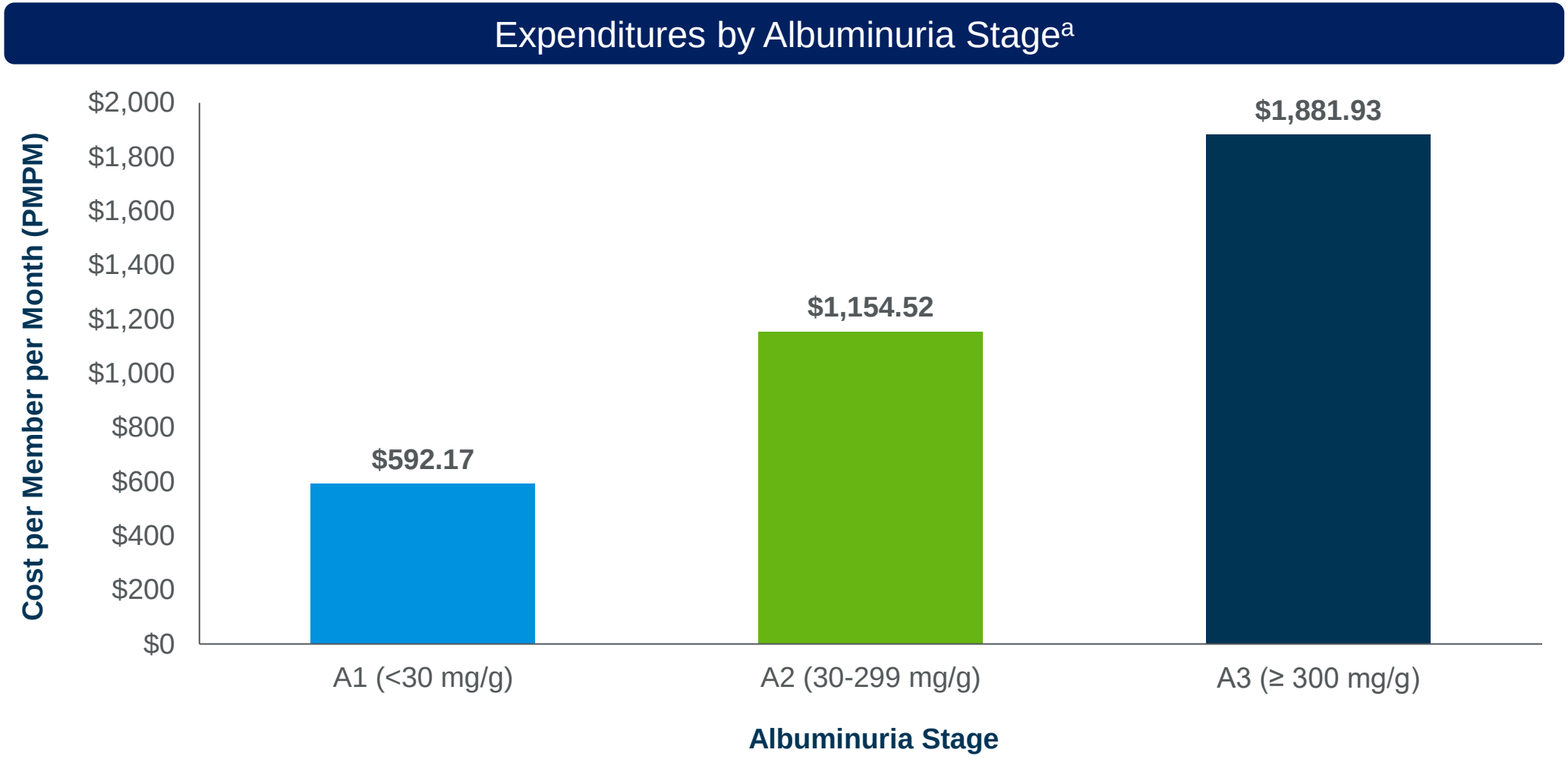
T2D and Presence of Albuminuria Are Strongly Associated With All-Cause Mortality

5-Year Probability of All-Cause Mortality in Patients With and Without T2D[a,b]



[a]Observational cohort study of 31,931 patients with diabetes and 33,201 patients without diabetes. [b]Probabilities and 95% error bars are extracted from life table analyses and are unadjusted.
DP, dipstick proteinuria; eGFR, estimated glomerular filtration rate; ESKD, end-stage kidney disease; T2D, type 2 diabetes; UACR, urine albumin-to-creatinine ratio.
Nichols GA, et al. *BMC Nephrology*. 2020;21:167. doi: 10.1186/s12882-020-01792-y.

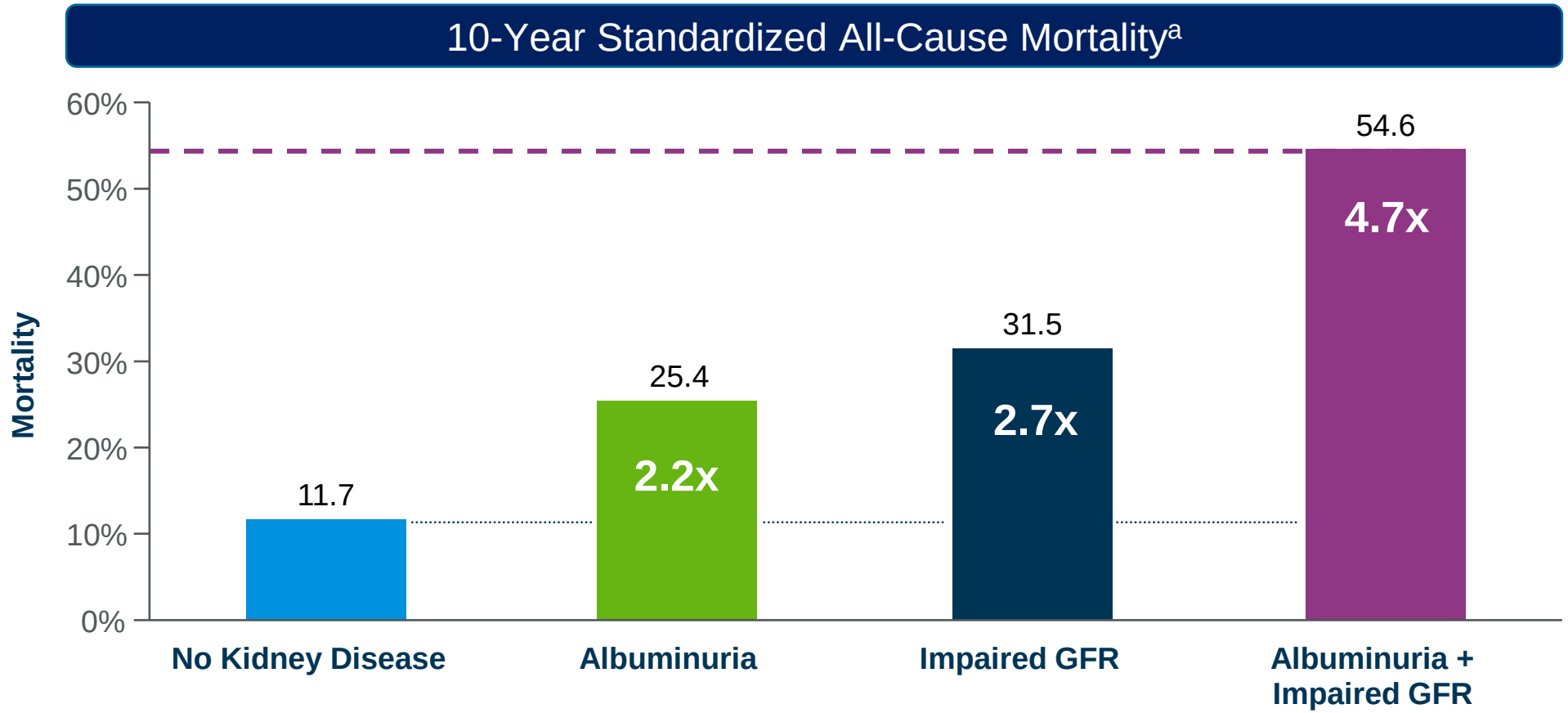
As Albuminuria Rises, Costs Multiply



[a]Data from the CareFirst and National Kidney Foundation quality improvement study, which was designed to test the impact of a CKD intervention in the primary care setting in 7420 patients at risk for CKD with diabetes and/or hypertension.

Vassalotti JA, et al. *Am J Manag Care*. 2019;25(11):e326-e333.

Albuminuria and Impaired GFR Are Independently Associated With Increased All-Cause Mortality in Patients With T2D[1,2]



[a]N=1430 T2D patients in NHANES III; all-cause mortality was standardized to age, gender, and race/ethnicity distribution of the study population.[1,2]

GFR, glomerular filtration rate; NHANES III, Third National Health and Nutrition Examination Survey; T2D, type 2 diabetes.

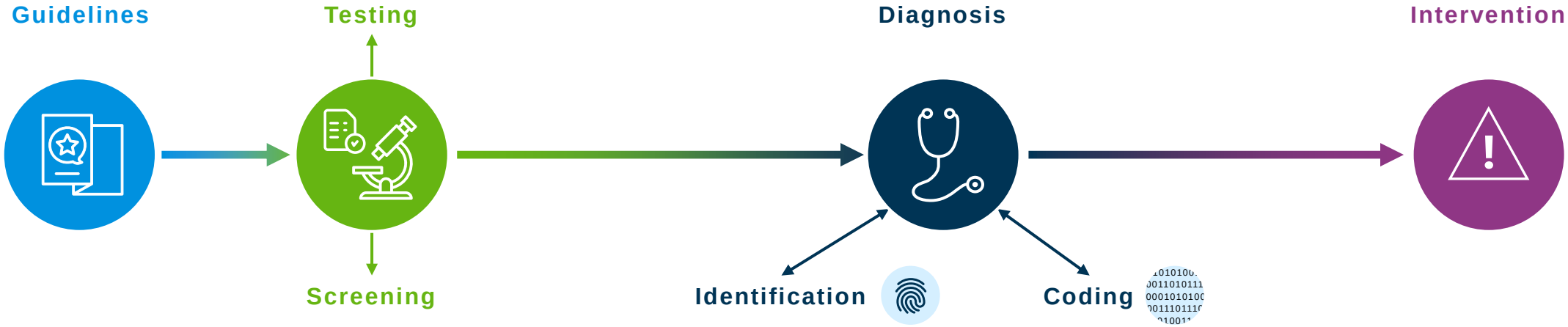
1. Afkarian M, et al. *J Am Soc Nephrol.* 2013;24:302-308. **2.** Afkarian M, et al. Supplementary Material. *J Am Soc Nephrol.* 2013;24.

Patient Awareness, Diagnostic and Coding Gaps

There Are Several Gaps Along the Pathway Between Recognizing CKD Associated With T2D and Taking Action

Overall awareness of kidney disease among patients with CKD is about 12%[1]
(CKD stages 1-5, US NHANES 2015-2018)

PATIENT AWARENESS



Many patients with CKD do not receive the appropriate tests[2]

Screening is often done less than annually in T2D patients[3]

Diagnosis of CKD is not occurring for many patients with CKD and T2D[3]

Diagnostic coding of CKD is suboptimal in Medicare beneficiaries[4]

Less than half of CKD patients take an ACEi/ARB[5,a]

[a]Study examined ACEi/ARB utilization in 38,885 participants aged ≥20 years old who had serum creatinine and UACR measurements surveyed through NHANES (1999-2014). CKD defined as eGFR <60 mL/min/1.73 m^2 or UACR ≥30 mg/g. Of 7085 participants with CKD, 34.9% used an ACEi/ARB over the study period, and 40.1% between 2011-2014.[5]

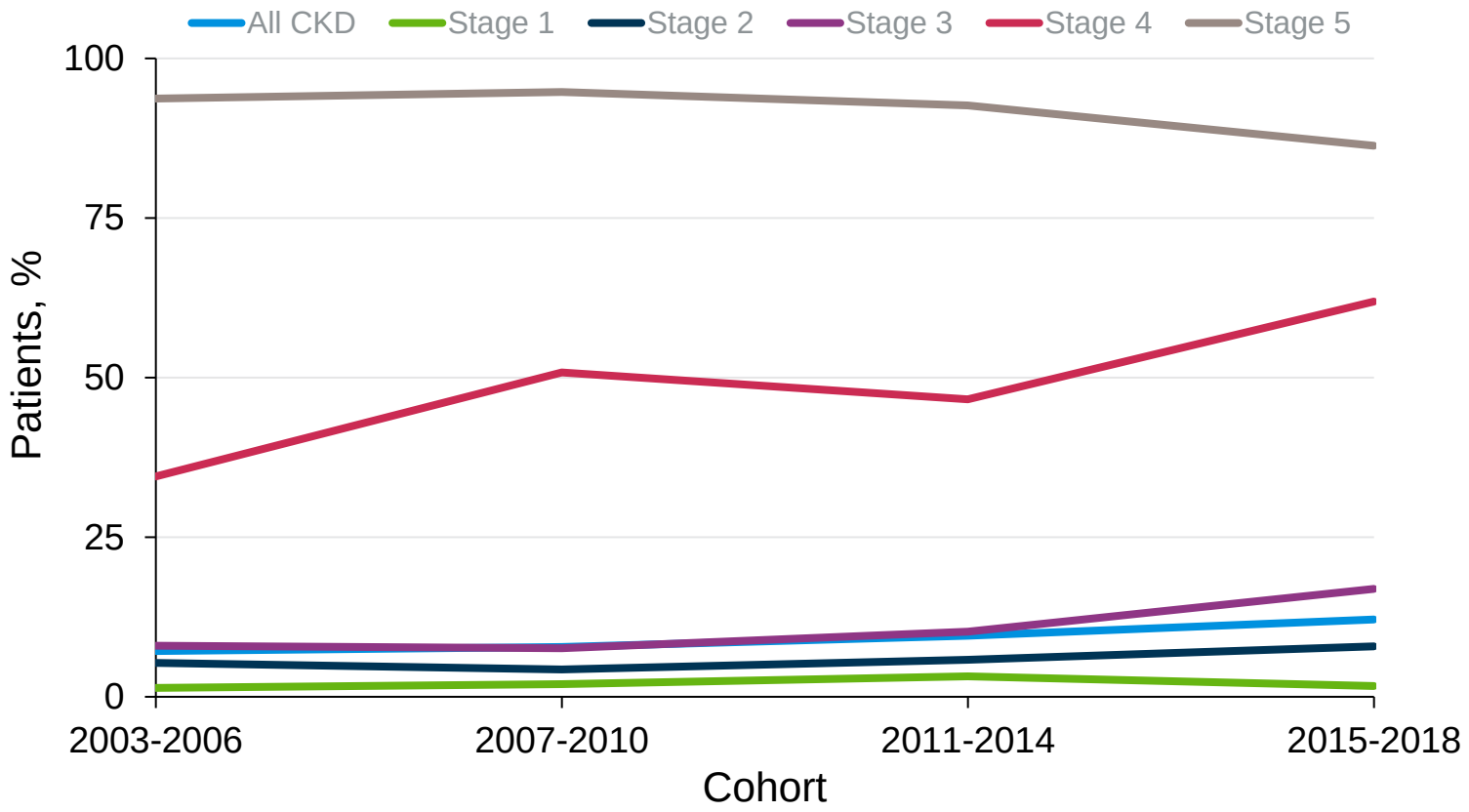
ACEi, angiotensin-converting enzyme inhibitor; ARB, angiotensin II receptor blocker; CKD, chronic kidney disease; NHANES, National Health and Nutritional Examination Survey; T2D, type 2 diabetes.

1. USRDS Annual Data Report Chapter 1, 2020. **2.** USRDS Annual Data Report Chapter 2, 2020. **3.** Szczech LA, et al. *PLoS One*. 2014;9:e110535.
4. USRDS Annual Data Report Chapter 2, 2021. **5.** Murphy DP, et al. *J Am Soc Nephrol*. 2019;30:1314-1321.

Overall Patient Awareness of CKD Remains Low, Especially in Early Stages of the Disease

Patients With CKD Aware of Their Kidney Disease

(US NHANES 2003-2018)[a]



- Overall patient awareness of CKD is about 12%
- Awareness is higher among patients with stage 4 and stage 5 disease
- There has been no systematic improvement in awareness from 2003 to 2018

The data reported here have been supplied by the United States Renal Data System (USRDS). The interpretation and reporting of these data are the responsibility of the author(s) and in no way should be seen as an official policy or interpretation of the US government.

[a]Data source: NHANES 2003-2006, 2007-2010, 2011-2014, and 2015-2018 participants age ≥20 with serum creatinine and urinary ACR. eGFR calculated using CKD-EPI equation.

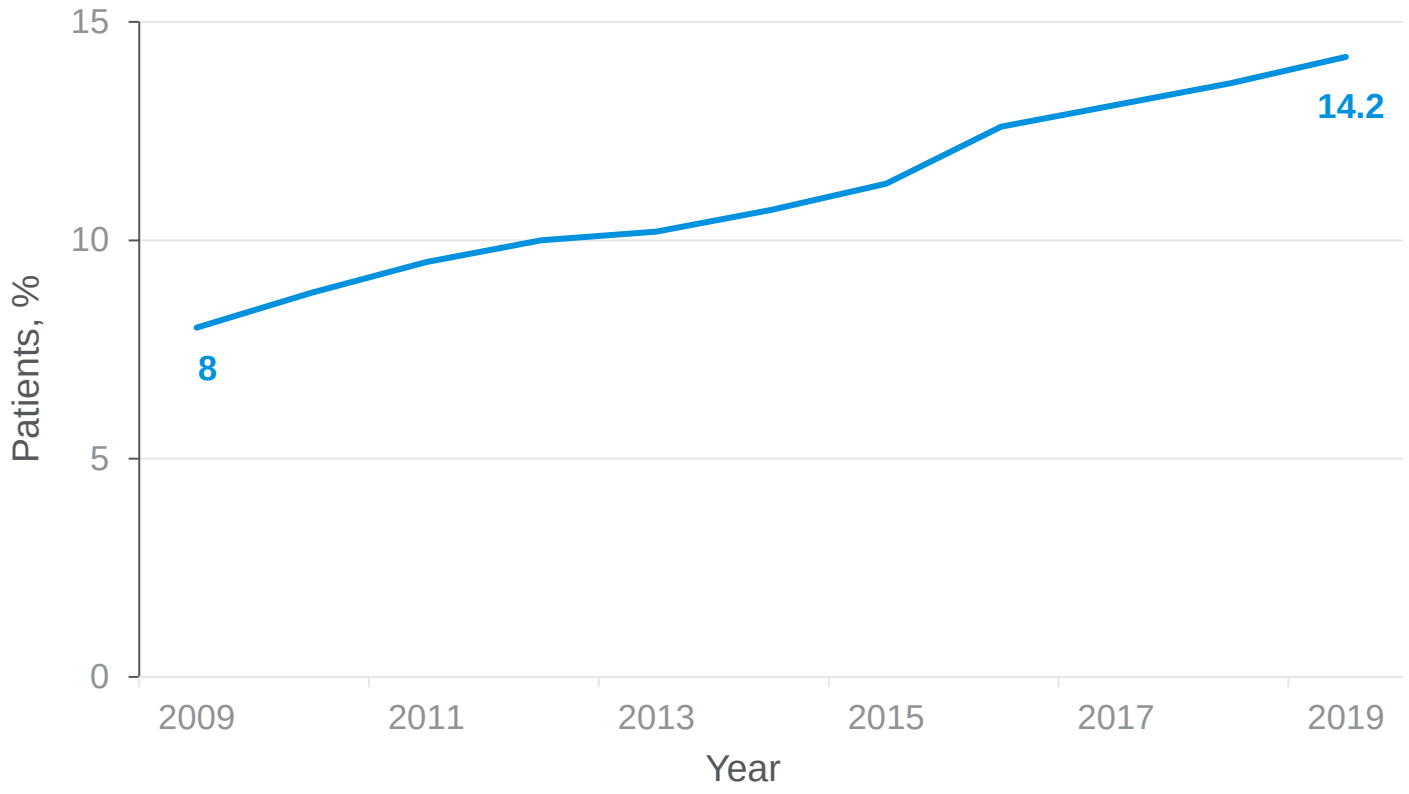
ACR, albumin-to-creatinine ratio; CKD, chronic kidney disease; CKD-EPI, Chronic Kidney Disease-Epidemiology Collaboration; eGFR, estimated glomerular filtration rate; NHANES, National Health and Nutrition Examination Survey.

USRDS Annual Data Report Chapter 1, 2020.

Prevalence of CKD Diagnosis by ICD-9-CM or ICD-10-CM Codes Has Increased, But Is Likely Underestimated

Prevalence of CKD (%) Among Medicare FFS Beneficiaries Aged ≥66 Years, 2009-2019[1]

(Medicare 5% Sample)[a]



- Prevalence of CKD diagnosed from codes used in billing claims has increased from 8.0% in 2009 to 14.2% in 2019[1]
- However, it is likely underestimated due to underutilization of ICD diagnostic codes for CKD[1,2]

The data reported here have been supplied by the United States Renal Data System (USRDS). The interpretation and reporting of these data are the responsibility of the author(s) and in no way should be seen as an official policy or interpretation of the US government.

[a]Data source: Medicare 5% sample (Medicare FFS). December 31, 2019 point prevalent enrollees aged ≥66 years (2019: N=1,275,567).[1]

CKD, chronic kidney disease; FFS, fee-for-service; ICD, International Classification of Diseases; ICD-9-CM, International Classification of Diseases, Ninth Revision, Clinical Modification; ICD-10-CM, International Classification of Diseases, Tenth Revision, Clinical Modification.

1. USRDS Annual Data Report Chapter 2, 2021. **2.** Friberg L, et al. *Clin Kidney J*. 2018;11(2):254-258.

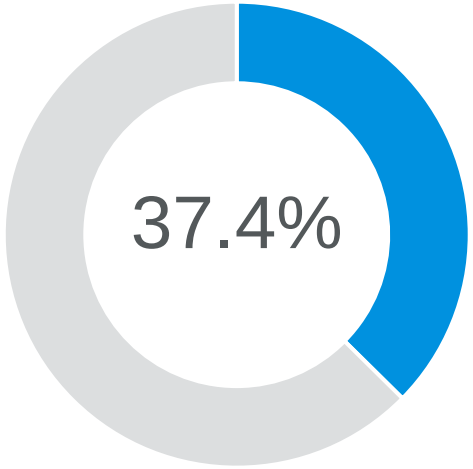
CKD Prevalence May Be Underestimated in Medicare Beneficiaries Due to Underrecognition/Undercoding of CKD

Prevalence of CKD (%) in Patients ≥66 Years, in NHANES (2015-2018) and Medicare (2019)[a]

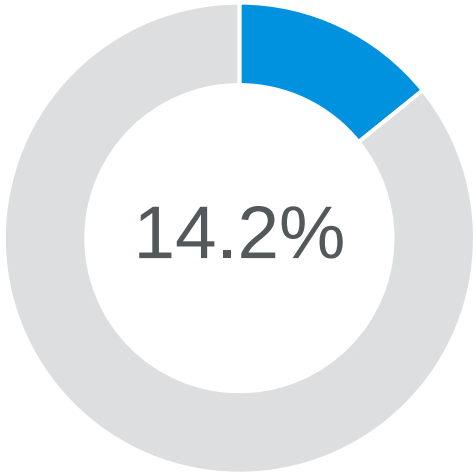
NHANES

CKD status determined by:

- Measurements of **kidney function** (eGFR and albuminuria)



Medicare



CKD status determined by:

- Presence of **diagnosis codes for CKD** from administrative claims

This large difference in prevalence suggests **underrecognition and/or undercoding of CKD** in Medicare beneficiaries

[a]Data source: Medicare 5% sample (Medicare FFS). December 31, 2019 point prevalent enrollees aged ≥66 years. NHANES, 2015-2018 participants aged ≥66 years with serum creatinine and urinary ACR measurements.

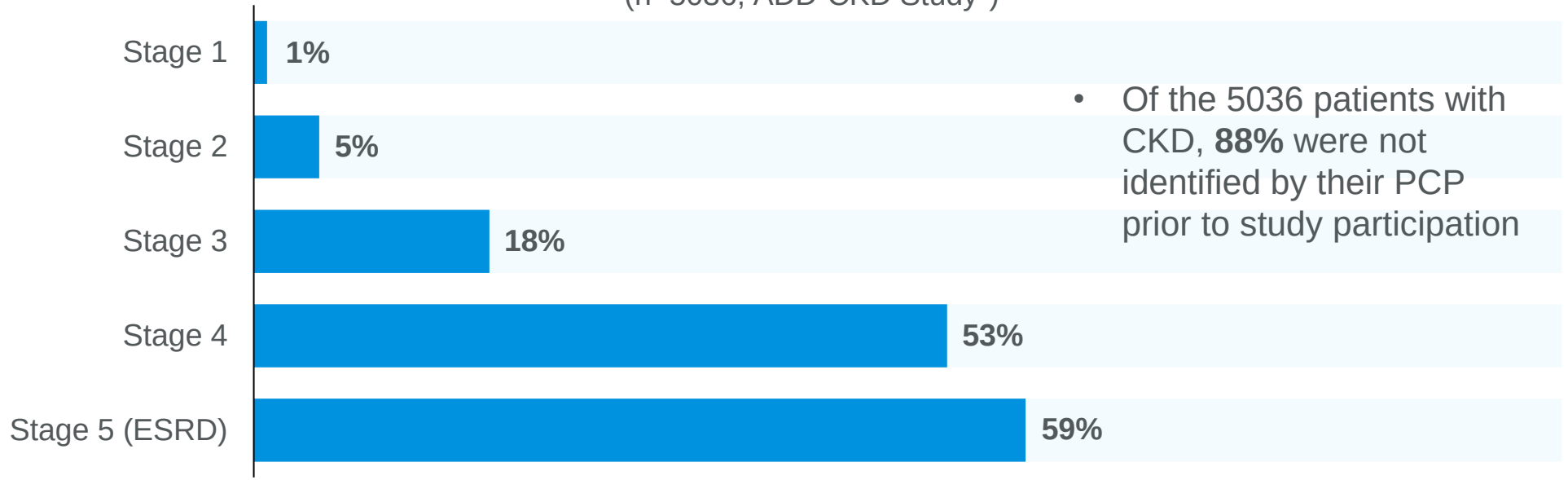
ACR, albumin-to-creatinine ratio; CKD, chronic kidney disease; eGFR, estimated glomerular filtration rate; FFS, fee-for-service; NHANES, National Health and Nutritional Examination Survey.

USRDS Annual Data Report Chapter 2, 2021.

CKD Diagnosis Is Not Occurring for Many Patients With CKD Associated With T2D

Rate of Diagnosed CKD in Patients With CKD Associated With T2D[1]

(n=5036, ADD-CKD Study[a])



- Of the 5036 patients with CKD, **88%** were not identified by their PCP prior to study participation

Accurate diagnosis and identification of CKD requires:

- Performing appropriate tests for screening, identification, and monitoring[2]
- Properly documenting the diagnosis and correctly coding the condition[3]

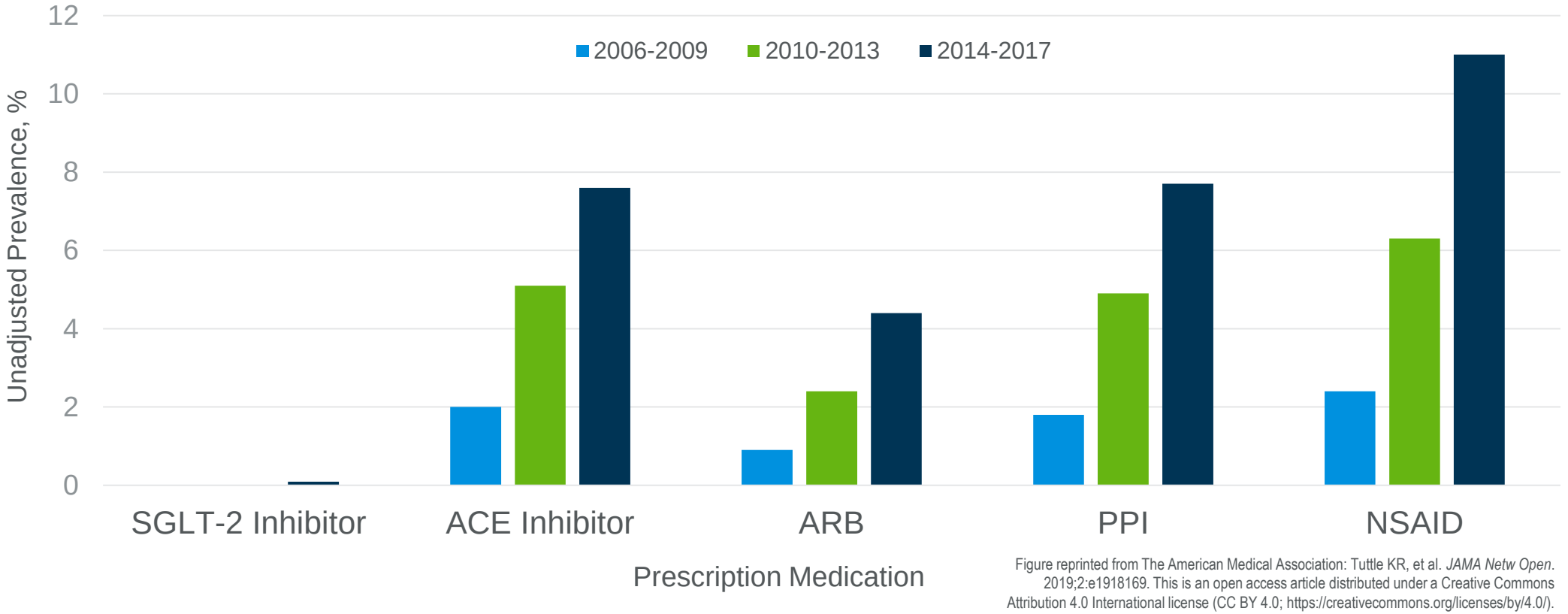
[a]Multicenter, observational, cross-sectional study conducted in 466 primary care practices in the United States between 2011 and 2012.[1]

ADD-CKD, Awareness, Detection and Drug Therapy in Type 2 Diabetes and CKD; CKD, chronic kidney disease; ESRD, end-stage renal disease; PCP, primary care provider; T2D, type 2 diabetes.

1. Szczech LA, et al. *PLoS One*. 2014;9:e110535. **2.** Tuttle KR, et al. *Diabetes Care*. 2014;37(10):2864-2883. **3.** McWaid D, et al. *CHIA Journal*. 2015;4.

Despite Increased Prevalence of Prescription Medication Use in CKD, Standard of Care Remains Underprescribed

Prevalence of Prescription Medication Use in CKD Categories 3a to 5 in 2006 to 2009, 2010 to 2013, and 2014 to 2017 in CURE-CKD Registry[a]



[a]The CURE-CKD registry is an EHR-based registry, which was jointly curated and sponsored by PSJH and UCLA health, and includes data from more than 2.6 million adults and children with CKD or at risk of CKD during 12 inclusive years.

ACE, angiotensin-converting enzyme; ARB, angiotensin II receptor blocker; CKD, chronic kidney disease; CURE-CKD, Center for Kidney Disease Research, Education, and Hope; EHR, electronic health record; NSAID, nonsteroidal anti-inflammatory drug; PPI, proton pump inhibitor; PSJH, Providence St Joseph Health; SGLT-2, sodium-glucose cotransporter-2; UCLA, University of California, Los Angeles.

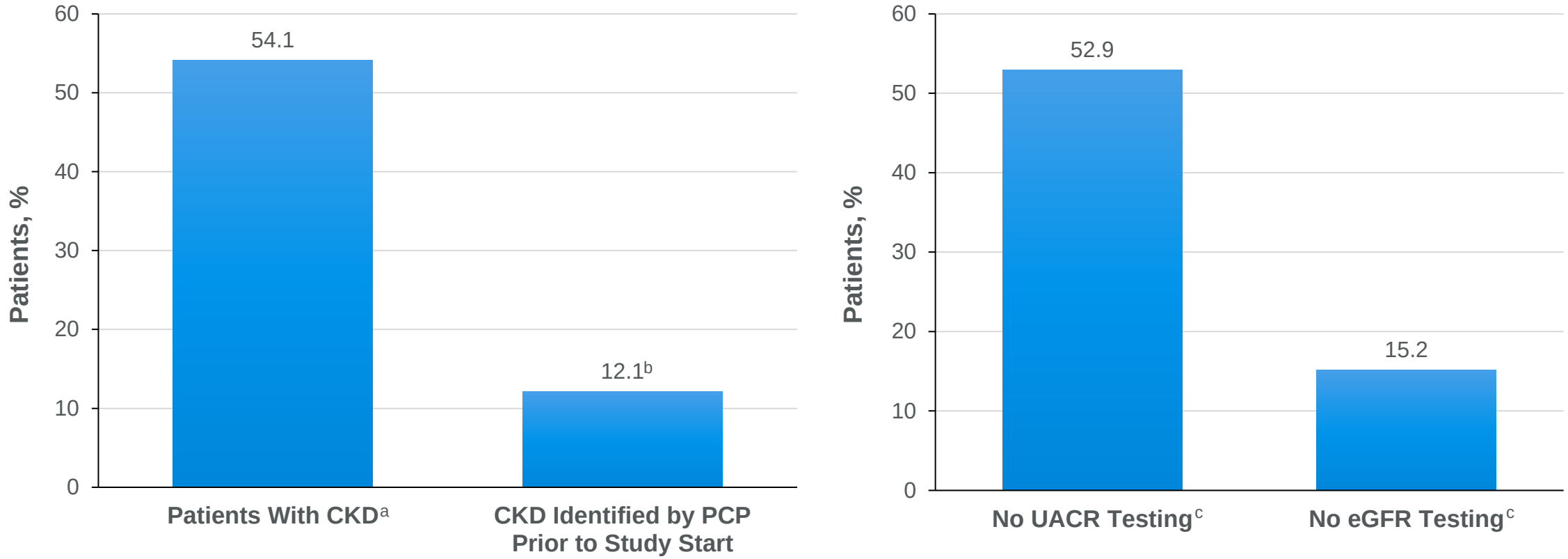
Tuttle KR, et al. *JAMA Netw Open*. 2019;2:e1918169.

Guidelines and Screening

There Are Gaps in CKD Identification in Patients With T2D Due to Underutilization of eGFR and UACR Testing

CKD Screening and Identification in Patients With T2D in the Primary Care Setting

(N=9307, ADD-CKD Study)



[a]Patients who were in true positive or false negative groups; true positive, patients who reported as diagnosed with CKD (on CKD History electronic case report form [eCRF] page) and with actual presence of CKD based on laboratory results from the study visit; false negative, patients who reported as not diagnosed with CKD (on CKD History eCRF page) and with actual presence of CKD based on laboratory results from the study visit. [b]n=607/5036 patients with CKD. [c]Based on a 15-month retrospective medical record review of a multicenter, observational, cross-sectional study conducted in the US (2011-2012) in T2D patients. ADD-CKD, Awareness, Detection and Drug Therapy in Type 2 Diabetes and CKD; CKD, chronic kidney disease; eGFR, estimated glomerular filtration rate; PCP, primary care provider; UACR, urine albumin-to-creatinine ratio; T2D, type 2 diabetes.

Szczech LA, et al. *PLoS One*. 2014;9:e110535.

GFR and Albuminuria Are Predictive of CKD Progression

Prognosis of CKD by GFR and Albuminuria Categories: *KDIGO 2012*[1]

GFR categories (mL/min/1.73 m^2) Description and range				Persistent albuminuria categories Description and range		
				A1	**A2**	**A3**
				Normal to mildly increased	Moderately increased	Severely increased
				<30 mg/g <3 mg/mmol	30-300 mg/g 3-30 mg/mmol	>300 mg/g >30 mg/mmol
	G1	Normal or high	≥90			
	G2	Mildly decreased	60-89			
	G3a	Mildly to moderately decreased	45-59			
	G3b	Moderately to severely decreased	30-44			
	G4	Severely decreased	15-29			
	G5	Kidney failure	<15			

Figure reprinted with permission of The International Society of Nephrology: Kidney Disease Improving Global Outcomes Diabetes Work Group. *Kidney Int*. 2021;99:S1-S87.

- **A2** = *microalbuminuria*[2] *(older classification system)*
- **A3** = *macroalbuminuria or proteinuria*[2] *(older classification system)*

Risk of CKD Progression[1]

- Low risk (if no other markers of kidney disease, no CKD)
- Moderately increased risk
- High risk
- Very high risk

CKD, chronic kidney disease; GFR, glomerular filtration rate; KDIGO, Kidney Disease Improving Global Outcomes.

1. Kidney Disease Improving Global Outcomes Diabetes Work Group. *Kidney Int*. 2021;99:S1-S87. **2.** Kidney Disease Improving Global Outcomes. *Kidney Int Suppl*. 2013;3:1-150.

Medical Societies Support eGFR and Albuminuria Screening in All Patients With Diabetes

	ADA (2022)	KDIGO (2021)	KDOQI (2007, 2012)
When to screen for CKD	Patients with **T1D duration ≥5 years** and **all patients with T2D** regardless of treatment should be screened **at least annually** for CKD[1] Patients with diabetes and **UACR ≥300 mg/g** and/or **eGFR 30-60 mL/min/1.73 m²** should be **monitored twice annually**[1]	Patients with **diabetes** should be screened for CKD[3] **Initiation and frequency** of CKD screening should be individualized **based on kidney and CV risk profiles and individual preferences**[3]	Patients with **T1D duration ≥5 years** and **all patients with T2D** should be screened **annually** for CKD[4]
Screening tests	**eGFR and UACR**[1]	**eGFR and UACR**[3]	**eGFR and UACR**[4]
Diagnosis	eGFR <60 mL/min/1.73 m²[a]: present for **>3 months**[1,2] **AND/OR** UACR ≥30 mg/g[b]: **2 of 3 specimens abnormal** within **3 to 6 months**[1]	Any of the following for **≥3 months**[3]: eGFR <60 mL/min/1.73 m²[c] UACR ≥30 mg/g[d]	eGFR <60 mL/min/1.73 m²: present for **>3 months**[4,5] **AND/OR** UACR ≥30 mg/g[b]: **2 of 3 specimens abnormal** within **3 to 6 months**[4]

Potential benefits of early screening include earlier detection and management to reduce/slow progression to ESRD, reduce CVD and other morbidity/mortality, improve quality of life, and reduce healthcare costs[2]

[a]Calculated from serum creatinine (CKD-EPI).[1,2] [b]With random spot urine sample.[1,4] [c]Accurate eGFR estimation includes both creatinine and cystatin C for diagnosis and staging.[3] [d]Early morning urine sample is preferred.[2]

ADA, American Diabetes Association; CKD-EPI, Chronic Kidney Disease Epidemiology Collaboration; CV, cardiovascular; CVD, cardiovascular disease; eGFR, estimated glomerular filtration rate; ESRD, end-stage renal disease; KDIGO, Kidney Disease Improving Global Outcomes; KDOQI, Kidney Disease Outcomes Quality Initiative; T1D, type 1 diabetes; T2D, type 2 diabetes; UACR, urine albumin-to-creatinine ratio.

1. American Diabetes Association. Section 11. *Diabetes Care*. 2022;45(Suppl. 1):S175-S184. **2.** Kidney Disease Improving Global Outcomes. *Kidney Int Suppl*. 2013;3:1-150.
3. Shlipak MG, et al. *Kidney International*. 2021;99:34-47. **4.** National Kidney Foundation Kidney Disease Outcomes Quality Initiative. *Am J Kidney Dis.* 2007;49(Suppl. 2):S1-S180.
5. Inker LA, et al. *Am J Kidney Dis*. 2014;63(5):713-735.

The ADA 2022 Guidelines Recommend eGFR and Albuminuria Screening at the Initial Visit and Annually in Patients With Diabetes[1]

Laboratory evaluation	Initial visit	Every follow-up visit	Annual visit
A1C, if the results are not available within the past 3 months	✓	✓	✓
If not performed/available within the past year	✓		✓
• Lipid profile, including total, LDL, and HDL cholesterol and triglycerides	✓		✓
• Liver function tests	✓		✓
• **Spot UACR**	✓		✓
• **Serum creatinine and eGFR[a]**	✓		✓
• Thyroid-stimulating hormone in patients with type 1 diabetes	✓		✓
• Vitamin B12 if on metformin	✓		✓
• Serum potassium levels in patients on ACE inhibitors, ARBs, or diuretics[a]	✓		✓

Additional Recommendations

✓ Patients with diabetes and **urinary albumin ≥300 mg/g** creatinine and/or **eGFR 30-60 mL/min/1.73 m²** should be **monitored twice annually** to guide therapy[2]

✓ Urinary albumin excretion and eGFR each vary within people over time, and abnormal results should be confirmed to stage CKD[2-4]

[a]May be needed more frequently in patients with known CKD or with changes in medications that affect kidney function and serum potassium.[1]

ACE, angiotensin-converting enzyme; ADA, American Diabetes Association; ARB, angiotensin II receptor blocker; CKD, chronic kidney disease; eGFR, estimated glomerular filtration rate; HDL, high-density lipoprotein; LDL, low-density lipoprotein; UACR, urine albumin-to-creatinine ratio.

1. American Diabetes Association. Section 4. *Diabetes Care.* 2022;45(Suppl. 1):S46-S59.
2. American Diabetes Association. Section 11. *Diabetes Care*. 2022;45(Suppl. 1):S175-S184.
3. Levey AS, et al. *JAMA*. 2015;313(8):837-846.
4. Ellam TJ. *Nephron Clin Pract.* 2011;118:c324-c330.

Kidney Health Evaluation HEDIS® Measure Aims to Improve Kidney Disease Testing in Patients With Diabetes[1]

Measure: Kidney Health Evaluation for Patients with Diabetes (KED)[2]

Description: The percentage of patients 18-85 years of age with diabetes (type 1 and type 2) who received a kidney health evaluation defined by **eGFR *and* UACR** during the measurement year[2]

NKF and NCQA partnered to develop new Kidney Health Evaluation Measure[1,a]

- First included in HEDIS® publication released July 2020, replacing previous measure that was less specific[1]
- Currently included in HEDIS® Measurement Year 2022[2]

This **claims-based measure** can[1]:

- Reveal gaps in care
- Recognize the importance of coding
- Provide a focal point for improvement for providers and health plans

HEDIS® is a registered trademark of the National Committee for Quality Assurance (NCQA).

[a]Representatives of several important stakeholder groups participated in the development of this measure including the American Diabetes Association, American Medical Group Association, Centers for Disease Control and Prevention, Indian Health Service, and the National Institute of Diabetes and Digestive and Kidney Diseases.

eGFR, estimated glomerular filtration rate; HEDIS®, Healthcare Effectiveness Data and Information Set; NCQA, National Committee for Quality Assurance; NKF, National Kidney Foundation; UACR, urine albumin-to-creatinine ratio.

1. National Committee for Quality Assurance. Kidney health: a new HEDIS measure. 2020. https://blog.ncqa.org/kidneyhealth/. Accessed January 20, 2022. **2.** Healthcare Effectiveness Data and Information Set. HEDIS MY 2022 measure descriptions. 2022. https://www.ncqa.org/wp-content/uploads/2021/12/HEDIS-MY-2022-Measure-Descriptions.pdf. Accessed January 20, 2022.

Both UACR and eGFR Are Recommended by Guidelines for Identification of CKD Progression in Patients With T2D[1]

eGFR
measures kidney function[2]

UACR
measures kidney damage[2]

When used **together**, eGFR and UACR are predictive of CKD progression in patients with CKD[1]

ADA, KDIGO, and KDOQI Guidelines:

- ✓ Recommend using both eGFR and UACR to monitor kidney health in patients with diabetes[1-3]
- ✓ Suggest routine testing in patients with diabetes can help detect CKD earlier[1-3]

⊖ **Limitations** exist when using other methods for detection of CKD in patients with T2D, such as **urine dipstick tests (less sensitive)** and **timed ACR collection (burdensome)**[1,2]

ACR, albumin-to-creatinine ratio; ADA, American Diabetes Association; CKD, chronic kidney disease; eGFR, estimated glomerular filtration rate; KDIGO, Kidney Disease Improving Global Outcomes; KDOQI, Kidney Disease Outcomes Quality Initiative; T2D, type 2 diabetes; UACR, urine albumin-to-creatinine ratio.

1. American Diabetes Association. Section 11. *Diabetes Care.* 2022;45(Suppl. 1):S175-S184. **2.** Kidney Disease Improving Global Outcomes. *Kidney Int Suppl*. 2013;3:1-150.
3. National Kidney Foundation Kidney Disease Outcomes Quality Initiative. *Am J Kidney Dis*. 2007;49(Suppl. 2):S1-S180.

Summary

- CKD associated with T2D is underrecognized and underscreened due to low patient and clinician awareness and documentation and screening barriers[1-9]
- UACR and eGFR should both be used to properly stage and monitor kidney health as eGFR alone may miss the earlier stages of CKD[10-13]
  - When used together, eGFR and UACR are predictive of CKD progression in patients with CKD
- Interventions to address modifiable barriers to CKD screening may lead to earlier detection[9]

CKD, chronic kidney disease; eGFR, estimated glomerular filtration rate; T2D, type 2 diabetes; UACR, urine albumin-to-creatinine ratio.

1. USRDS Annual Data Report Chapter 1, 2020. **2.** USRDS Annual Data Report Chapter 2, 2021. **3.** Szczech LA, et al. *PLoS One.* 2014;9:e110535. **4.** Tuttle KR, et al. *JAMA Netw Open.* 2019;2:e1918169. **5.** Zegan J. *J AHIMA.* 2018;44-45. **6.** Neale EP, et al. *BMC Nephrology*. 2020;21(83). **7.** Nicoletti B. *Fam Pract Manag.* 2018;25(2):21-25. **8.** Vest BM, et al. *J Am Board Fam Med*. 2015;28:624-631. **9.** Sperati CJ, et al. *PLoS One.* 2019;14(8):e0221325. **10.** American Diabetes Association. Section 4. *Diabetes Care.* 2022;45(Suppl. 1):S46-S59. **11.** Kidney Disease Improving Global Outcomes. *Kidney Int Suppl*. 2013;3:1-150. **12.** American Diabetes Association. Section 11. *Diabetes Care*. 2022;45(Suppl. 1):S175-S184. **13.** National Kidney Foundation Kidney Disease Outcomes Quality Initiative. *Am J Kidney Dis.* 2007;49(Suppl. 2):S1-S180.