Testing for kidney disease in type 2 diabetes: consensus statement and recommendations

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Diabetic kidney disease (DKD) is an important consideration for healthcare professionals supporting people with type 2 diabetes in primary care. An annual clinical review provides a critical opportunity for DKD screening and monitoring, using estimated glomerular filtration rate (eGFR) and urine albumin:creatinine ratio (UACR) to gain an understanding of an individual's level of adverse risk. This article aims to improve understanding of DKD and its impact, as well as the importance of screening for early identification. Key aspects of national and international clinical guidelines are explained, and useful resources are signposted. A quick-reference DKD Screening/Monitoring Tool has also been provided within the supplementary material to guide and support appropriate and timely DKD testing for all individuals with type 2 diabetes.

Diabetes is the commonest cause of chronic kidney disease (CKD) and end-stage kidney disease (ESKD; National Kidney Foundation, 2012; Renal Association, 2017). Diabetic kidney disease (DKD) is a sub-type of CKD observed in people with diabetes and a key aspect that should be prioritised alongside other cardiovascular (CV) risk factors during annual type 2 diabetes clinical reviews.

What is DKD?

DKD is a progressive condition strongly associated with adverse CV and renal outcomes, including acute kidney injury (AKI), heart disease and mortality (Afkarian et al, 2013; Winocour, 2017). A small but significant percentage of people may progress to ESKD, requiring renal replacement therapy (dialysis or kidney transplantation; Bilous, 2016).

The classical description of diabetic nephropathy (hyperglycaemia-induced glomerular disease) comprises a pattern of gradually rising urine albumin:creatinine ratio (UACR) followed by a steady reduction in estimated glomerular filtration rate (eGFR; Lewis, 2019). Other microvascular complications are usually present (e.g. retinopathy; Lewis, 2019). However, hypertension and renal atheromatous disease often coexist in diabetes and can cause varying degrees of glomerular damage, tubular fibrosis and interstitial fibrosis (Lewis, 2019). CKD can also arise from causes other than diabetes and vascular disease (Kim et al, 2018), so diabetes and CKD may coexist with no causal link (although this is rare). For practical purposes, people with type 2 diabetes and CKD can be classified as having DKD when no other basis for CKD is identified.

What are the implications of DKD?

Morbidity risk is significantly increased in people with DKD and may be comparable

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Article points

1. Diabetic kidney disease (DKD) is a serious and progressive condition associated with adverse cardiovascular (CV) and renal outcomes and mortality.
2. Screening for DKD is important in people with type 2 diabetes as early-stage disease is generally asymptomatic.
3. Declining estimated glomerular filtration rate (eGFR) and rising urine albumin:creatinine ratio (UACR) are indicative of DKD and progressive disease.
4. eGFR and UACR testing should be regarded as equally important in identifying and understanding CV and renal risk.
5. Both tests (eGFR and UACR) should be conducted annually in people with type 2 diabetes and more frequently for higher-risk individuals.

Key words

- Diabetic kidney disease
- Estimated glomerular filtration rate
- Haematuria, testing
- Pyuria
- Type 2 diabetes
- Urine albumin:creatinine ratio

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1. Timely diagnosis (through regular screening) and early treatment are important in slowing the progression of DKD.
2. eGFR measures kidney function and UACR provides an early marker of kidney damage.
3. When used together, eGFR and UACR testing improve risk stratification and diagnostic accuracy.
4. Decreasing eGFR and a persistently elevated UACR are each independent risk factors for adverse cardiorenal outcomes and mortality.

to coronary heart disease (Tziomalos and Athyros, 2015). DKD also represents a substantial economic burden; projections from a recent study utilising the 2010 Health Survey for England predict the economic burden of CKD per million individuals with diabetes to be approximately £11.4 billion by 2025 (Nguyen et al, 2018).

NICE recognises that treatment may prevent or delay the progression of DKD, reduce the onset of complications and lower the risk of CV disease (Heerspink and de Zeeuw, 2011; NICE, 2014). However, early intervention requires timely diagnosis, and screening for DKD plays a critical role in slowing disease progression (Bilous, 2016).

Detecting DKD in people with type 2 diabetes

In the early stages of DKD, there are typically no symptoms. However, early disease can be detected through regular screening. Kidney filtration function is measured using a blood test that assesses eGFR. A urinary albumin test (expressed as UACR) assesses glomerular albumin excretion. When used together, eGFR and UACR testing improve risk stratification and diagnostic accuracy (NICE, 2014).

Decreasing eGFR and a persistently elevated UACR are independent risk factors with similar weightings for important adverse outcomes and mortality (NICE, 2014; Fung et al, 2017). The rate of eGFR decline over time indicates disease progression and provides an indicator of prognosis (Perkins et al, 2011; Nojima et al, 2017). Elevated UACR is an early marker for kidney damage and for future risk of progressive disease, irrespective of the eGFR at the time of measurement (National Kidney Foundation, 2020; Heerspink et al, 2019). The risk of adverse cardiorenal outcomes is multiplied in the presence of both low eGFR and persistently elevated UACR (e.g. stroke, heart failure, ESKD; NICE, 2014).

eGFR testing

A validated formula is used to calculate an individual's eGFR based upon their serum creatinine level, age, sex and race (Renal Association, 2017). The majority of UK clinical laboratories use the Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) equation to calculate the eGFR, which is recommended by NICE (2014) and considered more accurate than the Modification of Diet in Renal Disease (MDRD) study equation. However, some laboratories have not yet switched from the MDRD to CKD-EPI equation.

UACR testing

Persistently high UACR (albuminuria), denoted by two positive tests (UACR >3 mg/mmol) over a period of three months or more, indicates the presence of kidney damage (National Kidney Foundation, 2012; Bilous, 2016).

Diagnosing kidney disease in people with type 2 diabetes

National and global guidelines on kidney disease are relevant to DKD screening and should be applied when conducting regular reviews of people with type 2 diabetes (KDIGO, 2012; NICE, 2014). Kidney Disease: Improving Global Outcomes (KDIGO; a global non-profit foundation) and NICE have each published guidance on the evaluation and management of CKD (KDIGO, 2012; NICE, 2014). The Renal Association (RA) updated relevant recommendations in 2017 and the Association of British Clinical Diabetologists (ABCD) alongside the RA also issued guidance on the management of hyperglycaemia in people with diabetes and CKD (Renal Association, 2017; Winocour et al, 2018).

UK and international recommendations for the detection and monitoring of kidney disease

Figure 1 shows the stages of CKD defined by KDIGO (2012), NICE (2014) and the RA (2017). The figure also summarises the recommended frequency of testing and additional factors that should be considered at each stage of disease (Winocour and Marshall, 1998; KDIGO, 2012; NICE, 2014). Following initial diagnosis, individuals are classified as G1–G5 and A1–A3 according to their eGFR and UACR results, respectively.

Initial assessment

Key criteria indicating a diagnosis of DKD are shown below (KDIGO, 2012; NICE, 2014; Renal Association, 2017):

- eGFR <60 mL/min/1.73 m^2 on at least two occasions, separated by a period of at least 90 days.
- UACR >3 mg/mmol – when <70 mg/mmol confirmed by repeat UACR – best done using an early morning urine (EMU) sample.

DKD should not be diagnosed on the basis of a single test result. If a new eGFR <60 mL/min/1.73 m^2 is identified, repeat eGFR testing is recommended within two weeks to exclude acute kidney injury (AKI; NICE, 2014). Where eGFR is >60 mL/min/1.73 m^2, kidney disease should only be diagnosed if another finding is present (NICE, 2014; Renal Association, 2017):

- UACR >3 mg/mmol.
- Haematuria with presumed/confirmed renal cause.
- Electrolyte abnormalities due to tubular disorders.
- Renal histological abnormalities.
- Structural abnormalities (e.g. polycystic kidneys).
- Reflux nephrology.
- History of kidney transplantation.

Frequency of testing/ongoing monitoring

NICE (2014) provides clear recommendations regarding the frequency of eGFR testing for each adverse risk category, although directions for UACR testing are less clear. Given that increased UACR correlates directly with both CV and renal risk, the DKD Testing Consensus Committee agrees with KDIGO (2012) recommendations on this topic, which suggest that UACR and eGFR should both be conducted at least annually for individuals in lower-risk categories (A1–A2 and G1–G3a) and more frequently for those in higher-risk groups (A3 and G3b–G5), as shown in *Figure 1*.

eGFR and UACR categories, risks of adverse outcomes and frequency of monitoring (number of times per year)			UACR categories (mg/mmol), description and range		
			<3 Normal to mildly increased	3–30 Moderately increased	>30 Severely increased
			A1	A2	A3
eGFR categories (mL/min/1.73 m^2), description and range	≥90 Normal and high	G1	≤1	1	≥1
	60–89 Mild reduction	G2	≤1	1	≥1
	45–59 Mild–moderate reduction	G3a	1	1	2
	30–44 Moderate–severe reduction	G3b	≤2	2	≥2
	15–29 Severe reduction	G4	2	2	3
	<15 Kidney failure	G5	4	≥4	≥4

Increasing risk

Increasing risk

Additional factors that should be considered when determining the frequency of DKD monitoring (Winocour and Marshall, 1998; KDIGO, 2012; NICE, 2014):

- Past patterns of eGFR and UACR. DKD progression is often non-linear; small fluctuations in eGFR are common and are not necessarily indicative of progression. Variability in UACR is also well recognised.
- Comorbidities (particularly heart failure).
- Changes to treatment (e.g. RAAS antagonists, NSAIDs, diuretics, SGLT2 inhibitors).
- Intercurrent illness.
- Whether the person has chosen conservative management of CKD.

CKD=chronic kidney disease; DKD=diabetic kidney disease; eGFR=estimated glomerular filtration rate; NSAID=non-steroidal anti-inflammatory drug; RAAS=renin–angiotensin–aldosterone system; SGLT2=sodium–glucose cotransporter 2; UACR=urine albumin:creatinine ratio.

Figure 1. Classification of chronic kidney disease using eGFR and UACR categories. Recommended frequency of monitoring is also provided according to risk and eGFR status. Adapted from NICE (2014).

Identifying progression

Current guidelines define markers for DKD progression as a sustained eGFR decrease ≥25% and a change in eGFR category (G1–G5) within 12 months (KDIGO, 2012; NICE, 2014; Renal Association, 2017). NICE (2014) and the RA (2017) state that a sustained eGFR decrease of ≥15 mL/min/1.73 m^2 in one year is indicative of progression. Although KDIGO (2012) defines rapid progression of disease as a sustained eGFR decrease of ≥5 mL/min/1.73 m^2 from baseline in 1 year, this magnitude of variation is often seen in clinical practice without cause for concern. The

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1. Implementation of recommended UACR testing varies considerably across UK practices.
2. The DKD Testing Consensus Committee recommends that people in moderate risk categories (A2, G1–G3a) receive both eGFR and UACR testing annually.
3. The DKD Testing Consensus Committee recommends that people in high risk categories (A3, G3b-G5) receive both eGFR and UACR testing 2–4 times per year.

DKD Testing Consensus Committee suggest, therefore, that a drop of 10 mL/min/1.73 m^2 may be more appropriate as an indication of progression in those with eGFR >60 mL/min/1.73 m^2 (including those with eGFR >90 mL/min/1.73 m^2).

If a decline in eGFR is noted, testing should be repeated within two weeks to ensure that the decline is not due to AKI and then again within 3 months (e.g. 4–8 weeks later) to confirm the new CKD stage and exclude continued rapid decline (NICE, 2014).

In addition, the DKD Testing Consensus Committee suggests that increasing UACR levels over time are important in identifying those at greatest risk of CV complications and progression of DKD.

Current testing – what is actually being achieved in practice?

Data from the National CKD Audit show that approximately 86% of people with diabetes receive annual blood tests for DKD, but only 54% have the relevant annual urine tests (Nitsch et al, 2017). Practice variation in the percentage of people with diabetes who were at risk of CKD (but not on the CKD 3–5 Register) and receiving the recommended UACR testing ranged between 0% and approximately 95% (Nitsch et al, 2017). National Diabetes Audit (NDA) data reveal that urine albumin tests are completed less frequently in general practice when compared with other key diabetes care processes (NHS Digital, 2019).

Barriers to testing

The DKD Testing Consensus Committee believes that removal of UACR testing from the Quality Outcomes Framework (QOF) incentive scheme might be responsible for observed reductions in UACR testing across England (NHS Digital, 2019; NHS England, 2019). This may have driven a perception that UACR testing is less valuable in the management of DKD, compared with eGFR testing.

DKD Testing Consensus Committee recommendations for clinical practice

The Committee has agreed on the following consensus recommendations for best practice DKD testing. The DKD Screening/Monitoring Tool is included as supplementary material, which aims to provide a practical quick-reference guide for healthcare professionals.

Initial diagnosis and categorisation of DKD severity are based upon an assessment of both eGFR and UACR, with each test providing an independent measure for risk of adverse outcomes (NICE, 2014). UACR and eGFR should be conducted at least annually for people with type 2 diabetes. Those in higher risk DKD categories should undergo screening more frequently:

- Annual testing: UACR 3–30 mg/mmol (A2) and eGFR ≥45 mL/min/1.73 m^2 (G1–G3a).
- 2–4 times per year: UACR >30 mg/mmol (A3) and eGFR <45 mL/min/1.73 m^2 (G3b–G5).

eGFR specimen requirements

Clinicians should advise individuals to arrive well-hydrated for their blood test and avoid eating high-protein meals (e.g. steak, hamburger) during the 12 hours prior to their appointment (NICE, 2014). Ensure that blood samples are received and processed within 12 hours of venepuncture.

eGFR pitfalls and cautions

It should be noted that eGFR calculation is an estimate, and a number of factors may affect the accuracy of the result, as summarised in *Table 1* (NICE, 2014). The CKD-EPI formula for eGFR under-estimates the true eGFR in obesity and type 2 diabetes (Camargo et al, 2011; Bouquengneau et al, 2013).

Calculations for eGFR assume that the level of creatinine in the blood is consistent (at steady state) and results are invalid in circumstances associated with fluctuating levels (e.g. AKI, dialysis; NICE, 2014; Renal Association, 2017). MDRD and CKD-EPI equations are invalid for individuals under 18 years of age (Renal Association, 2017). There are also pitfalls in over-diagnosing CKD in people over the age of 75 with an eGFR consistent with stage 3 CKD (Ellam et al, 2016) and when there is no other evidence of kidney disease.

Reporting and interpreting eGFR values

Sustained eGFR decline (e.g. >10 mL/min/1.73 m^2 over 1 year) should act as a flag for concern and must be raised with the local/practice diabetes lead (Winocour et al, 2020). In people of black ethnicity, apply a correction factor to eGFR values estimated using the CKD-EPI creatinine equation (multiply eGFR by 1.159; NICE, 2014). Allow variability of at least ±5% when interpreting eGFR results (NICE, 2014). In cases where eGFR is <60 mL/min/1.73 m^2, confirm the result with repeat testing (within two weeks) to exclude causes of acute deterioration of eGFR (e.g. AKI; NICE, 2014).

Interpret eGFR values ≥60 mL/min/1.73 m^2 with caution, as the accuracy of eGFR is reduced above this level (NICE, 2014). An increase in serum creatinine concentration >20% suggests decreased kidney function in people with eGFR >90 mL/min/1.73 m^2 (NICE, 2014).

Where AKI is suspected, follow NICE clinical guideline NG148 (NICE, 2019a).

Rationale for UACR testing

UACR is the recommended method for the identification and monitoring of kidney damage in people with diabetes (NICE, 2014). UACR is a more accurate measure than protein:creatinine ratio (PCR), and can help in understanding the underlying causes of renal decline (NICE, 2014; Renal Association, 2017).

UACR specimen requirements

EMU (first void) specimens are the ideal. Use plain collection tubes (usually white top). Tubes containing boric acid (typically red top) are not suitable for UACR specimens. The DKD Testing Consensus Committee recommends that all members of the local multidisciplinary team are resourced and informed to distribute the correct bottles and forms for urine collection (pharmacists, reception staff, healthcare assistants, nursing staff).

Although a first void EMU sample is preferred, a specimen collected at any time of day may be used where a timed sample is not available. Confirm true albuminuria using an EMU specimen when abnormal UACR results are obtained with a random untimed sample (KDIGO, 2012). Ensure that people with type 2 diabetes are informed that they should not collect UACR specimens during an acute illness or menstruation.

Table 1. Examples of factors that may affect accuracy of eGFR and UACR testing (Winocour and Marshall, 1998; NICE, 2014).

Factors	Potential impact on test results
eGFR testing	
Reduced muscle mass (e.g. muscle wasting, amputations)	False high
Increased muscle mass (e.g. body builders)	False low
Hypothyroidism	Overestimation/false high
Hyperthyroidism	Underestimation/false low
Dehydration	False low
Consumption of meat within 12 hours of sample provision	False low
Delayed processing of sample	False low
UACR testing*	
Exercise	False high
Acute febrile-inflammatory illness	False high
High dietary protein intake	False high
Congestive cardiac failure	False high
Menstruation or vaginal discharge	False high

*Ideally, UACR should be measured using a fresh early-morning sample.
eGFR=estimated glomerular filtration rate; UACR=urine albumin:creatinine ratio.

UACR pitfalls and cautions

UACR has marked variability, making confirmatory repeat tests important in the diagnosis and monitoring of DKD (Winocour and Marshall, 1998). UACR may be artificially high if the sample is taken under certain conditions (e.g. after exercise), as shown in *Table 1* (Winocour and Marshall, 1998). Random untimed urine specimens have an increased risk of false positive results.

Reporting and interpreting UACR values

Normal UACR (<3 mg/mmol) should be coded accordingly and monitored annually (NICE,

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1. The DKD Testing Consensus Committee believes it is good practice to assess haematuria using a dipstick/reagent strip at each annual type 2 diabetes review.
2. If urinary protein is detected using a dipstick/reagent strip, the sample should still be sent for UACR testing.
3. In cases where abnormal eGFR and UACR persist, treatment should aim to reduce cardiovascular risk, through optimised glycaemic control and blood pressure/lipid management.

2014). UACR between 3–30 mg/mmol is clinically important and must be confirmed using an EMU sample (KDIGO, 2012; NICE, 2014), given the variability of UACR values. However, UACR >10 mg/mmol should be considered unambiguously abnormal.

Individuals with UACR >70 mg/mmol do not require a repeat sample. Unless this increase is known to be caused by diabetes and already appropriately treated (e.g. optimisation of glycaemic control), refer these individuals to nephrology services (NICE, 2014). For nephrotic syndrome (ACR ≥220 mg/mmol) with a low serum albumin, an urgent renal referral is indicated (NICE, 2014).

Other testing considerations

Use dipsticks/reagent strips

NICE and the RA recognise the usefulness of reagent strips as a screening tool for haematuria, but query their sensitivity in the accurate detection of albuminuria, and KDIGO recommends that reagent strip results should be confirmed by clinical laboratory assessment (KDIGO, 2012; NICE, 2014; Renal Association, 2017).

The DKD Testing Consensus Committee believes that it is good practice to perform dipstick/reagent strip analysis for haematuria as an initial assessment at annual type 2 diabetes reviews and whenever there is a significant rise in UACR results. Reagent strip urinalysis can opportunistically reveal other findings, such as leukocytes and/or nitrites, which suggest the presence of a urinary tract infection (UTI) and protein. If protein is detected, the sample should still be sent for UACR, even if a UTI is suspected.

Assessment of haematuria

Causes of haematuria are shown in *Box 1* alongside factors associated with urine discolouration or false positive dipstick results. Refer people in appropriate age groups with persistent invisible haematuria (with/without proteinuria) for investigation for urinary tract malignancy (NICE, 2014; 2015). Painless macroscopic/visible haematuria must be urgently referred to urology, unless a definite cause for the bleeding is known (NICE, 2015).

Box 1. Key considerations when assessing haematuria.

Potential causes of haematuria

- Urological malignancy (bladder, prostate or kidney)
- Urinary tract infection
- Renal stones
- Benign prostatic disease
- Non-infected inflammatory cystitis
- Glomerulonephritis
- Other renal conditions or trauma

Unrelated factors that may cause discolouration of a urine sample

- Menstruation
- Jaundice
- Certain foods (e.g. beetroot, food colourings)
- Some types of drug (e.g. rifampicin, metronidazole, nitrofurantoin, warfarin, phenytoin)

Factors that may result in a false positive dipstick result

- Heavy bacteriuria
- Semen
- Extremely dilute urine

Use repeat testing to confirm positive results (unless high-grade haematuria [++ or above] is identified using a reagent strip) and refer to NICE (2014) guidelines for next steps.

Assessment of CKD progression

A recommendation of KDIGO and NICE is that risk stratification tools can be used for clinical practice. The Kidney Failure Risk Equation uses eGFR and UACR to define the risk of progression of CKD to end-stage renal failure. The tool can be used as an adjunct to testing in routine clinical practice and may be used for prognostic purposes (Major et al, 2019).

Management of DKD

In cases where abnormal eGFR and UACR results persist, the DKD diagnosis must be SNOMED-CT/Read coded appropriately,

Box 2. Specialist referral criteria according to NICE (2014).

eGFR and/or UACR criteria for referral

- eGFR <30 mL/min/1.73 m² (G4 or G5) – with or without diabetes
- UACR ≥70 mg/mmol – unless known to be caused by diabetes and already appropriately treated
- UACR >30 mg/mmol (A3) with haematuria
- Sustained decrease in eGFR of ≥25% and a change in eGFR category or sustained decrease in eGFR of ≥15 mL/min/1.73 m² within 12 months
- Suspected renal artery stenosis (including fall in eGFR >25% 7–10 days after starting RAAS antagonist treatment)

Other cardiovascular or renal criteria for referral

- Hypertension that remains poorly controlled despite the use of at least four antihypertensive drugs at therapeutic doses (see *NICE pathway: Hypertension*; NICE, 2019b)
- Known or suspected rare or genetic causes of CKD

and the person should be informed of their diagnosis. Aim to reduce CV risk factors through optimisation of glycaemic control, blood pressure and lipid management (NICE, 2014; Dasgupta et al, 2017; Mark et al, 2017; Winocour et al, 2018). Current guidelines recommend the optimal use of evidence-based renoprotective classes of therapy (Dasgupta et al, 2017; Davies et al, 2018).

Education for those with DKD is critical, and materials provided by organisations such as Diabetes UK (e.g. Information Prescriptions) and Kidney Care UK (e.g. CKD Health Check) are helpful and freely available online to support healthcare professionals and people with DKD (Kidney Care UK, 2017; Diabetes UK, 2020).

Referral criteria

Many people with DKD can be optimally managed in primary care. However, where appropriate and in line with local guidance, referral to specialist services may be required. The wishes of the individual and their comorbidities must be considered when assessing suitability for a referral. *Box 2* summarises the NICE (2014) criteria for specialist referral in people with kidney disease.

Driving quality improvement in clinical practice

The recommendations outlined by the DKD Testing Consensus Committee aim to enhance the quality of testing and care for people with type 2 diabetes who are at risk of developing or sustaining progression of DKD. It is important that healthcare professionals and people with type 2 diabetes recognise the equal significance of both UACR and eGFR testing in understanding and managing cardiorenal risk in DKD. These tests should be used to inform and guide clinical practice in line with the standards defined by national guidelines and will enable more individualised and effective approaches to DKD management. ■

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Declarations

Dr Peter H Winocour has received honoraria for delivering educational meetings and/or attending advisory boards for AstraZeneca, Boehringer Ingelheim, Eli Lilly, MSD,

Page points

1. Excellent educational materials on DKD are available from organisations such as Diabetes UK and Kidney Care UK.
2. Many people with DKD may manage their condition successfully with the support of their primary care team, with specialist referrals made in cases that meet local guidance and NICE criteria.
3. Referral to specialist renal services must take in to account the wishes of the individual with type 2 diabetes and any relevant comorbidities.

"Diabetic kidney disease is a sub-type of chronic kidney disease observed in people with diabetes and a key aspect that should be prioritised alongside other cardiovascular risk factors during annual type 2 diabetes clinical reviews."

Sanofi, Napp Pharmaceuticals, Novo Nordisk and Vifor Pharmaceuticals. He does not hold any shares in any pharmaceutical company.

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Consensus Committee

The DKD Testing Consensus Committee comprises a panel of clinical experts from across primary and specialist care and pharmacy services, who met with the objective of supporting quality improvement in DKD screening, diagnosis and ongoing monitoring. The Committee's goal was to provide healthcare professionals with comprehensive but succinct and practical guidance to support DKD testing in people with type 2 diabetes.

Endorsements

This document and the supplementary material have been endorsed by: Primary Care Diabetes Society (PCDS); Association of Clinical Diabetologists (ABCD); UK Clinical Pharmacy Association; TREND Diabetes; Renal Association; Association of Nephrology Nurses; and Diabetes UK (DUK).

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The following pages contain supplementary material, including a quick-reference DKD Screening/Monitoring Tool to guide and support appropriate and timely DKD testing for all individuals with type 2 diabetes.

"The recommendations outlined by the Diabetic Kidney Disease (DKD) Testing Consensus Committee aim to enhance the quality of testing and care for people with type 2 diabetes who are at risk of developing or sustaining progression of DKD."

This publication has been independently developed by the DKD Consensus Group, with medical writing services provided on behalf of the authors by Rebecca Down at Copperfox Communications Limited and Clark Healthcare Communications. Napp Pharmaceuticals has fully funded the creation of this manuscript, and has reviewed and certified it for technical accuracy.

Tips for successful testing:

To improve the reliability of the tests, the person attending their annual review should:

- Avoid exercise immediately before the test
- Ensure that they are hydrated
- Avoid eating a high-protein meal within 24 hours of the test
- Provide an early morning urine sample. If this is not possible, an untimed sample should be used

This information should be included in correspondence inviting attendance for annual diabetes reviews

Useful educational resources:

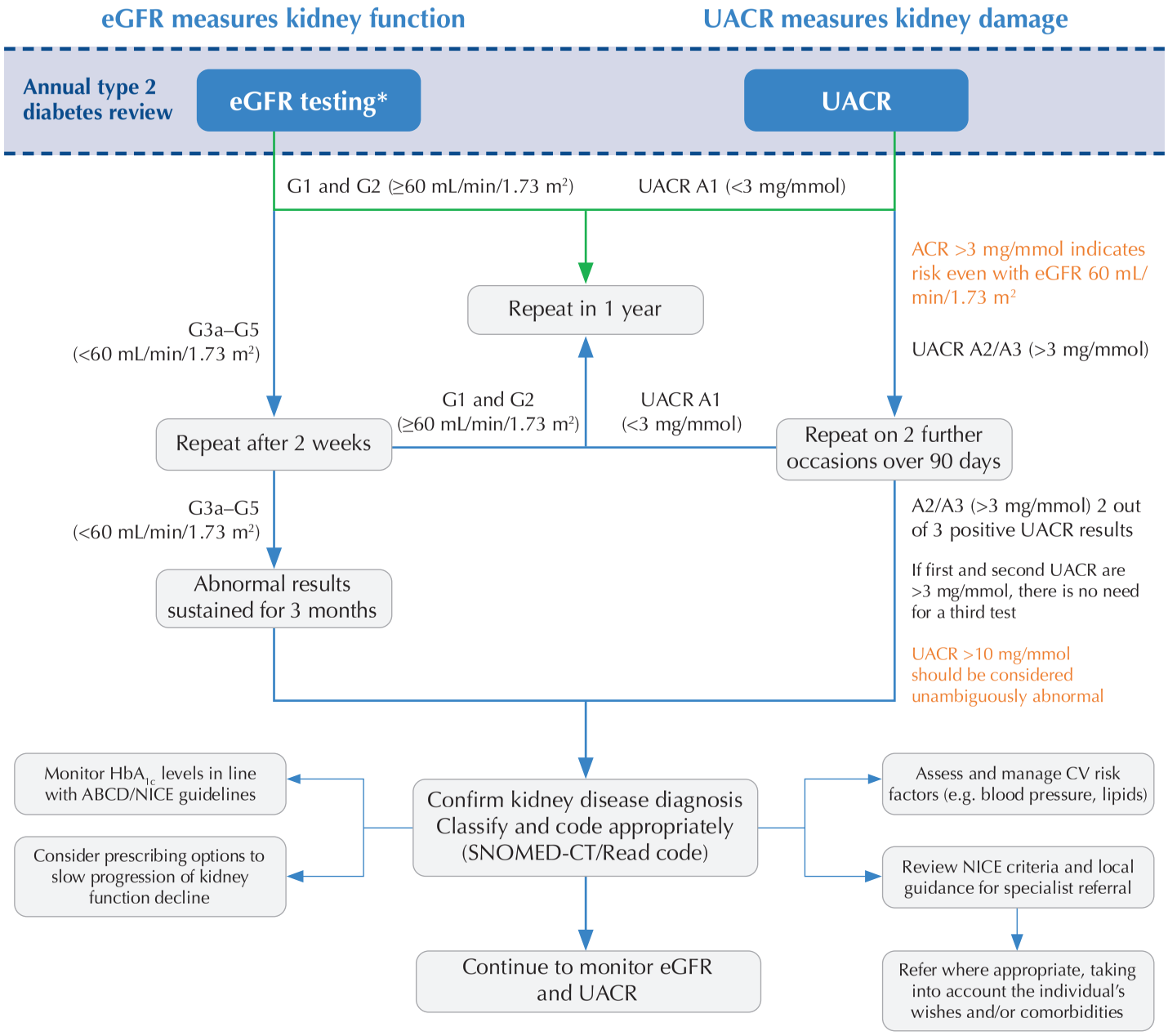
Diabetes UK:
Information Prescriptions

TREND Diabetes:
Diabetes and Your Kidneys

Kidney Care UK:
CKD Health Check

*CKD-EPI equation correction factor for people of black ethnicity (multiply eGFR by 1.159)[1]

Algorithm for diabetic kidney disease testing[1–4]



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Abbreviations: ABCD, Association of British Clinical Diabetologists; CV, cardiovascular; eGFR, estimated glomerular filtration rate; NICE, National Institute for Health and Care Excellence; UACR, urine albumin:creatinine ratio.

Quality improvement: putting the guidelines into practice

Why is it important to assess and monitor UACR and eGFR?

- Regular UACR and eGFR testing provides important indicators for renal and CV risk[1]
- Increased UACR and decreased eGFR in combination multiply the risk of adverse outcomes, including DKD progression, AKI, all-cause mortality and CV events (e.g. stroke, heart failure)[1]

Frequency of monitoring per year by eGFR and adverse risk category for people with (or at risk of) CKD[1,2]

Both UACR and eGFR should be conducted annually and more frequently for people in high-risk categories[2]

eGFR mL/min/1.73 m²	Albuminuria categories Albumin:creatinine ratio spot urine		
	A1 <3 mg/mmol	A2 3–30 mg/mmol	A3 >30 mg/mmol
G1 ≥90	≤1	1	≥1
G2 60–89	≤1	1	≥1
G3a 45–59	1	1	2
G3b 30–44	≤2	2	≥2
G4 15–29	2	2	3
G5 <15	4	≥4	≥4

Recommendations for testing frequency:

- Annual testing: UACR 3–30 mg/mmol (A2) and eGFR ≥45 mL/min/1.73 m² (G1–G3a)
- 2–4 times per year: UACR >30 mg/mmol (A3) and eGFR <45 mL/min/1.73 m² (G3b–G5)

Advice for quality improvement

- A urine dipstick test, conducted during a review, is helpful for excluding other pathologies
- All results should be reviewed by the practice Diabetes Lead to ensure continuity of care
- If an early morning urine sample is not available, a sample should be collected at the time of review. If the results of the initial test are abnormal, the repeat test should be conducted using an early morning urine sample
- Ensure all members of the local multidisciplinary team are resourced and informed to distribute the correct tubes and forms for urine collection (pharmacists, reception staff, healthcare assistants, nursing staff)
- Ensure the healthcare professionals and people attending the type 2 diabetes review are aware that the urine test is as important as the blood tests

NICE criteria for referral to specialist renal services[1,3]

- eGFR <30 mL/min/1.73 m² (G4–G5), with or without diabetes
- UACR ≥70 mg/mmol, unless known to be caused by diabetes and already appropriately treated
- UACR >30 mg/mmol (A3), together with haematuria
- Sustained decrease in eGFR of ≥25% and a change in eGFR category or sustained decrease in eGFR of ≥15 mL/min/1.73 m² within 12 months
- Hypertension that remains poorly controlled despite the use of at least four antihypertensive drugs at therapeutic doses
- Known or suspected rare or genetic causes of CKD
- Suspected renal artery stenosis

Take into account the individual's wishes and comorbidities when considering referral

Abbreviations: AKI, acute kidney injury; CKD, chronic kidney disease; CV, cardiovascular; DKD, diabetic kidney disease; eGFR, estimated glomerular filtration rate; UACR, urine albumin:creatinine ratio.

References: 1. NICE (2014) *Chronic kidney disease in adults: assessment and management* (CG182). Available at: https://nice.org.uk/guidance/cg182 (accessed 17.07.20); 2. KDIGO (2012) *Clinical practice guideline for the evaluation and management of chronic kidney disease*. Available at: https://kdigo.org/guidelines/ckd-evaluation-and-management/ (accessed 17.07.20); 3. NICE (2019) *Hypertension in adults: diagnosis and management* (NG136). Available at: https://nice.org.uk/guidance/ng136 (accessed 11.07.20)

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