

Summary of Recommendation Statements

Kidney International Supplements (2013) **3**, 5–14; doi:10.1038/kisup.2012.77

Chapter 1: Definition and classification of CKD

1.1: DEFINITION OF CKD

1.1.1: CKD is defined as abnormalities of kidney structure or function, present for > 3 months, with implications for health. (*Not Graded*)

Criteria for CKD (either of the following present for > 3 months)

Markers of kidney damage (one or more)	Albuminuria (AER \geq 30 mg/24 hours; ACR \geq 30 mg/g [\geq 3 mg/mmol]) Urine sediment abnormalities Electrolyte and other abnormalities due to tubular disorders Abnormalities detected by histology Structural abnormalities detected by imaging History of kidney transplantation
Decreased GFR	GFR < 60 ml/min/1.73 m ² (GFR categories G3a–G5)

Abbreviations: CKD, chronic kidney disease; GFR, glomerular filtration rate.

1.2: STAGING OF CKD

1.2.1: We recommend that CKD is classified based on cause, GFR category, and albuminuria category (CGA). (*1B*)

1.2.2: Assign cause of CKD based on presence or absence of systemic disease and the location within the kidney of observed or presumed pathologic-anatomic findings. (*Not Graded*)

1.2.3: Assign GFR categories as follows (*Not Graded*):

GFR categories in CKD

GFR category	GFR (ml/min/1.73 m ²)	Terms
G1	\geq 90	Normal or high
G2	60–89	Mildly decreased*
G3a	45–59	Mildly to moderately decreased
G3b	30–44	Moderately to severely decreased
G4	15–29	Severely decreased
G5	< 15	Kidney failure

Abbreviations: CKD, chronic kidney disease; GFR, glomerular filtration rate.

*Relative to young adult level

In the absence of evidence of kidney damage, neither GFR category G1 nor G2 fulfill the criteria for CKD.

1.2.4: Assign albuminuria* categories as follows (*Not Graded*):

*note that where albuminuria measurement is not available, urine reagent strip results can be substituted (Table 7)

Albuminuria categories in CKD

Category	AER (mg/24 hours)	ACR (approximate equivalent)		Terms
		(mg/mmol)	(mg/g)	
A1	< 30	< 3	< 30	Normal to mildly increased
A2	30–300	3–30	30–300	Moderately increased*
A3	> 300	> 30	> 300	Severely increased**

Abbreviations: AER, albumin excretion rate; ACR, albumin-to-creatinine ratio; CKD, chronic kidney disease.

*Relative to young adult level.

**Including nephrotic syndrome (albumin excretion usually > 2200 mg/24 hours [ACR > 2220 mg/g; > 220 mg/mmol]).

1.3: PREDICTING PROGNOSIS OF CKD

1.3.1: In predicting risk for outcome of CKD, identify the following variables: 1) cause of CKD; 2) GFR category; 3) albuminuria category; 4) other risk factors and comorbid conditions. (*Not Graded*)

- 1.3.2: In people with CKD, use estimated risk of concurrent complications and future outcomes to guide decisions for testing and treatment for CKD complications. (*Not Graded*)
- 1.3.3: In populations with CKD, group GFR and albuminuria categories with similar relative risk for CKD outcomes into risk categories. (*Not Graded*)

Prognosis of CKD by GFR and Albuminuria Categories: KDIGO 2012				Persistent albuminuria categories		
				Description and range		
				A1	A2	A3
				Normal to mildly increased <30 mg/g <3 mg/mmol	Moderately increased 30-300 mg/g 3-30 mg/mmol	Severely increased >300 mg/g >30 mg/mmol
GFR categories (ml/min/1.73 m ²) Description and range	G1	Normal or high	≥90	Green	Yellow	Orange
	G2	Mildly decreased	60-89	Green	Yellow	Orange
	G3a	Mildly to moderately decreased	45-59	Yellow	Orange	Red
	G3b	Moderately to severely decreased	30-44	Orange	Red	Red
	G4	Severely decreased	15-29	Red	Red	Red
	G5	Kidney failure	<15	Red	Red	Red

Green: low risk (if no other markers of kidney disease, no CKD); Yellow: moderately increased risk; Orange: high risk; Red, very high risk.

1.4: EVALUATION OF CKD

1.4.1: Evaluation of chronicity

- 1.4.1.1: In people with GFR < 60 ml/min/1.73 m² (GFR categories G3a-G5) or markers of kidney damage, review past history and previous measurements to determine duration of kidney disease. (*Not Graded*)
- If duration is > 3 months, CKD is confirmed. Follow recommendations for CKD.
 - If duration is not > 3 months or unclear, CKD is not confirmed. Patients may have CKD or acute kidney diseases (including AKI) or both and tests should be repeated accordingly.

1.4.2: Evaluation of cause

- 1.4.2.1: Evaluate the clinical context, including personal and family history, social and environmental factors, medications, physical examination, laboratory measures, imaging, and pathologic diagnosis to determine the causes of kidney disease. (*Not Graded*)

1.4.3: Evaluation of GFR

- 1.4.3.1: We recommend using serum creatinine and a GFR estimating equation for initial assessment. (1A)
- 1.4.3.2: We suggest using additional tests (such as cystatin C or a clearance measurement) for confirmatory testing in specific circumstances when eGFR based on serum creatinine is less accurate. (2B)
- 1.4.3.3: We recommend that clinicians (1B):
- use a GFR estimating equation to derive GFR from serum creatinine (eGFR_{creat}) rather than relying on the serum creatinine concentration alone.
 - understand clinical settings in which eGFR_{creat} is less accurate.
- 1.4.3.4: We recommend that clinical laboratories should (1B):
- measure serum creatinine using a specific assay with calibration traceable to the international standard reference materials and minimal bias compared to isotope-dilution mass spectrometry (IDMS) reference methodology.
 - report eGFR_{creat} in addition to the serum creatinine concentration in adults and specify the equation used whenever reporting eGFR_{creat}.

- report $\text{eGFR}_{\text{creat}}$ in adults using the 2009 CKD-EPI creatinine equation. An alternative creatinine-based GFR estimating equation is acceptable if it has been shown to improve accuracy of GFR estimates compared to the 2009 CKD-EPI creatinine equation.

When reporting serum creatinine:

- We recommend that serum creatinine concentration be reported and rounded to the nearest whole number when expressed as standard international units ($\mu\text{mol/l}$) and rounded to the nearest 100th of a whole number when expressed as conventional units (mg/dl).

When reporting $\text{eGFR}_{\text{creat}}$:

- We recommend that $\text{eGFR}_{\text{creat}}$ should be reported and rounded to the nearest whole number and relative to a body surface area of 1.73 m^2 in adults using the units $\text{ml/min}/1.73 \text{ m}^2$.
- We recommend $\text{eGFR}_{\text{creat}}$ levels less than $60 \text{ ml/min}/1.73 \text{ m}^2$ should be reported as “decreased.”

1.4.3.5: We suggest measuring cystatin C in adults with $\text{eGFR}_{\text{creat}} 45\text{--}59 \text{ ml/min}/1.73 \text{ m}^2$ who do not have markers of kidney damage if confirmation of CKD is required. (2C)

- If $\text{eGFR}_{\text{cys}}/\text{eGFR}_{\text{creat-cys}}$ is also $< 60 \text{ ml/min}/1.73 \text{ m}^2$, the diagnosis of CKD is confirmed.
- If $\text{eGFR}_{\text{cys}}/\text{eGFR}_{\text{creat-cys}}$ is $\geq 60 \text{ ml/min}/1.73 \text{ m}^2$, the diagnosis of CKD is not confirmed.

1.4.3.6: If cystatin C is measured, we suggest that health professionals (2C):

- use a GFR estimating equation to derive GFR from serum cystatin C rather than relying on the serum cystatin C concentration alone.
- understand clinical settings in which eGFR_{cys} and $\text{eGFR}_{\text{creat-cys}}$ are less accurate.

1.4.3.7: We recommend that clinical laboratories that measure cystatin C should (1B):

- measure serum cystatin C using an assay with calibration traceable to the international standard reference material.
- report eGFR from serum cystatin C in addition to the serum cystatin C concentration in adults and specify the equation used whenever reporting eGFR_{cys} and $\text{eGFR}_{\text{creat-cys}}$.
- report eGFR_{cys} and $\text{eGFR}_{\text{creat-cys}}$ in adults using the 2012 CKD-EPI cystatin C and 2012 CKD-EPI creatinine-cystatin C equations, respectively, or alternative cystatin C-based GFR estimating equations if they have been shown to improve accuracy of GFR estimates compared to the 2012 CKD-EPI cystatin C and 2012 CKD-EPI creatinine-cystatin C equations.

When reporting serum cystatin C:

- We recommend reporting serum cystatin C concentration rounded to the nearest 100th of a whole number when expressed as conventional units (mg/l).

When reporting eGFR_{cys} and $\text{eGFR}_{\text{creat-cys}}$:

- We recommend that eGFR_{cys} and $\text{eGFR}_{\text{creat-cys}}$ be reported and rounded to the nearest whole number and relative to a body surface area of 1.73 m^2 in adults using the units $\text{ml/min}/1.73 \text{ m}^2$.
- We recommend eGFR_{cys} and $\text{eGFR}_{\text{creat-cys}}$ levels less than $60 \text{ ml/min}/1.73 \text{ m}^2$ should be reported as “decreased.”

1.4.3.8: We suggest measuring GFR using an exogenous filtration marker under circumstances where more accurate ascertainment of GFR will impact on treatment decisions. (2B)

1.4.4: Evaluation of albuminuria

1.4.4.1: We suggest using the following measurements for initial testing of proteinuria (in descending order of preference, in all cases an early morning urine sample is preferred) (2B):

- 1) urine albumin-to-creatinine ratio (ACR);
- 2) urine protein-to-creatinine ratio (PCR);
- 3) reagent strip urinalysis for total protein with automated reading;
- 4) reagent strip urinalysis for total protein with manual reading.

1.4.4.2: We recommend that clinical laboratories report ACR and PCR in untimed urine samples in addition to albumin concentration or proteinuria concentrations rather than the concentrations alone. (1B)

1.4.4.2.1: The term microalbuminuria should no longer be used by laboratories. (Not Graded)

- 1.4.4.3: Clinicians need to understand settings that may affect interpretation of measurements of albuminuria and order confirmatory tests as indicated (*Not Graded*):
- Confirm reagent strip positive albuminuria and proteinuria by quantitative laboratory measurement and express as a ratio to creatinine wherever possible.
 - Confirm $\text{ACR} \geq 30 \text{ mg/g}$ ($\geq 3 \text{ mg/mmol}$) on a random untimed urine with a subsequent early morning urine sample.
 - If a more accurate estimate of albuminuria or total proteinuria is required, measure albumin excretion rate or total protein excretion rate in a timed urine sample.
- 1.4.4.4: If significant non-albumin proteinuria is suspected, use assays for specific urine proteins (e.g., α_1 -microglobulin, monoclonal heavy or light chains, [known in some countries as “Bence Jones” proteins]). (*Not Graded*)

Chapter 2: Definition, identification, and prediction of CKD progression

2.1: DEFINITION AND IDENTIFICATION OF CKD PROGRESSION

- 2.1.1: Assess GFR and albuminuria at least annually in people with CKD. Assess GFR and albuminuria more often for individuals at higher risk of progression, and/or where measurement will impact therapeutic decisions (see figure below). (*Not Graded*)
- 2.1.2: Recognize that small fluctuations in GFR are common and are not necessarily indicative of progression. (*Not Graded*)
- 2.1.3: Define CKD progression based on one of more of the following (*Not Graded*):
- Decline in GFR category (≥ 90 [G1], 60–89 [G2], 45–59 [G3a], 30–44 [G3b], 15–29 [G4], < 15 [G5] ml/min/1.73 m²). A certain drop in eGFR is defined as a drop in GFR category accompanied by a 25% or greater drop in eGFR from baseline.
 - Rapid progression is defined as a sustained decline in eGFR of more than 5 ml/min/1.73 m²/yr.
 - The confidence in assessing progression is increased with increasing number of serum creatinine measurements and duration of follow-up.
- 2.1.4: In people with CKD progression, as defined in Recommendation 2.1.3, review current management, examine for reversible causes of progression, and consider referral to a specialist. (*Not Graded*)

Guide to Frequency of Monitoring (number of times per year) by GFR and Albuminuria Category				Persistent albuminuria categories Description and range		
				A1	A2	A3
				Normal to mildly increased <30 mg/g <3 mg/mmol	Moderately increased 30–300 mg/g 3–30 mg/mmol	Severely increased >300 mg/g >30 mg/mmol
GFR categories (ml/min/1.73 m ²) Description and range	G1	Normal or high	≥ 90	1 if CKD	1	2
	G2	Mildly decreased	60–89	1 if CKD	1	2
	G3a	Mildly to moderately decreased	45–59	1	2	3
	G3b	Moderately to severely decreased	30–44	2	3	3
	G4	Severely decreased	15–29	3	3	4+
	G5	Kidney failure	<15	4+	4+	4+

GFR and albuminuria grid to reflect the risk of progression by intensity of coloring (green, yellow, orange, red, deep red). The numbers in the boxes are a guide to the frequency of monitoring (number of times per year).

2.2: PREDICTORS OF PROGRESSION

- 2.2.1: Identify factors associated with CKD progression to inform prognosis. These include cause of CKD, level of GFR, level of albuminuria, age, sex, race/ethnicity, elevated BP, hyperglycemia, dyslipidemia, smoking, obesity, history of cardiovascular disease, ongoing exposure to nephrotoxic agents, and others. (*Not Graded*)

Chapter 3: Management of progression and complications of CKD

3.1: PREVENTION OF CKD PROGRESSION

BP and RAAS interruption

- 3.1.1: Individualize BP targets and agents according to age, coexistent cardiovascular disease and other comorbidities, risk of progression of CKD, presence or absence of retinopathy (in CKD patients with diabetes), and tolerance of treatment as described in the KDIGO 2012 Blood Pressure Guideline. (*Not Graded*)
- 3.1.2: Inquire about postural dizziness and check for postural hypotension regularly when treating CKD patients with BP-lowering drugs. (*Not Graded*)
- 3.1.3: Tailor BP treatment regimens in elderly patients with CKD by carefully considering age, comorbidities and other therapies, with gradual escalation of treatment and close attention to adverse events related to BP treatment, including electrolyte disorders, acute deterioration in kidney function, orthostatic hypotension and drug side effects. (*Not Graded*)
- 3.1.4: We recommend that in both diabetic and non-diabetic adults with CKD and urine albumin excretion <30 mg/24 hours (or equivalent*) whose office BP is consistently >140 mm Hg systolic or >90 mm Hg diastolic be treated with BP-lowering drugs to maintain a BP that is consistently ≤140 mm Hg systolic and ≤90 mm Hg diastolic. (*1B*)
- 3.1.5: We suggest that in both diabetic and non-diabetic adults with CKD and with urine albumin excretion of ≥30 mg/24 hours (or equivalent*) whose office BP is consistently >130 mm Hg systolic or >80 mm Hg diastolic be treated with BP-lowering drugs to maintain a BP that is consistently ≤130 mm Hg systolic and ≤80 mm Hg diastolic. (*2D*)
- 3.1.6: We suggest that an ARB or ACE-I be used in diabetic adults with CKD and urine albumin excretion 30–300 mg/24 hours (or equivalent*). (*2D*)
- 3.1.7: We recommend that an ARB or ACE-I be used in both diabetic and non-diabetic adults with CKD and urine albumin excretion >300 mg/24 hours (or equivalent*). (*1B*)
- 3.1.8: There is insufficient evidence to recommend combining an ACE-I with ARBs to prevent progression of CKD. (*Not Graded*)
- 3.1.9: We recommend that in children with CKD, BP-lowering treatment is started when BP is consistently above the 90th percentile for age, sex, and height. (*1C*)
- 3.1.10: We suggest that in children with CKD (particularly those with proteinuria), BP is lowered to consistently achieve systolic and diastolic readings less than or equal to the 50th percentile for age, sex, and height, unless achieving these targets is limited by signs or symptoms of hypotension. (*2D*)
- 3.1.11: We suggest that an ARB or ACE-I be used in children with CKD in whom treatment with BP-lowering drugs is indicated, irrespective of the level of proteinuria. (*2D*)

*Approximate equivalents for albumin excretion rate per 24 hours—expressed as protein excretion rate per 24 hours, albumin-to-creatinine ratio, protein-to-creatinine ratio, and protein reagent strip results—are given in Table 7, Chapter 1.

CKD and risk of AKI

- 3.1.12: We recommend that all people with CKD are considered to be at increased risk of AKI. (*1A*)
 - 3.1.12.1: In people with CKD, the recommendations detailed in the KDIGO AKI Guideline should be followed for management of those at risk of AKI during intercurrent illness, or when undergoing investigation and procedures that are likely to increase the risk of AKI. (*Not Graded*)

Protein intake

- 3.1.13: We suggest lowering protein intake to 0.8 g/kg/day in adults with diabetes (2C) or without diabetes (2B) and GFR < 30 ml/min/ 1.73 m² (GFR categories G4-G5), with appropriate education.
- 3.1.14: We suggest avoiding high protein intake (> 1.3 g/kg/day) in adults with CKD at risk of progression. (2C)

Glycemic control

- 3.1.15: We recommend a target hemoglobin A_{1c} (HbA_{1c}) of ~7.0% (53 mmol/mol) to prevent or delay progression of the microvascular complications of diabetes, including diabetic kidney disease. (1A)
- 3.1.16: We recommend not treating to an HbA_{1c} target of <7.0% (<53 mmol/mol) in patients at risk of hypoglycemia. (1B)
- 3.1.17: We suggest that target HbA_{1c} be extended above 7.0% (53 mmol/mol) in individuals with comorbidities or limited life expectancy and risk of hypoglycemia. (2C)
- 3.1.18: In people with CKD and diabetes, glycemic control should be part of a multifactorial intervention strategy addressing blood pressure control and cardiovascular risk, promoting the use of angiotensin-converting enzyme inhibition or angiotensin receptor blockade, statins, and antiplatelet therapy where clinically indicated. (Not Graded)

Salt intake

- 3.1.19: We recommend lowering salt intake to <90 mmol (<2 g) per day of sodium (corresponding to 5 g of sodium chloride) in adults, unless contraindicated (see rationale). (1C)
- 3.1.19.1: We recommend restriction of sodium intake for children with CKD who have hypertension (systolic and/or diastolic blood pressure >95th percentile) or prehypertension (systolic and/or diastolic blood pressure >90th percentile and <95th percentile), following the age-based Recommended Daily Intake. (1C)
- 3.1.19.2: We recommend supplemental free water and sodium supplements for children with CKD and polyuria to avoid chronic intravascular depletion and to promote optimal growth. (1C)

Hyperuricemia

- 3.1.20: There is insufficient evidence to support or refute the use of agents to lower serum uric acid concentrations in people with CKD and either symptomatic or asymptomatic hyperuricemia in order to delay progression of CKD. (Not Graded)

Lifestyle

- 3.1.21: We recommend that people with CKD be encouraged to undertake physical activity compatible with cardiovascular health and tolerance (aiming for at least 30 minutes 5 times per week), achieve a healthy weight (BMI 20 to 25, according to country specific demographics), and stop smoking. (1D)

Additional dietary advice

- 3.1.22: We recommend that individuals with CKD receive expert dietary advice and information in the context of an education program, tailored to severity of CKD and the need to intervene on salt, phosphate, potassium, and protein intake where indicated. (1B)

3.2: COMPLICATIONS ASSOCIATED WITH LOSS OF KIDNEY FUNCTION

Definition and identification of anemia in CKD

- 3.2.1: Diagnose anemia in adults and children >15 years with CKD when the Hb concentration is <13.0 g/dl (<130 g/l) in males and <12.0 g/dl (<120 g/l) in females. (Not Graded)
- 3.2.2: Diagnose anemia in children with CKD if Hb concentration is <11.0 g/dl (<110 g/l) in children 0.5–5 years, <11.5 g/dl (115 g/l) in children 5–12 years, and <12.0 g/dl (120 g/l) in children 12–15 years. (Not Graded)

Evaluation of anemia in people with CKD

- 3.2.3: To identify anemia in people with CKD measure Hb concentration (Not Graded):
- when clinically indicated in people with GFR ≥ 60 ml/min/1.73 m² (GFR categories G1-G2);
 - at least annually in people with GFR 30–59 ml/min/1.73 m² (GFR categories G3a-G3b);
 - at least twice per year in people with GFR < 30 ml/min/1.73 m² (GFR categories G4-G5).

3.3: CKD METABOLIC BONE DISEASE INCLUDING LABORATORY ABNORMALITIES

- 3.3.1: We recommend measuring serum levels of calcium, phosphate, PTH, and alkaline phosphatase activity at least once in adults with GFR < 45 ml/min/1.73 m² (GFR categories G3b-G5) in order to determine baseline values and inform prediction equations if used. (1C)
- 3.3.2: We suggest not to perform bone mineral density testing routinely in those with eGFR < 45 ml/min/1.73 m² (GFR categories G3b-G5), as information may be misleading or unhelpful. (2B)
- 3.3.3: In people with GFR < 45 ml/min/1.73 m² (GFR categories G3b-G5), we suggest maintaining serum phosphate concentrations in the normal range according to local laboratory reference values. (2C)
- 3.3.4: In people with GFR < 45 ml/min/1.73 m² (GFR categories G3b-G5) the optimal PTH level is not known. We suggest that people with levels of intact PTH above the upper normal limit of the assay are first evaluated for hyperphosphatemia, hypocalcemia, and vitamin D deficiency. (2C)

Vitamin D supplementation and bisphosphonates in people with CKD

- 3.3.5: We suggest not to routinely prescribe vitamin D supplements or vitamin D analogs, in the absence of suspected or documented deficiency, to suppress elevated PTH concentrations in people with CKD not on dialysis. (2B)
- 3.3.6: We suggest not to prescribe bisphosphonate treatment in people with GFR < 30 ml/min/1.73 m² (GFR categories G4-G5) without a strong clinical rationale. (2B)

3.4: ACIDOSIS

- 3.4.1: We suggest that in people with CKD and serum bicarbonate concentrations < 22 mmol/l treatment with oral bicarbonate supplementation be given to maintain serum bicarbonate within the normal range, unless contraindicated. (2B)

Chapter 4: Other complications of CKD: CVD, medication dosage, patient safety, infections, hospitalizations, and caveats for investigating complications of CKD

4.1: CKD AND CVD

- 4.1.1: We recommend that all people with CKD be considered at increased risk for cardiovascular disease. (1A)
- 4.1.2: We recommend that the level of care for ischemic heart disease offered to people with CKD should not be prejudiced by their CKD. (1A)
- 4.1.3: We suggest that adults with CKD at risk for atherosclerotic events be offered treatment with antiplatelet agents unless there is an increased bleeding risk that needs to be balanced against the possible cardiovascular benefits. (2B)
- 4.1.4: We suggest that the level of care for heart failure offered to people with CKD should be the same as is offered to those without CKD. (2A)
- 4.1.5: In people with CKD and heart failure, any escalation in therapy and/or clinical deterioration should prompt monitoring of eGFR and serum potassium concentration. (Not Graded)

4.2: CAVEATS WHEN INTERPRETING TESTS FOR CVD IN PEOPLE WITH CKD

BNP/N-terminal-proBNP (NT-proBNP)

- 4.2.1: In people with GFR < 60 ml/min/1.73 m² (GFR categories G3a-G5), we recommend that serum concentrations of BNP/NT-proBNP be interpreted with caution and in relation to GFR with respect to diagnosis of heart failure and assessment of volume status. (1B)

Troponins

- 4.2.2: In people with GFR < 60 ml/min/1.73 m² (GFR categories G3a-G5), we recommend that serum concentrations of troponin be interpreted with caution with respect to diagnosis of acute coronary syndrome. (1B)

Non-invasive testing

- 4.2.3: We recommend that people with CKD presenting with chest pain should be investigated for underlying cardiac disease and other disorders according to the same local practice for people without CKD (and subsequent treatment should be initiated similarly). (1B)
- 4.2.4: We suggest that clinicians are familiar with the limitations of non-invasive cardiac tests (e.g., exercise electrocardiography [ECG], nuclear imaging, echocardiography, etc.) in adults with CKD and interpret the results accordingly. (2B)

4.3: CKD AND PERIPHERAL ARTERIAL DISEASE

- 4.3.1: We recommend that adults with CKD be regularly examined for signs of peripheral arterial disease and be considered for usual approaches to therapy. (1B)
- 4.3.2: We suggest that adults with CKD and diabetes are offered regular podiatric assessment. (2A)

4.4: MEDICATION MANAGEMENT AND PATIENT SAFETY IN CKD

- 4.4.1: We recommend that prescribers should take GFR into account when drug dosing. (1A)
- 4.4.2: Where precision is required for dosing (due to narrow therapeutic or toxic range) and/or estimates may be unreliable (e.g., due to low muscle mass), we recommend methods based upon cystatin C or direct measurement of GFR. (1C)
- 4.4.3: We recommend temporary discontinuation of potentially nephrotoxic and renally excreted drugs in people with a $\text{GFR} < 60 \text{ ml/min/1.73 m}^2$ (GFR categories G3a-G5) who have serious intercurrent illness that increases the risk of AKI. These agents include, but are not limited to: RAAS blockers (including ACE-Is, ARBs, aldosterone inhibitors, direct renin inhibitors), diuretics, NSAIDs, metformin, lithium, and digoxin. (1C)
- 4.4.4: We recommend that adults with CKD seek medical or pharmacist advice before using over-the-counter medicines or nutritional protein supplements. (1B)
- 4.4.5: We recommend not using herbal remedies in people with CKD. (1B)
- 4.4.6: We recommend that metformin be continued in people with $\text{GFR} \geq 45 \text{ ml/min/1.73 m}^2$ (GFR categories G1-G3a); its use should be reviewed in those with $\text{GFR} 30\text{--}44 \text{ ml/min/1.73 m}^2$ (GFR category G3b); and it should be discontinued in people with $\text{GFR} < 30 \text{ ml/min/1.73 m}^2$ (GFR categories G4-G5). (1C)
- 4.4.7: We recommend that all people taking potentially nephrotoxic agents such as lithium and calcineurin inhibitors should have their GFR, electrolytes and drug levels regularly monitored. (1A)
- 4.4.8: People with CKD should not be denied therapies for other conditions such as cancer but there should be appropriate dose adjustment of cytotoxic drugs according to knowledge of GFR. (Not Graded)

4.5: IMAGING STUDIES

- 4.5.1: Balance the risk of acute impairment in kidney function due to contrast agent use against the diagnostic value and therapeutic implications of the investigation. (Not Graded)

Radiocontrast

- 4.5.2: We recommend that all people with $\text{GFR} < 60 \text{ ml/min/1.73 m}^2$ (GFR categories G3a-G5) undergoing elective investigation involving the intravascular administration of iodinated radiocontrast media should be managed according to the *KDIGO Clinical Practice Guideline for AKI* including:
- Avoidance of high osmolar agents (1B);
 - Use of lowest possible radiocontrast dose (Not Graded);
 - Withdrawal of potentially nephrotoxic agents before and after the procedure (1C);
 - Adequate hydration with saline before, during, and after the procedure (1A);
 - Measurement of GFR 48–96 hours after the procedure (1C).

Gadolinium-based contrast media

- 4.5.3: We recommend not using gadolinium-containing contrast media in people with $\text{GFR} < 15 \text{ ml/min/1.73 m}^2$ (GFR category G5) unless there is no alternative appropriate test. (1B)
- 4.5.4: We suggest that people with a $\text{GFR} < 30 \text{ ml/min/1.73 m}^2$ (GFR categories G4-G5) who require gadolinium-containing contrast media are preferentially offered a macrocyclic chelate preparation. (2B)

Bowel preparation

- 4.5.5: We recommend not to use oral phosphate-containing bowel preparations in people with a $\text{GFR} < 60 \text{ ml/min/1.73 m}^2$ (GFR categories G3a-G5) or in those known to be at risk of phosphate nephropathy. (1A)

4.6: CKD AND RISKS FOR INFECTIONS, AKI, HOSPITALIZATIONS, AND MORTALITY

CKD and risk of infections

- 4.6.1: We recommend that all adults with CKD are offered annual vaccination with influenza vaccine, unless contraindicated. (*1B*)
- 4.6.2: We recommend that all adults with eGFR < 30 ml/min/1.73 m² (GFR categories G4-G5) and those at high risk of pneumococcal infection (e.g., nephrotic syndrome, diabetes, or those receiving immunosuppression) receive vaccination with polyvalent pneumococcal vaccine unless contraindicated. (*1B*)
- 4.6.3: We recommend that all adults with CKD who have received pneumococcal vaccination are offered revaccination within 5 years. (*1B*)
- 4.6.4: We recommend that all adults who are at high risk of progression of CKD and have GFR < 30 ml/min/1.73 m² (GFR categories G4-G5) be immunized against hepatitis B and the response confirmed by appropriate serological testing. (*1B*)
- 4.6.5: Consideration of live vaccine should include an appreciation of the patient's immune status and should be in line with recommendations from official or governmental bodies. (*Not Graded*)
- 4.6.6: Pediatric immunization schedules should be followed according to official international and regional recommendations for children with CKD. (*Not Graded*)

CKD and risk of AKI

- 4.6.7: We recommend that all people with CKD are considered to be at increased risk of AKI. (*1A*)
 - 4.6.7.1: In people with CKD, the recommendations detailed in the KDIGO AKI Guideline should be followed for management of those at risk of AKI during intercurrent illness, or when undergoing investigation and procedures that are likely to increase the risk of AKI. (*Not Graded*)

CKD and risk of hospitalization and mortality

- 4.6.8: CKD disease management programs should be developed in order to optimize the community management of people with CKD and reduce the risk of hospital admission. (*Not Graded*)
- 4.6.9: Interventions to reduce hospitalization and mortality for people with CKD should pay close attention to the management of associated comorbid conditions and cardiovascular disease in particular. (*Not Graded*)

Chapter 5: Referral to specialists and models of care

5.1: REFERRAL TO SPECIALIST SERVICES

- 5.1.1: We recommend referral to specialist kidney care services for people with CKD in the following circumstances (*1B*):
 - AKI or abrupt sustained fall in GFR;
 - GFR < 30 ml/min/1.73 m² (GFR categories G4-G5)*;
 - a consistent finding of significant albuminuria (ACR ≥ 300 mg/g [≥ 30 mg/mmol] or AER ≥ 300 mg/24 hours, approximately equivalent to PCR ≥ 500 mg/g [≥ 50 mg/mmol] or PER ≥ 500 mg/24 hours);
 - progression of CKD (see Recommendation 2.1.3 for definition);
 - urinary red cell casts, RBC > 20 per high power field sustained and not readily explained;
 - CKD and hypertension refractory to treatment with 4 or more antihypertensive agents;
 - persistent abnormalities of serum potassium;
 - recurrent or extensive nephrolithiasis;
 - hereditary kidney disease.
- 5.1.2: We recommend timely referral for planning renal replacement therapy (RRT) in people with progressive CKD in whom the risk of kidney failure within 1 year is 10–20% or higher[†], as determined by validated risk prediction tools. (*1B*)

*If this is a stable isolated finding, formal referral (i.e., formal consultation and ongoing care management) may not be necessary and advice from specialist services may be all that is required to facilitate best care for the patients. This will be health-care system dependent.

[†]The aim is to avoid late referral, defined here as referral to specialist services less than 1 year before start of RRT.

				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
GFR categories (ml/min/1.73 m ²) Description and range	G1	Normal or high	≥90		Monitor	Refer*
	G2	Mildly decreased	60–89		Monitor	Refer*
	G3a	Mildly to moderately decreased	45–59	Monitor	Monitor	Refer
	G3b	Moderately to severely decreased	30–44	Monitor	Monitor	Refer
	G4	Severely decreased	15–29	Refer*	Refer*	Refer
	G5	Kidney failure	<15	Refer	Refer	Refer

Referral decision making by GFR and albuminuria. *Referring clinicians may wish to discuss with their nephrology service depending on local arrangements regarding monitoring or referring.

5.2: CARE OF THE PATIENT WITH PROGRESSIVE CKD

- 5.2.1: We suggest that people with progressive CKD should be managed in a multidisciplinary care setting. (2B)
- 5.2.2: The multidisciplinary team should include or have access to dietary counseling, education and counseling about different RRT modalities, transplant options, vascular access surgery, and ethical, psychological, and social care. (Not Graded)

5.3: TIMING THE INITIATION OF RRT

- 5.3.1: We suggest that dialysis be initiated when one or more of the following are present: symptoms or signs attributable to kidney failure (serositis, acid-base or electrolyte abnormalities, pruritus); inability to control volume status or blood pressure; a progressive deterioration in nutritional status refractory to dietary intervention; or cognitive impairment. This often but not invariably occurs in the GFR range between 5 and 10 ml/min/1.73 m². (2B)
- 5.3.2: Living donor preemptive renal transplantation in adults should be considered when the GFR is <20 ml/min/1.73 m², and there is evidence of progressive and irreversible CKD over the preceding 6–12 months. (Not Graded)

5.4: STRUCTURE AND PROCESS OF COMPREHENSIVE CONSERVATIVE MANAGEMENT

- 5.4.1: Conservative management should be an option in people who choose not to pursue RRT and this should be supported by a comprehensive management program. (Not Graded)
- 5.4.2: All CKD programs and care providers should be able to deliver advance care planning for people with a recognized need for end-of-life care, including those people undergoing conservative kidney care. (Not Graded)
- 5.4.3: Coordinated end-of-life care should be available to people and families through either primary care or specialist care as local circumstances dictate. (Not Graded)
- 5.4.4: The comprehensive conservative management program should include protocols for symptom and pain management, psychological care, spiritual care, and culturally sensitive care for the dying patient and their family (whether at home, in a hospice or a hospital setting), followed by the provision of culturally appropriate bereavement support. (Not Graded)