University Hospitals Coventry & Warwickshire NHS Trust Clinical Guideline (full)	
Chronic Kidney Disease (CKD) - Conservative Management/ Pre-dialysis Dietetic Guidelines (Stages 4-5).	
E-Library Reference	CG 1336

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Approving forum (QIPS or equivalent):	Renal Services Procedure and Guideline Approval Group
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Department(s) / Primary Speciality:	Renal

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UHCW Associated Records:	no
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Clinical Operating Procedures relating to this guidance (please list)	no
Summary version available	☐

Guideline clinical content

Clinical Guidelines assist in decision-making; they do not replace clinical judgement. Regardless of the strength of evidence, it remains the responsibility of the clinician to interpret the application of the clinical guidance to local circumstances and the needs and wishes of the individual patient. Where variations of any kind do occur, it is important to document the variations and the reason for them in the patient's health record. If in doubt, seek senior advice.

Introduction
(Why this Trust-wide Clinical Guideline is necessary. Include reference to any relevant national guidelines, statutory requirements or other recommendations Identify the risk(s) the guideline will address.)

The target audience for these guidelines is the renal multidisciplinary team including consultant nephrologists, specialist registrars, specialist nurses, dietitians and pharmacists. This is a locally adapted guideline based on national recommendations and applies to patients with chronic kidney disease (CKD) stages 4 - 5.

Summary

(Summarise the main points of the guidance. Use flow diagrams where appropriate and limit to a single side of A4)

All renal patients with a glomerular filtration rate (GFR) <29ml/min, should be referred to a renal dietitian for nutritional assessment (KDIGO,2012). Patients attending a pre-dialysis clinic should have an estimated glomerular filtration rate (eGFR) available on CRRS, and be reviewed by the renal dietitian every 3-6 months. The dietetic CKD guidelines highlight the importance of renal dietetic referral, and when dietary adaptations are required.

A dietetic CKD management programme encompasses; blood pressure control, reduction of proteinuria, treatment of hyperlipidaemia, smoking cessation and dietary advice, treatment of anaemia, treatment of acidosis and metabolic bone disease, and the provision of timely and understandable information and education (NICE 2008).

NICE 2014 recognises the importance of dietary advice, in the management of hyperkalaemia, hyperphosphataemia, and salt and water

intake for people with advanced CKD (eGFR <20ml/min/1.73m2). This advice should be given by an appropriately trained professional, such as a renal dietitian.

Recommendations for guideline content:

Ideal Body Weight (IBW) should be calculated using a BMI of 20kg/m² where the patient's BMI is <20kg/m², 25kg/m² where the patient's BMI is > 25kg/m², and actual BMI if the patient's BMI is between 20 and 25kg/m² (Renal Association, 2010)

Energy: Aim for 30-35Kcal/ Kg/ IBW *(EDTNA, 2002; DOQI, 2002; Renal Assn, 2010)*

Reduced intakes (30 Kcal/Kg/IBW/ per day) may be appropriate in the elderly, and patients with reduced activity (agreed best practice). Where appropriate individuals with CKD should be encouraged to undertake physical activity compatible with cardiovascular health and tolerance, and to achieve a healthy BMI within (20-25 kg/m^2) (KDIGO, 2012).

Patients with a BMI > 30kg/m2 or <20 kg/m² should be referred to a Dietitian for advice (Renal Association Guideline, 2011).

Protein: Aim for 0.75-1.0g/Kg/IBW *(Renal Association 2010, National Service Framework)*

Protein should be biased in favour of high biological protein (HBV), until further evidence accumulates. 70% HBV protein is recommended locally.

Potassium: Aim for 1mmol/Kg/IBW/d

(EDTNA,2002,KDIGO,2012)

All pre-dialysis patients should maintain their serum potassium between 3.5-5.5 mmol/L (Renal Association 2002).Non-dietary causes of raised potassium should be considered on assessment (e.g. medications, dehydration, infusions, blood transfusions, hyperglycaemia). In patients with chronic kidney disease, dietary modification to avoid or reduce intake of high potassium foods may also be of benefit (Renal Association Hyperkalaemia

Guidelines, 2014). Aim for a normal range of serum bicarbonate (22-29mmol/L).

Mineral bone management;

All pre-dialysis patients should maintain their serum phosphate between 0.9-1.5 mmol/L (Renal Association CKD MBD, 2015) and patients with a phosphate greater than 1.4 mmol/L should be referred to a renal Dietitian for dietary advice (WMRN regional bone management guidelines, 2010).
Serum calcium should be maintained between 2.10-2.58 mmol/L (corrected for serum albumin) (Renal Association CKD MBD, 2015). In the presence of hypercalcaemia all calcium therapies should be reviewed.
The phosphate binders used locally are initially Calcium acetate (Phosex & Renacet), Calcium carbonate (Calcichew), Lanthanum (Fosrenol), Sevelemer hydrochloride (Renagel) and Sevelemer carbonate (Renvela).
Calcium acetate should be used as first line where appropriate (NICE 2013)
In cases where a vitamin D deficiency is detected colecalciferol or ergocalciferol should be used as corrective treatment (NICE, 2014).
In patients with an increasing iPTH remaining persistently about the upper limit for the assay used, an active vitamin D analogue such as alfacalcidol or calcitriol should be considered (KDIGO 2009, Renal Assn 2010, NICE 2014).
Dietary phosphate assessment and consideration of phosphate restriction and/or phosphate binders should be considered in patients with an increasing iPTH level even if the serum phosphate level is within the target range *(agreed best practice).*

Salt: Aim <100mmol/day sodium (<6g salt/day) *(Sign 2007 and 2008)*

This should help optimise blood pressure, reduce cardiovascular risk and improve oedema. Patients with end stage renal failure or nephrotic syndrome may require a fluid restriction. Targets for blood pressure control are less than 140/90mmHg or 130/80mmHg for diabetic patients with proteinuria greater than 1g/24hours. Salt substitutes that contain

potassium salts should be avoided in CKD.

CKD- Chronic Kidney Disease
IBW- Ideal body weight
iPTH- Intact Parathyroid hormone
MAC- Mid-arm circumference
SGA- subjective global assessment
MBD- mineral bone disease

Guideline details
(This is the main body of the guideline containing the detailed requirements, which will support implementation and decision-making. Use subheadings as required.)

- **Assessment**

- The pre-dialysis referral criteria should be used by nurses and doctors to ensure appropriate patients are referred for nutritional review (See Appendix A).

- HBA1c control should be targeted in the pre-dialysis dietary assessment. KDIGO 2012 recommends a target HBA1c of approximately 7% (53mmol/mol) to prevent or delay progression of the microvascular complications of diabetes, including diabetic kidney disease. This target can be extended in individuals with co-morbidities, limited life expectancy or risk of hypoglycaemia.

- Patients with a glomerular filtration rate (GFR) <29ml/min, should be referred to the dietitian for nutritional assessment. They should be offered dietary advice about potassium, phosphate, calorie and salt intake appropriate to the severity of CKD (NICE 2008, amended

2014).

- Where dietary intervention is agreed this is in the context of education, detailed dietary assessment and supervision to ensure that malnutrition is prevented (NICE 2008).

- Appendix B indicates the National Service Framework (NSF) classification of CKD, and the recent NICE guidelines on CKD classification taking into account GFR and albumin creatinine ratio (ACR).

- Weight, height, BMI, and where applicable % weight loss should be measured in all patients with CKD stage 4-5 (Renal Association 2010)

- The Nutrition & CKD guideline (Renal Association, 2010) encourages regular screening of CKD 4-5 patients (2-3 monthly where GFR <20) and suggests using the following parameters for screening.
- Actual Body Weight (ABW) (< 85% of Ideal Body Weight (IBW))
- Reduction in oedema free body weight (of 5% or more in 3 months or 10% or more in 6 months)
- BMI (<20kg/m2)
  The above nutritional screening methods can be used by all clinical staff.
- Subjective Global Assessment (SGA) (B/C on 3 point scale or 1-5 on 7 point scale)
- In addition the RA recommends auditing the regularity of this nutritional screening, for example, the percent of CKD 4-5 non-dialysis patients who have had an SGA completed in the last 12 months.

(**See Appendix Ci & Cii)**

- All patients attending the pre-dialysis clinic should have the

opportunity to attend an educational day, including a session conducted by a renal dietitian/dietetic assistant.

2. Nutrient intakes

During the dietary assessment of pre-dialysis patients the following aspects of the diet should be considered:

(i) Energy

Aim:To achieve / maintain an IBW and nitrogen balance

- The recommended dietary energy intake is 30-35Kcal/Kg/IBW per day (Renal Association 2010)

- Lower intakes (30Kg/IBW/per day) may be appropriate in older adults (those >60 years of age), and patients with reduced activity (agreed best practice).

- Where appropriate individuals with CKD should be encouraged to undertake physical activity compatible with cardiovascular health and tolerance, to achieve a healthy BMI within (20-25kg/m2) (KDIGO, 2012).

- Renal patients are at high risk of hyperlipidaemia and cardio-vascular disease (CVD) should be advised on healthy lifestyle choices (KDIGO, 2013).

- Individuals with a low BMI should be assessed by a dietitian and where appropriate advised on ways to increase their energy intake and body weight.

- Individuals with a BMI > 30kg/m2 should be referred to a dietitian for

advice (Renal Association Guideline, 2011).

(ii) Protein

Aim: To maintain nitrogen balance

- A dietary protein intake of 0.75-1.0g protein/Kg/IBW should be recommended (Renal Association 2010, National Service Framework). 70% HBV protein is recommended locally (agreed best practice).

- NICE 2014 advised not to offer low-protein diets (dietary protein intake less than 0.6-0.8g/kg/d) to people with CKD. Diets containing less than 0.75g protein/Kg/IBW can increase risk of protein energy malnutrition and therefore should not be recommended. SIGN 2008 highlights issues of; malnutrition, compliance and palatability with low protein diets.

- Where patients are unable to meet their protein or energy requirements, despite dietary advice, nutritional supplementation should be discussed with the patient, and prescribed if appropriate.

- Patients prescribed nutritional supplements should be reviewed more frequently (at least 3 monthly) so that nutritional intake can be re-calculated and appropriateness of supplements re-assessed (agreed best practice).

- All patients should be assessed for signs of malnutrition using the nutrition screening guidelines **(see Appendix C i & Cii).**

(iii) Potassium

Aim:To maintain serum potassium levels between 3.5-5.5 mmol/L
(Renal Association, 2002; SIGN, 2008)

- Where appropriate a patient will be advised on a low potassium diet; aiming for a maximum potassium intake of 1 mmol/Kg/IBW (agreed best practice).

- The Renal Association hyperkalaemia guidelines (2014) recommend that all patients with mild (K+ ≥ 5.5-5.9 mmol/L) or moderate (K+ 6.0-6.4 mmol/L) hyperkalaemia have a review of their medication and diet and regular monitoring of serum potassium; the urgency of assessment and frequency of potassium monitoring will depend on individual circumstances, and biochemical levels.

- Non dietary sources of potassium should always be considered (see Appendix D)

- A patient's level of dietary potassium restriction should be altered depending on the serum potassium level.

- Aim for a normal range of serum bicarbonate (22-29 mmol/L) to help correct the effects of metabolic acidosis.

(iv) Mineral bone management;

Aim: To maintain serum phosphate levels between 0.9-1.5mmol/l
(Renal Association 2015)

- The serum calcium should be maintained between normal laboratory levels 2.10-2.58mmol/L (corrected for serum albumin), with

avoidance of hypercalcaemic episodes (Renal Association, 2015).

- It is recommended that therapeutic decisions are based on the clinical situation, and trends in parameters, rather than a single laboratory value (Renal association 2015)
- The phosphate content of the diet should first be reduced through processed foods and additives before protein sources of phosphate are considered.

- Referral to a renal dietitian will ensure a suitable step wise approach to phosphate reduction. 50% of the phosphate we eat could come from food additives.

- 90% of phosphate from additives is absorbed by the body compared to only 40 – 60% of phosphate naturally found in foods (Kamyar et al,2010)

- In patients with hyperphosphataemia and persistent hypercalaemia the dose of calcium based phosphate binders, and/or vitamin D analogues should be reduced. They should also be reduced in the presence of arterial calcification, adynamic bone disease and in the presence of over-suppression of PTH (KDIGO, 2009). Where appropriate and required non calcium binders should be used.

- Generally PTH levels are elevated when GFR falls below 60ml/min (stage 3) and secondary hyperparathyroidism begins. Dietary phosphate restriction, phosphate binders, and/or vitamin D analogues should be considered in patients with an increasing PTH level, which remains persistently higher than the upper reference limit for the assay, once vitamin D levels have been corrected, even if the serum phosphate level is within the target range *(agreed best practice).*

- Patients should also be advised on the appropriate timing of phosphate binders with high phosphate foods. Iron tablets and phosphate binders should not be taken together because this

decreases the effectiveness (refer to phosphate binders diet sheet on the e-library).

- The phosphate binders used locally are initially Calcium acetate (Phosex & Renacet), Calcium carbonate (Calcichew), Lanthanum (Fosrenol), Sevelemer hydrochloride (Renagel) & Sevelemer carbonate (Renvela). Calcium acetate should be used as first line where appropriate (NICE 2013)

- The management of hyperphosphataemia clinical guidelines (NICE 2013) recommends calcium acetate as an effective first-line treatment for adults. In those patients who are unable to tolerate calcium acetate, in its different manufactured forms, calcium carbonate is an effective alternative.

- However phosphate binders and use should be individualised and based on the presence of other components of CKD-MBD, tolerance, and side effect profile (KDIGO 2009, Renal Assn 2010)

- Renal Association 2015 highlights a reasonable case exists for the measurement and correction of vitamin D. 25- hydroxyvitamin D should be measured at baseline with a view to correction of insufficiency or deficiency (>75nmol/L = repletion, 37.5 -75nmol/L = insufficiency, <37.5nmol/L = deficiency) . In cases where a vitamin D deficiency is detected colecalciferol or ergocalciferol should be used to treat this (NICE, 2014)

- Vitamin D analogues should be used to down regulate PTH and renal osteodystrophy. It is important to monitor calcium and phosphate concentrations in people receiving alfacalcidol or calcitriol supplements (NICE 2014).

(v) Sodium and fluid balance

Aim: To advise patients on how to control their dietary intake of sodium and improve blood pressure control and fluid balance. (DOQI and Hypertension guidelines).

NICE and SIGN both emphasize the importance of good BP control (<130/70mmHg) in order to down regulate proteinuria and CKD progression.

- All pre-dialysis patients (with the exception of 'salt losers') should be advised on a reduced sodium intake <100mmol/day (<6g/day of salt) (EDTNA 2002, Renal Association, 2011, SIGN 2008).

- Targets for blood pressure control are less than 140/90mmHg or 130/80mmHg for diabetic patients with proteinuria greater than 1g/24hours.

- Sodium restriction should be prioritised individually with consideration for a patients' nutritional status.

- Patients should be advised on the best ways to manage their prescribed fluid allowance and salt restriction should always be prescribed in combination with this.

- Fluid restrictions are not normally prescribed unless a patient has nephrotic syndrome, or end stage renal failure (ESRF). This may be 500ml + previous day's fluid output, but always check with a member of the medical team.

NB: A consultant may still request a fluid restriction for certain patients.

(vi) Vitamins

Aim:To ensure adequate intakes of vitamins and minerals.

- The dietitian will assess adequacy of vitamin intake, and advise on supplementation if appropriate. There is no real guidance in the national standards on the level of vitamin supplementation in pre-dialysis patients. However, agreed best practice is that the B vitamins, Folate, and Vitamin C are most commonly deficient in patients on a low potassium diet.

- Supplementation with Vitamin A is not advised as this can accumulate to harmful levels in renal failure. Also over supplementation with Vitamin C is not encouraged because of its links with the formation of renal stones. Experimentally it has been found that 1-4g of Vitamin C has been required to increase Oxalate excretion and hence the risk of renal stone disease (Williams et al, 1990).

- The dietitian will review patients to help avoid any inappropriate restrictions, which may be decreasing the patient's vitamin intake unnecessarily.

Note: Patients should be discouraged from taking herbal remedies as there is no medical evidence to support these, and some Chinese remedies have been found to be harmful in CKD (SIGN 2008).

Implementation
(If the guideline relates to a service, pathway or external agency, provide details and reference any associated clinical operating procedure (COP) or corporate business record (CBR))

N/A

Training
(Provide details of how any associated training is delivered, target audience, and if online training is available

provide link. If training provided in Trust or Departmental induction, please specify to which staff groups.)

N/A

Patient Information
(Reference any associated Patient information leaflets)

There are a number of Patient Information Leaflets available on this subject

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Audit & Monitoring
(Detail how the implementation and effectiveness of the clinical guideline will be monitored)

Aspect being monitored	Monitoring method	Responsible department(s)	Frequency	Group / committee receiving report & responsible for actions
Audit of nutritional screening for CKD 4-5 not on dialysis	Proton and dietetic record cards	Dietetics	annually	Renal Dietetics Team
Audit of serum biochemistry levels	Pre-dialysis data base	Dietetics	annually	Renal multi-disciplinary team

End of Governance content

Guideline References

CEBIS Evidence Summary
(, NICE Guidelines, and other National Guidance. Other national guidance may include those issued by speciality college, patient safety agency, monitoring agencies, or other external governing bodies)

References cited in guideline	Grade*
KDOQI Clinical Practice Guidelines for Nutrition in Chronic Renal Failure (2000) and KDOQI Clinical Practice Guidelines for Bone Metabolism and Disease in Chronic Kidney Disease (2002)	1-5
European Guidelines for the Nutritional Care of Adult Renal Patients (2002)	1-5
KDIGO- Clinical Practice Guidelines for the Diagnosis, Evaluation, Prevention & Treatment of Chronic kidney disease and mineral and bone disorders (CKD-MBD), 2009	1-5
Renal Association Guidelines - Nutrition(2010)	1-5
West Midlands guidelines for management of CKD related mineral and bone disorders in HD patients (WMRN)- 2010	1-5
KDIGO 2012- Clinical practice guidelines for the evaluation and management	1-5

of CKD	
NICE- Management of Hyperphosphataemia- March 2013	1-5
KDIGO Nov 2013- Clinical practice guideline for lipid management in CKD	1-5
NICE July 2014- Early identification and management of CKD in adults in primary & secondary care.	1-5
CKD- MBD- Renal Association March 2015	1-5
Treatment of acute hyperkalaemia in adults- March 2014	1-5
Kamyar et al 2010. 'Understanding sources of dietary phosphorus in the treatment of patients with CKD.' Clin J Am Soc Nephrol 5: 519-530	1-5

***Grade:- The references are graded through the CEBIS process according to the criteria outlined below.**

Grade of evidence	Based on
1	Systematic review or meta-analysis
2	Randomised controlled trial/s
3	Controlled study without randomisation (e.g. case controlled) or quasi-experimental study, such as a cohort study
4	Descriptive studies such as case series and reports.
5	Expert opinion, narrative review

Add any Appendices below

(Please use a "Page Break" before each appendix, and list each clearly in the section on the title page. Appendices may include a summary, a flowchart, a proforma, or other materials, but its purpose must be clearly identified)

APPENDICES

Appendix A

Coventry Renal Dietitians
Out patient referral criteria for renal dietetic review

Please refer the following patients for dietetic review:-

Pre-Dialysis patients

Stage 4-5 CKD, and any of the following:

- Phosphate > 1.40mmol/L
- Potassium > 5.5mmol/L with a normal bicarbonate (22-29mmol/L)
- Uraemic symptoms, including poor appetite or weight loss
- Any questions about diet
- Attending clinic with family or carers who also need to be present during consultation
- Poor diabetic control IFCC HbA1c >58mmol/mol
- Hypertensive

In addition to the above please consider referring the following patients for dietetic review:-

- Phosphate 0.9-1.49 (normal range) with increasing PTH **and** patient is appropriate to follow a phosphate restriction

- All patients with a GFR <30mls/min

Contact us on 024 7696 6151, or ext 26151 at UHCW NHS Trust or Bleep on 2138,1258, 1261 or 2621

Appendix B: National Service Framework classification of Chronic Kidney Disease

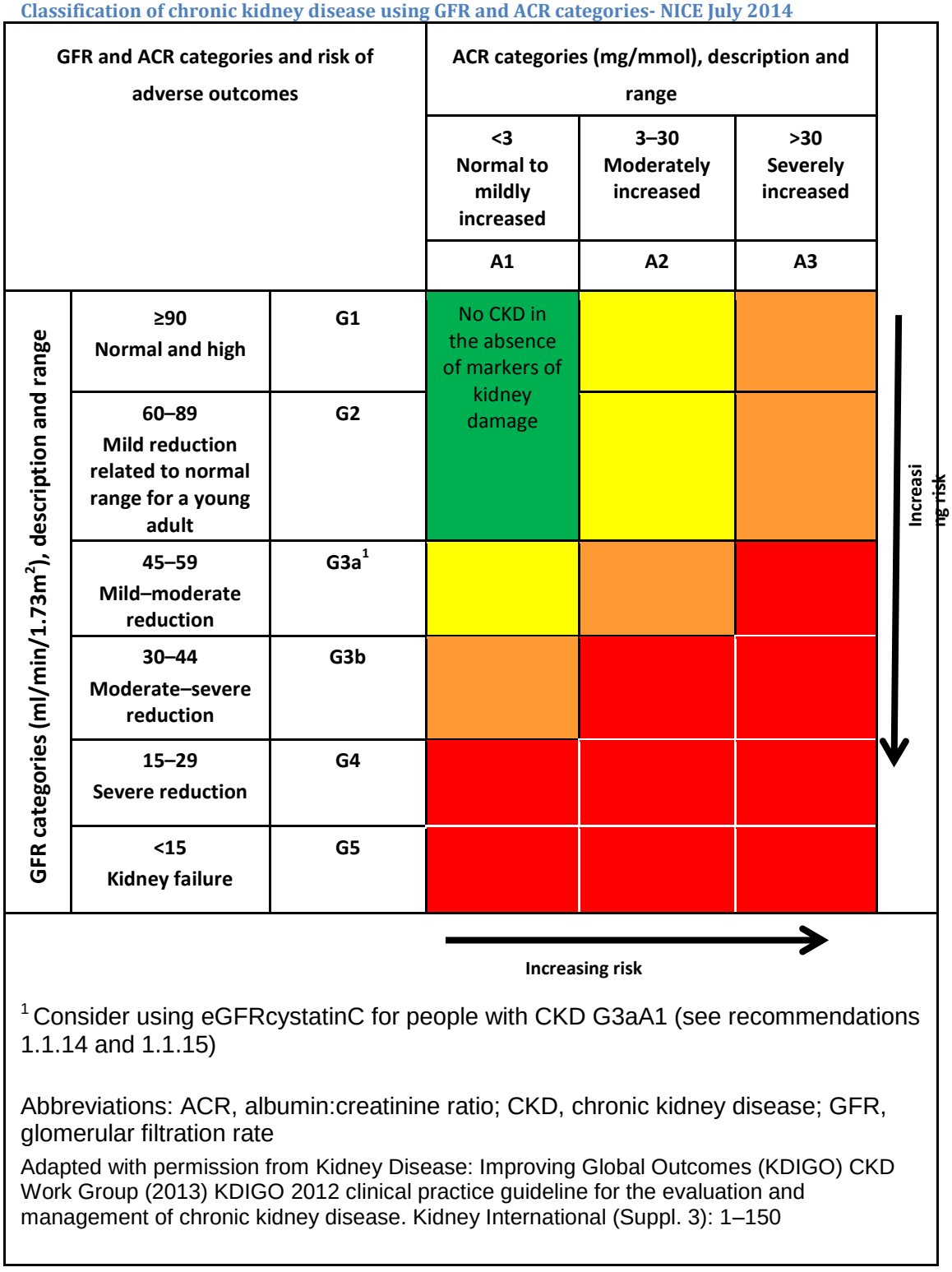
The stages of CKD (Chronic Kidney Disease) are mainly based on measured or estimated **GFR** (Glomerular Filtration Rate). There are five stages but kidney function is normal in Stage 1, and minimally reduced in Stage 2.

The KDOQI stages of kidney disease are:

Stage	GFR*	Description	Treatment stage
1	**90+**	Normal kidney function but urine findings or structural abnormalities or genetic trait point to kidney disease	Observation, control of blood pressure.
2	**60-89**	Mildly reduced kidney function, and other findings (as for stage 1) point to kidney disease	Observation, control of blood pressure and risk factors.
3A **3B**	**45-59** **30-44**	Moderately reduced kidney function	Observation, control of blood pressure and risk factors.
4	**15-29**	Severely reduced kidney function	Planning for endstage renal failure.
5	**<15 or on dialysis**	Very severe, or **end stage** kidney failure (sometimes called **established renal failure**)	Treatment choices.

* All GFR values are normalized to an average surface area (size) of $1.73m^2$

Classification of chronic kidney disease using GFR and ACR categories- NICE July 2014



[1] Consider using eGFRcystatinC for people with CKD G3aA1 (see recommendations 1.1.14 and 1.1.15)

Abbreviations: ACR, albumin:creatinine ratio; CKD, chronic kidney disease; GFR, glomerular filtration rate

Adapted with permission from Kidney Disease: Improving Global Outcomes (KDIGO) CKD Work Group (2013) KDIGO 2012 clinical practice guideline for the evaluation and management of chronic kidney disease. Kidney International (Suppl. 3): 1–150

Appendix Ci:

Nutritional screening:

Subjective assessment
Height (m) (first contact only)

Weight (Kg)/
Dry weight
(For peritoneal dialysis patients (PD) at UHCW NHS Trust this is the weight including the fluid from the bag).
(For HD patients this is the weight set by medical staff where JVP and chest xray are clear and the patient has no oedema).

Body mass index (BMI)

Ideal body weight (IBW) is equivalent to:

Actual BMI if BMI between 20-25kg/m2

BMI of 20kg/m2 if BMI is less than 20kg/m2

BMI of 25kg/m2 if BMI is greater than 25kg/m2

(Renal Association Guidelines 2010 - Screening for under nutrition in CKD)

Percent weight loss in a documented time period.

Mid-arm-circumference (MAC), grip strength and subjective global assessment (SGA) as appropriate.

This should be used in those patients felt to be nutritionally at risk, assessment of dry weight for those with oedema/ on dialysis.

Repeat measurements on a 6-12 monthly basis to highlight any changes.

Remember to document this on the appropriate sheet inside the record card, or highlight in the body of the notes, and record which arm is measured.

Relevant Biochemistry (i.e. those specified on blood card), and cholesterol, triglycerides, HbA1C, glucose, CRP and magnesium when available.

Diet history/ food diary

Estimated nutritional requirements.

Estimated calorie and protein intake.

Appendix Cii:

Renal Association Guidelines 2010; Screening for under nutrition in CKD

Screening methods for under nutrition in CKD

We recommend that all patients with stage 4-5 CKD should have the following parameters measured as a minimum in order to identify under nutrition (1C):

- o Actual Body Weight (ABW) (< 85% of Ideal Body Weight (IBW))
- o Reduction in oedema free body weight (of 5% or more in 3 months or 10% or more in 6 months)
- o BMI (<20kg/m2)
- o Subjective Global Assessment (SGA) (B/C on 3 point scale or 1-5 on 7 point scale)

The above simple audit measures have been linked to increased mortality and other adverse outcomes.

Appendix D: Factors affecting serum potassium levels in renal failure

Normal serum potassium levels: 3.5 – 5.5 mmol/L
HD patients: 3.5 – 6.0 mmol/L
PD patients : 3.5 – 5.5 mmol/L

An **INCREASE** in serum potassium could be due to :-

- **Diet**
    - High potassium foods

- **Drugs**
    - Erythropoetin (EPO) therapy.
    - Regulan treatment
    - Fybogel treatment
    - ACE inhibitors, for example; Captopril, Enalopril, Lisinopril
    - ARBs, for example losartan, candesartan, irbesartan
    - Potassium salts for example Slow K (occasionally used where levels are low. Renal; function changes and someone forgets to stop them).
    - Potassium sparing diuretics, e.g. Spironolactone etc. (Not usually used in renal failure for this reason).

- **Metabolic**
    - Poor diabetic control / Insulin deficiency
    - Dehydration.
    - Acidosis.
    - Hypoaldosteronism.

- **Catabolic**
    - Infection / Sepsis.
    - Rapid catabolism / Weight loss.
    - Burns.
    - Crush injuries / Rhabdomyolosis / Ischaemia.

- **Other**
    - Constipation (more potassium is generally excreted in the stools of renal patients)
    - A small temporary increase in potassium of 0.5 mmol/l is usual following exercise
    - Blood Transfusion.
    - Haemolysed blood sample.

- In HD patients, other factors to consider
    - Inadequate dialysis
    - Incorrect dialysate used
    - Recirculation

Treatment for high potassium:

1. Calcium gluconate
2. Dextrose and insulin. This works by moving potassium into the cells; temporary measure
3. Dialysis – haemodialysis, haemofiltration

4. Ion exchanges resins e.g. calcium resonium. This binds potassium in the gut and removes it via the stools. The usual dose is 15g orally 3 or 4 times daily in water or 30g rectally.
5. Dietary potassium restriction

A **DECREASE** in serum potassium could be due to:-

- Diet
    - Over enthusiastic dietary restriction

- Drugs
    - Diuretics that cause potassium loss e.g. frusemide (note: potassium levels will rise when patient ceases these).
    - Salbutamol – orally or high dose inhaled
    - Amphotericin – damages the renal tubule and causes potassium loss from the body.
    - Sodium bicarbonate treatment lowers potassium.
    - Laxative abuse

- Increased potassium losses
    - Recovery of renal function while maintaining reduced dietary intake
    - Vomiting
    - Fistula/wound losses
    - Diarrhoea
    - Ileostomy

- Metabolic
    - Alkalosis