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Hyperphosphataemia in chronic kidney disease

Clinical case scenarios for adult renal services

March 2013

Clinical Guideline Implementation Tools

NICE clinical guideline 157

These clinical case scenarios accompany the clinical guideline: 'Hyperphosphataemia in chronic kidney disease' (available at http://guidance.nice.org.uk/CG157).

Issue date: March 2013

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Contents

Introduction

NICE clinical case scenarios

Clinical case scenarios are an educational resource that can be used for individual or group learning. Each case scenario includes details of the person's initial presentation, their medical history and their clinician's summary of the situation after examination. The clinical decisions about management are then examined using a question and answer approach. Each question should be considered by the individual or group before referring to the answers.

These 4 clinical case scenarios have been put together to improve your knowledge on the management of hyperphosphataemia in chronic kidney disease (CKD) and its application in practice. They illustrate how the recommendations from Management of hyperphosphataemia in chronic kidney disease (NICE clinical guideline 157) can be applied to the care of adults (18 years and older) with stage 4 and 5 CKD, including those who are on dialysis known as stage 5D).

The clinical case scenarios are available in 2 formats: this PDF, which can be used for individual learning, and a slide set that can be used for groups.

You will need to refer to the NICE guideline to help you decide what steps you would need to follow to manage each case, so make sure that users have access to a copy (either online at http://guidance.nice.org.uk/CG157 or as a printout). You may also want to refer to the corresponding NICE pathway on Management of hyperphosphataemia in chronic kidney disease.

Relevant recommendations from the NICE guideline are quoted in the text (after the answer), with the corresponding recommendation numbers. Information and details from the full guideline have been included in the answers and the 'Supporting information' boxes with reference to the source page number in the full guideline.

In practice, it is acknowledged that when providing patients with information, clinicians will deliver this in a way that meets the patients' needs. In addition, it is noted that many patients will have holistic needs that go beyond the scope of

these fictional cases and therefore, these cases should not be used as treatment plans for any patients.

Learning objectives

After working through these clinical case scenarios, you will be able to:

- describe the need for improved management of hyperphosphataemia
- make informed clinical judgments about the management of serum phosphate with people with chronic kidney disease

Hyperphosphataemia in chronic kidney disease

Definitions

Chronic kidney disease (CKD): abnormal kidney function and/or structure. It is long-lasting and often progresses over time.

National Kidney Foundation kidney disease outcomes quality initiative' (NKF-KDOQI): This is a classification of CKD and is adopted by the 'National service framework for renal services'. It divides CKD into 5 stages according to the extent of a person's loss of renal function.

Stage 4 CKD: defined by a glomerular filtration rate (GFR) of 15–29 ml/min/1.73 m^2.

Stage 5 CKD: defined by a GFR of less than 15 ml/min/1.73 m^2.[1]

Stage 5D CKD: When stage 5 CKD advances to end-stage renal disease (ESRD), some people progress to renal replacement therapy (RRT)[2]. If this involves dialysis, this stage is classified as CKD stage 5D.

Background

In people with CKD, as kidney dysfunction advances, there is a higher risk of mortality and some comorbidities become more severe. Hyperphosphataemia is

[1] A GFR of over 90 ml/min/1.73 m^2 is considered normal unless there is other evidence of kidney disease.
[2] Note: in this guideline, those who choose not to participate in an active treatment programme for their ESRD (which would generally include RRT, diet, pain management, etc.), instead opting for 'conservative management', are considered to be a subset of the stage 5 population who are not on dialysis.

one example of this, and occurs because of insufficient filtering of phosphate from the blood by poorly functioning kidneys. This means that a certain amount of the phosphate does not leave the body in the urine, instead remaining in the blood at abnormally elevated levels.

High serum phosphate levels can directly and indirectly increase parathyroid hormone (PTH) secretion, leading to the development of secondary hyperparathyroidism. Left untreated, secondary hyperparathyroidism increases morbidity and mortality and may lead to renal bone disease, with people experiencing bone and muscular pain, increased incidence of fracture, abnormalities of bone and joint morphology, and vascular and soft tissue calcification.

Standard management of hyperphosphataemia involves using both pharmacological and non-pharmacological interventions, as well as providing education and support.

Clinical case scenarios – adults

Case scenario 1: John, aged 72 years, receiving haemodialysis, needing a phosphate management plan

Presentation and past medical history

John is a 72-year old man with established CKD who has very recently started haemodialysis after recent acute deterioration in his renal function. He currently receives hospital based haemodialysis 3 times a week via a tunnelled catheter.

John is married with 3 grown up children and lives in a 2-bedroomed house. He had just begun to think about his treatment options before the recent episode and had rejected home therapy.

At his routine dialysis appointment John's blood results are: corrected calcium 2.24 mmol/L, phosphate 2.01 mmol/L and PTH 35.6 pmol/L.

Case continues on next page.

Relevant recommended levels from the Renal Association CKD-Mineral and Bone Disorders guideline, (2010)[3]

Guideline 2.2 CKD-MBD: Serum calcium in dialysis patients (stage 5D)

The Renal Association suggest that serum calcium, adjusted for albumin concentration, should be maintained within the normal reference range for the laboratory used, measured before a "short-gap" dialysis session in haemodialysis patients. Ideally, adjusted serum calcium should be maintained between 2.2 and 2.5 mmol/L, with avoidance of hypercalcaemic episodes (2D).

Guideline 3.2 CKD-MBD: Serum phosphate in dialysis patients (stage 5D)

The Renal Association suggest that serum phosphate in dialysis patients, measured before a "short-gap" dialysis session in haemodialysis patients, should be maintained between 1.1 and 1.7 mmol/L (2C).

Guideline 4.2.1 CKD-MBD: Target range of serum PTH in patients on dialysis

The Renal Association suggest that the target range for parathyroid hormone measured using an intact PTH assay should be between 2 and 9 times the upper limit of normal for the assay used (2C).

Next steps for management

Question 1.1

What initial steps would you take to develop a phosphate management plan for John?

[3] Steddon, S. and Sharples, E. (2010) Clinical practice guidelines in CKD-Mineral and Bone Disorders (CKD-MBD) 5th Edition (final version 6.12.10). Renal Association. This Renal Association guideline was the most recent publication at the time of publishing these clinical cases. The Renal Association guideline is not specifically referred to in the NICE clinical guideline 157 recommendations but this information has been added here to help you work through this case

Answer 1.1

NICE clinical guideline 157 identifies that for adults with stage 5 CKD who are on dialysis, the UK Renal Association guidelines recommended that serum phosphate levels be maintained at between 1.1 and 1.7 mmol/l.

You explain to John that raised phosphate levels can occur in patients with renal disease and people on dialysis, and treatment involves dialysis, control of dietary phosphate and if necessary the use of phosphate binders.

According to these figures, John's phosphate is raised. Therefore, you refer him to a specialist dietitian to carry out a dietary assessment and provide information including management of dietary phosphate, while taking into account other changes he may need to make to his diet since starting haemodialysis[4].

Relevant recommendations

A specialist renal dietitian, supported by healthcare professionals with the necessary skills and competencies, should carry out a dietary assessment and give individualised information and advice on dietary phosphate management. [1.1.1]

Related recommendation

At every routine clinical review, assess the patient's serum phosphate control, taking into account:

- dietary phosphate management
- phosphate binder regimen
- adherence to diet and medication
- other factors that influence phosphate control, such as vitamin D or dialysis. [1.1.16]

[4] Dietary management in relation to haemodialysis is specifically beyond the scope of this guideline but reference to this aspect of dietitian input has been included for context.

Supporting information

Dietary management should be a key component of regimens designed to manage hyperphosphataemia in CKD stages 4 and 5. [pg 106]

Given the broad, in-depth knowledge needed in formulating effective, individualised therapeutic options, the Guideline Development Group (GDG) felt that a specialist renal dietitian would be the most appropriate person to conduct a patient's dietary assessment and offer them individualised advice. It was also felt that early contact with a dietitian is important as a means of reducing patient misinformation. In addition to dietitian input, appropriately trained, multidisciplinary healthcare professionals/teams can play an important role in a patient's ongoing dietary management through education, reinforcing nutritional advice and providing support on a more day-to-day basis. [pg 84]

Next steps for management

Question 1.2

John and his wife request a diet sheet and an information leaflet, and they ask you about what food and drinks are high in phosphate. What information should be provided and what should be considered when you and the multidisciplinary team deliver dietary information and advice to John?

Answer 1.2

Information should be provided about controlling intake of phosphate-rich foods to control serum phosphate while maintaining protein intake taking in additional to any dietary instructions relating to receiving haemodialysis[5].

The information for the public version of the NICE clinical guideline 157 suggests to patients that they may want to ask their healthcare professionals for a diet sheet and an information leaflet about what high phosphate food and drinks are. It could be helpful for you to have these resources ready for John and his wife.

It is important to tailor advice and information to individual learning needs and preferences. In the case of John, as his wife does most of the cooking, the dietitian met with John and his wife, and the information given was reinforced with written information as requested by them both.

Relevant recommendations

- Advice on dietary phosphate management should be tailored to individual learning needs and preferences, rather than being provided through a generalised or complex multicomponent programme of delivery. [1.1.2]
- Give information about controlling intake of phosphate-rich foods (in particular, foods with a high phosphate content per gram of protein, as well as food and drinks with high levels of phosphate additives) to control serum phosphate, while avoiding malnutrition by maintaining a protein intake at or above the minimum recommended level. For people on dialysis, take into account possible dialysate protein losses. [1.1.3]

[5] Dietary management in relation to haemodialysis is specifically beyond the scope of this guideline but reference to this aspect of dietitian input has been included for context.

Supporting information

Information and advice

When developing the guideline, the GDG considered individualised approaches to be particularly important as different patients will have different diets, needs and preferences. These should be evaluated through dietary assessment, from which a treatment regimen can be developed. [pg 84]

It is important for patients to understand the need to manage their health and minimise the risks they face. Education empowers many patients to take steps to limit such risks and, in this instance, to minimise the impact of high phosphate levels on their bones and vasculature. [pg 84]

In addition to dietitian input, appropriately trained, multidisciplinary healthcare professionals/teams can play an important role in a patient's ongoing dietary management through education, reinforcing nutritional advice and providing support on a more day-to-day basis. [pg 84]

Dietary management

According to the current guidance from the British Dietetic Association's Renal Nutrition Group, the recommended nutrient intake for protein in adults on:

- haemodialysis is a minimum of 1.1 g/kg of ideal body weight/day
- peritoneal dialysis is a minimum of 1.1 to 1.2 g/kg of ideal body weight/day.

Given the risks and disadvantages of a protein-restricted diet and the lack of evidence in this area, the GDG did not feel that the evidence was sufficient to recommend restricting protein intake below these levels for managing hyperphosphataemia in adults on dialysis [pg 55]. According to the current Renal Association guidelines, recommended protein intake levels for adults with CKD stage 4 or 5 who are not on dialysis is a minimum of 0.75 g/kg of ideal body weight/day [pg 38]. This highlights the additional protein needs for people on dialysis.

According to the consensus of the GDG, based on their clinical knowledge and experience, advising patients to reduce their intake of phosphate-rich foods is

good clinical practice [pg 38]. Usual practice is to advise a reduction in certain types of food: generally those with a high phosphate to protein ratio, such as some dairy products and nuts, or food and drinks with high levels of phosphate additives, such as cola drinks or processed foods. The emphasis is more on the phosphate content of food and drinks rather than focusing on the restriction of protein. [pg 40]

Next steps for management

Question 1.3

Approximately 2 weeks later, you are asked to see the patient again as he is complaining of itching. Blood results show corrected calcium 2.28 mmol/L and phosphate 1.96 mmol/L. What would you do next?

Answer 1.3

NICE clinical guideline 157 identifies that for adults with stage 5 CKD who are on dialysis, the UK Renal Association guidelines recommended that serum phosphate levels be maintained at between 1.1 and 1.7 mmol/l.

According to these figures, John's phosphate is still raised. Therefore, you provide dietary information and advice to him, and discuss the patient with the dietitian. The dietitian speaks to John and his wife to ensure they are managing to restrict his dietary phosphate.

Relevant recommendations

See recommendations 1.1.1–1.1.3 above.

Supporting information

People learn and respond to interventions in different ways and have different approaches to dietary education; management may therefore need to be explored over the course of a patient's treatment. [pg 84]

Next steps for management

Question 1.4

The dietitian feels that John has made adequate changes to his diet and that further changes cannot be made without restricting protein intake. What would you do next?

Answer 1.4

You discuss with John that he needs to start a phosphate binder to help reduce his phosphate levels. You discuss his ability to swallow tablets; John reports that he has no problem swallowing tablets. You also discuss the options available and recommend that he starts calcium acetate as a phosphate binder.

The dietitian suggests that John doesn't need a phosphate binder with his breakfast as he only has toast and marmalade. He would need 1 phosphate binder at lunchtime to cover his phosphate intake as he has a light lunch, and then 2 with his main meal in the evening. The patient is advised to take the medication as prescribed, with food.

Relevant recommendations

- For adults, offer calcium acetate as the first-line phosphate binder to control serum phosphate in addition to dietary management. [1.1.8]
- Take into account patient preference and the ease of administration, as well as the clinical circumstances, when offering a phosphate binder in line with recommendations 1.1.5–1.1.12. [1.1.14]
- Advise patients (or, as appropriate, their parents and/or carers) that it is necessary to take phosphate binders with food to control serum phosphate. [1.1.15]

Related recommendation

- At every routine clinical review, assess the patient's serum phosphate control, taking into account:
  - dietary phosphate management
  - phosphate binder regimen
  - adherence to diet and medication
  - other factors that influence phosphate control, such as vitamin D or dialysis. [1.1.16]

Supporting information

Early intervention to prevent or manage high phosphate levels was considered key to preventing downstream complications resulting from the poor management of serum calcium and PTH. Phosphate binders should be started in the context of concurrent dietary management of serum phosphate. [pg 103]

The evidence reviewed for patients on dialysis showed that no one binder was clearly the most effective in terms of impact on the serum phosphate levels at the time points considered. [pg 214]

Calcium acetate's consistently good performance in the review of phosphate binder use in dialysis patients led the GDG to recommend calcium acetate as the first-line choice of phosphate binder in both pre-dialysis and dialysis patients. [pg 103]

For patients on dialysis, a cost–utility model was built based on effectiveness data from network meta-analyses comparing various phosphate binders. The model suggests that calcium acetate is likely to be the preferred first-line option. It provides appreciable benefit, when compared with calcium carbonate, at a relatively modest additional cost. While the use of non-calcium-based binders may be associated with some extension of quality-adjusted life expectation compared with the first-line calcium acetate, this gain is insufficient to justify the additional costs of the proprietary binders, when judged according to conventional standards (incremental cost effectiveness ratios [ICERs] around £90,000 per quality-adjusted life year [QALY] gained or greater were estimated). [pg 218]

Adherence to medication is important. Providing appropriate formulations will improve the ease of administration of these medications. The right formulation for a particular patient can substantially improve their ability to achieve (and sustain) adherence to a regimen. The appropriate binder formulation for each patient should be discussed with the patient and, where appropriate, their carers. This can be an important step in promoting adherence to a binder regimen. [pg 220]

It is important to provide information relating to phosphate binder use [pg 84].

For example, because the phosphate-binding action occurs in the stomach, it is important that these medications are taken with food and not on an empty stomach. [pg 260]

Next steps for management

Question 1.5

John asks what else, if anything, can be done if the phosphate binder doesn't reduce the phosphate level in his blood. You say that if necessary the dose can be increased.

John also asks if there any problems with taking this medication. You advise of the common side effects (nausea, vomiting, diarrhoea, constipation and loss of appetite)[6] and also advise him to stop taking it if he experiences any problems and to notify the Dialysis Unit staff.

When would you review him again?

[6] Advice about side effects and contact points for problems are not NICE recommendations but have been included in this case to create a realistic context.

Answer 1.5

You advise the patient that you will review his next set of monthly bloods.

Relevant recommendations

- At every routine clinical review, assess the patient's serum phosphate control, taking into account:
  - dietary phosphate management
  - phosphate binder regimen
  - adherence to diet and medication
  - other factors that influence phosphate control, such as vitamin D or dialysis. [1.1.16]

Supporting information

It is important to continuously and regularly monitor the treatment regimen used to manage a patient's serum phosphate and adjust the regimen when a patient's phosphate control is not at the desired level. [pg 241]

Case scenario 2: Janet, aged 36 years, established on peritoneal dialysis and has a raised phosphate level

Presentation and past medical history

Janet is a 36-year old woman established on automated peritoneal dialysis for 8 months, and is currently on the transplant list and under the care of the home therapy team. She attends a routine clinical review. Blood results show corrected calcium 2.53 mmol/L, phosphate 2.26 mmol/L and PTH 21 pmol/L.

Relevant recommended levels from the Renal Association CKD-Mineral and Bone Disorders guideline, (2010)[7]

Guideline 2.2 CKD-MBD: Serum calcium in dialysis patients (stage 5D)

The Renal Association suggest that serum calcium, adjusted for albumin concentration, should be maintained within the normal reference range for the laboratory used, measured before a "short-gap" dialysis session in haemodialysis patients. Ideally, adjusted serum calcium should be maintained between 2.2 and 2.5 mmol/L, with avoidance of hypercalcaemic episodes (2D).

Guideline 3.2 CKD-MBD: Serum phosphate in dialysis patients (stage 5D)

The Renal Association suggest that serum phosphate in dialysis patients, measured before a "short-gap" dialysis session in haemodialysis patients, should be maintained between 1.1 and 1.7 mmol/L (2C).

Guideline 4.2.1 CKD-MBD: Target range of serum PTH in patients on dialysis

The Renal Association suggest that the target range for parathyroid hormone measured using an intact PTH assay should be between 2 and 9 times the upper limit of normal for the assay used (2C).

[7] Steddon, S. and Sharples, E. (2010) Clinical practice guidelines in CKD-Mineral and Bone Disorders (CKD-MBD) 5th Edition (final version 6.12.10). Renal Association. This Renal Association guideline was the most recent publication at the time of publishing these clinical cases. The Renal Association guideline is not specifically referred to in the NICE clinical guideline 157 recommendations but this information has been added here to help you work through this case

Next steps for management

Question 2.1

NICE clinical guideline 157 identifies that for adults with stage 5 CKD who are on dialysis, the UK Renal Association guidelines recommended that serum phosphate levels be maintained at between 1.1 and 1.7 mmol/l.

According to this, Janet's phosphate is raised. What will you do?

Answer 2.1

You enquire about Janet's adherence to her phosphate binder. She reports that she is currently established on a calcium-based binder that she takes as prescribed with meals and with no problems. You review the dialysate calcium concentrate; the patient receives low calcium dialysate fluid and there are no other sources of calcium that the patient can identify such as vitamin D, calcium supplements, dietary calcium or certain over-the-counter preparations (for example indigestion remedies).

You refer Janet to a specialist dietitian for a dietary review to check whether diet and phosphate binder regimen can be modified to reduce serum phosphate.

Relevant recommendations

- At every routine clinical review, assess the patient's serum phosphate control, taking into account:
  - dietary phosphate management
  - phosphate binder regimen
  - adherence to diet and medication
  - other factors that influence phosphate control, such as vitamin D or dialysis. [1.1.16]
- A specialist renal dietitian, supported by healthcare professionals with the necessary skills and competencies, should carry out a dietary assessment and give individualised information and advice on dietary phosphate management. [1.1.1]
- Give information about controlling intake of phosphate-rich foods (in particular, foods with a high phosphate content per gram of protein, as well as food and drinks with high levels of phosphate additives) to control serum phosphate, while avoiding malnutrition by maintaining a protein intake at or above the minimum recommended level. For people on dialysis, take into account possible dialysate protein losses. [1.1.3]

Supporting information

It is important to continuously and regularly monitor the treatment regimen used to manage a patient's serum phosphate and adjust the regimen when a patient's phosphate control is not at the desired level. [pg 231]

If considering the use of non-calcium-based binders because of high serum calcium levels in patients on calcium-based binders, it is important to review other sources of calcium, such as vitamin D, calcium supplements, dietary calcium or certain over-the-counter preparations (for example indigestion remedies), before making any changes. Sometimes, it might be easier to make small changes to these than changing (and ensuring adherence to) the phosphate binder regimen. [pg 105]

Dietary management should be a key component of regimens designed to manage hyperphosphataemia in CKD stages 4 and 5. [pg 106]

When developing the guideline, the GDG considered individualised approaches to be particularly important as different patients will have different diets, needs and preferences. These should be evaluated through dietary assessment, from which a treatment regimen can be developed. People learn and respond to interventions in different ways and have different approaches to dietary education; management may therefore need to be explored over the course of a patient's treatment. [pg 84]

Given the broad, in-depth knowledge needed in formulating effective, individualised therapeutic options, the GDG felt that a specialist renal dietitian would be the most appropriate person to conduct a patient's dietary assessment and offer them individualised advice. It was also felt that early contact with a dietitian is important for reducing patient misinformation. In addition to dietitian input, appropriately trained, multidisciplinary healthcare professionals/teams can play an important role in a patient's ongoing dietary management through education, reinforcing nutritional advice and providing support on a more day-to-day basis. [pg 84]

According to the current guidance from the British Dietetic Association's Renal

Nutrition Group, the recommended nutrient intake for protein in adults on:

- haemodialysis is a minimum of 1.1 g/kg of ideal body weight/day
- peritoneal dialysis is a minimum of 1.1 to 1.2 g/kg of ideal body weight/day. [pg 55]

According to the current Renal Association guidelines, recommended protein intake levels for adults with CKD stage 4 or 5 who are not on dialysis is a minimum of 0.75 g/kg of ideal body weight/day [pg 38]. This highlights the additional protein needs for people on dialysis.

Next steps for management

Question 2.2

On discussion with the dietitian, Janet admits that her diet varies from day to day as she is working and has a family. The dietitian makes a couple of suggestions to reduce her dietary intake of phosphate. However, after discussion with the dietitian and the multidisciplinary team, you do not think it will bring about a sufficient change. What would you do next?

Answer 2.2

In collaboration with the dietitian, you feel Janet needs additional phosphate binders to cover her diet on days when her intake of dietary phosphate is greater.

You discuss with Janet that because of hyperphosphataemia, she needs to take more phosphate binders and you discuss the options with her. You explain that because her calcium is at the top of the normal range you need to add in a non-calcium-based binder rather than increasing her calcium-based binder further. Janet feels able to manage 2 different binders; therefore, you recommend that she combines her calcium-based binder with a non-calcium-based binder.

Relevant recommendations

- For adults with stage 5 CKD who are on dialysis and remain hyperphosphataemic despite adherence to the maximum recommended or tolerated dose of calcium-based phosphate binder, consider either combining with, or switching to, a non-calcium-based binder. [1.1.11]
- If a combination of phosphate binders is used, titrate the dosage to achieve control of serum phosphate while taking into account the effect of any calcium-based binders used on serum calcium levels (also see recommendations 1.1.6, 1.1.7 and 1.1.10–1.1.12). [1.1.13]
- Take into account patient preference and the ease of administration, as well as the clinical circumstances, when offering a phosphate binder in line with recommendations 1.1.5–1.1.12. [1.1.14]
- Advise patients (or, as appropriate, their parents and/or carers) that it is necessary to take phosphate binders with food to control serum phosphate. [1.1.15]

Supporting information

The health economic model created to support development of this guideline demonstrated that, in patients for whom calcium-based binders are not an option, both sevelamer hydrochloride and lanthanum carbonate would be cost-effective options, although there was insufficient evidence to include other non-calcium-based binders in the evaluation. [pg 216]

Non-calcium-based binders are associated with lower serum calcium levels. [pg 214]

Defining thresholds for biochemical parameters (serum calcium and PTH) to drive a change in binder regimen is difficult because of insufficient evidence. Clinicians should use their clinical judgement to determine acceptable levels, using indicators such as trends observed across a series of measurements, as well as relative levels of other biochemical markers that are known to impact serum calcium or PTH levels. [pg 215]

The evidence for the effectiveness of different combinations of binders is limited; thereby preventing the GDG from selecting one combination over the other, preferring instead to leave the decision to patient preference and clinical judgement. [pg 216]

If considering the use of non-calcium-based binders because of high serum calcium levels in patients on calcium-based binders, it is important to review possible causes of high calcium, such as dialysate calcium content, vitamin D, calcium supplements, dietary calcium or certain over-the-counter preparations (for example indigestion remedies), before making any changes to the choice of binder. In some cases, it might be easier to make small changes to these sources of elemental calcium than changing (and ensuring adherence to) the phosphate binder regimen. For example, it may be the case that a patient is on a high dose of vitamin D, and a reduction in this may be the most appropriate course of action. [pg 217]

For adults with stage 5 CKD who are on dialysis and remain hyperphosphataemic despite adherence to the maximum recommended or tolerated dose of calcium-based phosphate binder, a non-calcium-based binder

may need to be added to the regimen, producing a combination. The aim would be for the added phosphate-binding capacity to raise phosphate control to the desired level without exceeding the recommended daily intake for elemental calcium. [pg 216]. Please note the GDG did not specify which non calcium based binders to use in this scenario.

Adherence to medication is important. Providing appropriate formulations will improve the ease of administration of these medications. The right formulation for a particular patient can substantially improve their ability to achieve (and sustain) adherence to a regimen. The appropriate binder formulation for each patient should be discussed with the patient and, where appropriate, their carers. This can be an important step in promoting adherence to a binder regimen. [pg 220]

It is important to provide information relating to phosphate binder use [pg 84]. For example, because the phosphate-binding action occurs in the stomach, it is important that these medications are taken with food and not on an empty stomach. [pg 260]

Next steps for management

Question 2.3

The patient asks how she should take the binders.

Answer 2.3

You recommend that she continues to take her calcium-based binders with meals and start the non-calcium-based binder when she eats between meals or adds it to a particularly higher-phosphate containing meal.

You explain that you will review her next set of monthly bloods.

The patient also asks if there are any problems with taking the non-calcium-based binder. You advise of the common side effects (nausea, vomiting, diarrhoea, constipation, indigestion, abdominal pain and flatulence)[8] and also advise her to stop taking it if she experiences any problems and to notify the Home Therapy team.

Relevant recommendations

- At every routine clinical review, assess the patient's serum phosphate control, taking into account:
  - dietary phosphate management
  - phosphate binder regimen
  - adherence to diet and medication
  - other factors that influence phosphate control, such as vitamin D or dialysis. [1.1.16]

Related recommendations

There is no specific NICE recommendation about distribution of binders but this relates to recommendation 1.1.15:

- Advise patients (or, as appropriate, their parents and/or carers) that it is necessary to take phosphate binders with food to control serum phosphate. [1.1.15]

[8] Advice about side effects and contact points for problems are not NICE recommendations but have been included in this case to create a realistic context.

Supporting information

It is important to include information relating to phosphate binder use, giving the specific example of the need to take binders with high-phosphate snacks and not simply with meals, as well as the need to match binder dose with the phosphate load in the snack or meal. [pg 84]

It is important to continuously and regularly monitor the treatment regimen used to manage a patient's serum phosphate and adjust the regimen when a patient's phosphate control is not at the desired level. [pg 241]

Case scenario 3: Leroy, aged 52 years, established on home haemodialysis and has a low parathyroid hormone level

Presentation and past medical history

Leroy is a 52-year old man established on home haemodialysis for the last 3 years. He attends a routine clinical review. Blood results show corrected calcium 2.45 mmol/L, phosphate 1.45 mmol/L and PTH 2 pmol/L. He takes a calcium-based phosphate binder to manage his phosphate.

Relevant recommended levels from the Renal Association CKD-Mineral and Bone Disorders guideline, (2010)[9]

Guideline 2.2 CKD-MBD: Serum calcium in dialysis patients (stage 5D)

The Renal Association suggest that serum calcium, adjusted for albumin concentration, should be maintained within the normal reference range for the laboratory used, measured before a "short-gap" dialysis session in haemodialysis patients. Ideally, adjusted serum calcium should be maintained between 2.2 and 2.5 mmol/L, with avoidance of hypercalcaemic episodes (2D).

Guideline 3.2 CKD-MBD: Serum phosphate in dialysis patients (stage 5D)

The Renal Association suggest that serum phosphate in dialysis patients, measured before a "short-gap" dialysis session in haemodialysis patients, should be maintained between 1.1 and 1.7 mmol/L (2C).

Guideline 4.2.1 CKD-MBD: Target range of serum PTH in patients on dialysis

The Renal Association suggest that the target range for parathyroid hormone measured using an intact PTH assay should be between 2 and 9 times the upper limit of normal for the assay used (2C).

Next steps for management

Question 3.1

You are concerned that Leroy's PTH levels are low. What could you do?

[9] Steddon, S. and Sharples, E. (2010) Clinical practice guidelines in CKD-Mineral and Bone Disorders (CKD-MBD) 5th Edition (final version 6.12.10). Renal Association. This Renal Association guideline was the most recent publication at the time of publishing these clinical cases. The Renal Association guideline is not specifically referred to in the NICE clinical guideline 157 recommendations but this information has been added here to help you work through this case

Answer 3.1

NICE clinical guideline 157 identifies that for adults with stage 5 CKD who are on dialysis, the UK Renal Association guidelines recommended that serum phosphate levels be maintained at between 1.1 and 1.7 mmol/l.

According to this, Leeroy's phosphate level is within recommended limits. However, because Leroy's PTH level is low, you consider switching his phosphate binder to either sevelamer hydrochloride or lanthanum carbonate.

You discuss the patient's blood results with him and explain that although his current phosphate binder is controlling his serum phosphate, you would advise that he changes from a calcium-based binder to a calcium-free binder because of the low PTH level.

You explain to the patient that, because his PTH levels are very low, his bone activity is likely to be reduced (adynamic bone disease), which will reduce the strength of his bones and increase the risk of fractures. You therefore recommend that it is advisable to reduce his calcium intake from his phosphate binders, which may increase parathyroid activity in time.

Relevant recommendations

- For adults with stage 5 CKD who are on dialysis and who are taking a calcium-based binder, if serum phosphate is controlled by the current diet and phosphate binder regimen but:
  - serum calcium goes above the upper limit of normal, or
  - serum parathyroid hormone levels are low,

  consider either combining with, or switching to, sevelamer hydrochloride or lanthanum carbonate, having taken into account other causes of raised calcium. [1.1.12]

Related recommendation

- At every routine clinical review, assess the patient's serum phosphate control, taking into account:
  - dietary phosphate management

- phosphate binder regimen
- adherence to diet and medication
- other factors that influence phosphate control, such as vitamin D or dialysis. [1.1.16]

Supporting information

The health economic model created to support development of this guideline demonstrated that, in patients for whom calcium-based binders are not an option, both sevelamer hydrochloride and lanthanum carbonate would be cost-effective options, although there was insufficient evidence to include other non-calcium-based binders (such as aluminium hydroxide) in the evaluation. [pg 216]

Non-calcium-based binders are associated with lower serum calcium levels. [pg 214]

Defining thresholds for biochemical parameters (serum calcium and PTH) to drive a change in binder regimen is difficult because of insufficient evidence. Clinicians should use their clinical judgement to determine acceptable levels, using indicators such as trends observed across a series of measurements, as well as relative levels of other biochemical markers that are known to impact serum calcium or PTH levels. [pg 215]

It should also be noted that low serum PTH is considered to have 3 main interpretations or implications: 1) the patient is at an increased risk of adynamic bone disease, 2) the patient has undergone parathyroidectomy, or 3) the patient is on calcimimetics. Only low serum PTH interpreted as a risk factor for adynamic bone disease should prompt the adjustment of the treatment regimen to include a non-calcium-based binder.[pg 215]

The evidence for the effectiveness of different combinations of binders is limited; thereby preventing the GDG from selecting one combination over the other, preferring instead to leave the decision to patient preference and clinical judgement. [pg 216]

If considering the use of non-calcium-based binders because of high serum calcium levels in patients on calcium-based binders, it is important to review possible causes of high calcium, such as dialysate calcium content, vitamin D, calcium supplements, dietary calcium or certain over-the-counter preparations (for example indigestion remedies), before making any changes to the choice of binder. In some cases, it might be easier to make small changes to these sources of elemental calcium than changing (and ensuring adherence to) the phosphate binder regimen. For example, it may be the case that a patient is on a high dose of vitamin D, and a reduction in this may be the most appropriate course of action. [pg 217]

For people who are on dialysis and who are taking a calcium-based binder, if serum phosphate is controlled by the current diet and phosphate binder regimen but serum calcium goes above the upper limit of normal, or serum PTH levels are low, the calcium-based binders should be stopped, and non-calcium-based binders started in their place. Of all the non-calcium-based binders, only sevelamer hydrochloride or lanthanum carbonate is recommended in this situation for people on dialysis. As an alternative, it may be considered appropriate to replace a proportion of the calcium-based binder dose with non-calcium-based binders, producing a lower calcium combination without impairing the control of serum phosphate. [pg 216]

Next steps for management

Question 3.2

What steps can you take to enhance Leroy's adherence to his new phosphate binder regimen?

Answer 3.2

You discuss the administration options with the patient and ask whether he would prefer a tablet that he can swallow or chew.

As the patient is currently taking a tablet that he swallows, he opts for a non-calcium-based binder that he can swallow. You discuss the dosage and that he should take it with food.

The patient also asks if there any problems with taking this medication. You advise of the common side effects (nausea, vomiting, diarrhoea, constipation, indigestion, abdominal pain and flatulence)[10] and also advise him to stop taking it if he experiences any problems and to notify the Home Therapy team.

Relevant recommendations

- Take into account patient preference and the ease of administration, as well as the clinical circumstances, when offering a phosphate binder in line with recommendations 1.1.5–1.1.12. [1.1.14]
- Advise patients (or, as appropriate, their parents and/or carers) that it is necessary to take phosphate binders with food to control serum phosphate. [1.1.15]

Supporting information

Adherence to medication is important. Providing appropriate formulations will improve the ease of administration of these medications. The right formulation for a particular patient can substantially improve their ability to achieve (and sustain) adherence to a regimen. The appropriate binder formulation for each patient should be discussed with the patient and, where appropriate, their carers. This can be an important step in promoting adherence to a binder regimen. [pg 210]

It is important to provide information relating to phosphate binder use [pg 84].

[10] Advice about side effects and contact points for problems are not NICE recommendations but have been included in this case to create a realistic context.

For example, because the phosphate-binding action occurs in the stomach, it is important that these medications are taken with food and not on an empty stomach. [pg 260]

Case scenario 4: Bob, aged 39 years, not on dialysis, needing a review of his phosphate management plan

Presentation and past medical history

Bob, a 39-year old builder, has progressive CKD because of reflux nephropathy. He has been seen in a general nephrology clinic for the past 5 years, during which time his e-GFR has fallen from 43 ml/min/1.73 m^2 to 20 ml/min/1.73 m^2.

Three months ago, Bob's plasma calcium was noted to be 2.32 mmol/l (normal range for your laboratory: 2.2–2.55 mmol/l) and plasma phosphate had risen from 1.4 mmol/l to 1.78 mmol/l. NICE clinical guideline 157 identifies that for adults with stage 4 or 5 CKD who are not on dialysis, the UK Renal Association guidelines recommend that serum phosphate be maintained at between 0.9 and 1.5 mmol/l. Bob's serum PTH was elevated at 3 times the upper limit of normal, in keeping with a diagnosis of CKD–mineral bone disorder.

Bob was initially treated with calcium acetate tablets 3 times daily with meals. He was also advised by a doctor in the clinic to drink less cola, but he was not assessed or given any detailed advice by a specialist renal dietitian.

Relevant recommended levels from the Renal Association CKD-Mineral and Bone Disorders guideline, (2010)[11]

Guideline 2.1 CKD-MBD: Serum calcium in patients with CKD stage 3-5 (not on dialysis)

The Renal Association suggest that serum calcium, adjusted for albumin concentration, in patients with CKD stage 3-5 should be kept within the normal reference range for the laboratory used (2D).

Guideline 3.1 CKD-MBD: Serum phosphate in patients with CKD 3-5 (not on dialysis)

The Renal Association suggest that serum phosphate in patients with CKD stage 3b-5 should be maintained between 0.9 and 1.5 mmol/L (2C).

Guideline 4.1 CKD-MBD: Serum PTH in patients with CKD 3b-5 (not on dialysis)

The Renal Association suggest that treatment is considered in patients with CKD stages 3b-5 not on dialysis therapy in whom serum PTH levels are progressively increasing and remain persistently higher than the upper reference limit for the assay, despite correction of modifiable factors (2C).

Next steps for management

Question 4.1

On reviewing Bob's case notes, what aspects of the care delivered was not in line with NICE clinical guideline 157?

[11]Steddon, S. and Sharples, E. (2010) Clinical practice guidelines in CKD-Mineral and Bone Disorders (CKD-MBD) 5th Edition (final version 6.12.10). Renal Association. This Renal Association guideline was the most recent publication at the time of publishing these clinical cases. The Renal Association guideline is not specifically referred to in the NICE clinical guideline 157 recommendations but this information has been added here to help you work through this case

Answer 4.1

Dietary management should be a key component of regimens designed to manage hyperphosphataemia in CKD stages 4 and 5; therefore, it could be suggested that the dietary management input Bob received was not in line with NICE guidance. He should have received a dietary assessment and been provided with individualised information and advice on dietary phosphate management by the specialist dietitian, supported by healthcare professionals with the necessary skills and competencies for managing Bob's care.

Offering calcium acetate as a first-line phosphate binder is in line with NICE guidance; however, NICE guidance also states that the phosphate binders should be offered to control phosphate with concurrent dietary management of serum phosphate. As described above in the information given in Bob's case notes, the phosphate binder was not delivered in concordance with dietary management.

Relevant recommendations

- A specialist renal dietitian, supported by healthcare professionals with the necessary skills and competencies, should carry out a dietary assessment and give individualised information and advice on dietary phosphate management. [1.1.1]
- Advice on dietary phosphate management should be tailored to individual learning needs and preferences, rather than being provided through a generalised or complex multicomponent programme of delivery. [1.1.2]
- Give information about controlling intake of phosphate-rich foods (in particular, foods with a high phosphate content per gram of protein, as well as food and drinks with high levels of phosphate additives) to control serum phosphate, while avoiding malnutrition by maintaining a protein intake at or above the minimum recommended level. For people on dialysis, take into account possible dialysate protein losses. [1.1.3]
- For adults, offer calcium acetate as the first-line phosphate binder to control serum phosphate in addition to dietary management. [1.1.8]

Related recommendation

- At every routine clinical review, assess the patient's serum phosphate control, taking into account:
  - dietary phosphate management
  - phosphate binder regimen
  - adherence to diet and medication
  - other factors that influence phosphate control, such as vitamin D or dialysis. [1.1.16]

Supporting information

Dietary management

The 2 key interventions for managing hyperphosphataemia in people with advanced CKD are, as first-line, dietary management and, as second-line, phosphate binders. [pg 240]

Given the broad, in-depth knowledge needed in formulating effective, individualised therapeutic options, the GDG felt that a specialist renal dietitian would be the most appropriate person to conduct a patient's dietary assessment and offer them individualised advice. It was also felt that early contact with a dietitian is important for reducing patient misinformation. In addition to dietitian input, appropriately trained, multidisciplinary healthcare professionals/teams can play an important role in a patient's ongoing dietary management through education, reinforcing nutritional advice and providing support on a more day-to-day basis. [pg 84]

When developing the guideline, the GDG considered individualised approaches to be particularly important as different patients will have different diets, needs and preferences. These should be evaluated through dietary assessment, from which a treatment regimen can be developed. [pg 84]

According to the consensus of the GDG, based on their clinical knowledge and experience, advising patients to reduce their intake of phosphate-rich foods is good clinical practical [pg 38]. Usual practice is to advise a reduction in certain

types of food: generally those with a high phosphate to protein ratio, such as some dairy products and nuts, or food and drinks with high levels of phosphate additives, such as cola drinks or processed foods. The emphasis is more on the phosphate content of food and drinks rather than focusing on the restriction of protein. [pg 40]

According to the current Renal Association guidelines, recommended protein intake levels for adults with CKD stage 4 or 5 who are not on dialysis is a minimum of 0.75 g/kg of ideal body weight/day. [pg 38]

Calcium-based phosphate binders

Early intervention to prevent or manage high phosphate levels was considered key to preventing downstream complications resulting from the poor management of serum calcium and PTH. Phosphate binders should be started in the context of concurrent dietary management of serum phosphate. [pg 103]

The GDG felt it would be inappropriate to use the limited evidence available about the use of phosphate binders in people not on dialysis, to recommend a different phosphate binder for pre-dialysis patients than that recommended for those on dialysis, which was supported by a more substantial evidence base. [pg 103]

The evidence reviewed for patients on dialysis showed that no binder was clearly the most effective in terms of impact on the serum phosphate levels at the time points considered. [pg 214]

Calcium acetate's consistently good performance in the review of phosphate binder use in dialysis patients led the GDG to recommend calcium acetate as the first-line choice of phosphate binder in both pre-dialysis and dialysis patients. [pg 103]

For patients on dialysis, a cost–utility model was built based on effectiveness data from network meta-analyses comparing various phosphate binders. The model suggests that calcium acetate is likely to be the preferred first-line option. It provides appreciable benefit, when compared with calcium carbonate, at a relatively modest additional cost. While the use of non-calcium-based binders

may be associated with some extension of quality-adjusted life expectation compared with first-line calcium acetate, this gain is insufficient to justify the additional costs of the proprietary binders, when judged according to conventional standards (ICERs around £90,000 per QALY gained or greater were estimated). [pg 218]

Next steps for management

Question 4.2

You are now reviewing Bob and have noted that plasma calcium has risen to 2.34 mmol/l, with no significant change in plasma phosphate (1.79 mmol/l). NICE clinical guideline 157 identifies that for adults with stage 4 or 5 CKD who are not on dialysis, the UK Renal Association guidelines recommend that serum phosphate be maintained at between 0.9 and 1.5 mmol/l.

You refer Bob to a specialist renal dietitian for assessment. The dietitian identifies that Bob was not taking the phosphate binders with meals, as prescribed. He also said that he found the calcium acetate tablets difficult to swallow and unpalatable. Given this information, what suggested changes would you make to Bob's phosphate management?

Answer 4.2

You would ensure that he knows the importance of taking phosphate binders with food.

Discuss with Bob the options of phosphate binders, taking into account ease of administration and his preferences. You would suggest chewable calcium carbonate tablets to be taken shortly before food.

Relevant recommendations

- For adults, consider calcium carbonate if calcium acetate is not tolerated or patients find it unpalatable. [1.1.9]
- Take into account patient preference and the ease of administration, as well as the clinical circumstances, when offering a phosphate binder in line with recommendations 1.1.5–1.1.12. [1.1.14]
- Advise patients (or, as appropriate, their parents and/or carers) that it is necessary to take phosphate binders with food to control serum phosphate. [1.1.15]

Related recommendation

- At every routine clinical review, assess the patient's serum phosphate control, taking into account:
  - dietary phosphate management
  - phosphate binder regimen
  - adherence to diet and medication
  - other factors that influence phosphate control, such as vitamin D or dialysis. [1.1.16]

Supporting information

In patients who cannot tolerate calcium acetate (for example, those who find it difficult to swallow tablets, find them unpalatable or experience side effects), the GDG felt that calcium carbonate would be an effective alternative first-line phosphate binder. [pg 104]

Adherence to medication is important. Providing appropriate formulations will improve the ease of administration of these medications. The right formulation for a particular patient can substantially improve their ability to achieve (and sustain) adherence to a regimen. The appropriate binder formulation for each patient should be discussed with the patient and, where appropriate, their carers. This can be an important step in promoting adherence to a binder regimen. [pg 220]

It is important to provide information relating to phosphate binder use [pg 84]. For example, because the phosphate-binding action occurs in the stomach, it is important that these medications are taken with food and not on an empty stomach. [p260]

Next steps for management

When you review Bob again, his plasma phosphate had fallen to within the target range, 1.49 mmol/l, and serum calcium had risen to 2.50 mmol/l. Dietary advice was reiterated and Bob was encouraged to continue taking the calcium carbonate tablets with food at meal times.

Relevant recommendations

- At every routine clinical review, assess the patient's serum phosphate control, taking into account:
  - dietary phosphate management
  - phosphate binder regimen
  - adherence to diet and medication
  - other factors that influence phosphate control, such as vitamin D or dialysis. [1.1.16]

Supporting information

The risks of misinformation can also be reduced by appropriately trained, multidisciplinary healthcare professionals/teams who also play an important role in a patient's ongoing dietary education, reinforcing nutritional advice and providing support on a more day-to-day basis. [pg 84]

It is important to continuously and regularly monitor the treatment regimen used to manage a patient's serum phosphate and adjust the regimen when a patient's phosphate control is not at the desired level. [pg 241]

Question 4.3

Bob has returned for a further review and his serum phosphate was still within target range (1.47 mmol/l). However, his serum calcium has risen to just outside the laboratory normal range of 2.56 mmol/l. PTH levels had fallen and there was no evidence of another cause for increasing calcium levels.

What would you do next?

Answer 4.3

Offer Bob a non-calcium-based phosphate binder instead of calcium carbonate.

You discuss the options of non-calcium-based phosphate binders with Bob and consider administration and his preferences, as well as clinical factors when deciding on the most appropriate non-calcium-based phosphate binder.

Relevant recommendations

- For adults with stage 4 or 5 chronic kidney disease (CKD) who are not on dialysis and who are taking a calcium-based binder:
  - consider switching to a non-calcium-based binder if calcium-based phosphate binders are not tolerated
  - consider either combining with, or switching to, a non-calcium-based binder if hypercalcaemia develops (having taken into account other causes of raised calcium), or if serum parathyroid hormone levels are low. [1.1.10]
- Take into account patient preference and the ease of administration, as well as the clinical circumstances, when offering a phosphate binder in line with recommendations 1.1.5–1.1.12. [1.1.14]

Related recommendation

- At every routine clinical review, assess the patient's serum phosphate control, taking into account:
  - dietary phosphate management
  - phosphate binder regimen
  - adherence to diet and medication
  - other factors that influence phosphate control, such as vitamin D or dialysis. [1.1.16]

Supporting information

The health economic model created to support development of this guideline demonstrated that, in patients for whom calcium-based binders are not an option, both sevelamer hydrochloride and lanthanum carbonate would be cost-effective options, although there was insufficient evidence to include other non-calcium-based binders in the evaluation. [pg 216]

Non-calcium-based binders are associated with lower serum calcium levels. [pg 214]

Defining thresholds for biochemical parameters (serum calcium and PTH) to drive a change in binder regimen is difficult because of insufficient evidence. Clinicians should use their clinical judgement to determine acceptable levels, using indicators such as trends observed across a series of measurements, as well as relative levels of other biochemical markers that are known to impact serum calcium or PTH levels. [pg 215]

The evidence for the effectiveness of different combinations of binders is limited; thereby preventing the GDG from selecting one combination over the other, preferring instead to leave the decision to patient preference and clinical judgement. [pg 216]

If considering the use of non-calcium-based binders because of high serum calcium levels in patients on calcium-based binders, it is important to review possible causes of high calcium, including certain over-the-counter preparations (for example indigestion remedies), before making any changes to the choice of binder. Sometimes, it might be easier to make small changes to these sources of elemental calcium than changing (and ensuring adherence to) the phosphate binder regimen. [pg 217]

Because of the lack of evidence for the use of phosphate binders for people not on dialysis, the GDG extrapolated results from the evidence review for people on dialysis. Therefore, the information above applies to both people on and not on dialysis.

A non-calcium-based binder could help to reduce the daily intake of elemental

calcium in those who are hypercalcaemic, have low serum PTH or in whom calcium-based binders are not tolerated. It should be noted, however, that low serum PTH is considered to have 3 main interpretations or implications: 1) the patient is at an increased risk of adynamic bone disease, 2) the patient has undergone parathyroidectomy, or 3) the patient is on calcimimetics. Only low serum PTH interpreted as a risk factor for adynamic bone disease should prompt the adjustment of the treatment regimen to include a non-calcium-based binder [pg 104]. Please note that for patients *not on* dialysis (like Bob) and who are taking a calcium based binder and who develop hypercalcaemia or serum parathyroid hormone levels are low the GDG did not recommend any particular non calcium based binder to consider switching to or combining with. For patients *on* dialysis who are taking a calcium based binder, in the same situation (phosphate controlled but calcium goes above upper limit of normal or serum parathyroid hormone levels are low) the GDG recommended either switching to or combining with sevelamer hydrochloride or lanthanum carbonate.

Next steps for management

Question 4.4

Bob was concerned that this might not be so effective. How would you reassure him?

Answer 4.4

You would reassure him that if his phosphate level rose to above the target level, then it would be possible to increase the dose of the non-calcium-based binder or to add a tablet of calcium carbonate, to be taken with his main meal, in addition to the non-calcium-containing binder if his calcium had come back into range or improved.

Bob was very happy with this and commented that he appreciated being given all the information that he needed to participate in the decision-making, as he felt that this helped him to take the rather unpalatable medication.

Related recommendation

If a combination of phosphate binders is used, titrate the dosage to achieve control of serum phosphate while taking into account the effect of any calcium-based binders used on serum calcium levels (also see recommendations 1.1.6, 1.1.7 and 1.1.10–1.1.12). [1.1.13]

Other implementation tools

NICE has developed the following tools to help organisations implement the clinical guideline on Hyperphosphataemia in chronic kidney disease: These are available on the NICE website (www.nice.org.uk/guidance/CG157).

- Costing report and template
- Clinical audit support for adult and children and young people's services
- Baseline assessment
- Clinical case scenarios for children and young people's renal services
- Educational slide set for children and young people's renal services

A practical guide to implementation, How to put NICE guidance into practice: a guide to implementation for organisations, is also available.

Acknowledgements

NICE would like to thank the members of the National Clinical Guideline Centre and the Guideline Development Group, especially Nora Kerigan, Dialysis Adequacy Practitioner, Lancashire Teaching Hospitals NHS Trust and Dr David Bennett Jones, Consultant, Renal and General Medicine, UHCW, Coventry.

We would also like to thank Dr Hugh Gallagher, Consultant Nephrologist, Epsom and St Helier University Hospital NHS Foundation Trust of our External Reference Group and Dr Laurie Tomlinson, Senior Clinical Research Associate and Honorary Consultant, Cambridge University Hospital NHS Trust.