

# 2026 iCatCare consensus guidelines on the diagnosis and management of chronic kidney disease in cats



**Practical relevance:** Chronic kidney disease (CKD) is common in senior cats. Early diagnosis can facilitate interventions to slow progression and minimise clinical signs. Management according to the International Renal Interest Society (IRIS) staging system for CKD can lead to prolonged survival and an excellent quality of life for affected cats.

**Aim:** The '2026 iCatCare consensus guidelines on the diagnosis and management of chronic kidney disease in cats' provide information on the pathogenesis of CKD, guidance on making a diagnosis and staging of disease, and practical content on medical and nutritional treatment. They also discuss optimising the home and veterinary clinic environment to positively influence mental wellbeing and, in turn, physical health, as well as working with the whole veterinary team and caregivers to slow disease progression and maximise quality of life.

**Clinical challenges:** Affected cats may show minimal or no clinical signs in the early stages of CKD, which can result in a delay in diagnosis. The condition is generally progressive and management requires consideration of multiple factors in order to address clinical signs. Complications such as hypercalcaemia, hypertension, proteinuria and anaemia may develop, requiring treatment. Moreover, as advancing age is a risk factor for CKD, cats may have important comorbidities that need to be balanced, with impacts on the kidney. Caring for a cat with CKD can result in caregiver burden. Hence, supporting caregivers, contextualising monitoring to the individual cat, and involving both the veterinary and nursing teams is important.

**Evidence base:** These Guidelines have been created by a panel of experts brought together by International Cat Care (iCatCare) Veterinary Society. Information is based on the available literature, expert opinion and the panel members' experience.

**Keywords:** Renal; creatinine; urinalysis; phosphate; diet

**Specific abbreviations:** ACE = angiotensin-converting enzyme; ACKD = acute-on-chronic kidney disease; AKI = acute kidney injury; ARB = angiotensin receptor blocker; CKD = chronic kidney disease; CKD-MBD = CKD–mineral and bone disorder; FGF23 = fibroblast growth factor 23; GFR = glomerular filtration rate; iCa = ionised calcium; ICGN = immune-complex glomerulonephritis; IRIS = International Renal Interest Society; PTH = parathyroid hormone; SDMA = symmetric dimethylarginine

## Introduction

Chronic kidney disease (CKD) is a common cause of illness in cats. The previous 'ISFM consensus guidelines on the diagnosis and management of feline chronic kidney disease'<sup>1</sup> were published by the then International Society of Feline Medicine in 2016 to provide clinicians with practical information on the condition. However, over the past 10 years, a large body of research has progressed the understanding of CKD in terms of causes, early diagnosis and management strategies.

The '2026 iCatCare consensus guidelines on the diagnosis and management of chronic

kidney disease in cats' from International Cat Care (iCatCare) Veterinary Society seek both to supply updated information – with the addition of dedicated sections on comorbidities, anaesthesia and analgesia – and to discuss the importance of early diagnosis in order to allow the integration of measures to slow the progression of CKD. In addition, accompanying these Guidelines are resources from iCatCare Veterinary Society – for caregivers on managing a cat with CKD and for nurses and technicians to enable a team-based approach to this important condition.



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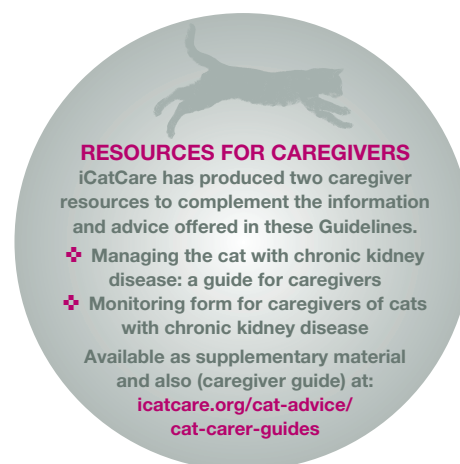
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## Prevalence of CKD and the importance of routine health screening

CKD is frequently encountered by veterinarians and, generally, the disease has a very low prevalence in young cats, becoming more common with age.<sup>2-4</sup> Congenital renal disease is usually recognised in cats <3 years of age, after which the prevalence of CKD decreases and then increases again from 6 years onwards.<sup>5</sup> CKD is one of the most commonly diagnosed diseases in older cats, with studies variously reporting a prevalence of 28–81% in all cats aged >12 years.<sup>5-8</sup> It was the most common cause of death in an investigation of cats in the UK aged 5 years or older; death due to renal disease occurred in 13.6% of the study cats, with a median age at death of 15 years.<sup>9</sup> Kidney disease was also the most common cause of death in insured cats dying before the age of 13 years in a Swedish study.<sup>10</sup>

Many cats with CKD may be diagnosed at an advanced stage of disease, as they exhibit few clinical signs during the early stages. However, early diagnosis and intervention can allow monitoring, as well as the initiation of dietary and other therapeutic measures, when appropriate. Therefore, screening of cats ≥7 years of age is recommended. Screening is achieved by performing regular body weight measurement, blood examination and urinalysis, even in asymptomatic cats.<sup>1,2</sup> For mature adult cats, aged 7–10 years, annual examinations are recommended, whereas senior cats (>10 years) should preferably be presented twice a year for a routine health check.<sup>2,11,12</sup>

Such health screening revealed subclinical CKD (International Renal Interest Society [IRIS] stage 2 or higher) in 8% of apparently healthy older cats in two prospective studies at Ghent University, Belgium.<sup>13,14</sup> The disease occurred significantly more frequently in healthy-appearing senior cats (15%) compared with mature adult cats (3%).<sup>14</sup> Of cats



**Early-stage CKD represents a significant diagnostic challenge, yet is of critical clinical importance.**

who were confirmed healthy during the first screening, a further 24% aged  $\geq 11$  years and 8% aged 7–10 years developed azotaemia within 2 years.<sup>14</sup> Therefore, even when initial health screening results are unremarkable, and cats are non-azotaemic, it is advised to monitor older cats longitudinally and evaluate serial laboratory data for the individual cat so that changes (eg, creatinine trending upwards or sudden increases in creatinine) can be identified sooner.<sup>11,12,14,15</sup>

## Pathophysiology of CKD

### Risk factors for CKD

Age is the most consistently identified risk factor for CKD in cats.<sup>6</sup> Histopathological changes consistent with renal ageing develop in older cats,<sup>16</sup> suggesting that age-associated structural alterations may increase renal susceptibility to further injury. Also, a species-related predisposition to CKD is recognised in felids, including domestic and wild species, and their obligate carnivore status has been suggested to contribute to this risk.<sup>17</sup> Tubular lipid accumulation is a species-specific phenomenon that may play an important role in CKD pathogenesis and progression.<sup>5,16,18</sup> Dietary factors associated with obligate carnivore status – such as high protein<sup>19,20</sup> and phosphate<sup>21</sup> intake, increased dietary acid load<sup>22</sup> and alterations in gut-derived uraemic toxin profiles<sup>23</sup> – may be contributing risk factors in the pathogenesis of CKD.

Several comorbid conditions are associated with an increased risk of developing or exacerbating CKD. These include hyperthyroidism,<sup>24</sup> persistent (including borderline) proteinuria (which may be due to hypertension),<sup>25–27</sup> repeated renal ischaemic events and repeated ureteral obstructions.<sup>5,28</sup> Additionally, cohort studies have identified periodontal disease as being a potential risk factor,<sup>29,30</sup> indicating that chronic inflammatory and systemic conditions may influence renal health. Frequent vaccination status has also been proposed as a risk factor,<sup>29</sup> although current evidence remains limited and further investigation is required.

### Role of dietary inorganic phosphate in the development of CKD

Epidemiological evidence from human medicine suggests that a high intake of processed foods with soluble sources of inorganic phosphate represents a risk factor for the development of CKD.<sup>35–37</sup> Studies indicate that the phosphate content of food may also be important in the development of CKD in cats.<sup>21,37,38</sup> In vitro and experimental models suggest that if postprandial serum phosphate concentration increases at every meal, fibroblast growth factor 23 (FGF23) and parathyroid hormone (PTH) inhibit reabsorption of filtered phosphate in the kidney; this leads to a rise in phosphate concentration along the proximal convoluted tubule, resulting in processes that trigger cellular stress, nephron death, interstitial fibrosis and inflammation.<sup>37</sup>

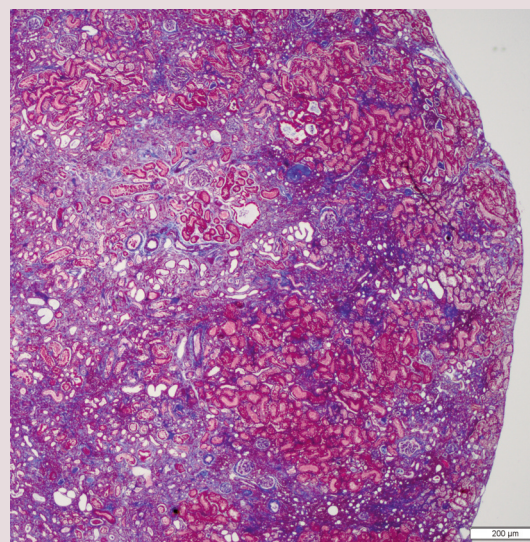
Phosphate content is not always stated on the packaging of cat foods. Moreover, it is likely that the source of phosphate, calcium:phosphate ratio and feeding patterns will make a difference to how quickly phosphate ions are absorbed postprandially in individual cats. Future studies assessing postprandial serum phosphate or FGF23 concentrations in adult cats at routine health screening could help determine safe levels of dietary phosphate for each cat.

## Histopathological lesions in cats with CKD

The predominant histopathological lesions in cats with CKD are considered irreversible and include interstitial inflammation, tubular degeneration, fibrosis and glomerulosclerosis (Figure 1).<sup>31</sup> These lesions increase in severity with IRIS stage.<sup>31</sup> Peritubular capillary rarefaction is also present in the kidneys of cats with CKD.<sup>32</sup>

In biopsies from proteinuric cats (urine protein:creatinine ratio [UPC]  $>0.2$ ) submitted to the International Veterinary Renal Pathology Service, 58% had immune-complex glomerulonephritis (ICGN).<sup>33</sup>

**Figure 1** Histology section (trichrome stain) of tubulointerstitial nephritis, the typical change found in cats with chronic kidney disease (CKD). This image illustrates focal areas of interstitial inflammation, fibrosis and tubular loss (blue, purple) interspersed among healthy tubules. Image courtesy of Shannon McLeland



**Most cats with CKD have chronic tubulointerstitial nephritis of unknown aetiology, but known inciting causes should be excluded.**



### Known aetiologies of feline CKD

In the majority of cats with CKD, the underlying cause of their disease cannot be determined; if renal biopsies are performed, histopathology (see box, 'Histopathological lesions in cats with CKD') reveals chronic tubulointerstitial nephritis of unknown aetiology.<sup>34</sup> However, there are a number of well recognised diseases or conditions that are known or suspected to be an inciting cause of CKD (Box 1), as outlined in the following discussion.

## Box 1

## Potential aetiologies of CKD in cats

- ✦ Idiopathic CKD (most common)
- ✦ Congenital and hereditary causes
  - Polycystic kidney disease (Figure 2)
  - Inherited amyloidosis
  - Juvenile nephropathy
- ✦ Glomerular disease
  - ICGN
- ✦ Obstructive and postrenal causes
  - Ureterolithiasis
  - Ureteral strictures
  - Neoplastic obstruction
  - Ureteral stenosis
  - Hydronephrosis
- ✦ Infectious causes
  - Bacterial pyelonephritis
  - Viruses: feline leukaemia virus, feline infectious peritonitis
  - Parasites: *Diocotophyme renale*
- ✦ Toxic causes (chronic or delayed effects)
  - Plants: lilies
  - Drugs: non-steroidal anti-inflammatory drugs, chemotherapeutics, aminoglycosides
  - Chemicals: ethylene glycol, heavy metals (eg, lead)
- ✦ Vascular and haemodynamic causes
  - Systemic hypertension (via proteinuria)
  - Renal ischaemia
  - Thromboembolic disease
- ✦ Endocrine and metabolic disorders
  - Hyperthyroidism
  - Primary hyperaldosteronism
  - Diabetes mellitus
  - Hypercalcaemia
- ✦ Neoplastic causes
  - Renal lymphoma
  - Renal carcinoma (Figure 3)
  - Infiltrative neoplasia
- ✦ Iatrogenic causes
  - Repeated anaesthesia with hypotension
  - Chronic nephrotoxin exposure
  - Radiation therapy involving the kidneys
- ✦ Sequela of acute kidney injury (AKI)

## Inherited/genetic causes of CKD

Autosomal dominant polycystic kidney disease, the result of a mutation in the *PKD1* gene, is the most prominent inherited disease of cats, affecting 38% of Persians worldwide (6% of all cats).<sup>39</sup>

Hereditary forms of amyloid A amyloidosis (AA-amyloidosis) are recognised in Abyssinian, Somali, Siamese and Oriental cats, in which the deposition of amyloid can lead to dysfunction in multiple organs, resulting in decreasing kidney function or hepatic rupture and fatal haemorrhage. Research is ongoing to characterise which

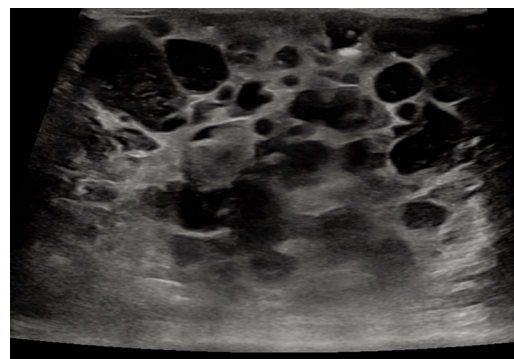


**Figure 2** Ultrasound image of a polycystic kidney in a Persian cat. Image courtesy of Lumbry Park Veterinary Specialists



**Figure 3** Renal carcinoma in an 11-year-old cat presenting with azotaemia and unilateral renomegaly. Image courtesy of Samantha Taylor

genetic variants are implicated in this condition.<sup>40,41</sup> Additionally, AA-amyloidosis has been reported in shelter cats with rapidly progressive CKD, with the hypothesis that chronic inflammation may have triggered amyloid deposition or horizontal transmission may have occurred.<sup>42</sup>

In the future, our understanding of the genetic risk factors for idiopathic CKD in cats is likely to expand. Recent work has identified an association between a genetic variant in the gene encoding for feline apoptosis inhibitor of macrophages (a protein involved in kidney repair) and declining kidney function in CKD.<sup>43</sup>

## Nephrolithiasis

It has long been debated whether nephrolithiasis causes CKD, or if CKD results in urolithiasis. The vast majority of nephroliths in cats are calcium oxalate,<sup>44,45</sup> making dissolution impossible. Epidemiological research shows that incidental nephroliths are not associated with progression of CKD in older cats,<sup>46</sup> but nephroliths that move and lead to ureteral obstruction can result in severe kidney damage – the extent of injury being proportional to both the degree and duration of the obstruction.



**Figure 4** 'Big kidney-little kidney' syndrome occurs when a prior, undetected, unilateral ureteral obstruction results in damage to one kidney, leading to fibrosis and shrinkage of that kidney over time. The contralateral kidney hypertrophies to help increase the global glomerular filtration rate. The size difference may be exacerbated if the second kidney suffers a ureteral obstruction, and this may be the point at which the cat presents as azotaemic and unwell. Image courtesy of Rebecca Geddes

Unilateral ureteral obstruction can easily be overlooked in the clinic because azotaemia will not develop when the contralateral kidney has normal function. However, subsequent damage can lead to marked fibrosis and shrinking of the affected kidney. A disparity in size of  $>0.7$  cm between the kidneys is referred to as 'big kidney-little kidney' syndrome (Figure 4),<sup>47</sup> and this has been documented in 33% of cats with upper urinary tract (kidney and/or ureter) stones.<sup>45</sup>

When ureteral obstruction is identified, surgical intervention is recommended over medical management due to improved outcomes.<sup>48</sup> However, medical management can result in good outcomes, with younger age and more distal small uroliths showing a significant association with successful treatment.<sup>49</sup> After surgical management to restore urine flow from the kidney to the bladder (eg, subcutaneous ureteral bypass placement, ureteral reimplantation), cats should be considered to have CKD; this appears analogous to idiopathic CKD in terms of future disease progression.<sup>50</sup>

### Acute kidney injury

Any cause of AKI due to renal insult (eg, pyelonephritis, toxin or drug-related, ischaemic injury or postrenal obstruction) should be considered to be a contributing factor to the subsequent development of CKD.<sup>51</sup>

### Hypercalcaemia and nephrocalcinosis

Nephrocalcinosis is the deposition of calcium in the parenchyma of the kidney, which, in cats, typically consists of calcium phosphate deposits in the renal medulla.<sup>52</sup> The incidence of histological nephrocalcinosis is higher in

cats with azotaemic CKD compared with non-azotaemic cats.<sup>53</sup>

The relationship between nephrocalcinosis and the progression of CKD is complex. Retrospective data indicate that it takes time for nephrocalcinosis to develop, because cats with rapidly progressive CKD and shorter survival times are the least likely to demonstrate microscopic nephrocalcinosis at post-mortem examination.<sup>52</sup> Prospective studies of hypercalcaemic cats managed on renal diets have shown that they are more likely to develop nephrocalcinosis.<sup>54</sup> In turn, this is associated with a greater increase in serum creatinine, phosphate and FGF23 over time when compared with cats fed a renal diet who did not develop nephrocalcinosis, suggesting that nephrocalcinosis may contribute to CKD progression.<sup>54</sup> Thus, when feeding a renal diet, serum calcium (preferably ionised) should be monitored. If hypercalcaemia develops, measures to reduce serum calcium will be needed (see 'Management of hypercalcaemia').

### Glomerular diseases

Glomerulonephropathies are an uncommon cause of CKD but important to recognise. Primary glomerular diseases include ICGN and non-immune-complex glomerulonephritis.<sup>55</sup> ICGN is a significant cause of proteinuric renal disease, typically affecting younger cats who present with azotaemia, marked proteinuria, hypoalbuminaemia, anaemia, renomegaly<sup>33</sup> and, in some cases, plasma cell pododermatitis.<sup>56</sup> As early diagnosis and management may increase the chances of disease control, urinalysis, including quantification of protein, should be performed in azotaemic patients.

### Primary hyperaldosteronism

Primary hyperaldosteronism, which is the result of excessive aldosterone secretion secondary to adrenal neoplasia or hyperplasia, is an uncommon endocrinopathy in cats, but CKD is a frequently reported comorbidity.<sup>57</sup> It is possible that excess aldosterone contributes directly to the development of CKD through stimulation of fibrosis and that further renal damage occurs due to associated systemic hypertension.<sup>58</sup> Importantly, cats with CKD may have adrenal gland hyperplasia, so appropriate diagnostic testing is indicated before making a diagnosis of hyperaldosteronism.<sup>59</sup>



**When feeding a renal diet, serum calcium should be monitored. If hypercalcaemia develops, measures to reduce calcium will be needed.**

## Progression of CKD

CKD progression can follow two principal pathways. In the first, disease advances gradually and continuously due to ongoing intrarenal processes, ultimately leading to loss of nephrons and replacement of the functional parenchyma with fibrotic tissue. The second involves a stepwise trajectory characterised by discrete episodes of AKI. Some of these episodes may be subclinical and go unnoticed, yet still contribute to disease progression, while others are clinically evident and classified as acute-on-chronic kidney disease (ACKD).<sup>60,61</sup> The relative prevalence and the impact of these pathways remain incompletely understood.

All the known aetiologies of AKI, including ischaemia, infection, inflammation and nephrotoxicity, are potential triggers of ACKD. In a study of ACKD in cats, ischaemia, ureteral obstruction and pyelonephritis were the most common presumed causes; yet, in 66% of cases, the aetiology remained unidentified at presentation and throughout the course of disease.<sup>61</sup>



**CKD-MBD contributes to progression of CKD and is associated with increased mortality.**

AKI and CKD have traditionally been regarded as distinct clinical entities. However, increasing evidence suggests a bidirectional interplay – with CKD representing a risk factor for AKI,<sup>61</sup> and AKI episodes potentially initiating or accelerating the progression of CKD.<sup>51</sup>

### Factors associated with the progression of CKD

Several factors are associated with CKD progression in cats, as illustrated by the findings of a number of studies. The severity of proteinuria is strongly associated with survival time,<sup>62</sup> while the UPC is an independent predictor of CKD progression within the first 12 months following diagnosis.<sup>63</sup> Variables involved in CKD–mineral and bone disorder (CKD-MBD; Box 2) are also associated with CKD progression and outcomes: increased serum phosphate concentration is associated with progression within 12 months of diagnosis<sup>63</sup> and also with a short survival time;<sup>70</sup> higher serum FGF23 concentration at the point of diagnosis of azotaemic CKD is similarly

### Box 2

#### CKD–mineral and bone disorder

CKD-MBD describes the biochemical abnormalities, soft tissue calcification and bone changes that occur with CKD (Figure 5). These anomalies stem from a decreased glomerular filtration rate (GFR), which leads to a reduction in urinary excretion of phosphate, eventually resulting in hyperphosphataemia in the later stages of CKD. In cats, the main abnormalities documented clinically are increasing serum phosphate concentrations, an increase in phosphatonin FGF23 and/or PTH concentrations, and the development of nephrocalcinosis.<sup>64</sup> However, calcification of the vasculature, renal osteodystrophy and parathyroid hyperplasia have also been documented,<sup>65</sup> although are seldom recognised in clinical patients.

CKD-MBD contributes to progression of CKD and is associated with increased mortality.

#### Treatment of CKD-MBD

The focus of treatment for CKD-MBD in cats is a reduced dietary phosphate intake. This can usually be achieved by feeding a phosphate-restricted renal diet and/or with the addition of a dietary phosphate binder if phosphate remains above target ranges (see later). Veterinary therapeutic renal diets should take priority over phosphate binders, as numerous studies have shown a marked survival benefit when these are fed to cats with CKD.<sup>66–68</sup> A phosphate binder should be added to the diet when serum phosphate remains above the IRIS target for the relevant CKD stage despite dietary intervention (see 'IRIS staging of CKD'). The use of phosphate restriction in non-azotaemic CKD (when serum phosphate is within the IRIS target of <1.45 mmol/l [ $<4.5$  mg/dl]) can be guided by measurement of serum FGF23. The recommendation from IRIS is that phosphate restriction may be indicated if FGF23 concentrations exceed 400 pg/ml.<sup>69</sup>

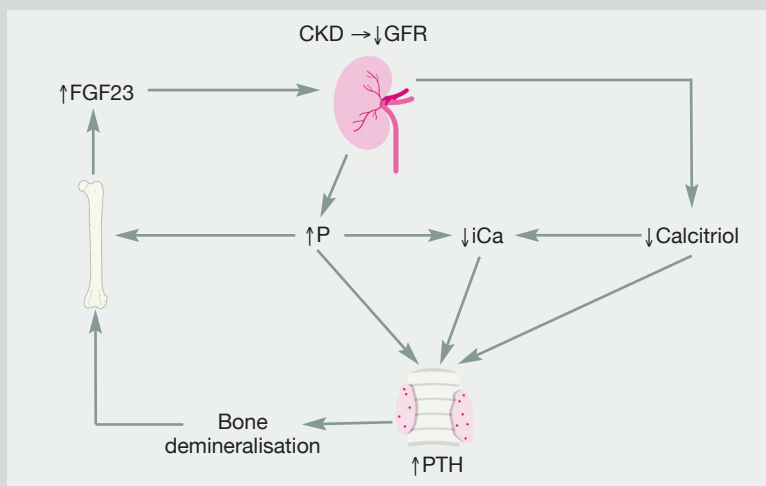


**Figure 5** Pathophysiology of CKD-MBD. A reduced glomerular filtration rate (GFR) leads to reduced filtration and excretion of phosphate. Increasing phosphate stimulates fibroblast growth factor 23 (FGF23) secretion, which attempts to increase renal phosphate excretion but is limited by decreasing nephron numbers. FGF23 reduces calcitriol concentrations, while increased phosphate complexes with calcium, causing ionised hypocalcaemia. Increased serum phosphate and reduced ionised calcium (iCa) and calcitriol all stimulate parathyroid hormone (PTH) secretion. These chronic biochemical changes lead to soft tissue mineralisation including nephrocalcinosis, renal osteodystrophy, CKD progression and reduced survival times

associated with both disease progression and mortality.<sup>71</sup>

Monitoring in the first 3 months from diagnosis can aid prediction of progression, suggesting serial monitoring of creatinine, phosphate and body weight can identify cats with progressive CKD vs stable disease; cats with progressive CKD have a significantly shorter survival time (>60% dying within 365 days of diagnosis).<sup>72</sup> Other factors associated with progression of CKD include anaemia,<sup>63</sup> uraemic toxins (Box 3)<sup>74</sup> and hypokalaemia.<sup>77</sup>

### Clinical signs of CKD

Clinical signs associated with CKD are typically insidious in onset and often non-specific. The most commonly reported signs, both historically and in more recent studies, have been polyuria (PU), polydipsia (PD) and weight loss, followed by loss of appetite and vomiting.<sup>78–80</sup> Other common signs include lethargy and weakness, although many cats show no clinical signs and may only be diagnosed via health screening.<sup>14,80,81</sup> Weight loss (Figure 6), which is typically gradual in onset,<sup>82</sup> may occur due to nausea and malaise associated with complications of CKD, such as hypokalaemia, anaemia, acidosis, constipation and dehydration, as well as appetite dysregulation due to accumulation of anorexigenic substances.<sup>83</sup>

Insidious weight loss and loss of muscle mass may go unnoticed by caregivers or be incorrectly attributed to age. One large study of over 500 cats reported a median loss of 8.9% body weight in the 12 months before diagnosis of CKD, but found that weight loss was already present 3 years before diagnosis and accelerated after diagnosis.<sup>82</sup> Unintended



**Figure 6** Weight loss is common in cats with CKD and may be the only clinical sign. This patient also has a poor haircoat and reduced muscle condition, which are further typical findings in cats with CKD. Image courtesy of Sarah Caney

### Box 3

#### Uraemic toxins

Uraemic toxins are substances that accumulate in patients with a decreased GFR and can have multiple deleterious effects. Of particular interest are uraemic toxins that are the waste products of protein catabolism (eg, indoxyl sulphate, p-cresyl sulfate), as these are thought not only to have negative pathophysiological effects, but also to contribute to the clinical syndrome of uraemia. Uraemic toxins that are the product of protein catabolism are produced in the colon via protein fermentation.<sup>73</sup>

Cats with CKD have increased serum concentrations of uraemic toxins, a factor that has been associated with disease progression.<sup>74–76</sup> Interestingly, even IRIS stage 2 cats (see 'IRIS staging of CKD') can have uraemic toxin concentrations that are significantly higher than those of control cats, and increased indoxyl sulphate is associated with the onset of azotaemic CKD.<sup>23,75</sup> Uraemic toxin production is exacerbated by dysbiosis. Cats with CKD can have faecal dysbiosis, characterised by decreased faecal microbial diversity and richness based on 16S ribosomal RNA gene sequencing.<sup>75</sup>

weight loss or a deterioration in body condition score (BCS) or muscle condition score (MCS) should not be ignored, and should prompt consideration of further diagnostic testing.

Less frequent signs of CKD include neck ventroflexion due to hypokalaemia (Figure 7)<sup>84</sup> and lower urinary tract signs due to urinary tract infection (UTI) and constipation.<sup>85,86</sup> Constipation may indicate chronic dehydration and/or hypokalaemia. Uraemic halitosis and oral ulceration may develop in cats with advanced CKD (Figure 8).<sup>79</sup>



**Figure 7** Neck ventroflexion and generalised weakness in a cat due to hypokalaemia associated with CKD. Image courtesy of Sarah Caney



**Figure 8** Painful uraemic oral ulcers and halitosis may develop in cats with severe azotaemia due to CKD. Image courtesy of Sarah Caney

## Making a diagnosis of CKD

Although standardised diagnostic criteria for cats have not been established, feline CKD is generally defined following principles analogous to human CKD,<sup>87</sup> requiring documentation of chronic (eg,  $\geq 3$  months) functional impairment or structural renal change. However, in practical terms, postponing interventions to confirm persistent change would not be recommended in cats with clinical signs or higher stage CKD. Confirmation of persistent azotaemia sooner is desirable in order to expedite interventions (eg, repeat testing 2 weeks later).

In the clinical setting, a diagnosis may be based on a serum creatinine concentration above the laboratory reference interval (RI), in combination with an inappropriately low urine specific gravity (USG) or persistent azotaemia (when urine cannot be obtained). In addition, consideration is given to other supportive findings such as evidence of structural change on imaging or kidney palpation and/or proteinuria. A USG  $< 1.035$  should raise suspicion for decreased urine-concentrating ability and early-stage CKD, even when other markers of kidney function remain within the RI, particularly when documented consistently over time. In such cases, further investigations including serial measurement of serum creatinine and diagnostic imaging can support a diagnosis of CKD.

Not all cats with CKD will meet all criteria; for example, CKD can be diagnosed based on structural changes on diagnostic imaging or persistent proteinuria (UPC  $> 0.4$ ) without azotaemia (see 'IRIS staging of CKD'). Other important aspects that clinicians should be aware of in relation to the diagnosis of CKD are addressed in Box 4.



**Figure 9** Pallor in a cat with non-regenerative anaemia due to CKD. Image courtesy of Sarah Caney

## History and physical examination

Pertinent historical findings were discussed in the earlier section, 'Clinical signs of CKD'. Physical examination may be unremarkable in cats with CKD, but suggestive findings include pallor due to anaemia (Figure 9), clinical evidence of dehydration, signs of target organ damage due to systemic hypertension (Box 5),<sup>90</sup> abnormal renal palpation (often small, firm kidneys), firm faeces in the colon, and reduced BCS and/or MCS.<sup>78,79</sup> Cats should also be assessed for signs of comorbidities such as periodontal disease, cardiac disease, hyperthyroidism, cognitive dysfunction syndrome and degenerative joint disease (DJD) (see 'CKD and important comorbidities').

## Serum creatinine

Creatinine is the most widely used surrogate marker of GFR. It is the preferred marker over urea as it is less affected by non-renal factors and so has greater specificity.<sup>91</sup> However, creatinine concentration has its limitations: it is influenced by muscle mass and hydration status. Moreover, RIs vary among reference laboratories and analytical methods.<sup>92</sup> Creatinine also demonstrates a non-linear relationship with GFR; therefore, a substantial decline in GFR might occur prior to an increase in serum creatinine above the laboratory RI.<sup>93</sup>

Ideally, an RI designed for the population to which the cat belongs is used. Since CKD occurs more commonly in older cats, age-appropriate RIs for older cats may best be used in cats aged  $\geq 7$  years.<sup>94</sup> It has been shown that serum creatinine is lower in older cats, possibly due to loss of lean muscle mass, and so the upper limit of the RI for creatinine needs to be adjusted downwards.<sup>95,96</sup> Additionally, 'trending' can be performed if previous blood examination results are

### Box 4

#### Key points relating to CKD diagnosis

- ❖ A diagnosis of CKD needs to be made *before* IRIS parameters for staging are applied (see 'IRIS staging of CKD').
- ❖ Cats with CKD can still have serum creatinine concentrations that fall within the laboratory RI. Use of laboratory RIs to determine an increased creatinine concentration (ie, basing a CKD diagnosis on the presence of azotaemia) can lead to underdiagnosis of CKD for the following reasons:
  - The upper limit of the RI for creatinine in older cats (aged  $\geq 7$  years), who are most likely to have CKD, should be lower than the general population RI, but most laboratories do not offer age-specific cut-offs.
  - Serum creatinine concentrations can vary

between individuals, making a population-based RI less appropriate than for other serum parameters such as symmetric dimethyl-arginine (SDMA) or serum phosphate. Ideally, the cat's own baseline value (whenever this is available from past visits) should be used to assess whether creatinine concentration is significantly increasing (a so-called 'subject-based RI').

- ❖ Monitoring individual 'trends' is necessary in order not to miss a creatinine concentration that is significantly increasing in a clinically stable cat compared with baseline (ie,  $> 25$ – $30\%$  higher than the lowest value measured in this cat in the past), even if creatinine is not (yet) exceeding the laboratory RI.

**Cats with CKD can have serum creatinine concentrations that fall within laboratory RIs.**



## Box 5

## Diagnosis of systemic hypertension in cats with CKD

## Measure systolic blood pressure

Use a Doppler or high-definition oscillometry monitor in a quiet location with minimal handling (Figure 10); ideally, the cat should not have been administered pre-visit anxiolytics such as gabapentin or pregabalin, as these may reduce systolic blood pressure (SBP).<sup>88</sup> However, 'white coat' hypertension may



**Figure 10** Blood pressure measurement should be performed as the first part of the clinical examination and in as calm a manner as possible, with minimal handling, allowing the cat to adopt a natural position. Here the cat is in the base of their carrier, with the cuff placed around the tail. Image courtesy of Sarah Caney



**Figure 11** Distant indirect ophthalmoscopy. The technique is performed in a darkened room (for the purposes of this image, there is daylight), with the examiner standing at arm's length from the cat, directing the light source towards the cat's eye. The angle of the light beam should be adjusted until a bright tapetal reflection is seen; then a 20–30 dioptre hand lens is placed just in front of the eye, perpendicular to the beam of light. The 'belly' (bulging side) of the lens should be facing the examiner ('belly to belly'). An inverted image of the fundus is obtained and the lens magnification typically ensures that much of the fundus is visible in one view. Image courtesy of Sarah Caney

occur in cats with protective emotions, so clinicians should confirm results with repeat measurement and assessment for target organ damage. Ensure that the cuff size is 30–40% of the tail or limb circumference and that the cuff is positioned at the level of the right atrium. Collect between five and seven readings, discarding the first reading and averaging the remainder.

## Look for evidence of target organ damage

SBP results should be interpreted in the light of the physical examination findings. Distant indirect ophthalmoscopy is a quick and easy way of assessing the fundus (Figure 11). For detailed information on fundoscopy, readers are referred to a recent review entitled 'Fundoscopy in cats: a practical guide and common findings' by Giannakopoulou and Blacklock.<sup>89</sup>

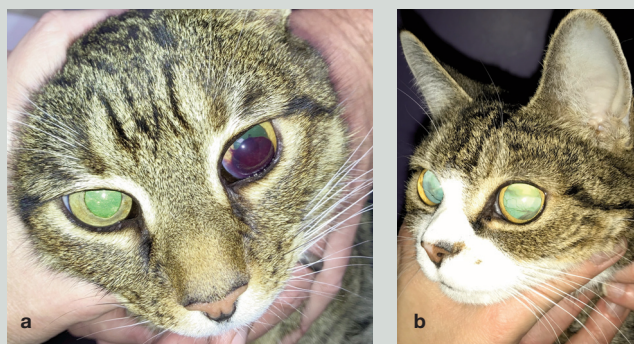


**Figure 12** Ocular target organ damage is present in up to 80% of cats with systemic hypertension and can manifest as (a) anterior changes such as hyphaema and/or (b) retinal and choroidal changes such as oedema, haemorrhage and detachment. Images courtesy of Sarah Caney

Evidence of target organ damage might include:

- ❖ Ocular (Figure 12): eg, blindness, hyphaema, retinal oedema/detachment, papilloedema;
- ❖ Neurological (hypertensive encephalopathy): eg, ataxia, mentation/behaviour changes, seizures;
- ❖ Cardiac: eg, novel murmur, gallop/arrhythmia;
- ❖ Renal: eg, proteinuria.

See 'Management of CKD' for discussion of the treatment approach to hypertension in cats with CKD.

available (see Box 4), ideally using the same laboratory for measurements.

## Symmetric dimethylarginine

SDMA is a more recently available biomarker of GFR. Initial studies showed that SDMA demonstrated greater sensitivity than creatinine for the detection of reduced renal function, with some studies indicating that elevations in SDMA might be documented 17 months before creatinine exceeds the upper limit of the RI in cats with CKD.<sup>95</sup> Subsequent research, however, has shown that the correlation between SDMA and GFR, and creatinine and GFR, is comparable.<sup>97,98</sup> Unlike creatinine, SDMA concentrations are less affected by

muscle mass and may be more reliable during inflammatory states and in animals with loss of muscle mass.<sup>99,100</sup>

Pre-renal and non-renal factors influence serum SDMA concentrations. Importantly, this includes hyperthyroidism in older cats, where factors other than GFR may lead to elevations in serum SDMA (see 'CKD and important comorbidities').<sup>101,102</sup> Lymphoma can elevate SDMA concentrations.<sup>103</sup> Conversely, cats with diabetes mellitus often have significantly lower SDMA concentrations than healthy controls or those with renal or cardiac disease.<sup>104</sup> For older cats, a higher diagnostic threshold ( $\geq 18 \mu\text{g/dl}$ ) than the standard commercial immunoassay cut-off ( $>14 \mu\text{g/dl}$ ) has been proposed for SDMA.<sup>96</sup>

## Differentiating between AKI and CKD

AKI and CKD can be challenging to distinguish in some cats presenting with azotaemia and no history of CKD. Additionally, AKI can occur in cats with pre-existing CKD (ie, ACKD).<sup>61</sup> Differentiating between AKI and CKD relies on history, physical examination findings, clinical pathology results, imaging and, occasionally, renal biopsy.<sup>105,106</sup>

### History and physical examination

Cats with AKI typically do not have a history of chronic illness. Caregivers may report exposure to nephrotoxic drugs or toxins, and cats with AKI often present with more severe clinical signs (eg, vomiting, hyporexia, oliguria) than cats with CKD. On physical examination, cats with AKI are often in normal body condition; they may have a small bladder due to anuria/oliguria, renal pain and

normal or mildly enlarged kidneys, or a disparity in kidney size if ureteral obstruction is present.<sup>107</sup> Although CKD can be diagnosed without a reported history of chronic illness, historical signs of weight loss, PU/PD, hyporexia and lethargy may be documented. Physical examination may reveal a reduced BCS and MCS, pale mucous membranes and small, firm kidneys. Clinical signs of hypertension can accompany both AKI and CKD.

### Clinicopathological parameters

Severe azotaemia in the absence of a history of chronic illness is typical of AKI, and affected cats may also have moderate to severe hyperphosphataemia. Hypercalcaemia is a less common feature of AKI compared with CKD, unless the cat has been exposed to specific toxins such as

vitamin D. Hypocalcaemia is reported with AKI caused by ethylene glycol toxicity.<sup>108</sup> Non-regenerative anaemia is more typically seen in cats with higher IRIS stage CKD than in cats with AKI. Cats with AKI may have indicators of active tubular damage on urinalysis such as cylindruria and glucosuria.

### Imaging findings

Abdominal ultrasound in cats with AKI may identify renomegaly with hyperechoic cortices, along with pyelectasia (with retroperitoneal fluid associated with oliguria/anuria),<sup>109</sup> while the kidneys of cats with CKD are small and irregular, with loss of corticomedullary definition (see 'Diagnostic imaging'). Imaging findings may alternatively point to other causes for the azotaemia, such as renal lymphoma or ureterolithiasis.

### Serum total and/or ionised calcium

Calcium concentrations in cats with CKD may be low, normal or increased, and should be interpreted as part of CKD-MBD. Total calcium reflects protein-bound, complexed and ionised fractions, but only the ionised fraction is biologically active and clinically relevant. Therefore, direct measurement of ionised calcium (iCa) is recommended whenever possible in cats with CKD.

Ionised hypercalcaemia is present at diagnosis in 20% of cats with CKD,<sup>110</sup> and is typically mild, yet can exacerbate CKD by further lowering GFR and contributing to anorexia, PU/PD, muscle weakness, constipation, urolithiasis and soft tissue calcification. Identification of azotaemia concurrent with hypercalcaemia can be challenging to interpret because CKD may promote hypercalcaemia, while ionised hypercalcaemia can reduce GFR; therefore, dependent on case presentation, clinicians should consider evaluating for additional causes such as neoplasia or diet-related factors.

### Serum phosphate

The kidneys play a key role in phosphate regulation. Hyperphosphataemia develops in CKD because of decreased renal excretion of phosphate, although phosphate concentrations are often within the RI in earlier stages of disease because of PTH and FGF23 regulatory mechanisms.<sup>111–113</sup> Therefore, serum phosphate should not be considered a sensitive marker of CKD.

### Phosphate vs phosphorus

In veterinary medicine, serum phosphate and serum phosphorus are often used interchangeably, but there is an important difference in these parameters. Phosphorus refers to the element itself (P), while phosphate refers to the biologically active ion in serum ( $\text{HPO}_4^{2-}$  and  $\text{H}_2\text{PO}_4^-$ ). Hence, serum phosphate is the correct term in the context of CKD.

### Glomerular filtration rate

GFR is considered the most accurate and sensitive measure of kidney function, although RIs are wide and measurements can vary temporally in an individual cat.<sup>91</sup> In cats with established azotaemic CKD, assessment of GFR is rarely indicated because it does not add useful diagnostic information beyond an increase in serum creatinine concentration. Measurement of GFR may be considered in suspected early, non-azotaemic CKD, or when precise evaluation of renal function is required to guide the safe use or dosing of renally excreted drugs. In such cases, simplified and single-sample iohexol clearance protocols are available for estimating GFR in cats, but are rarely performed in practice.<sup>91,93,114</sup>

### Haematology

Normocytic normochromic non-regenerative anaemia is common in cats with CKD,<sup>34,63</sup> especially in the later stages of disease. Thus, a complete blood count, or, as a minimum, assessment of packed cell volume (PCV) and a blood smear review, is indicated. Cats with pyelonephritis may exhibit leukocytosis.

### Urinalysis

The most important urinary parameters to evaluate as part of the diagnostic work-up are USG and urine protein.

❖ **Urine-concentrating ability** One of the earliest manifestations of a decline in kidney function is a reduction in urine-concentrating ability (USG <1.035).<sup>115,116</sup> In many cases, urine-

concentrating ability decreases or is lost before serum creatinine exceeds the upper limit of the RI.<sup>79</sup> However, despite urine concentration being one of the earliest markers of decreased kidney function, cats with early-stage CKD and mildly elevated creatinine could have appropriately

concentrated urine (ie, USG  $\geq 1.035$ ). Unless a cat is being fed a high-moisture diet, or has another reason for producing dilute urine, a USG  $< 1.035$  should alert the clinician to the possibility of CKD and prompt repeated assessment and further investigation, if persistent.<sup>91</sup>

## Box 6

### Urinary tract infections, subclinical bacteriuria and pyelonephritis

Cats with CKD are more likely to have a positive urine bacterial culture than healthy cats, with a prevalence rate of 22–29%.<sup>85,119,120</sup> Despite the increased likelihood of positive cultures, not all cats will show lower urinary tract signs (see below) or indications of pyelonephritis (also see below) warranting antimicrobial treatment.<sup>119,120</sup> Furthermore, bacteriuria (subclinical or UTI) does not seem to affect disease progression or survival in azotaemic patients.<sup>121,122</sup> Hence, routine urine bacterial culture is not recommended in cats with CKD who have no lower urinary tract signs or indications of pyelonephritis.<sup>85,123</sup>

#### Urinary tract infection

A UTI is defined as bacteriuria accompanied by compatible clinical signs such as stranguria, pollakiuria and haematuria. In suspected cases of UTI, urine for bacterial culture should be obtained via cystocentesis, with treatment selected according to susceptibility testing. Specific considerations for performing cystocentesis in a cat friendly manner (Figure 13) are described in the '2022 AAFP/ISFM cat friendly veterinary interaction guidelines: approach and handling techniques'.<sup>124</sup>

Most UTIs in cats involve a single bacterial species, most frequently a member of the host's own urogenital or faecal microflora (*Escherichia coli*, *Streptococcus* species, *Enterococcus faecalis*, *Staphylococcus felis*).<sup>125,126</sup> Previously, antimicrobial treatment courses of 4 weeks' duration were recommended for 'complicated' cases such as UTIs in cats with CKD. However, in cats with non-recurrent UTI and no indication of pyelonephritis, a shorter course of 2 weeks may be appropriate.<sup>85,123</sup> If empirical treatment is needed prior to culture results, potentiated amoxicillin is a reasonable choice.<sup>127</sup> The response to treatment should be monitored based on clinical signs, and repeat culture performed any time there are new or recurrent clinical signs.

#### Subclinical bacteriuria

Subclinical bacteriuria is defined as the presence of bacteria in urine (as determined by a positive bacterial culture) in the absence of lower urinary tract signs.<sup>123</sup> In one study, cats with CKD and positive urine culture results, but without clinical signs of UTI, had similar survival times to those without positive urine cultures, and were no more likely to show progression of CKD, although these cats



**Figure 13** Where possible, urine should be obtained via cystocentesis for bacterial culture. The technique can be performed using minimal handling, with the cat in a comfortable standing position and food offered as a distraction. Image courtesy of Jessica Quimby

were treated with antimicrobials.<sup>121</sup> A further study found that subclinical bacteriuria in cats with CKD was not significantly associated with death, disease progression or the development of pyelonephritis, although many were treated with antimicrobials.<sup>122</sup> Hence, treatment of subclinical bacteriuria in cats with CKD is not indicated when pyelonephritis is not suspected, but affected cats should be monitored for signs of pyelonephritis or clinical signs of UTI.<sup>85</sup> Culture of *Enterococcus* species is particularly likely to represent subclinical bacteriuria, and treatment is typically not required unless clinical signs exist.<sup>128,129</sup>

#### Pyelonephritis

Pyelonephritis is an infection – most commonly bacterial (*E coli*, *Enterococcus* species, *Proteus* species, *Staphylococcus* species)<sup>130,131</sup> but occasionally fungal<sup>132,133</sup> –

of the renal pelvis, but it may extend to the tubular interstitium and renal parenchyma.<sup>130</sup> Cats with CKD have a higher risk of developing AKI due to pyelonephritis; hence, any clinical deterioration and/or increase in serum creatinine concentration should prompt consideration of this diagnosis.<sup>61,131</sup>

Typical clinical manifestations of pyelonephritis include pyrexia, PU/PD, vomiting, hyporexia, lethargy and abdominal/renal pain; lower urinary tract signs may or may not be present. Blood test results may show an increase in creatinine from the previous measured value, neutrophilia (with toxic changes) and elevated inflammatory markers such as serum amyloid A,<sup>134</sup> while urinalysis may show minimally concentrated urine with an active sediment. Urine culture should be performed on a sample obtained by cystocentesis. Pyelocentesis may be considered in selected cases with pyelectasis, but is technically challenging with some risks, although complications are generally minor.<sup>135</sup> Ultrasonographic findings (eg, renal pelvic dilation, increased or altered echogenicity of the renal cortex and/or medulla) may be present but are not specific for pyelonephritis, as cats with stable CKD may have comparable pelvic dilation.<sup>136</sup>

Antimicrobial therapy should be guided by urine culture and antimicrobial susceptibility testing results. For empirical treatment of suspected or confirmed pyelonephritis pending culture results, fluoroquinolones are commonly recommended, but should be considered on an individual basis to optimise antibiotic stewardship.<sup>123</sup>

**Routine urine bacterial culture is not recommended in cats with CKD who have no lower urinary tract signs or indications of pyelonephritis.**

## Urinalysis is an integral part of the diagnostic work-up of CKD.



❖ **Proteinuria** An important and clinically relevant parameter in the diagnosis and evaluation of CKD in cats is proteinuria. A persistent high-magnitude renal proteinuria most commonly reflects glomerular injury, which may be the inciting cause of the disease and may be present before marked increases in serum creatinine occur.<sup>55</sup> Proteinuria may also be the result of hyperfiltration and hypertension, and thus a secondary consequence of tubular interstitial disease.<sup>63,117</sup> The presence of proteinuria (UPC >0.2) in conjunction with other abnormalities, such as azotaemia, inappropriate urine-concentrating ability, structural changes or increases in SDMA, supports a diagnosis of CKD. In addition, the magnitude of UPC provides prognostic information and is associated with disease progression, making the identification and monitoring of this urinary parameter an integral component of CKD assessment in cats (see 'IRIS staging of CKD').<sup>62,118</sup> UPC should be interpreted alongside sediment examination and biochemistry results to exclude pre- and post-renal proteinuria.

❖ **Urine sediment examination** An additional essential part of urinalysis in cats with suspected CKD is urine sediment examination, which provides clinically relevant information that may either identify the cause or highlight complications of the disease (eg, crystalluria, bacteriuria; Box 6).

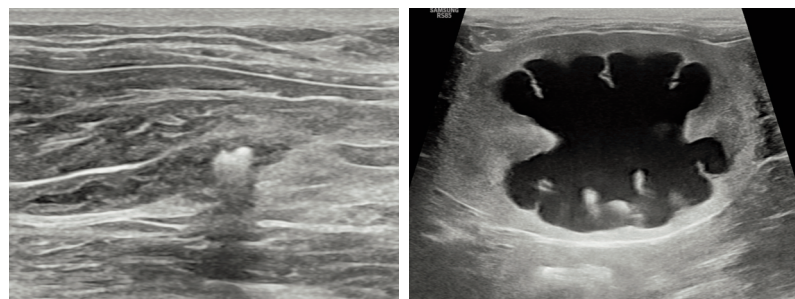


**Figure 14** Imaging such as ultrasound can be used to look for underlying causes of CKD and exclude causes of postrenal azotaemia such as (a) ureterolithiasis or (b) hydronephrosis. Images courtesy of Lumbry Park Veterinary Specialists

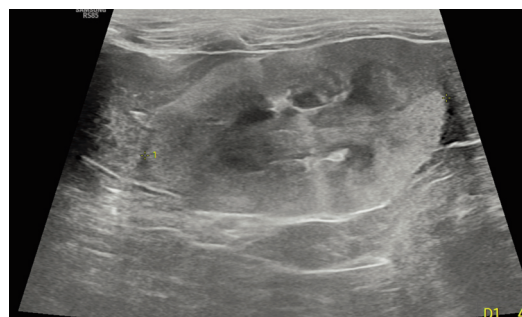


**Figure 15** Typical ultrasound findings in a cat with intrinsic CKD, including a small, irregular kidney with loss of corticomedullary definition. Image courtesy of Lumbry Park Veterinary Specialists

## Diagnostic imaging

Diagnostic imaging is an important part of the assessment of cats presenting with azotaemia or suspected renal disease. The aim is to rule in intrinsic renal disease, as well as rule out postrenal azotaemia (ie, ureteral obstruction and/or hydronephrosis; Figure 14) or other causes of azotaemia such as renal neoplasia,<sup>137</sup> polycystic kidney disease or infectious causes (feline infectious peritonitis, pyelonephritis).<sup>138</sup> Imaging (radiographs, ultrasound, CT) may also demonstrate the presence of CKD when serum creatinine and other biomarkers are normal in early (IRIS stage 1) disease. Findings typical of CKD on imaging include small kidney size, irregular margins and loss of corticomedullary definition (Figure 15).<sup>138</sup> Additional findings that may be observed in cats with CKD include renal mineralisation, nephroliths or striations in the cortex.

## Renal cytology and histopathology

Fine-needle aspiration of the kidneys is indicated when neoplasia or infection (eg, feline infectious peritonitis) is suspected.<sup>139</sup> Kidney biopsy or SDS-PAGE (sodium dodecyl sulfate polyacrylamide gel electrophoresis) on urine is indicated in cats with suspected glomerular disease to assess for ICGN.<sup>33</sup> Contraindications to tissue biopsy such as coagulopathies or uncontrolled hypertension must be excluded, and the procedure should only be performed when the potential diagnostic and therapeutic benefits justify the risks, which include haemorrhage, hydronephrosis and death.<sup>140</sup>

Renal sampling has limited utility once CKD has been diagnosed, as typical irreversible histopathological changes are expected and will not alter management approaches. Sampling may be considered in cases of suspected ACKD or rapidly progressive disease where imaging abnormalities are present suggesting additional pathology (eg, neoplasia).

## Biomarkers

Research into biomarkers of kidney injury is rapidly expanding in both human and veterinary medicine, largely driven by the limitations of currently used markers of renal function. Serum creatinine and SDMA are surrogate markers of GFR and, as such, are insensitive to renal injury where there is no concurrent decline in kidney function.<sup>91</sup>

Initial investigations into novel biomarkers primarily focused on the early detection of AKI, and multiple studies have demonstrated that injury biomarkers can identify AKI days before increases in functional markers are observed.<sup>106</sup> In several of these studies, animals with CKD were included as control groups and, unexpectedly, many individuals with apparently stable CKD exhibited increased

concentrations of injury biomarkers, suggesting the presence of ongoing tubular epithelial damage or stress.<sup>141</sup> In preliminary studies in dogs with stage 1 CKD, an association between markers of tubular epithelial injury and the rate of disease progression has been shown;<sup>142</sup> however, comparable data in cats with CKD (particularly IRIS stage 1) are currently lacking.

Serum cystatin C is a protein produced by nucleated cells and filtered freely at the glomerulus before reabsorption in the proximal tubules. It was proposed as a useful biomarker for CKD in cats, but data showed only a weak correlation between GFR and serum cystatin C and, hence, it was concluded not to be useful.<sup>143</sup> It also remains to be determined whether biomarkers of tubular epithelial injury (eg, cystatin B), or other markers reflecting intrarenal pathophysiological processes, are sufficiently sensitive for the diagnosis of early-stage CKD. This stage represents a significant diagnostic challenge, yet is of critical clinical importance, as current diagnostic approaches often identify CKD only after substantial nephron loss has already occurred. Earlier identification of CKD through sensitive biomarkers might enable more effective therapeutic intervention before irreversible loss of kidney function has developed.<sup>141</sup>

FGF23 is a hormone produced by osteocytes and osteoblasts that is responsible for regulation of phosphate and calcitriol (see Box 2). Serum FGF23 concentrations have been shown to be significantly higher in cats with azotaemic CKD than in healthy cats; moreover, concentrations increased significantly with increasing severity of CKD.<sup>71,144</sup> FGF23 is a biomarker for phosphate derangement in CKD, identifying cats who may benefit from intervention, but it is not recommended as a screening test for early diagnosis of the disease.<sup>145</sup>

**IRIS staging parameters are distinct from laboratory RIs. CKD diagnosis should be confirmed prior to staging.**



## IRIS staging of CKD

IRIS staging standardises assessment of the severity of CKD, guides evidence-based treatment and monitoring decisions, and improves communication and prognostication for the benefit of clinicians and caregivers alike. It is based on either fasting serum creatinine concentration alone or creatinine and SDMA (Figure 16). Subsequent substaging is based on the magnitude of renal proteinuria and SBP, which are therapeutically modifiable risk factors for disease progression.

### When to perform IRIS staging

- ❖ IRIS staging should only be performed in a cat with a confirmed diagnosis of CKD, based on evidence of persistent functional or chronic structural changes (see 'Making a diagnosis of CKD').
- ❖ IRIS staging should be restricted to cats with clinically stable CKD. Staging is not appropriate in cats with AKI or ACKD, or when creatinine or SDMA concentrations are rapidly changing (eg, with dehydration, upper or lower urinary tract obstruction, or recent fluid therapy).
- ❖ Prerenal and postrenal causes of azotaemia should be corrected before staging. IRIS recommends using fasting serum creatinine alone, or creatinine and SDMA, measured on at least two occasions in a well-hydrated, clinically stable patient. If concentrations are inconsistent, measurement(s) should be repeated after 2–4 weeks before staging is confirmed.

### How to perform IRIS staging

- ❖ **Initial staging (IRIS stages 1–4)** Following a confirmed diagnosis of CKD, assign an IRIS stage based on fasting creatinine alone, or creatinine and SDMA, in a stable, hydrated cat, ensuring consistent results on at least two occasions (Table 1).<sup>1,69</sup> If discrepancies between

### IRIS staging and substaging of CKD

Laboratory, imaging or histological criteria compatible with CKD? (see 'Making a diagnosis of CKD')

YES

Is the cat:  
❖ Clinically stable?  
❖ Well hydrated?

YES

Are two sequential and consistent values available of:  
❖ Creatinine ( $\pm$  SDMA)?  
❖ UPC?  
❖ SBP?

YES

Assign IRIS stage and substage  
→ Check need for dietary change and/or medication (see 'Management of CKD')

**Figure 16** Decision-making for International Renal Interest Society (IRIS) staging and substaging of chronic kidney disease (CKD). SBP = systolic blood pressure; SDMA = symmetric dimethylarginine; UPC = urine protein:creatinine ratio

**Table 1** IRIS staging of feline CKD, based on stable creatinine and SDMA

| Stage             | 1    | 2       | 3       | 4    |
|-------------------|------|---------|---------|------|
|                   |      |         |         |      |
| <b>Creatinine</b> |      |         |         |      |
| $\mu\text{mol/l}$ | <140 | 140–250 | 251–440 | >440 |
| mg/dl             | <1.6 | 1.6–2.8 | 2.9–5   | >5   |
| <b>SDMA</b>       |      |         |         |      |
| $\mu\text{g/dl}$  | <18  | 18–25   | 26–38   | >38  |

Adapted from the International Renal Interest Society (IRIS),<sup>69</sup> with permission  
CKD = chronic kidney disease; SDMA = symmetric dimethylarginine

**Table 2** IRIS substaging of feline CKD, based on UPC and SBP

|            | Non-proteinuric | Borderline proteinuric | Proteinuric  |                       |
|------------|-----------------|------------------------|--------------|-----------------------|
| UPC        | <0.2            | 0.2–0.4                | >0.4         |                       |
|            | Normotensive    | Pre-hypertensive       | Hypertensive | Severely hypertensive |
| SBP (mmHg) | <140            | 140–159                | 160–179      | ≥180                  |

Adapted from the International Renal Interest Society (IRIS),<sup>69</sup> with permission  
CKD = chronic kidney disease; SBP = systolic blood pressure; UPC = urine protein:creatinine ratio

creatinine and SDMA exist regarding the CKD stage, IRIS recommends repeating the measurements within 2–4 weeks. If the discrepancy persists, assigning the more advanced stage of CKD would be an appropriate response.<sup>69</sup>

❖ **Substaging** Substage the IRIS classification according to the degree of proteinuria and the SBP.

– *Proteinuria* – a substage of non-proteinuric, borderline proteinuric or proteinuric (Table 2) is assigned based on UPC (ideally, measured on a minimum of two urine samples collected at least 2 weeks apart).<sup>62,69,146,147</sup>

– *SBP* – a substage of normotensive, pre-hypertensive, hypertensive or severely hypertensive (Table 2) is assigned based on multiple sequential SBP measurements. The exception is

if extra-renal target organ damage is already present, in which case immediate treatment is indicated (see 'Management of CKD').<sup>1,69</sup>

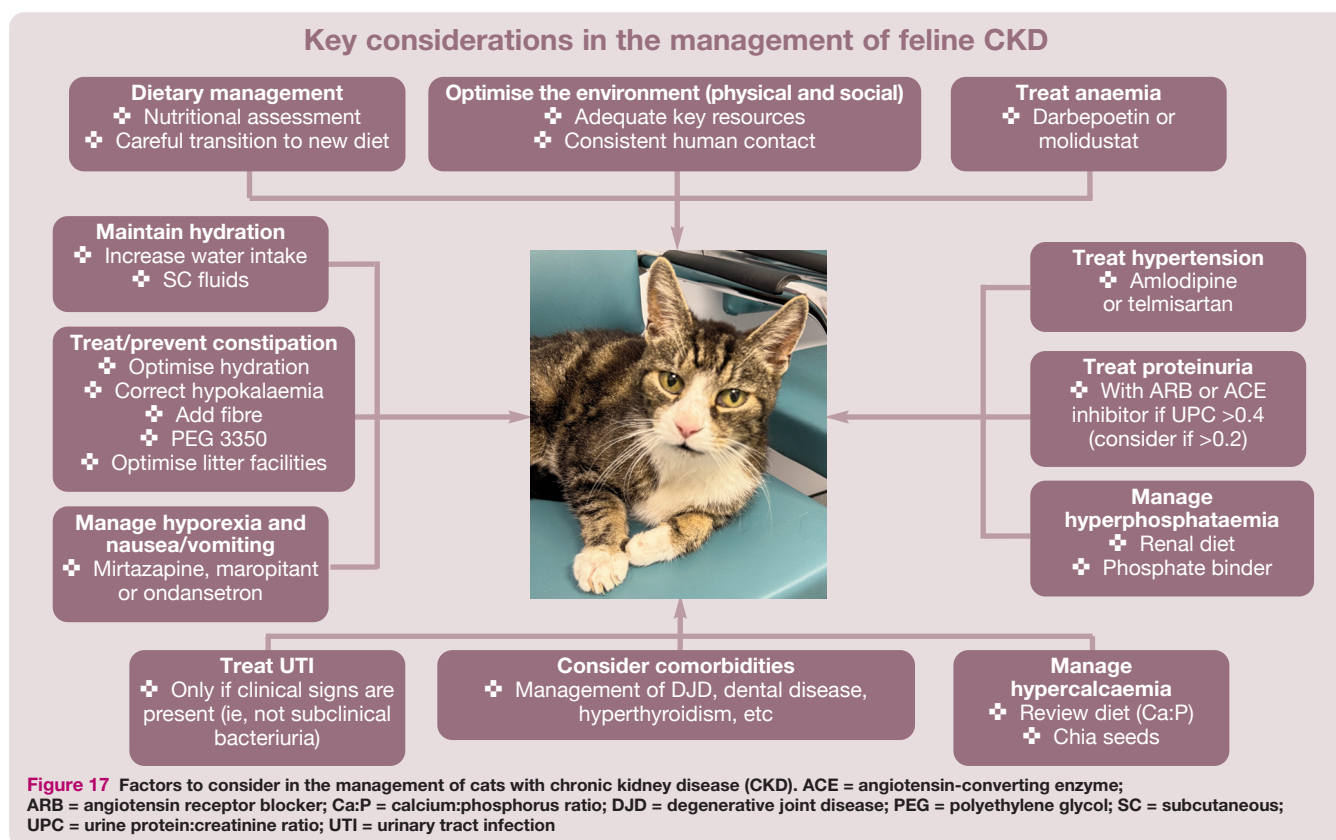
❖ **Re-evaluation and monitoring** Repeat the staging process if there is a significant change in creatinine/SDMA concentrations, proteinuria or SBP, or a change in the cat's treatment regimen or clinical status.

## Management of CKD

In broad terms, the aims of management of CKD are to address clinical signs to optimise the quality of life of the affected cat and to implement measures aimed at slowing progression of the disease, all the while working as a team with the caregiver to ensure interventions are appropriate for the individual situation (Figure 17).<sup>78,148</sup> The former aims assume most importance as the cat reaches the later IRIS stages, whereas the latter measures are more important in the earlier IRIS stages. Compliance should always be considered when prescribing medications; a requirement for multiple drugs is commonplace and can impact quality of life in cats with CKD,<sup>149</sup> as well as contributing to 'caregiver burden' (Box 7).<sup>80</sup>

### Dietary intervention

There is strong evidence to support dietary modification in cats with CKD. Feeding a veterinary therapeutic renal diet can prolong



## Box 7

## Addressing the caregiver burden of CKD

It is important to recognise the common and often substantial burden associated with caring for a cat with CKD.<sup>150</sup> Caregivers often may feel anxious about their cat's prognosis and quality of life, as well as their ability to administer medications. In addition, they may worry about disruption to daily routines and restrictions on their personal life.<sup>148</sup>

Client communication around feline CKD should focus on the individual cat and the caregiver's unique needs, involving caregivers as much as they wish and adopting a non-judgemental, empathetic and shared decision-making approach. Clinicians should:

- ❖ Consider this emotional strain in consultations and validate caregivers' worries;
- ❖ Provide clear, ongoing communication about CKD progression, expectations and management goals. Caregivers appreciate being well informed about their cat's illness;<sup>80</sup>
- ❖ Involve veterinary nurses/technicians in communicating with caregivers to provide key practical information on aspects such as administering medications, introducing dietary changes and

monitoring cats with CKD (see 'Nursing the cat with chronic kidney disease' in the supplementary material);

- ❖ Encourage active involvement of caregivers in the monitoring of their cat (Figure 18).

Actively addressing the burden of caring for a cat with CKD improves caregiver compliance, supports long-term disease management, and enhances outcomes for both cats and their families. Further tips for supporting caregivers in medicating their cats are provided in Box 8.

**Figure 18** Including caregivers in the monitoring of their cat – for example, by encouraging assessment of body weight at home and keeping a diary – can help caregivers feel informed about the status of their cat's illness and encourage communication between the veterinary clinic and caregiver. Image courtesy of Samantha Taylor



survival and reduce the risk of uraemic crises.<sup>66,151</sup> The primary nutrient of concern to slow the progress of CKD and prolong survival is dietary phosphorus (both organic and inorganic); typically, renal diets provide ~80–130 mg phosphorus/100 kcal, whereas non-renal diets may contain up to 400–600 mg/100 kcal. Hyperphosphataemia is associated with reduced survival in cats with CKD.<sup>70,146,147</sup>

There is strong evidence to support dietary modification in cats with CKD.



In one study, for every 0.32 mmol/l (1 mg/dl) increase in serum phosphate, there was an 11.8% increased risk of death.<sup>70</sup>

Plasma phosphate concentration is a potent stimulator of FGF23, a phosphatonin involved in the development of CKD-MBD (see Figure 5).<sup>152</sup> Feeding a reduced-phosphorus diet decreases serum phosphate and FGF23 in cats with CKD.<sup>153</sup>

## Box 8

## Medicating cats with CKD: strategies for improving caregiver compliance

Ultimately, caring for a patient with CKD is a balance between providing necessary therapies and preserving quality of life. A management plan should be tailored to the individual patient based on the caregiver's abilities and the cat's level of acceptance. Education regarding the rationale for, and evidence behind, prescribed therapies may improve compliance.<sup>80</sup>

The goals of medical management may differ based on the disease stage – with emphasis on treatments that delay progression in early-stage disease and emphasis on treatments that may improve quality of life (eg, improve appetite, and address anaemia and constipation) in more advanced disease.<sup>149</sup>

Tips for medicating cats with CKD include:

- ❖ Prioritising the most important medications for cats who are challenging to medicate;
- ❖ Researching and discussing options for different medication formulations (liquids, tablets, powders, capsules) based on individual cat and caregiver preferences;
- ❖ Informing caregivers about the practicalities of giving the medication; for example, administering

in food (liquid treats, pill 'putty' products), including the option to crush tablets or open capsules;

- ❖ Demonstrating how to give the medication directly into the mouth, if necessary, without causing the cat discomfort;
- ❖ For painful cats, considering administering injectable analgesics initially at the veterinary clinic, to improve comfort and help facilitate ongoing oral medication administration;
- ❖ Avoiding bitter-tasting medications or those requiring a large volume of liquid or large tablet size;
- ❖ Avoiding hiding medication in the cat's main meals, as this can cause food aversion; the exception to this is phosphate binders, which should ideally be mixed with the cat's food, but could be given after eating;
- ❖ Combining medications in a gel capsule, so only a single administration is required.

Following up with caregivers via their preferred communication route (telephone, text, email) allows challenges to be discussed and alternatives found, if necessary (see 'Nursing the cat with chronic kidney disease' in the supplementary material).

Caring for a patient with CKD is a balance between providing necessary therapies and preserving quality of life.



Renal diets may also have other benefits for cats with CKD; for example, supplementation with omega 3 fatty acids such as eicosapentaenoic acid (EPA). In one study, the renal diet with the highest EPA content was the most effective in extending survival in cats with CKD.<sup>67</sup> Additional benefits include supplementation with antioxidants, potassium and B vitamins; they may also contain alkalising ingredients.

When it comes to choosing a specific reduced phosphate diet for an individual cat, a nutritional assessment should be performed to include measurement of body weight, BCS and MCS, and to identify cat preferences (flavour, texture, frequency of feeding) as well as relevant caregiver factors (finances, lifestyle).<sup>154</sup> Other considerations are outlined below.

❖ Feeding a canned or moist diet will provide more water to the cat, which can aid in maintaining adequate hydration.

❖ Canned diets will be lower in caloric density, requiring cats to eat a greater volume of food, and it may thus be challenging for some cats to maintain weight. By contrast, kibble or dry diets will typically provide about four times more calories per gram than most canned or fresh diets.

❖ Cats with CKD can have a waxing and waning appetite; hence, it is often desirable to have multiple appropriate diet options that meet nutritional needs.

When introducing a new diet to a cat with CKD, it is best to offer small amounts of the new food gradually over at least 1–2 weeks alongside the existing food. Cats often do not like having the new and existing diets mixed, so offering the foods side by side may be better tolerated. It is important never to introduce a novel diet during a period of illness or while, for example, a cat is undergoing diagnostic investigations within the veterinary clinic, as they could develop food aversions affecting long-term acceptance of the food.

Diets marketed for early kidney disease typically provide slightly more protein than diets marketed for more advanced disease. Ultimately, the decision of whether to feed an 'early' or 'advanced' renal diet may be based on factors other than the cat's assigned IRIS stage. For example, if a cat is eating fewer calories than ideal, then feeding a higher protein diet may be preferable to ensure the cat's protein requirement is being met. Additionally, many of the 'early' renal diets provide slightly more phosphate and may have a lower calcium:phosphorus (Ca:P) ratio; however, this is not universally the case.

Preserving a healthy body weight, BCS and MCS through maintaining an adequate caloric

**Renal diets should not be introduced during periods of illness, to avoid the development of food aversions.**



intake should be prioritised in the management of CKD. Some cats will maintain weight simply by eating their resting energy requirement (RER; calculated as  $70 \times \text{body weight [kg]}^{0.75}$ ). However, for others the RER will need to be multiplied by a maintenance energy requirement (MER) factor of approximately 1.2–1.4. If a cat requires more than 2.0 x RER, additional diagnostics should be performed to assess for comorbid conditions (eg, hyperthyroidism, chronic enteropathy, exocrine pancreatic insufficiency).

Although, ideally, a therapeutic renal diet would be fed exclusively, this is not always possible, and caregivers should be encouraged to continue to feed the renal diet even if it only makes up a proportion of the calories eaten. A diet that is 50% or more renal diet can have a beneficial effect on survival.<sup>66</sup>

#### Further management of hyperphosphataemia

Feeding a phosphate-restricted renal diet is the initial treatment of choice to maintain serum phosphate concentrations within the target range recommended by IRIS for each stage of CKD (Table 3). Evidence is available that these diets slow CKD progression and prolong survival time.<sup>66–68,151</sup>

However, if feeding a renal diet is not sufficient to reduce serum phosphate to within the target range after 4–6 weeks, a phosphate binder can be considered to help reduce phosphate further (Figures 19 and 20). Phosphate binders should be thoroughly mixed into all meals fed to the cat, with the total daily dose divided between the number of meals fed. This is because their efficacy requires simultaneous administration of dietary phosphate and the binding compound. Calcium-containing phosphate binders (eg, calcium carbonate ± chitosan) are effective and relatively cheap, but these should be avoided in hypercalcaemic cats. Alternative, non-calcium-containing phosphate binders include aluminium hydroxide, sevelamer and lanthanum carbonate.

**Table 3** Target serum phosphate concentrations according to IRIS stage of CKD

| IRIS stage | Phosphate target mmol/l (mg/dl) |
|------------|---------------------------------|
| 1          | N/A                             |
| 2          | 0.81–1.45 (2.5–4.5)             |
| 3          | 0.81–1.63 (2.5–5.0)             |
| 4          | 0.81–1.94 (2.5–6.0)             |

CKD = chronic kidney disease; IRIS = International Renal Interest Society; N/A = not applicable

### Approach to the cat with early-stage CKD

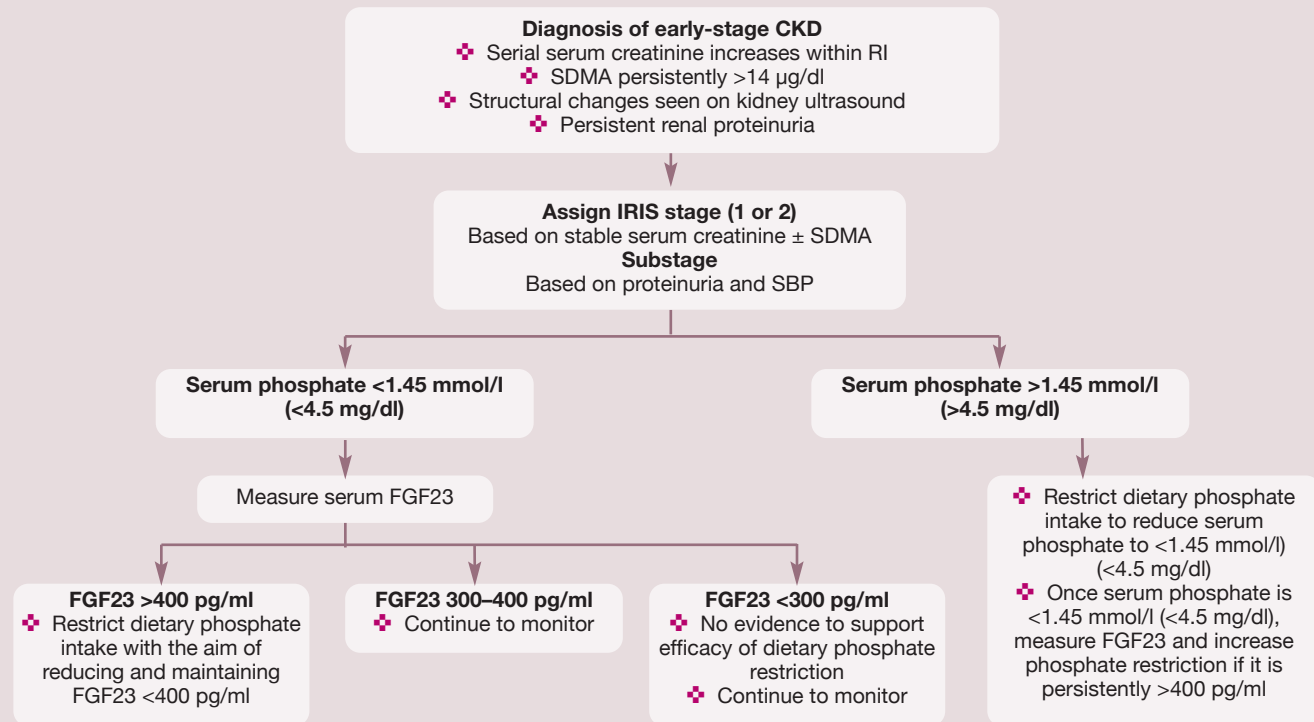


**Figure 19** Recommended interventions based on serum phosphate in cats with early (International Renal Interest Society [IRIS] stage 1 or 2) chronic kidney disease (CKD). FGF23 = fibroblast growth factor 23; RI = reference interval; SBP = systolic blood pressure; SDMA = symmetric dimethylarginine

### Approach to the cat with azotaemic CKD

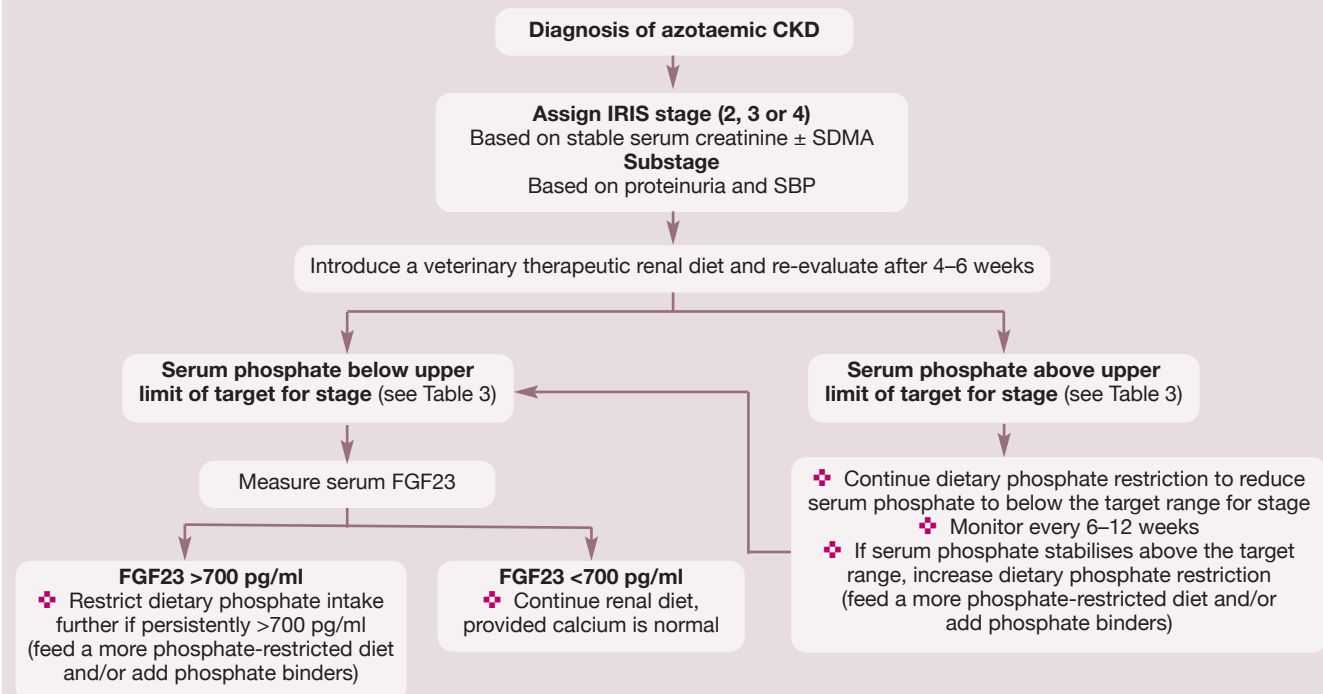


**Figure 20** Recommended interventions based on serum phosphate in cats with azotaemia (International Renal Interest Society [IRIS] stage 2, 3 or 4) chronic kidney disease (CKD). FGF23 = fibroblast growth factor 23; SBP = systolic blood pressure; SDMA = symmetric dimethylarginine

### Management of hypercalcaemia

Kidney disease is routinely cited as one of the top three aetiologies associated with ionised hypercalcaemia in cats (other common causes are idiopathic hypercalcaemia and neoplasia).<sup>155,156</sup> A retrospective cohort study found that, of cats with azotaemic CKD, approximately 20% demonstrated ionised hypercalcaemia at diagnosis, and an additional 26% went on to develop marked or persistent ionised hypercalcaemia within 12 months of diagnosis.<sup>157</sup> Approximately half of all cats with azotaemic CKD will demonstrate increasing calcium concentrations over time after transition onto a phosphate-restricted renal diet.<sup>112</sup> The consequence of ionised hypercalcaemia in cats with CKD is an increased risk of nephrocalcinosis, which appears to be associated with more progressive CKD.<sup>54</sup>

For some cats, feeding a phosphate-restricted diet induces ionised hypercalcaemia via PTH-independent mechanisms;<sup>157</sup> hence, transition onto a higher phosphate diet can normalise elevated iCa concentrations. In one study, the key difference between diets fed to cats who developed hypercalcaemia vs those in whom hypercalcaemia resolved was the dietary Ca:P ratio: a Ca:P ratio of 1.9:1 induced hypercalcaemia and a ratio of 1.3:1 resulted in normalisation of iCa.<sup>158</sup> As such, a newer approach to manage hypercalcaemia in cats with CKD combines these two nutritional goals – namely, feeding a diet with  $\leq 200$  mg calcium/100 kcal and a Ca:P ratio  $<1.4:1$ . In a recent case series, this approach was found to improve ionised hypercalcaemia in 9/10 cats with either CKD or idiopathic hypercalcaemia.<sup>159</sup>

Ideally, the calcium and phosphate concentrations of all cats with newly diagnosed CKD should be carefully assessed prior to initiating dietary phosphate restriction. Unfortunately, there is a poor correlation between total calcium and iCa concentrations, particularly in cats with azotaemic CKD.<sup>157,160</sup> Total calcium underestimates iCa concentrations and, as a result, measurement of iCa is the preferred method for assessment of hypercalcaemia, whenever possible. Alternatively, a total calcium concentration at the high end of the laboratory RI should raise concern for ionised hypercalcaemia.

If a cat is hypercalcaemic at diagnosis of CKD or following the introduction of a therapeutic renal diet, or is diagnosed with calcium oxalate uroliths, careful selection of an alternative therapeutic renal diet that meets the

**Measurement  
of iCa is  
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in cats with  
CKD.**



**A newer approach to manage hypercalcaemia  
in cats with CKD involves feeding a diet with  
 $\leq 200$  mg calcium/100 kcal and a Ca:P ratio  $<1.4:1$ .**

criteria of  $\leq 200$  mg calcium/100 kcal and a Ca:P ratio  $<1.4:1$  is recommended. It is important to remember that the nutrient profiles of specific diets evolve frequently (as often as every 6–12 months); hence, contacting manufacturers may be advisable if unexpected increases in calcium are documented.

Magnesium supplementation of renal diets has been proposed to reduce the tendency for ionised hypercalcaemia and to stabilise serum FGF23 as part of the management of CKD-MBD;<sup>64,161</sup> hence, the addition of magnesium to renal foods may be useful in managing cats who develop hypercalcaemia when fed renal diets, allowing greater phosphate restriction. Supplementation with chia seeds may also be considered for hypercalcaemic cats, either in conjunction with the above nutritional approach or on its own.<sup>159,162</sup> Chia seeds can be mixed with wet food after being soaked for 20 mins, or alternatively overnight, and therefore contribute additionally to water intake. A suggested dosage is 1–2 g/cat/q24h divided and mixed into each meal.<sup>159,162</sup> Other options include bisphosphonates,<sup>163</sup> and a novel therapeutic, cinacalcet, which is a calcimimetic that upregulates the calcium-sensing receptor on the parathyroid gland and has been used to treat hypercalcaemia of CKD in humans.<sup>164</sup> There is limited information on its use in feline CKD, but successful management of idiopathic hypercalcaemia has been reported.<sup>165</sup>

### Management of nausea and hyporexia

Cats with CKD can suffer from nausea, vomiting and inappetence as a result of uraemic toxins (see Box 3) affecting the central chemoreceptor trigger zone, as well as appetite dysregulation due to the accumulation of anorexigenic substances secondary to decreased renal excretion.<sup>83</sup> These clinical signs are more prevalent in cats with higher stage CKD;<sup>166</sup> hence, when observed in cats with IRIS stage 1 or 2 CKD, comorbidities should be considered.

Inappetence is a significant quality of life concern for caregivers,<sup>149</sup> and in the CKD patient may result in protein and calorie malnutrition, with subsequent losses in body weight and reductions in BCS and MCS.<sup>167</sup> A reduced appetite should, therefore, be actively managed as soon as such losses are appreciated, and any complications of CKD that can contribute to inappetence, such as dehydration, constipation, hypokalaemia, acidosis or anaemia, should be addressed. Centrally acting antiemetics, such as maropitant, mirtazapine and ondansetron,<sup>168–170</sup> should be considered for management. In placebo-controlled trials of cats with IRIS stage 2 or 3 CKD, maropitant (given orally for 2 weeks) was shown to reduce vomiting,<sup>170</sup> and

**Table 4** Commonly used antiemetics, appetite stimulants and antacids in cats with CKD\*

| Drug                           | Dosage                                                                                                                                           | Indications in CKD                                                    | Adverse effect(s)                                                                                                          |
|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|
| Maropitant <sup>170</sup>      | 1 mg/kg SC, IV or PO q24h                                                                                                                        | Prevention and treatment of nausea and vomiting                       | Pain on subcutaneous injection                                                                                             |
| Mirtazapine <sup>169,171</sup> | 2 mg/cat PO or transdermally q24h (q48h with higher stage CKD, due to reduced renal clearance)                                                   | Prevention and treatment of nausea and vomiting<br>Appetite stimulant | Vocalisation and agitation<br>Erythema at application site with transdermal use                                            |
| Ondansetron <sup>168</sup>     | 0.1–1 mg/kg IV (slowly), IM, SC or PO q6–12h (subcutaneous route is associated with higher bioavailability; use higher end of dose range orally) | Prevention and treatment of nausea and vomiting                       | Gastrointestinal effects, constipation and rare hypersensitivity reactions<br>Increased liver enzymes (reported in humans) |
| Omeprazole <sup>177</sup>      | 1 mg/kg PO q12h                                                                                                                                  | Strongly suspected or proven gastroduodenal ulceration                | Anorexia, vomiting and diarrhoea                                                                                           |
| Capromorelin <sup>172</sup>    | 2 mg/kg PO q24h                                                                                                                                  | Appetite stimulant                                                    | Hyperglycaemia, vomiting, hypersalivation, lethargy, bradycardia and hypotension                                           |

\*Information contained in this table represents a consensus of opinion and experience of the Guidelines panel members. Treatment is at the discretion of the attending veterinary surgeon  
CKD = chronic kidney disease; IM = intramuscularly; IV = intravenously; PO = orally; SC = subcutaneously

mirtazapine (given orally or transdermally for 3 weeks) reduced vomiting and also increased appetite and body weight.<sup>169,171</sup> Mirtazapine, therefore, is a useful adjunct to the nutritional management of cats with CKD. Based on anecdotal experience, dosage can be titrated to effect (eg, administering q48h) to stimulate appetite and avoid side effects, and long-term administration is often utilised.

The ghrelin receptor agonist capromorelin is a logical choice for managing the appetite dysregulation that accompanies CKD.<sup>172</sup> Transient bradycardia and hypotension have been reported as side effects of capromorelin treatment in cats; thus, appropriate monitoring is required, and the drug is not recommended for haemodynamically compromised patients.

Anecdotally, there are reports of histamine H<sub>2</sub> receptor antagonists (eg, famotidine) or proton pump inhibitors (eg, omeprazole) alleviating inappetence in some feline CKD patients; however, the presence and degree of gastric hyperacidity, and efficacy of these medications remain unproven. Recent evidence indicates that hypergastrinaemia and gastric ulceration are less common than previously assumed.<sup>173,174</sup> If therapy for hyperacidity in cats is considered, omeprazole is superior to famotidine, as the latter loses efficacy after a couple of days.<sup>175</sup> However, given the caregiver burden associated with administering multiple medications, prescribing should be reserved for cases with a strong suspicion of, or confirmed, gastroduodenal ulceration.<sup>176</sup>

Table 4 provides dosage information for medications commonly used to treat nausea, vomiting and inappetence in cats with CKD. A feeding tube (eg, oesophagostomy tube) may be beneficial in cats with persistent hyporexia, higher stage CKD and/or during episodes of

ACKD;<sup>167,178</sup> a tube can also assist with maintaining hydration and administering medications. Information and accompanying videos on how to place feeding tubes are provided in the '2022 ISFM consensus guidelines on management of the inappetent hospitalised cat'.<sup>167</sup>

### Management and prevention of dehydration

Dehydration is common in CKD patients due to their impaired ability to concentrate urine, and can lead to inappetence, lethargy, weakness, constipation and an increased susceptibility to uraemic crises.<sup>166</sup> Dehydration may precipitate pathophysiological responses that have a negative effect on the kidney. Cats with clinical dehydration may benefit from hospitalisation and intravenous fluid therapy to correct deficits, followed by home interventions to increase their voluntary water intake.

An iCatCare resource entitled 'Encouraging your cat to drink: a guide for caregivers' (available at [icatcare.org/cat-advice/cat-carer-guides](http://icatcare.org/cat-advice/cat-carer-guides)) describes various ways in which water intake can be increased. These include:

- ❖ Providing free access to multiple water sources, including water fountains and wide-brimmed ceramic bowls, positioned in easily accessible locations for the cat (Figure 21a);
- ❖ Raising water bowls so that cats with DJD do not need to lower their head to drink (Figure 21b);
- ❖ Feeding a wet diet (taking into consideration the need for a careful transition, as well as the lower calorie content per gram in wet foods);
- ❖ Adding water to the food (taking care not to adversely affect the cat's calorie or nutrient intake);
- ❖ Using nutrient-enriched water products; these supplements have been shown to improve

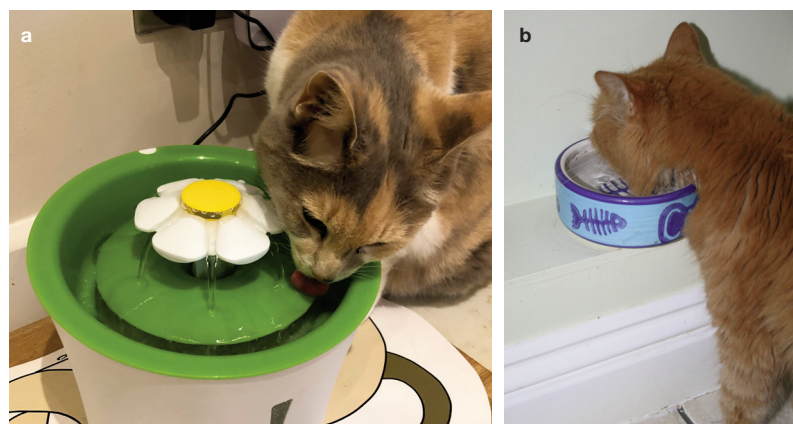


**Figure 21** Interventions to increase voluntary water intake, such as (a) encouraging use of a water fountain or (b) raising the water bowl to a more comfortable position, can benefit cats with CKD. Images courtesy of Samantha Taylor (a) and Sarah Collins (b)

voluntary water intake and hydration in dehydrated cats.<sup>179</sup>

Administration of subcutaneous fluids at home by caregivers is not recommended for all cats with CKD, but is well accepted by most cats and, hence, can be considered for those with ongoing dehydration despite the measures discussed above (Figure 22).<sup>180</sup> Techniques such as warming the fluids, offering treats and performing the procedure efficiently improve patient tolerance.<sup>180</sup> Giving 75–100 ml/cat every 1–3 days is generally well tolerated. Ideally, hypotonic solution (half-strength lactated Ringer's solution, 0.45% saline, Normosol-M) is used to reduce the sodium load, but, in practice, cats tolerate other crystalloid fluids without clinical complication. Fluid is administered via a giving set and butterfly or standard needle; potassium chloride can be added to the solution in deficient cats (eg, 20–30 mEq KCl per 1000 ml fluid).<sup>180</sup>

If cats have an oesophagostomy tube in situ, it can be used to provide water and maintain hydration.

  
For multiple reasons, anaemia should be actively managed in CKD patients.

### Management of anaemia

The kidney is responsible for producing the hormone erythropoietin (EPO), which stimulates the bone marrow to produce red blood cells. As CKD progresses, EPO production decreases and anaemia can result. Consequences of anaemia include weakness, lethargy, inappetence and potential acceleration of CKD progression due to hypoxia driving the development of fibrosis.<sup>63,181–183</sup> Anaemia may also cause left heart enlargement, which could predispose patients to heart failure and fluid overload.<sup>184</sup>

Moderate to severe anaemia likely has the potential to affect the quality of life of cats with CKD as a result of lethargy and inappetence. In a recent study, anaemia (PCV <27%) was associated with poorer health-related quality of life scores in cats with CKD.<sup>149</sup> Therefore, for multiple reasons, anaemia should be actively managed in CKD patients.

EPO deficiency can be supplemented with artificial products such as darbepoetin alpha (or, if unavailable, recombinant human EPO). Darbepoetin is a longer acting form of EPO and is thought to give rise to fewer anti-EPO antibodies than human EPO. The recommended starting dosage for darbepoetin is 0.75–1 µg/kg subcutaneously once weekly until the low end of the PCV RI is reached (30%).<sup>185</sup> Thereafter, the dosing frequency is decreased to once every other week, as needed, to maintain an adequate PCV (eg, ≥30%) (Figure 23). The patient's SBP and PCV should be measured before each injection during the induction period; once maintenance has been reached, a regular monitoring schedule (eg, checking SBP and PCV every 1–3 months) can be followed.

Iron supplementation (iron dextran 50 mg/cat IM q3–4 weeks, ferrous sulphate 50–100 mg/cat PO q24h, ferrous fumarate 30–60 mg/cat [one-fifth of a 305 mg capsule] q24h) is recommended when EPO therapy is initiated, as a relative iron deficiency is often present in cats with CKD. Oral ferrous sulphate can result in gastrointestinal upset (albeit usually mild); this side effect is reduced if the dose is divided and administered with food. Note that in the face of chronic inflammation and elevated serum hepcidin concentrations, absorption of orally administered iron will be compromised.<sup>181</sup>

Hypoxia-inducible factor–prolyl hydroxylase inhibitors (HIF-PHIs) have been used in human medicine for some time. They are considered to have a similar, if not better, efficacy and safety profile than darbepoetin.<sup>186</sup> Molidustat (an HIF-PHI suspension) given to healthy adult cats in a pilot study resulted in a significant and dose-dependent increase in serum EPO concentrations, and an increase in

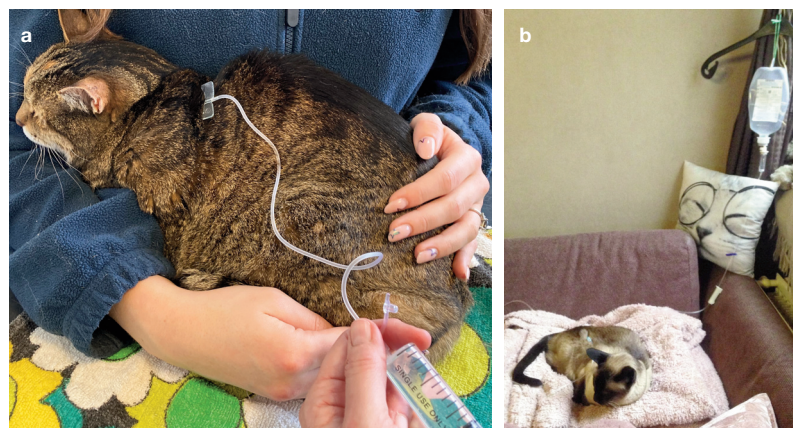


**Figure 22** Subcutaneous fluid therapy. (a) The procedure for administering subcutaneous fluids should be demonstrated to caregivers for use in the home environment. (b) A cat receiving subcutaneous fluids at home using a giving set and fluid bag. Images courtesy of Sarah Caney (a) and Femke Mortier (b)

### Treatment of anaemia of CKD with darbepoetin

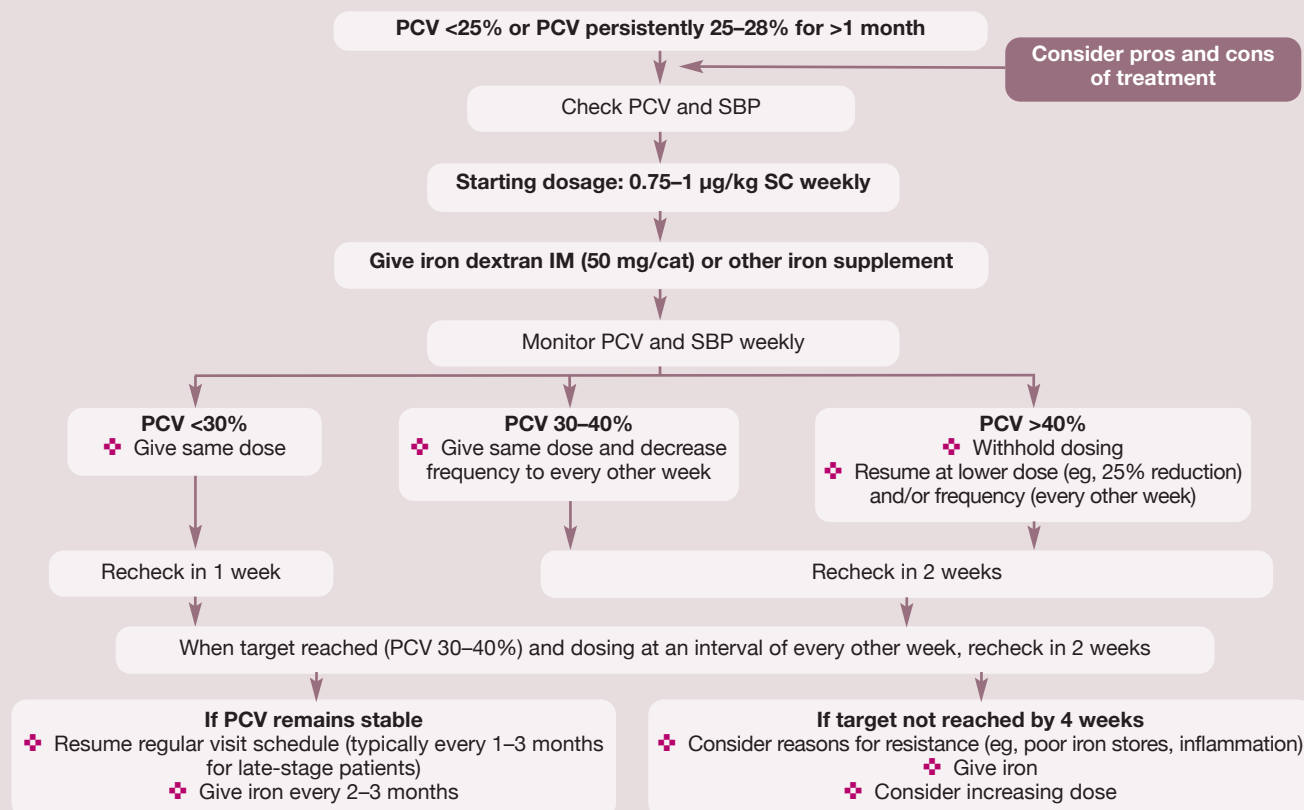
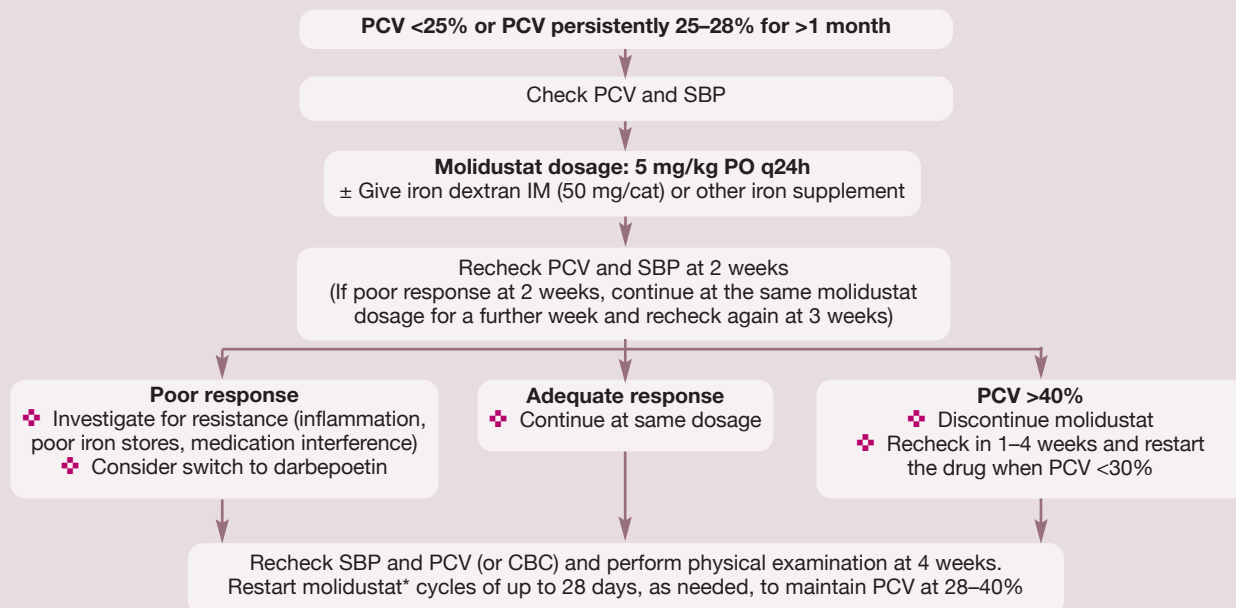


**Figure 23** Approach to the treatment of anaemia of chronic kidney disease (CKD) with darbepoetin, an erythropoiesis-stimulating agent. IM = intramuscularly; PCV = packed cell volume; SBP = systolic blood pressure; SC = subcutaneously

### Treatment of anaemia of CKD with molidustat



\*In some countries, licensing requires a 7-day break between 28-day molidustat cycles

**Figure 24** Approach to the treatment of anaemia of chronic kidney disease (CKD) with molidustat, a hypoxia-inducible factor–prolyl hydroxylase inhibitor. CBC = complete blood count; IM = intramuscularly; PCV = packed cell volume; PO = orally; SBP = systolic blood pressure

haematocrit, in comparison with placebo-treated cats.<sup>187</sup> In another study, where 21 cats with CKD were treated with molidustat or placebo for 28 days, cats who received the drug had a significant increase in PCV compared with the control group.<sup>188</sup> Adverse effects include vomiting and polycythaemia, with the latter less likely in cats with CKD, presumably due to the many counter-regulatory mechanisms suppressing red blood cell production in CKD.<sup>188</sup> The recommended dosage for molidustat is 5 mg/kg PO q24h for 28 days, restarting after a 1-week pause, as needed (Figure 24).<sup>189</sup>

In humans with CKD treated with molidustat, the drug may lower hepcidin and increase haematocrit without lowering serum iron,<sup>190</sup> suggesting that HIF-PHIs have a beneficial effect on iron metabolism and that their efficacy in increasing red cell mass is less dependent on iron supplementation. However, some patients will require iron supplementation due to reduced ferritin and iron concentrations,<sup>191</sup> so it is presumed there may be a requirement for iron supplementation in some treated cats.

### Management of proteinuria

Persistent proteinuria is associated with disease progression and mortality in cats with CKD.<sup>62,63,192</sup> Patients with a persistent UPC of >0.4 (IRIS substage proteinuric, see Table 2) should be treated with a renal diet and pharmacological inhibition of the renin-angiotensin-aldosterone system (RAAS). RAAS inhibition should only be considered in non-dehydrated cats with stable CKD to avoid possible adverse effects. As treatment of hypertension can reduce proteinuria,<sup>192</sup> hypertensive cats should be reassessed for proteinuria once SBP is <160 mmHg and prior to additional antiproteinuric medication.

Options for the treatment of proteinuria include:

❖ **Telmisartan, an angiotensin receptor blocker (ARB).** Telmisartan prevents angiotensin II from binding to one of its receptors

**Persistent proteinuria should be treated with a renal diet and RAAS inhibition with medication.**



(angiotensin receptor-1). In so doing, it reduces proteinuria in cats with CKD.<sup>193</sup> The dosage of telmisartan for proteinuria is 1 mg/kg PO q24h.

❖ **An angiotensin-converting enzyme (ACE) inhibitor, such as benazepril.** ACE inhibitors reduce proteinuria by blocking the production of angiotensin II.<sup>194</sup> The dosage of benazepril for proteinuria is 0.25–0.5 mg/kg PO q12h, and this ACE inhibitor is available both in tablet form and as a medicated food.

Cats with borderline proteinuria (UPC 0.2–0.4) may be more likely to develop renal disease and have an increased mortality risk compared with cats with a UPC <0.2.<sup>28,62</sup> Although there is no current evidence that treatment with antiproteinuric medication is beneficial at the borderline proteinuric substage, some clinicians may consider prescribing such medication.

Adverse effects of RAAS inhibition can include hypotension, hyperkalaemia and worsening azotaemia. Hence, ACE inhibitors and ARBs should be used with care, especially in cats with late-stage CKD and in dehydrated cats. As well as monitoring for any clinical deterioration, cats undergoing treatment should be reassessed regularly, as described in Table 5 (contextualising to the caregiver's resources). An increase in creatinine of >25–30% may warrant review of treatment and a dosage adjustment; the effect of any intervention should be assessed around 4 weeks later.

### Management of hypertension

CKD is a common underlying cause of hypertension, and all cats with CKD should have their SBP measured at diagnosis and as part of routine monitoring (see 'Monitoring the cat with CKD'). Management of hypertension can prevent target organ damage and reverse or improve any existing clinical signs of target organ damage. Ocular target organ damage is often slow to resolve but some vision can be regained with treatment of the hypertension,<sup>195</sup> and signs of hypertensive encephalopathy can be reversed.<sup>196</sup>

**Table 5** Monitoring schedule for cats receiving ARB or ACE inhibitor treatment for proteinuria/borderline proteinuria

| Time since starting ARB or ACE inhibitor treatment               | Parameters to check                                          | Aims                                                                                      |
|------------------------------------------------------------------|--------------------------------------------------------------|-------------------------------------------------------------------------------------------|
| 1–2 weeks                                                        | Clinical signs, SBP, serum creatinine and potassium          | Assess tolerance of medication. Creatinine increase >25–30% may warrant dosage adjustment |
| 4 weeks after commencing treatment or making a dosage adjustment | Clinical signs, SBP, UPC                                     | Assess efficacy for reducing UPC                                                          |
| Every 3 months                                                   | Clinical signs, SBP, UPC (see 'Monitoring the cat with CKD') | Long-term monitoring                                                                      |

ACE = angiotensin-converting enzyme; ARB = angiotensin receptor blocker; CKD = chronic kidney disease; SBP = systolic blood pressure; UPC = urine protein:creatinine ratio



**Cats being treated for proteinuria should be reassessed regularly.**

**Table 6** Options for management of hypertension in cats with CKD

| Class of agent                 | Agent(s) and oral dosage regimen                                                                                                                                                  | Comments                                                                                                                                                                                 |
|--------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Calcium channel blocker</b> | Amlodipine 0.125–0.25 mg/kg q24h <sup>198</sup><br>(typically 0.625 or 1.25 mg/cat q24h)<br>Cats with severe hypertension may require higher doses (eg, 0.5 mg/kg) <sup>199</sup> | Often effective as sole therapy. Adverse effects include hypotension and gingival hyperplasia<br>Transdermal amlodipine is less effective than oral treatment <sup>200</sup>             |
| <b>ARB</b>                     | Telmisartan 2 mg/kg q24h <sup>201,202</sup>                                                                                                                                       | Typically lowers SBP by 20–25 mmHg<br>When used as a sole agent, a dosage of 2 mg/kg q24h is suggested. If used in combination with amlodipine, start at a dosage of $\leq 1$ mg/kg q24h |
| <b>ACE inhibitor</b>           | Benazepril 0.5–1.0 mg/kg q24h<br>Enalapril 0.25–0.5 mg/kg q24h<br>Ramipril 0.125–0.25 mg/kg q24h                                                                                  | Not generally recommended as monotherapy for hypertension, especially if marked (SBP >180 mmHg). Benazepril can be used in combination with amlodipine <sup>203</sup>                    |

ACE = angiotensin-converting enzyme; ARB = angiotensin receptor blocker; CKD = chronic kidney disease; SBP = systolic blood pressure

The goal of management is to reduce SBP to a normotensive level (ideally <140 mmHg, but otherwise <160 mmHg).<sup>90,197</sup> Options for treatment are listed in Table 6. Efficacy should be reassessed after 1–2 weeks of starting or adjusting therapy. Outpatient management is usually appropriate, although patients with severe hypertension and target organ damage may be hospitalised to allow closer monitoring of SBP (eg, after 24 h).<sup>25</sup> If significant proteinuria is present, an ARB (telmisartan) could be considered as an initial choice of therapy for hypertension. An ARB or ACE inhibitor could also be used in addition to amlodipine if proteinuria persists despite the cat being normotensive. When using combinations of medications, the cat should be monitored closely for hypotension.

#### Management of hypokalaemia

Hypokalaemia is common in cats with higher stages of CKD, and an inadequate dietary intake or increased urinary loss of potassium and activation of the RAAS are thought to be contributing factors.<sup>204</sup> Potassium is vital for normal muscle function and gastrointestinal motility, and hypokalaemia is associated with lethargy, inappetence, myopathy (eg, cervical ventroflexion and plantigrade stance) and constipation.<sup>86</sup> In humans, a potassium level <4.0 mmol/l is associated with an increased risk of end-stage renal disease and mortality,<sup>77</sup> but hypokalaemia has not been identified as a risk factor for progression in cats. However, serum potassium levels are not representative of systemic tissue potassium levels, and so cats with low-normal serum potassium may still be systemically depleted.<sup>205</sup>

Some clinicians recommend supplementation even when serum potassium is within the low end of the RI, with a goal of maintaining serum potassium >4 mmol/l. Maintaining



**Metabolic acidosis is a significant risk factor for CKD progression and mortality in humans, and may be more common in feline CKD than previously thought.**

serum potassium concentrations is particularly important in cats with CKD and constipation.

Renal diets are supplemented with potassium, but to a very variable degree. In stable, mildly hypokalaemic patients, switching to a higher potassium diet may be beneficial. In moderately to severely hypokalaemic, but stable, patients, supplementation with oral potassium gluconate or potassium citrate is indicated (1–4 mEq/cat q12h, adjusted according to response). In patients with evidence of acidosis, potassium citrate may be a better choice than potassium gluconate due to its greater alkalinising properties. In decompensated, severely hypokalaemic patients, hospitalisation and intravenous potassium chloride supplementation is necessary, followed by oral supplementation at home.

#### Management of acidosis

Metabolic acidosis is a significant risk factor for CKD progression and mortality in humans,<sup>206</sup> and may be more common in feline CKD than previously thought.<sup>207</sup> Urinary ammonia excretion is significantly impaired in cats with CKD and is inversely associated with serum creatinine concentration.<sup>207</sup> Feeding a renal diet formulated to minimise acidosis may be beneficial; however, alkali supplementation may still be necessary in some cats and is currently under investigation by one of the Guidelines' panel members (JQ). Oral supplementation with potassium citrate (40–75 mg/kg q12h) or sodium bicarbonate (10–12 mg/kg q8–12h) may be used to maintain serum bicarbonate concentrations >16 mmol/l.

#### Management of constipation

The prevalence of constipation associated with CKD has not been reported; however, constipation appears to be a common medical

concern and can cause discomfort, nausea and reduced food intake, and thereby affect quality of life (Figure 25).<sup>86,149</sup> Cats with CKD are observed to defecate less frequently than healthy cats.<sup>208,209</sup> The aetiology of constipation associated with CKD is likely a dysfunction of water balance, possibly combined with abnormal gastrointestinal motility. The kidneys fail to provide appropriate urine-concentrating ability and, hence, chronic sub-clinical dehydration results in water being reabsorbed from the colon to compensate. Factors such as hypokalaemia, uraemic toxins, diet and the use of phosphate binders may additionally contribute to constipation.

A clinical history is very important in the assessment of constipation. Questions to discuss with the caregiver include the frequency of defecation, time spent defecating, faecal consistency, the degree of difficulty or straining, and any vomiting associated with defecation, as this information may not be volunteered. Also, faecal pellets left around the house may indicate dyschezia. An assessment of the cat's hydration status should be noted in the medical record at each assessment. Physical examination may reveal small hard faeces in the descending colon with a build-up of faecal material before the pelvic inlet, or, in more severe cases, a large amount of hard faecal material in the colon.

Factors additional to the CKD to consider in affected cats include:

- ✦ Pain from DJD, causing reluctance to defecate and/or use a litter tray; and
- ✦ Environmental factors, including the availability/number of litter trays, their location and the litter substrate.



**Constipation in cats with CKD can affect quality of life by causing discomfort, nausea and reduced food intake.**



**Figure 25** Lateral abdominal radiograph of a cat with constipation associated with CKD. Constipation can reduce food intake and cause nausea and discomfort. When imaging such patients, examination of joints can help to identify DJD as an additional contributing factor causing reluctance to defecate and/or use a litter tray. Image courtesy of Lumbry Park Veterinary Specialists

Managing pain and optimising litter facilities for older cats can encourage regular defecation.

As the primary inciting cause of constipation secondary to CKD is considered to be chronic dehydration, the patient's hydration status should be addressed before other medical therapies are instituted. Serum potassium should be measured and supplemented, if needed. After correction of dehydration and hypokalaemia, oral osmotic stool softeners are introduced. Polyethylene glycol (PEG) 3350 is an osmotic laxative that has been assessed in normal cats and found to be effective as a stool-softening agent.<sup>210</sup> Although its efficacy in cats with CKD has not been evaluated, it is commonly prescribed (one-eighth to one-quarter of a teaspoon q12–24h); moreover, it is thought by some to be more effective than lactulose, which is processed by intestinal microflora and may lead to bloating, as well as being challenging to administer to many cats.<sup>210</sup> Another important consideration is that PEG 3350 comes as a powder that appears to be well tolerated. Bulk-forming agents such as psyllium (starting dose one-quarter teaspoon q24h or divided q12h) or canned pumpkin (starting dose one-half to one teaspoon q24h or divided q12h) may also be useful as fibre sources in the management of constipation associated with CKD in patients with normal hydration, if accepted mixed into food.<sup>211,212</sup>

Promotility agents are a second tier of medical management for constipation associated with CKD, as the degree to which inherent colonic motility is affected has not been assessed in feline CKD patients. Cisapride (1 mg/kg q8h PO) is the most common promotility medication used, and has been demonstrated to have a positive effect on contractility in normal and abnormal feline colonic smooth muscle in vitro.<sup>213,214</sup>

### Management of uraemic toxins

Strategies to decrease the production of uraemic toxins include dietary management (eg, avoidance of high protein), use of pre-biotics, probiotics or adsorbents, and management of constipation. Renaltec, a carbon-based adsorbent designed to bind indoxyl sulfate precursors in the digestive tract, has recently been demonstrated to decrease serum uraemic toxins in cats with CKD.<sup>215,216</sup>

### Future developments

Vascular endothelial function is thought to be impaired in cats with CKD, and beraprost, a prostacyclin analogue, is thought to have protective effects on injured endothelial cells. Beraprost has been assessed in a retrospective cohort study. Progression-free survival in cats with stage 3 CKD was reported to be significantly higher in treated patients.<sup>217</sup>

## Optimising the home and veterinary clinic environment for cats with CKD

The environment in which the cat lives, both physical and social, can influence mental wellbeing and, therefore, impact physical health.<sup>218</sup> Optimising the home environment for a cat with CKD can improve quality of life in several ways. For example, adequate litter trays and appropriate water provision can encourage regular defecation and hydration, and an optimised environment can reduce stressors and thus encourage food intake. Additionally, cats with CKD require diagnostic testing and monitoring; hence, the veterinary environment will also be impactful. Distress associated with visits to the clinic can affect a cat's health and alter physical examination and biochemical parameters. Moreover, observing their cat's protective (negative) emotions during a visit can discourage caregivers from presenting them to the clinic in the future, affecting the detection of complications and limiting important interventions.<sup>218,219</sup>

### Home environment

Optimising the home environment for a cat with CKD can focus on meeting the 'five pillars' of a healthy feline environment.<sup>220,221</sup> This involves providing: a safe space; multiple and separated resources; opportunity for play and predatory behaviour; positive, consistent and predictable human-cat social interactions; and an environment that respects the cat's sense of smell and other senses. In practical terms, a home environment can be improved for cats with CKD as suggested in Table 7.

### Veterinary clinic environment

The clinic environment can be stressful for any cat, and older cats, such as those with CKD, may be more vulnerable to stressors such as leaving the home environment. They may have concurrent disease (eg, DJD, hypertension) resulting in pain, which can increase protective emotions.<sup>222</sup> A comprehensive discussion on improving the veterinary visit experience for cats is provided in the ISFM/AAFP cat friendly guidelines, which cover both veterinary interactions<sup>124</sup> and the veterinary environment,<sup>221</sup> and are available at [bit.ly/JFMSCatFriendly](http://bit.ly/JFMSCatFriendly). Key principles from these pivotal practice resources are listed in the inset box.

The practice team – including veterinarians, reception staff, nurses/technicians and patient care assistants – should all be familiar with cat friendly principles. Clinic meetings to discuss how to reduce distress in senior cats can be helpful.

**Figure 26** Blood sampling in this cat is being performed using a lickable treat as a distraction, gentle handling (including a soft cover over the consultation table) and use of the medial saphenous vein with a butterfly catheter. Note that the small amount of food/treats used in this way is unlikely to affect serum biochemistry results. Image courtesy of Jessica Quimby



### Improving the veterinary experience for cats

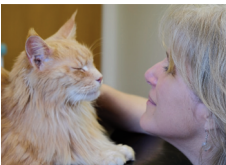
- ❖ **Species separation** Ideally, have feline-only waiting areas, wards and consulting rooms. Where this is not feasible, allow cats to wait in the car and/or offer senior/feline-only clinic consulting periods.
- ❖ **Cat friendly interactions** Ensure gentle handling and avoid restraint and body positions that could cause pain (eg, elbow extension for cephalic blood sampling). Examination should be conducted in comfortable positions and in locations of the patient's choosing (eg, in the base of the cat carrier or on a soft bed).
- ❖ **Analgesia** Provide pain relief prior to examinations and procedures.
- ❖ **Pre-visit anxiolysis** Consider the use of gabapentin or pregabalin pre-visit to reduce anxiety. Note that a lower dose of gabapentin may be preferred (eg, up to 10 mg/kg, with 25–50 mg usually adequate as a total dose) due to increased serum levels in cats with CKD.<sup>223</sup> Similarly, pregabalin is renally excreted and the dose may be reduced for cats with CKD (eg, 2.5 mg/kg).<sup>224</sup>
- ❖ **Blood sampling considerations** Practical recommendations include use of local anaesthetic creams for blood sampling, provision of treats as a distraction (Figure 26), and taking only the minimum volume of blood required for necessary tests to avoid iatrogenic lowering of PCV.
- ❖ **Preparation of equipment** Have all equipment ready in the consulting room to avoid going in and out (eg, blood pressure machine, blood sampling kit, quiet clippers).
- ❖ **Ward environment** Make the ward cat friendly with a warm ambient temperature and provide accessible resources close to the cat, including low-sided litter trays and somewhere to hide. Minimise hospitalisation periods, where possible.
- ❖ **Dietary considerations** Gather a nutritional history and provide the cat with their familiar food while in hospital. Note that it is important not to introduce a new diet, such as a renal diet, to a cat who is unwell and hospitalised.

## CKD and important comorbidities

Given the high prevalence of CKD in senior cats, comorbidities are common. Not only can they further impact the cat's quality of life, but they pose a number of challenges for patient management. Presenting signs of each condition may be masked by the presence of concurrent conditions. The need to give several medications can increase the caregiver burden<sup>225</sup> and also the risk of drug interactions; additionally, CKD can result in reduced

renal clearance of medications used to treat concurrent conditions.<sup>226</sup> Moreover, nutritional requirements may conflict.<sup>227</sup> It can be challenging to make optimal nutritional recommendations for cats with multiple diseases, especially those with CKD and comorbid conditions. The first step is to identify nutritional goals for each disease; in some situations, there is a need to prioritise one goal over another. Consultation with a board-certified veterinary nutritionist may be warranted in some cases.

**Table 7** Optimising the home environment for a cat with CKD using the 'five pillars' model as a guide<sup>218,220,221</sup>

|                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | <b>Pillar 1: Provide a safe space</b><br>Provide predictable, secure and readily accessible resting areas in multiple locations. They should be within easy reach for a cat with mobility issues or pain from DJD, with the use of ramps or steps, as necessary, and located away from busy areas of the home. Quiet, warm, sunny resting spots with deep bedding encourage use.                                                                                                                                                                                                                                                                                                               |
|   | <b>Pillar 2: Provide multiple and separated resources</b><br>Cats with CKD may need to urinate and drink more frequently, so should have easy access to litter trays and multiple water sources. Resources should be distributed across all levels of the home and in sufficient number (at least two of each resource per cat). Food and water can be offered in raised bowls, and horizontal scratching opportunities provided for cats with DJD. Litter trays should be low sided with a soft substrate and regularly cleaned.                                                                                                                                                              |
|   | <b>Pillar 3: Provide opportunity to play and perform predatory behaviour</b><br>Even older cats with chronic illness will benefit from activity. Analgesia may help cats with DJD engage with light activity and low-impact play, which can also help trigger engaging emotions and prevent constipation. Cats could be encouraged to walk around a garden or engage with a fishing toy for short periods. Incorporating toys with auditory or olfactory stimuli (eg, crinkle material, catnip, valerian, silvervine), playing at predictable times and locations, using short, consistent sessions, and offering cardboard boxes placed on their sides supports safe, comfortable engagement. |
|   | <b>Pillar 4: Provide positive, consistent and predictable human-cat social interaction</b><br>Allow cats to choose the type and duration of interaction and never force handling. Some cats with chronic illness may groom less and enjoy being brushed; others may still have the appetite for occasional treats from their caregivers. All family members should be educated not to pick up the cat, but approach slowly with a soft voice to prevent startling. The cat should be allowed to disengage from interactions with people at their choosing.                                                                                                                                     |
|  | <b>Pillar 5: Provide an environment that respects the importance of the cat's senses</b><br>Strong scents should be avoided (perfumes, air fresheners) and use of feline pheromone products considered. Food could be warmed to increase aromas and encourage eating. Sudden loud noises should be avoided to prevent startling the cat.                                                                                                                                                                                                                                                                                                                                                       |

Images courtesy of Samantha Taylor (Pillars 1, 2 and 5), International Cat Care (Pillar 3) and Sarah Caney (Pillar 4)

The 'five pillars' model offers practical ways in which the home environment can be improved for a cat with CKD.



Despite the challenges, by focusing on the disease with the greatest impact on the cat, managing pain, supporting caregivers while remaining mindful of compliance and caregiver burden, and monitoring responses to treatment, senior cats with multiple conditions can enjoy a good quality of life.<sup>228</sup>

### CKD and hyperthyroidism

Hyperthyroidism is the most common feline endocrinopathy and mainly occurs in the same population of cats affected by CKD. Given that 15–51% of cats with hyperthyroidism are reported also to have CKD,<sup>229–232</sup> managing both conditions in the same cat is not an unusual scenario. The concurrent presence of the two conditions creates some diagnostic challenges for both illnesses for the following reasons:

- ❖ Clinical signs may overlap (ie, weight loss, vomiting, PU/PD);
- ❖ CKD may mask more obvious signs of hyperthyroidism, such as polyphagia;
- ❖ Hyperthyroidism may increase the GFR and decrease muscle mass, with the result that creatinine is lowered into the RI but is 'unmasked' post-treatment;<sup>232</sup>

❖ CKD may reduce total thyroxine (T4) into the RI;<sup>233</sup>

❖ Secondary hypertension occurs with both CKD and hyperthyroidism;<sup>90</sup> thus, measurement of blood pressure is a priority in cats with these concurrent conditions.

It is difficult to make a diagnosis of CKD in a cat with hyperthyroidism without azotaemia and, hence, predict which cats will develop 'unmasked' azotaemia post-treatment. Cats with high SDMA concentrations prior to treatment for hyperthyroidism are more likely to have CKD, but a normal SDMA level does not exclude the development of azotaemia when the cat becomes euthyroid.<sup>234</sup> Hyperthyroid cats with low USG (<1.035) pretreatment are more likely to develop azotaemia post-treatment.<sup>235</sup> It is important to reassess renal parameters once a patient is euthyroid in order to diagnose the underlying CKD.

Key points in managing these comorbidities are summarised in Box 9.

Cats with CKD and hyperthyroidism can have very reasonable median survival times. Cats who are azotaemic at the point of diagnosis of hyperthyroidism have a poorer prognosis than those without azotaemia, with

## Box 9

## Management of CKD and hyperthyroidism

- ❖ Cats with CKD and concurrent hyperthyroidism should be optimally managed for both diseases. It is a misconception that leaving T4 above the RI will benefit the kidneys. On the contrary, it will ultimately be detrimental due to progression of CKD and the negative impacts of uncontrolled hyperthyroidism on the cat.
- ❖ Curative therapies such as radioactive iodine or thyroidectomy can be considered in cats with concurrent CKD, except for higher stage cats for whom trial medical treatment is appropriate.
- ❖ For cats with IRIS stage 3 or 4 CKD, a lower starting dose of antithyroid medications (eg, 1 mg thiamazole q12h) should be used initially, titrating upwards while monitoring the effect on markers of kidney function.
- ❖ Iatrogenic hypothyroidism should be avoided in cats with CKD. Hence, cats with a subnormal T4 post-thyroidectomy or radioactive iodine therapy should have their thyroid-stimulating hormone level assessed and thyroxine supplementation instigated, if needed. Medically treated cats should have their antithyroid medication dosage reduced.
- ❖ Nutrition, BCS and MCS are important parameters to monitor and manage in cats with these comorbidities, due to their combined negative impacts on feline health.

documented survival times of around 6 months to 2 years.<sup>236–238</sup> Hyperthyroid cats who become azotaemic after treatment have significantly shorter survival times (2.8 years) than those remaining non-azotaemic (4.3 years).<sup>232</sup>

Cats with post-treatment iatrogenic hypothyroidism and azotaemia have significantly shorter survival times.<sup>239</sup> Hence, hypothyroidism is particularly important to avoid in cats with CKD.

#### CKD and chronic pain

DJD is the most studied cause of chronic pain in cats.<sup>240</sup> However, many other conditions will result in pain, such as dental disease (Figure 27),<sup>241</sup> urinary tract disease, ocular disease and neoplasia; persistent postoperative pain, neuropathic pain and medical pain (from gastrointestinal/hepatic disease) are other forms of chronic pain.<sup>242,243</sup> While CKD itself is unlikely to be painful, associated conditions such as dehydration, nausea, pyelonephritis, urolithiasis and target organ disease from hypertension could cause discomfort.

Chronic pain should be managed using a multimodal approach, ideally involving pharmacological and non-pharmacological therapies (eg, environmental modifications).<sup>244</sup> For the CKD patient specifically, the fear of adverse effects of analgesics could result in unmanaged pain, and so it is important that

The fear of adverse effects of analgesics in the CKD patient could result in unmanaged pain.



**Figure 27** Resorptive lesion in a cat with CKD. Dental disease should be managed in CKD patients to reduce pain. In turn, this can improve food intake and long-term health. Image courtesy of Samantha Taylor

the identification and treatment of pain is considered part of the management approach for cats with CKD. Similarly, procedures that could reduce pain, such as dental extractions, should not be avoided because of the presence of CKD, although the kidneys must, of course, be carefully considered when prescribing medications or planning anaesthesia.<sup>245,246</sup>

#### Use of non-steroidal anti-inflammatory drugs in cats with CKD

Comprehensive guidance to support veterinarians in decision-making around prescribing non-steroidal anti-inflammatory drugs (NSAIDs) in situations of chronic pain, including cats with CKD, is provided in the '2024 ISFM and AAFP consensus guidelines on the long-term use of NSAIDs in cats'.<sup>247</sup>

For the purpose of these current Guidelines, it is important to note that there is limited evidence either supporting or refuting the long-term use of NSAIDs in cats with chronic pain and concomitant CKD. Much of the earlier data was retrospective in nature, with studies of meloxicam and robenacoxib hampered by selective bias, differing definitions of stable CKD and relatively short periods of administration of the NSAID. However, current evidence suggests that low doses of meloxicam or robenacoxib can be administered cautiously to cats with stable CKD, as studies have not demonstrated detectable renal injury in these patients under specific conditions.<sup>248–251</sup>

Patient selection is vital if NSAIDs are to be used. These drugs should be avoided in cats with unstable (progressive) CKD, cats who are dehydrated, hypovolaemic, hypotensive or otherwise unwell, or those with IRIS stage 4 CKD.

Stable CKD in cats, in the context of prescribing NSAIDs, is defined as minimal changes in body weight and creatinine concentration over a period of at least 2 months, with control of concurrent conditions such as hypertension, hyperphosphataemia and UTI. If NSAIDs are to be prescribed to cats with IRIS

stage 1 or 2 CKD, they should be hydrated and eating and drinking normally, with caregivers informed of potential adverse effects and providing informed consent. Treatment of some stage 3 cats may also be considered, but use of NSAIDs is less studied in this group.

Cats should be monitored for both efficacy of the NSAID for pain management and for adverse effects, and caregivers educated on maintaining the cat's water intake. Routine checks are recommended to allow tapering to the lowest effective dose for the individual cat and for early recognition of adverse effects.<sup>247</sup> The combination of NSAID and ACE inhibitor, ARB or amlodipine could increase the risk of hypotension and adverse effects. Additionally, NSAIDs could reduce the anti-hypertensive effects of amlodipine/ARBs (as documented in humans<sup>252</sup>), and so combination therapy should be avoided, or, if used, the cat should be closely monitored.

#### Alternative analgesics for chronic pain in cats with CKD

When NSAIDs are not considered suitable, or additional analgesia is needed, alternative medication choices may be required. Possible drugs, and the evidence supporting their use, are summarised below. Importantly, most of these drugs are understudied in terms of efficacy, and so effectiveness should be monitored, ideally with an objective pain scale such as the Feline Musculoskeletal Pain Index.<sup>253</sup>

❖ **Gabapentinoids** In one study,<sup>254</sup> gabapentin decreased activity in geriatric cats, potentially due to sedative effects, while also improving impaired activities compared with placebo. However, cats with CKD have higher serum levels of gabapentin, so dosage adjustment may be required to avoid adverse effects.<sup>223</sup> Although less well studied, similar concerns apply to pregabalin.<sup>255</sup> Dosage regimens for gabapentinoids in cats with CKD have not been established.

❖ **Frunevetmab** The anti-nerve growth factor monoclonal antibody frunevetmab is used to manage DJD in cats,<sup>256</sup> but there is currently no published data on the safety of the drug in cats with concurrent DJD and CKD.

❖ **Tramadol** The synthetic opioid analgesic tramadol has been demonstrated to improve mobility in cats with osteoarthritis,<sup>257</sup> but has not been studied in cats with CKD.

❖ **Amantadine** A blinded, placebo-controlled study showed that amantadine, an antagonist of *N*-methyl-D-aspartate receptors, improved owner-identified impaired mobility and quality of life in cats with osteoarthritis;<sup>258</sup> however, activity was decreased, potentially due to sedation, in the treatment group. This drug has not been studied in cats with CKD.

Comorbidities in cats with CKD may cause conflicts in terms of nutrition. Serum phosphate should nevertheless still be controlled.



❖ **Buprenorphine** Oral transmucosal buprenorphine can be effective for analgesia, but is less practical for long-term use.<sup>259</sup> There are no studies investigating the use of opioids for feline chronic pain.

❖ **Subcutaneous ketamine** Ketamine administration via the subcutaneous route is anecdotally used for chronic pain at a dosage of 0.5 mg/kg monthly. Further study is required, but initial work suggested a beneficial effect on pain in dogs with osteoarthritis when combined with other analgesics.<sup>260</sup>

Monitoring, including chronic pain assessment, is crucial in CKD patients on analgesics. Drug accumulation, overdosing and adverse effects may occur as excretion is impaired in these cats. Conversely, underdosing may result in subtherapeutic concentrations, leading to continuous pain or misleading placebo effects.

#### CKD and chronic enteropathy

As mentioned, the primary nutrient of concern for CKD is phosphorus. Nutritional management of chronic enteropathy (eg, food-responsive enteropathy, chronic inflammatory enteropathy) typically revolves around limiting dietary antigen exposure (eg, single protein + single carbohydrate diet vs a hydrolysed diet).<sup>261</sup> Hence, selecting such a diet, but with an appropriate phosphate content, may be possible; alternatively, phosphate binders could be added to the food. Some manufacturers produce hydrolysed diets that are also phosphate restricted. Follow-up assessment of serum phosphate would allow monitoring and adjustment according to patient response. Other measures to manage chronic enteropathy may be required, such as fibre supplementation<sup>212</sup> or immunomodulation.

#### CKD and diabetes mellitus

To manage a cat with diabetes mellitus, a low carbohydrate diet may be introduced.<sup>262,263</sup> Making specific nutritional recommendations for a cat with CKD and diabetes is a balancing act between feeding a reduced phosphate diet and trying to avoid an excessively high carbohydrate load. Some canned veterinary therapeutic renal diets are sufficiently low in carbohydrates (<5 g/100 kcal) to be fed to a cat with these comorbid conditions. If it is not feasible to feed a canned diet exclusively, the priority should be feeding a higher carbohydrate, lower phosphate diet (vs feeding a lower carbohydrate, higher phosphate diet), and diabetic remission may still be achieved.

It is important to remember that while dry diets generally provide more carbohydrates than canned diets, not all canned diets are low in carbohydrates. Many cats with diabetes mellitus are obese, and obesity can contribute to insulin resistance. If the cat is obese (ie, BCS 8–9/9),



**The goal of anaesthesia in cats with CKD is to preserve renal perfusion and oxygen delivery, and avoid hypotension and dehydration.**

then additional consideration should be given to feeding a diet with a lower calorie density and higher protein concentration to aid in the maintenance of muscle mass as the cat loses weight. In this case, the goal for weight loss may be to achieve a BCS of 6–7/9 for long-term survival benefits, with monitoring of phosphate and the addition of a phosphate binder, if required.

### Diabetic nephropathy

There is recent evidence that cats may develop early diabetic nephropathy.<sup>264</sup> However, they likely do not experience a cumulative glucose exposure in their life span sufficient to cause overt diabetic nephropathy, as is observed in human medicine. The reported prevalence of microalbuminuria (70%)<sup>265</sup> and proteinuria (39%<sup>266</sup> to 75%<sup>265</sup>) in diabetic cats may also suggest the presence of the glomerular pathology

that characterises diabetic nephropathy. As progression to overt diabetic nephropathy, in which there is declining GFR, is not typically recognised in diabetic cats, it is unlikely a cat will have a progressive increase in serum creatinine. However, the UPC should be monitored. RAAS inhibition is recommended if a cat with diabetes mellitus becomes persistently proteinuric in the absence of an active urinary sediment.

Consideration could be given to the use of a sodium–glucose cotransporter-2 inhibitor (SGLT2i) over insulin therapy in a newly diagnosed diabetic cat who is proteinuric, because of the additional renoprotective benefits this class of drug offers. Further information on SGLT2i therapy is provided in the ‘2025 iCatCare consensus guidelines on the diagnosis and management of diabetes mellitus in cats’.<sup>267</sup>

## Anaesthesia in cats with CKD

While a comprehensive discussion of anaesthesia in the feline CKD patient is beyond the scope of these Guidelines, fundamental considerations include the cat’s current clinical status, as well as the influence of reduced renal function on drug pharmacokinetics. Anaesthesia should not be withheld in cats with CKD, when indicated, but it does require special consideration. The goal is to

preserve renal perfusion and oxygen delivery, avoid hypotension and dehydration, and minimise changes in GFR that could lead to additional renal damage. Priorities are listed in the inset box.

Seeking advice from a veterinary anaesthesia specialist may be beneficial in cases where longer or complex procedures are required in cats with CKD.

### Priorities include:

- ❖ IRIS staging and substaging prior to anaesthesia so that the stage and severity of renal dysfunction is understood. Preoperative blood pressure should be recorded;
- ❖ Measurement of PCV and electrolytes shortly before the procedure;
- ❖ Correction of dehydration and electrolyte abnormalities prior to anaesthesia. Caregivers may be asked to bring their cat in earlier for intravenous fluid therapy to restore circulating volume and support haemodynamics prior to the procedure;
- ❖ Maintaining the cat’s access to water up to the point of premedication and limiting fasting to 4–6 h (after, ideally, feeding one-quarter of the daily food ration as wet food);
- ❖ Considering the potential for prolonged activity of drugs undergoing renal elimination and adjusting dosage intervals accordingly. For example, ketamine is excreted unchanged in cats and may accumulate in patients with CKD;
- ❖ Where relevant, withholding treatment with ACE inhibitors or ARBs on the day of anaesthesia to avoid the risk of hypotension.<sup>268</sup> Withdrawal of amlodipine could result in uncontrolled hypertension, so any decision on withholding this treatment is dependent on individual patient factors;
- ❖ Keeping in mind that some premedication agents, such as acepromazine or alpha<sub>2</sub>-agonists, may cause vasodilation, hypotension and/or a reduction in cardiac output or GFR, particularly when combined with volatile anaesthetics. Selection should be made on an individual patient basis. For some cats with higher stage CKD, premedication with an opioid, with or without a benzodiazepine, for example, may be adequate;
- ❖ Titrating drugs for induction and maintenance of anaesthesia to avoid cardiovascular depression, and optimising locoregional analgesic techniques to reduce the dosages needed;
- ❖ Monitoring mean arterial pressure and maintaining it at or above 70 mmHg to ensure adequate renal perfusion. Downward trends in blood pressure should be promptly managed by decreasing inhalational anaesthesia, instituting bolus fluid therapy or with the use of vasopressor/positive inotropic agents, when needed. Planning interventions in advance of anaesthesia can facilitate prompt responses;
- ❖ Providing fluid therapy with crystalloids (eg, Ringer’s solution) on an individual patient basis to restore and maintain an effective circulating volume while avoiding dehydration and fluid overload; an appropriate fluid therapy rate is usually around 3–4 ml/kg/h. Reassessment of hydration status and renal parameters may be considered after surgery, particularly with higher risk procedures. Cats with CKD are at risk of fluid deficits but, importantly, also fluid overload due to impaired fluid excretion, so monitoring and adjustment is recommended. Monitoring of urine output (assessment of bladder size or amount collected via a urinary catheter) can also be useful;<sup>269</sup>
- ❖ Maintaining normothermia intraoperatively and during recovery;
- ❖ Avoiding NSAIDs, where possible. If they are considered, CKD must be stable (see ‘CKD and chronic pain’), bleeding should not have occurred during surgery, and the cat should be conscious, eating, drinking or receiving fluids so that return of renal blood flow autoregulation is confirmed. Alternative analgesics and locoregional blocks, for example, should be utilised and pain scoring systems implemented;
- ❖ Encouraging a rapid return to voluntary food and water intake postanaesthesia (if required, providing analgesia, antiemetics and appetite stimulants).

### Cardiorenal syndrome

Cardiorenal syndrome in cats describes the close, bidirectional relationship between cardiac and renal disease, where dysfunction in one organ system can contribute to dysfunction in the other, or both systems can be affected by systemic disease.

This syndrome is important in cats because heart disease, CKD, hypertension, fluid imbalance and inflammatory complications often coexist. Reduced cardiac output may lower renal perfusion and lead to worsening kidney function or AKI, while CKD can

drive hypertension, volume overload, electrolyte disturbances and cardiac remodeling. Shared mechanisms, including RAAS activation, sympathetic stimulation, inflammation and oxidative stress, as well as the impact of uraemic toxins, may exacerbate both cardiac disease and CKD.<sup>270</sup>

Diagnosis relies on recognising evidence of concurrent cardiac and renal involvement. Clinical examination, blood screening, blood pressure measurement, urinalysis and imaging are all important for

detecting dysfunction when disease is already present in the other organ system.

Management can be complex because treatment for one system may affect the other, particularly the use of fluid therapy, diuretics, antihypertensives and renally excreted drugs. Careful attention to perfusion, congestion, electrolytes, nutrition and water intake is essential. Earlier recognition through close monitoring and integrated management is likely to improve outcomes in affected cats.<sup>271</sup>

## Monitoring the cat with CKD

Monitoring checks for cats with CKD are aimed at understanding patient progress (improvements and deteriorations), compliance challenges and other caregiver support needs, and should be individualised in the light of cat and caregiver factors such as temperament and financial limitations.

A spectrum of veterinary care is described for cats with diabetes mellitus,<sup>272</sup> and similar principles can be applied to cats with CKD; in other words, individualising treatment goals and monitoring to optimise quality of life within the capacity of the caregiver, and taking into account the mental wellbeing of the cat, without compromising care. For example, repeated appointments for a cat who is distressed by the examination process could cause harm; monitoring might, therefore, incorporate verbal/email reports from the caregiver. More generally, nurse/technician involvement can be invaluable in maintaining contact, performing check-up consultations and supporting caregiver compliance with instituting dietary recommendations and administering therapeutic medications (see 'Nursing the cat with chronic kidney disease' in the supplementary material).

Following the initial diagnosis of CKD or any significant changes in the cat's clinical condition, it can be helpful to (re)assess the cat's progress relatively frequently – for example, every 2–4 weeks, depending on the patient's IRIS stage and the severity of their clinical signs. This will allow identification of cats with more progressive CKD who may require more intervention.<sup>72</sup>

### Identifying cats with progressive CKD

Monitoring the cat in the first 3 months following diagnosis of CKD may be useful to determine if they have progressive CKD. Cats with progressive CKD have a shorter survival time and are likely to benefit from closer monitoring and interventions.<sup>72</sup> Therefore, monitoring appointments could be scheduled initially more frequently to compare results with those at diagnosis, and the interval between checks then assigned based on changes in parameters such as serum creatinine, as well as body weight and caregiver-reported information.

## Box 10

### Checklist for CKD monitoring consultations

- ❖ A history can be taken while the cat is acclimatising to the consultation room. Key aspects to cover in the history include:
  - Demeanour, routines and general wellbeing of the cat;
  - Types and amount of food offered and amount eaten – is nutritional support needed?
  - Any vomiting or nausea (lip smacking, exaggerated swallowing, turning away from food) or diarrhoea;
  - Toileting behaviour, frequency and faecal consistency – as markers of dehydration or other issues;
  - Thirst and hydration support (ie, tactics employed to support voluntary fluid intake at home);
  - Medications – frequency, route and ease of administration, compliance, challenges and concerns;
  - If subcutaneous fluids are being administered at home – frequency, volume, hydration status before and after, and speed of fluid absorption.
- ❖ If collection of blood is intended, consider doing this first, or immediately after measurement of SBP, especially in anxious cats (see 'Optimising the home and veterinary clinic environment for cats with CKD').
- ❖ SBP measurement.
- ❖ Body weight, BCS and MCS assessment.
- ❖ Ocular examination for target organ disease.
- ❖ Routine physical examination including:
  - Hydration assessment (recognising that detection of mild dehydration can be challenging in senior cats);
  - Mucous membrane colour;
  - Oral examination, palpation for goitre, thoracic auscultation and abdominal palpation.

As noted, and if appropriate, monitoring need not necessarily always entail examining the cat, but can involve evaluation of caregiver records and reports received via email or verbally. In cats with stable CKD, the frequency of check-ups can be reduced to every 3–6 months, incorporating a detailed history and physical examination (Box 10).

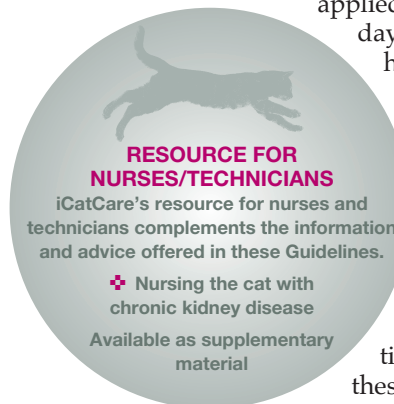
With appropriate education and training, caregivers can often become valuable contributors to clinical insight; for example, by providing information on their cat's appetite, toileting behaviour and hydration status.

Encouraging the use of clumping cat litter can allow more precise monitoring of urination patterns, while monitoring defecation frequency and faecal consistency can help identify poor hydration and hypokalaemia, as dehydrated or hypokalaemic cats tend to defecate less often and pass hard, dry faeces. A reduction in defecation frequency is an important potential indicator of dehydration.<sup>208,209</sup>

In cats with stable CKD who are doing well, laboratory tests at the 3- to 6-monthly consultations may (similar to the initial assessment of patients) be aimed at assessing the stage of disease and the presence of complications that would benefit from intervention. In addition, the clinician needs to remain vigilant to the development of any new concurrent conditions. As mentioned, most CKD patients are older cats, and concurrent diseases including hyperthyroidism, cognitive dysfunction, periodontal disease and DJD are common.<sup>81,227,228</sup> Therefore, periodic laboratory assessment should ideally include blood pressure measurement, urinalysis, haematology, serum biochemistry (creatinine, phosphate, electrolytes [including calcium and magnesium, where possible] and albumin) and measurement of total T4. In cats with phosphate within the IRIS target range, the inclusion of FGF23 concentrations, where feasible, may be helpful in guiding phosphate restriction. SDMA assessment can be helpful in poorly muscled cats, as creatinine measurement may falsely indicate a lower IRIS stage.

A spectrum-of-care approach to laboratory testing, allowing for caregiver and cat factors,

**The frequency of monitoring checks should be individualised, based on cat and caregiver factors.**



may mean measuring T4 only if the cat is tachycardic or has a goitre, limiting haematology to a PCV, focusing on the key elements of a biochemistry profile (eg, running just a 'renal panel') and asking caregivers to collect a urine sample at home, if indicated.

Routine urinalysis should be considered for cats being treated for renal proteinuria in order to re-evaluate the UPC and determine dose adjustments for antiproteinuric therapy. However, most cats with CKD are non-proteinuric (see Table 2) and, hence, routine urinalysis is unlikely to be necessary. If urinalysis is performed and an active sediment or positive urine culture is obtained, care should be taken to document the presence or absence of lower urinary tract signs or signs suggestive of pyelonephritis (see Box 6).

In patients where complications have been identified, the timing of future check-ups will depend on the complication and intervention applied (eg, SBP might be reassessed 5–7 days after starting or changing antihypertensive therapy).

Where finances are constrained, and especially in the later stages of CKD (late IRIS stage 3 and stage 4), control of clinical signs such as poor appetite, nausea or poor hydration status can be highly effective even in the absence of detailed laboratory data. Nurse/technician consultations are worthy of consideration in these cases.

## Box 11

### Palliative care options for cats with late-stage CKD

Cats with stage 3 or 4 CKD are likely to be exhibiting significant clinical signs from their disease, but nevertheless there are measures that can be implemented to improve their management, as summarised below. For detailed information, readers are referred to the '2023 AAFP/IAAHPC feline hospice and palliative care guidelines'.<sup>273</sup>

- ❖ **Hydration support** Consider administering subcutaneous fluids or, if a feeding tube is in situ, providing fluids via the tube.
- ❖ **Nutritional support** Consider antiemetic and appetite stimulant medications, or, for suitable patients, an oesophagostomy tube for longer term nutritional support. Offer whatever food the cat is likely to eat (little and often, warmed if preferred) rather than restricting the patient to veterinary therapeutic renal diets. Deter caregivers from attempting to syringe-feed their cat or provide oral hydration support via syringe, as this is generally very stressful for feline patients and risks aspiration.
- ❖ **Medication support** Consider transdermal medications, where available, if oral administration of medications is stressful for the caregiver or cat. Alternatively, if a feeding tube has been placed, try to use this where possible (choosing liquids or medications that can be crushed). In the latter stages of CKD, priority should be given to medications that support the control of clinical signs rather than those that aim to minimise disease progression (eg, antiemetics over phosphate restriction).
- ❖ **Support of caregiver decision-making** Maintain open communication with caregivers, discussing the cat's quality of life and, if useful, utilising quality-of-life scoring systems to aid decision-making regarding euthanasia.
- ❖ **Optimisation of the home environment** Ensure the home environment is optimised for the cat's clinical condition; for example, by making certain that resources are within easy reach and providing steps or ramps up to favoured resting places. The 'five pillars' model (see Table 7) offers valuable guidance.
- ❖ **Cat friendly hospitalisation** If the cat is hospitalised, consider the aims of in-clinic care and avoid prolonged or repeated stays. Ensure cat friendly hospitalisation measures are in place (eg, provide a hiding place, low-sided litter trays and analgesia, within a quiet ward) and discharge the patient as soon as possible.<sup>221</sup>

## Prognosis for cats with CKD

The prognosis for cats with CKD is highly variable and unpredictable. Many cats diagnosed with the disease and managed with appropriate supportive care, as outlined in these Guidelines, remain stable and well for years. However, progression (vs stability) has a significant influence on survival time, with cats with progressive CKD having a median survival time of 287 days (95% confidence interval [CI] 246–354) vs 894 days (CI 812–1052) for cats with stable CKD.<sup>72</sup> Tracking patients in as much detail as possible assists in identifying those cats whose disease is progressing at a faster rate and, in turn, advising and supporting caregivers in this situation.

Palliative care options for cats with late-stage CKD are outlined in Box 11.

## Conclusions

CKD is common in senior cats and most frequently caused by tubulointerstitial nephritis of unknown aetiology. It results in a reduction in GFR and, hence, consequences such as increased serum phosphate, CKD-MBD and the accumulation of uraemic toxins, as well as complications such as anaemia, hypercalcaemia, hypertension and proteinuria. Cats can be well managed, with a good quality of life and prolonged survival times. These outcomes are facilitated when caregivers are supported by the veterinary team to transition their cats onto renal diets, administer medications and encourage hydration.

## Supplementary material

The following supplementary material files are available at [go.jfms.com/CKDGLs2026\\_supplementarymaterial](http://go.jfms.com/CKDGLs2026_supplementarymaterial):



The FelineVMA is pleased to endorse these practice guidelines from iCatCare.

- ❖ Video demonstrating blood pressure measurement with Doppler. *Courtesy of Sarah Caney.*
- ❖ Managing the cat with chronic kidney disease: a guide for caregivers.
- ❖ Monitoring form for caregivers of cats with chronic kidney disease.
- ❖ Nursing the cat with chronic kidney disease.

## Author note

The following members of the Guidelines panel are IRIS board members: Jonathan Elliott, Jessica Quimby, Gilad Segev and Joanna White.

## Conflict of interest

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## SUMMARY POINTS

- ❖ Clinical signs of CKD include weight loss, PU/PD, vomiting, lethargy and hyporexia, along with constipation. Signs may go unnoticed in the early stages of disease.
- ❖ Diagnosis is based on serum creatinine and/or SDMA measurement, plus urinalysis and imaging of the kidneys.
- ❖ Following diagnosis, repeat measurement of creatinine concentration 2–4 weeks later can differentiate progressive from stable CKD, which is of prognostic significance.
- ❖ Factors associated with progression of CKD include increasing severity of proteinuria, raised serum phosphate concentrations, accumulation of uraemic toxins and anaemia.
- ❖ Staging, followed by substaging, should be performed once a diagnosis of CKD is made, based on the IRIS staging scheme.
- ❖ Management is focused on the control of CKD-MBD by addressing raised serum phosphate, treating hypertension and proteinuria, if present, and managing other abnormalities such as anaemia, hypokalaemia, nausea/vomiting/hyporexia and constipation.
- ❖ Neither anaesthesia nor analgesic therapy should be withheld due to CKD, but procedures and treatment regimens should be planned to ensure no further renal impacts.



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