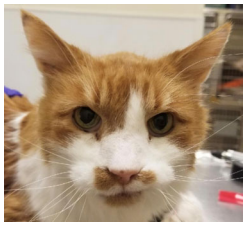

From Diet to Binders: Targeted Management of Hyperphosphatemia in Cats with CKD

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The Phosphorus Problem

Why control phosphorus?

- Drives renal secondary hyperparathyroidism
- Accelerates CKD progression
- Stimulates FGF-23 production
- Correlates with decreased survival
- Impacts quality of life

Phosphate retention drives renal secondary hyperparathyroidism and mineral-bone disorder in CKD, with links to poorer survival. Serum phosphate concentration strongly stimulates the production of fibroblast growth factor-23 (FGF-23), a phosphatonin that plays a key role in the development of CKD mineral-bone disorder. Dietary phosphate restriction reduces FGF-23 and PTH and is central to slowing disease and improving quality of life.

Summers S, Michael HT, Szlosek D, et al. Blood fibroblast growth factor 23 concentration in cats with and without chronic kidney disease: a scoping study. *J Feline Med Surg* 2024;26(4):1098612X241234984.

Stage-Specific Phosphorus Targets

IRIS phosphorus targets by stage:

- Stage 1-2: 2.7-4.6 mg/dL
- Stage 3: < 5.0 mg/dL
- Stage 4: < 6.0 mg/dL

For cats with CKD, the IRIS stage determines the serum phosphorus target and when to intervene.

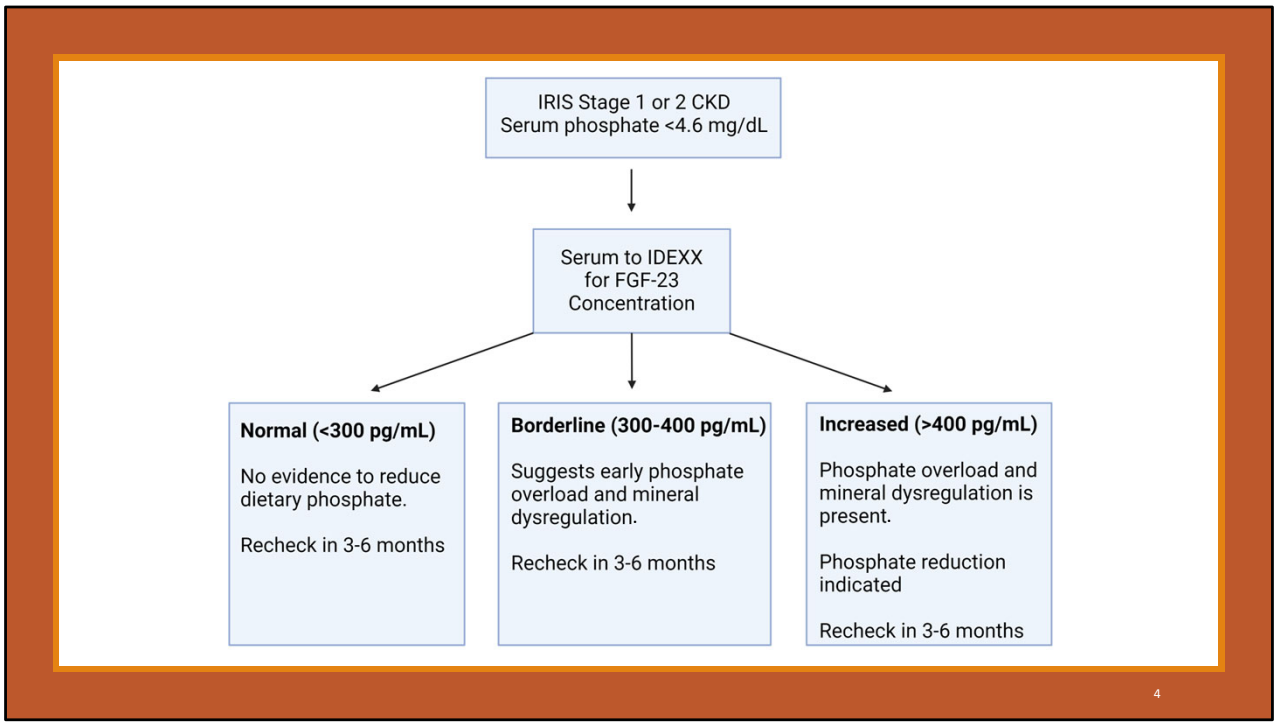
In Stage 1 and 2, the target is between 2.7-4.5 mg/dL.
In Stage 3, the serum phosphate target is less than 5.0 mg/dL.
In Stage 4, the target is less than 6.0 mg/dL.

When to Act

Intervene when:

- Fasted serum phosphate exceeds IRIS target for CKD stage
- FGF-23 concentration >400 pg/mL (even if phosphate normal)

Many cats with early-stage CKD will have normal serum phosphate concentration. In cats with Stage 1 or 2 CKD and a serum phosphate within IRIS target range, measuring serum FGF-23 can be beneficial to identify those cats that need dietary phosphate restriction. In this scenario, an elevated serum FGF-23 concentration (> 400 pg/mL) indicates phosphate overload, particularly in the absence of hypercalcemia, anemia, or marked inflammatory disease, and treatment is indicated.



The IDEXX FGF-23 test is intended for cats already diagnosed with—or highly suspected of having—IRIS CKD Stages 1 or 2, to help detect early phosphate overload that may precede obvious hyperphosphatemia or traditional kidney biomarkers. It supports clinicians in making evidence-based decisions about when to initiate phosphate-reduction therapy such as dietary changes.

FGF-23 testing is indicated in Stage 1–2 CKD cats—especially when serum phosphorus is still below 4.6 mg/dL and kidney biomarkers like SDMA or creatinine suggest early disease. The test is not recommended for cats with total serum phosphorus already above the IRIS target (> 4.6 mg/dL), or those with confounding comorbidities hypercalcemia, severe anemia, or marked inflammatory disease. These comorbidities can independently increase serum FGF23 concentrations independent of phosphate.

Treatment Hierarchy

Diet first, then binders

1. Decrease dietary phosphate intake
2. Add binders if serum phosphate remains above target despite diet

Phosphate overload is first addressed by decreasing dietary phosphate intake. If serum phosphate concentration remains above the stage-specific target after dietary restriction, give enteric phosphate binder to effect while avoiding signs of toxicity.

Dietary Phosphorus Targets in CKD Cats

- IRIS Stages 1–2: ≤ 150 mg/100 kcal
- IRIS Stages 3–4: ideally ≤ 120 mg/100 kcal
- If cat won't eat renal diet or has comorbidities:
  - Use palatable maintenance diet with moderate phosphate content (< 200 mg/100 kcal)
  - Add phosphate binder

When selecting a renal diet for cats with CKD, aim for a phosphorus density of no more than 150 mg/100 kcal for IRIS Stages 1–2 and ideally 120 mg/100 kcal or less for Stages 3–4. If the cat refuses all renal diets or you need to choose a diet that treats comorbid conditions, choose a palatable maintenance diet (ideally with a diet that has moderate in phosphate, <200 mg/100 kcal) and plan to start a binder.

Parker VJ. Nutritional management for dogs and cats with chronic kidney disease. *Vet Clin North Am Small Anim Pract* 2021;51(3):685-710.

Renal Therapeutic Rx Diets

AAFCO Dietary Minimums for Adult Maintenance (Cats):
Protein, 6.5 g/100 kcal
Phosphate, 125 mg/100 kcal

Early vs advanced renal diets - what is the difference?

Stage 1–2 "early" CKD diets

- Moderate dietary protein (range, 7.3-9.5 g/100 kcal)
- Low to moderate dietary phosphate (range, 90-130 mg/100 kcal)
- Often just above AAFCO minimums for adult maintenance

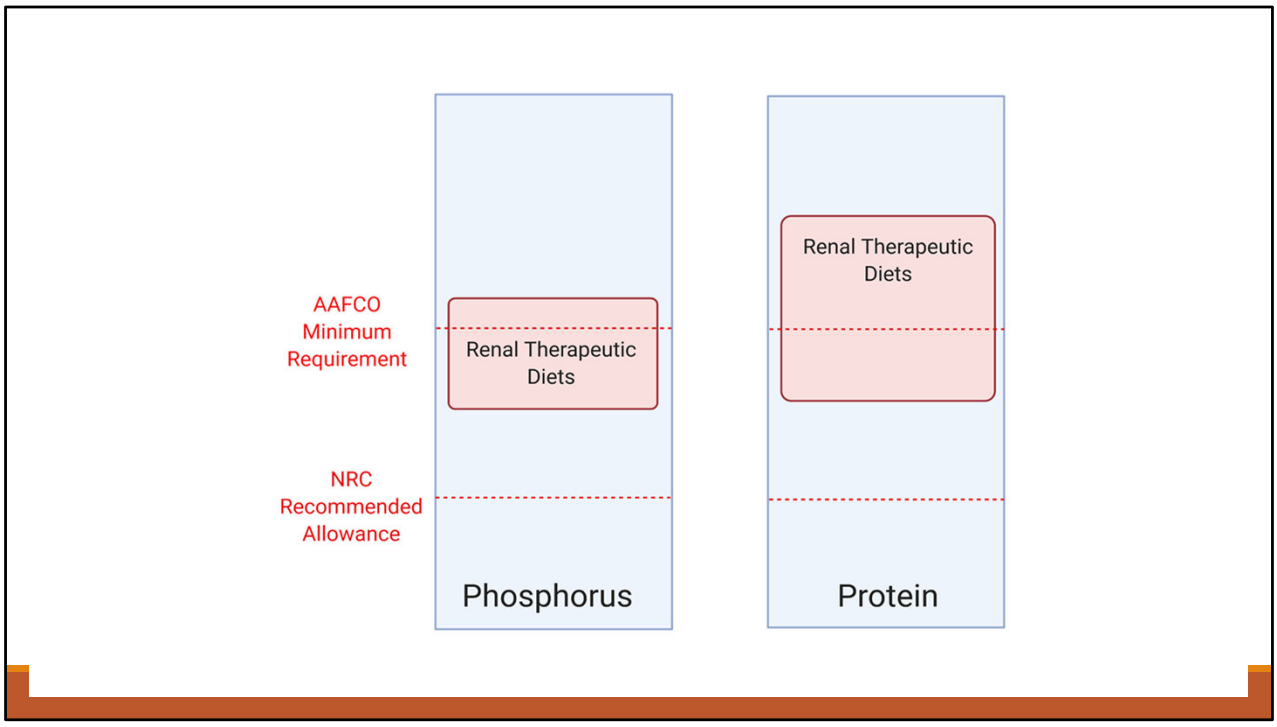
Stage 3–4 "advanced" CKD diets

- Low dietary protein (range, 5.8-7.0 g/100 kcal)
- Low dietary phosphate (range, 80-125 mg/100 kcal)
- Often fall below AAFCO minimums for adult maintenance

Diets for early-stage CKD (Stage 1–2) are designed to begin controlling phosphorus while still maintaining higher protein to support lean body mass and appetite. These formulations often contain dietary protein and phosphate just above the AAFCO minimums for adult maintenance in cats.

In contrast, advanced CKD diets (Stage 3–4) are more restrictive. They aim to further limit phosphorus intake and manage uremic signs with low dietary protein. Because of this restriction, these advanced diets may actually fall below the AAFCO minimums for protein or phosphorus set for healthy adult cats—but they are appropriate for CKD management.

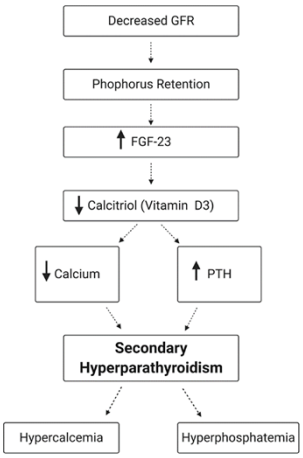
Key point for practitioners: Diet selection should be stage-specific and individualized, balancing phosphorus control with the need to maintain nutrition and quality of life.


AAFCO
Minimum
Requirement
NRC
Recommended
Allowance
Renal Therapeutic
Diets
Phosphorus
Renal Therapeutic
Diets
Protein

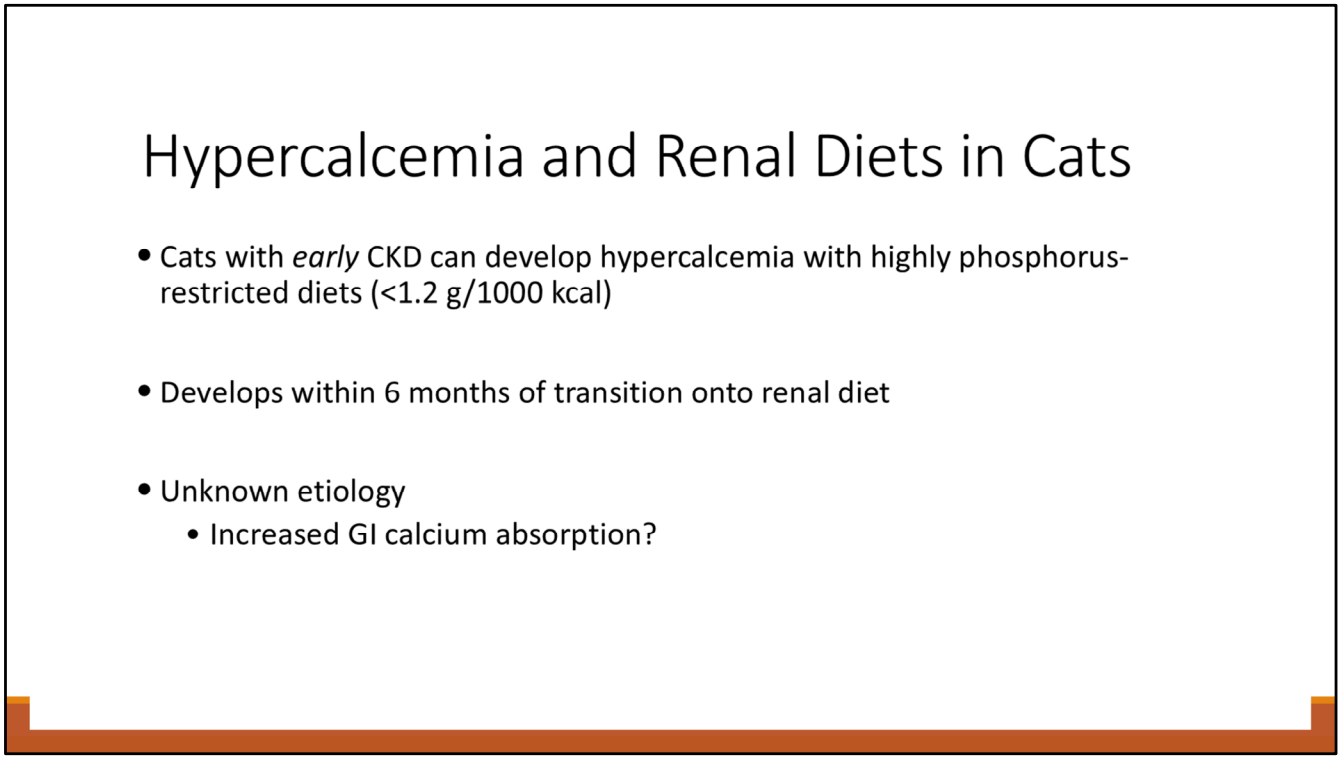
Effect of Renal Diet on Phosphorus

Feeding renal diet and reducing phosphate intake for 4-8 weeks resulted in decreased phosphate, FGF-23, PTH

Feeding a renal diet to *normo*phosphatemic cats still resulted in decreased FGF-23



Geddes RF, J Elliott, HM Syme. The effect of feeding a renal diet on plasma fibroblast growth factor 23 concentrations in cats with stable azotemic chronic kidney disease. *J Vet Intern Med* 2013;27(6):1354-61.



Renal diets are phosphate-restricted and can reduce serum phosphate and suppresses FGF-23. As FGF-23 decreases, there's less inhibition of calcitriol (active vitamin D) production. This can increase intestinal calcium absorption. Also, the calcium-to-phosphorus ratio in many renal diets is higher (often >1.3:1), which may further increase calcium absorption.

Cats in early CKD may still have relatively preserved kidney function and calcitriol synthesis, making them more prone to rising serum calcium compared with advanced CKD cats. In some cats, the net effect is ionized or total hypercalcemia once phosphate restriction is implemented.

Schauf S, JC Coltherd, J Atwal, et al. Clinical progression of cats with early-stage chronic kidney disease fed diets with varying protein and phosphorus contents and calcium to phosphorus ratios. *J Vet Intern Med* 2021;35(6):2797-2811.

Hypercalcemia Risk

Risk factors for hypercalcemia after transitioning to a renal diet:

- Stage 1-2 CKD with serum phosphorus < 3.9 mg/dL
- Low phosphate renal diets (<120 mg/100 kcal)

Management:

- Monitor total calcium regularly
- If total calcium >12 mg/dL after feeding a low phosphate diet, switch to less restricted diet (130-150 mg/100 kcal) with Ca:P ratio < 1.4:1

Some cats with Stage 1 or 2 CKD with serum phosphate within the IRIS target may be at increased risk of developing hypercalcemia when phosphate-restricted renal diet is introduced; particularly, a renal diet with phosphate <120 mg/100 kcal. Monitoring serum calcium is important and if total calcium exceeds 3 mmol/L (12 mg/dL) switch to a less phosphate restricted diet (between 130-150 mg/100 kcal) with a calcium-to-phosphorus (Ca:P) ratio less than 1.4:1.

Geddes RF, DHN van den Broek, Y Chang, et al. The effect of attenuating dietary phosphate restriction on blood ionized calcium concentrations in cats with chronic kidney disease and ionized hypercalcemia. *J Vet Intern Med* 2021:35(2)997-1007.

What if Cat Refuses a Renal Diet?

1. Treat nausea and dysrexia
2. SLOWLY transition to the new renal diet
3. Rotational feeding
4. Entice the pet to eat
5. Esophagostomy tube
6. Supplement a renal diet with senior diet

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Treat nausea and dysrexia first: Many CKD cats feel nauseous; anti-nausea therapy and appetite stimulants can improve willingness to try new foods. Transdermal mirtazapine is documented to improve appetite and body weight in cats with CKD.

Quimby JM, KK Benson, S Summers, et al. Assessment of compounded transdermal mirtazapine as an appetite stimulant in cats with chronic kidney disease. *J Feline Med Surg* 2020;22(4):376-383.

Slow transition is critical: Abrupt changes often lead to food aversion. Transition over 2–3 weeks.

Rotational feeding: Offer different renal diet brands/textures (pâté, chunks, dry) to find what the cat will accept.

Entice the cat: Warm food, add water or low-sodium broth, or hand-feed small portions to encourage interest.

Feeding tube option: In refractory cases with advanced kidney disease, an esophagostomy tube ensures adequate calorie intake and allows gradual renal diet introduction.

Consider supplement a renal diet with a senior maintenance diet to balance palatability with phosphorus restriction—better partial compliance than none.

Low Phosphate OTC Feline Diets

Diet	Kcal per can/cup	Phosphorus (mg/100 kcal)	Protein (g/100 kcal)
Weruva Wx Chicken & Tilapia in Gravy (3 oz)	81	67	13.4
Weruva Wx Chicken in Gravy (3 oz)	81	81	13.1
Royal Canin Aging 12+ Loaf in Sauce (5.1 oz)	122	120	11.0
Royal Canin Aging 12+ Thin Slices in Gravy (3 oz)	71	120	11.0
Hill's Science Diet Tender Tuna Dinner (5.5 oz)	162	127	10.1
Hill's Science Diet 7+ Tender Tuna Dinner (5.5 oz)	146	135	10.0
Hill's Science Diet Adult 11+ healthy Cuisine Seared Tuna & Carrot Medley (2.8 oz)	66	135	8.9
Hill's Science Diet Adult Tender Chicken Dinner (5.5 oz)	160	138	8.7

Some over-the-counter (OTC) feline diets are low in phosphate, often marketed senior diets. This is a list of low phosphate over-the-counter (OTC) diets and is not an exhaustive list. These diets can be useful alternatives or supplemental diet if a cat refuses to solely eat a therapeutic renal diet. Key consideration: protein content is highly variable. Some OTC diets are moderate protein and closer to renal diet formulations for early-stage CKD. Others are high protein (>10 g/100 kcal), which may increase uremic toxin burden.

These diets may be most appropriate for early-stage CKD cats where phosphorus restriction is the priority, but protein restriction is less critical. This list is not comprehensive—refer to product guides or contact manufacturers for additional nutrient information. The nutrient profiles of pet foods often change, so use this list as a starting point and refer to current product guides.

Management of Comorbid Cats

- Set nutritional goals and prioritize them to support the cat's health and quality of life
- Strive to keep dietary phosphate < 200 mg/100 kcal

Cats with CKD often have other chronic diseases (e.g., diabetes mellitus, chronic enteropathy, urolithiasis). Nutritional management requires balancing multiple priorities while always keeping the cat's quality of life at the center.

General approach:
Set nutritional goals based on the comorbidity, then prioritize what matters most for the individual patient.
Calories first—ensure adequate intake before fine-tuning diet restrictions.

Management of Comorbid Cats

CKD + chronic enteropathy

- Hill's d/d Duck – phosphate 174 mg/100 kcal (dry) and 167 mg/100 kcal (canned)
- Hill's z/d – 157 mg/100 kcal (dry) and 164 mg/100 kcal (canned)
- *Royal Canin Hydrolyzed Protein Adult (dry) – 148 mg/100 kcal
- *Royal Canin Ultamino (dry) – 128 mg/100 kcal
- *Royal Canin Renal Support + Hydrolyzed Protein (dry) – 100 mg/100 kcal

*These diets have a moderate protein content (6.3 g/100 kcal), similar to many renal diets formulated for advanced-stage CKD and thus would be most appropriate for those cats with Stage 3 and 4 CKD.

The other diets may be most appropriate for early-stage CKD cats where phosphorus restriction is the priority but protein restriction is less critical. This list is not comprehensive—refer to product guides or contact manufacturers for additional nutrient information. The nutrient profiles of pet foods often change, so use this list as a starting point and refer to current product guides.

Management of Comorbid Cats

CKD + urolithiasis

- Canned food preferred to increase water intake and dilute urine
- Urinary diets that have moderate phosphate content:
  - Royal Canin SO Aging 7+ Calm – phosphate 170 mg/100 kcal (dry) and 150 mg/100 kcal (can)
  - Purina UR (can) – 170 mg/100 kcal
  - Hill's c/d Multicare Stress Chicken & Vegetable Stew –161 mg/100 kcal
  - Hill's c/d Multicare Stress with Ocean Fish (dry) – 163 mg/100 kcal

These diets may be most appropriate for early-stage CKD cats where phosphorus restriction is the priority but protein restriction is less critical. This list is not comprehensive—refer to product guides or contact manufacturers for additional nutrient information. The nutrient profiles of pet foods often change, so use this list as a starting point and refer to current product guides.

Management of Comorbid Cats

CKD + diabetes mellitus

- Low carbohydrate diet (< 4.0 g/100 kcal)
  - Often high in protein to counterbalance the carb restriction
- In general, canned foods contain fewer carbohydrate than dry counterparts but not all canned foods are low carb
- Low carb, moderate phosphate diet options:
  - Just Food for Dogs Just Cats Fresh Frozen Fish & Chicken – carb 2.8 g/100 kcal, phosphate 163 mg/100 kcal
  - Royal Canin Hair & Skin Care Loaf in Sauce – carb 2.9 g/100 kcal, phosphate 190 mg/100 kcal
  - Hill's m/d (dry) – carb 3.6 g/100 kcal, phosphate 189 mg/100 kcal
  - Hill's m/d (can) – carb 3.0 g/100 kcal, phosphate 151 mg/100 kcal

Management of a cat with both CKD and diabetes mellitus is challenging because the nutritional goals can conflict. Cats with diabetes can benefit from a low carbohydrate diet (< 4.0 g/100 kcal), but low carbohydrate diets can be high in protein. In commercial diets, when carbohydrate is reduced, manufacturers typically replace those calories with protein.

Canned diets usually have fewer carbohydrates than dry, but not all canned foods are low-carb—product guides must be checked carefully.

Goal is to find a low-carb, moderate-phosphate option that balances both conditions.

These diets may be most appropriate for early-stage CKD cats where phosphorus restriction is the priority but protein restriction is less critical. This list is not comprehensive—refer to product guides or contact manufacturers for additional nutrient information. The nutrient profiles of pet foods often change, so use this list as a starting point and refer to current product guides.

Phosphate Binders Overview

- If still not meeting IRIS target after dietary phosphate restriction, add phosphate binder
- Available options

1. Aluminum hydroxide – Most widely used, inexpensive
2. Lanthanum carbonate - Potent, palatable, commercial product for cats
3. Calcium carbonate - Avoid if hypercalcemic
4. Sevelamer - Ca/Al-free option
5. Chitosan + calcium - Gentle combination

When to use: Add a phosphate binder if the cat's serum phosphorus remains above the IRIS stage-specific target despite dietary phosphate restriction. Always prioritize caloric intake first—don't compromise appetite to force binder use.

Options available:
Aluminum hydroxide – Most commonly used in practice; inexpensive. Monitor for constipation, muscle weakness, or microcytosis with chronic use. Recent publication found no change in serum phosphate after 6 weeks at dose 90 mg/kg/day in CKD cats fed a wet renal diet.
Lanthanum carbonate – Potent, palatable, and now available as a feline-specific product.
Calcium carbonate – Can be effective, but avoid in cats with ionized hypercalcemia.
Sevelamer – Free of calcium and aluminum, useful if those are contraindicated. More expensive and less commonly used.
Chitosan + calcium – Marketed as a gentler, nutraceutical-style option. Still supplies calcium, so monitor ionized calcium closely.

Beita KC, BN Lourenco, M Rehagen, et al. Effect of aluminum hydroxide on serum phosphate and fibroblast growth factor 23 concentrations in young adult cats with surgically induced chronic kidney disease. *Am J Vet Res* 2024;85(10):ajvr.24.04.0123.

Binder	Starting dose (total daily)	Pros	Watch-outs / pearls
Aluminum hydroxide	30–60 mg/kg/day (elemental). Max dose, 100 mg/kg/day.	Inexpensive	
Lanthanum carbonate	30 mg/kg/day, up to 95 mg/kg/day PO.	Potent, palatable; Ca- and aluminum-free	Commercial product in cats available
Sevelamer	30-50 mg/kg PO q 8 hours; 40-80 mg/kg PO q 12 hours	Ca- and aluminum-free	
Calcium carbonate	60–90 mg/kg/day (elemental Ca)	Cheap, effective	Avoid if high iCa
Chitosan and calcium	Per product label	Gentle option	Still supplies Ca; monitor iCa

Practical Binder Tips

- Must give with food - not between meals
- Divide daily dose across all meals
- Start low, titrate every 4-6 weeks
- Mix with palatable food first
- Prioritize calories if appetite poor
- Monitor ionized calcium when using calcium-based binders

When using a phosphate binder, the binder must be given with food, and the daily dose is divided into multiple meals. The dose is titrated to effect, while avoiding toxicity. Side effects of aluminum hydroxide include constipation, generalized muscle weakness, neurologic signs, and microcytosis. If appetite is marginal, prioritize calories first; you can phase in binders as soon as intake is reliable. Monitor for ionized hypercalcemia with the use of calcium salts.

Monitoring

Initial phase:

- Check serum calcium and phosphate every 4-6 weeks until meet stage-specific IRIS phosphate target
- Adjust diet/binders based on results

Maintenance phase:

- Check every 3-6 months when stable
- Once serum phosphate within IRIS target range
  - Measuring FGF-23 may help to determine if additional phosphate restriction advantageous
  - If serum FGF-23 > 700 pg/mL, further restriction is recommended

Check serum calcium and phosphate concentrations every 4–6 weeks until values are stable, then monitor every 3–6 months. Once serum phosphate is within the IRIS target range, measuring FGF-23 may help determine if additional phosphate restriction would be advantageous. If the FGF-23 concentration exceeds 700 pg/mL, further restriction is recommended—provided there is no hypercalcemia, anemia, or significant inflammatory disease, as these conditions can elevate FGF-23 independently of phosphate overload.

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