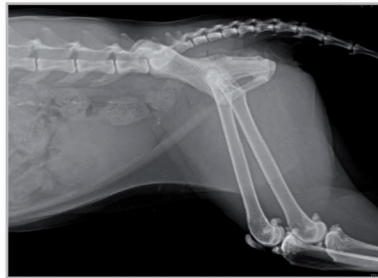


VETERINARY **focus**

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The challenge of ageing cats in Practice



Diego Esteban
Claude Muller
Thomas Rieker
Kit Sturgess

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From left to right: Diego Esteban, Thomas Rieker, Claude Muller and Kit Sturgess.

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Diego Esteban graduated from the Veterinary School of Universitat Autònoma de Barcelona in 1998. After one year in general small animal practice he started his clinical work at an exclusively feline practice Tot Cat in Barcelona where he is responsible for the internal medicine cases.

Diego Esteban is a former treasurer and current member of the scientific board of the AVEPA Spanish Feline Study Group (GEMFE). He is also a member of the ISFM (International Society of Feline Medicine). Diego Esteban has published several papers in national journals and has been an invited speaker on feline internal medicine topics at national and international scientific events.

Claude Muller

Claude Muller graduated from the National Veterinary School of Maisons-Alfort (France) in 1996. After two years of internship, she received her French certificate of specialisation in internal medicine (CEAV). For 12 years, she was in charge of geriatric consultation in the Vet School. Currently, she works in a general and referral practice in Lomme, in the North of France.

Claude Muller is also the President of the Working Group on Oncology (GEO) within the French Association of Companion Animal Vets (AFVAC).

Thomas Rieker

Thomas Rieker graduated in 1990 from the Munich Veterinary School, where he started his professional life at the Department of Small Animal Medicine. In 1994 Thomas Rieker took over his father's surgery in Ravensburg. Over the next few years he developed the practice from a mixed practice to a referral practice for small animal internal medicine.

In 2010 the surgery merged into the newly built modern Small Animal Clinic am Hochberg, of which Thomas Rieker is co-founder. He is also responsible for internal medicine, imaging and clinical pathology. Over the last decade Thomas Rieker has given than 100 lectures and seminars and he is co-author of numerous publications.

Kit Sturgess

Kit Sturgess graduated from Cambridge University Veterinary School in 1986 and has worked in first opinion and private referral practice as well as teaching at both Bristol and London Veterinary Schools.

Kit was awarded a PhD looking at feline mucosal immunity to FIV and has further professional qualification in internal medicine, cardiology and radiology. He is an RCVS Recognised Specialist in Small Animal Medicine.

Kit has lectured to veterinary audiences all over the world as well as presenting the results of various research projects he has undertaken. He is the author of numerous peer reviewed publications, several book chapters and two text books.

Kit remains an active clinician with a special interest in feline medicine particularly cardiorespiratory, gastrointestinal and urinary tract disease. With age, Kit has developed an increasing interest in gerontology!

Introduction



C. Renner

A thousand shades of grey

With the elderly cat, nothing is ever simply “black” or “white”, but rather an infinite range of greys.

Clinical signs in elderly cats are often non-specific and subtle going unnoticed by the owner. It can also be hard to investigate certain potential diseases due to the peculiarities of feline behaviour; taking a cat’s blood pressure for example is notoriously difficult due to the “white coat” effect.

Above all, in the elderly or geriatric cat, it is difficult to determine whether a particular sign represents “normal” ageing or underlying pathology. To further complicate the matter, there is often a lack of consensus amongst experts.

The challenges of history, physical examination and investigation posed by elderly cats continues into the treatment phase, with a higher risk of drug toxicity than in the dog and only a very limited range of drugs licensed for use in cats due to the high costs of development and registration.

Life stage food is a simple, low risk option to try and reduce the risk or minimise the progression of age-related disease in the elderly cat. Nutrition can help to prolong life expectancy and improve the quality of life of the senior cats. Nevertheless, the feeding behaviour of cats is not fully understood and despite advances in palatability of diets and in our understanding of aversion to certain foods, you can lead a cat to the feed bowl but you cannot make them eat!

The field of feline gerontology is still in its infancy, which is why Royal Canin has asked four specialists in feline medicine to share their experiences of the elderly cat and shed light on their many “shades of grey”.

Philippe Marniquet,
DVM, Dipl. ESSEC
Royal Canin



1. Meeting the challenge of ageing in cats

> SUMMARY

- The number of senior and geriatric cats is increasing.
- Ageing is the accumulation of adverse changes in cells and tissues that increases the risk of that cell dying and ultimately failure of the organ and death of the individual.
- Incidence of degenerative and neoplastic disease increases as cats age.
- A senior health care plan is an important part of improving health care for elderly cats.
- Older pets account for approximately 15% of practice patients but generate 35% of practice income.
- Screening tests for elderly cats should be accompanied by clear “what if” strategy to respond to any abnormal results identified on the screening.
- Screening is likely to be most productive if targeted at information derived from history and physical examination.
- Using a quality of life survey will help to improve targeting of the consultation and subsequent screening.

1/ When young turns to old

A) When is a cat old?

We are all aware that cats age more quickly than man and for many years it was said that one human year was equivalent to 7 cat years. However, when looking at the age that a cat can have kittens together with the fact that many cats live until they are 15 years old, this linear association is clearly not the case (**Figure 1**). There is general consensus that cats become old (senior) between 11 and 12 years and considered geriatric when over 15 years. Studies on the GIT however have documented reduced function significantly earlier at 7-8 years old.

B) What happens as we age?

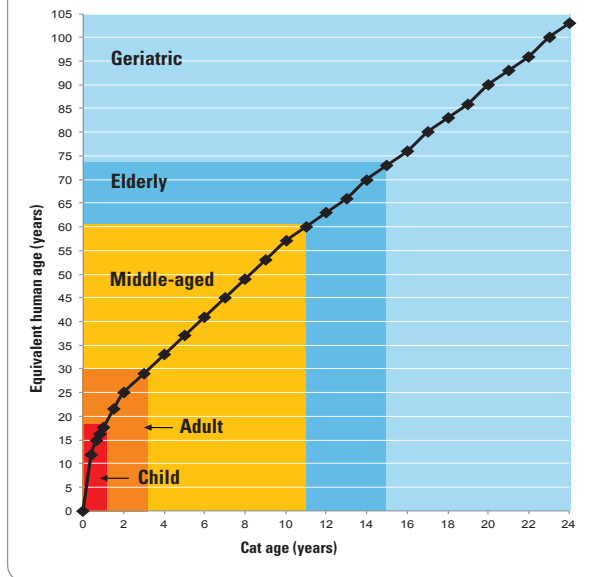
Ageing is the accumulation of adverse changes in cells and tissues that increases the risk of that cell dying and ultimately failure of the tissue and death of the individual.

Ageing is an in-built process that occurs in all individuals, however the rate of ageing between individuals is different and is affected by an enormous range of factors but that can be grouped into developmental defects and genetic make-up, environmental factors and disease. On a molecular level ageing occurs due to cellular damage by free radicals, deteriorating immune function (Greely, 2001), senescence genes and chromosomal changes (**Figure 2**) (Blount, 2004). As an individual ages, changes occur in all organs increasing the likelihood of multiple organ dysfunction that impact on each other (domino effect) and can prove challenging when deciding upon therapy.

C) What constitutes “normal” ageing?

This can be a difficult question to answer for a client as it is poorly defined in cats; for example as cats age their ability to jump up on to fences, cupboards or work surfaces declines - what is a “normal” reduction and what might constitute evidence of pathology such as osteo-

Figure 1. Relative cat and human ages and life stages. How old is my cat?



arthritis? In many cases it is the speed of change that suggests an underlying disease process rather than necessarily the level the patient is at. Generally the ageing process is slowly progressive with older animals having poorer appetites and being less active, less mentally alert and less adaptable to sudden changes in their environment. Their lean body tissue (muscle) tends to be lost. Ageing of itself does not cause disease but organ

performance, reserve and the ability to regenerate is reduced making older individuals more susceptible to disease and the consequences of previous organ damage more significant. In the initial stages, deteriorating organ function does not cause outward disease as the majority of organs have a large functional reserve that can be gradually used up. The mean age of onset of disease deemed to be age related in one study was 11.9 years (± 2 years).

D) Common changes with ageing

The majority of organ systems will show changes with age and the incidence of disease such as dental disease (**Figure 3**) or urinary tract infection (**Figure 4**) have been shown to increase with age. Skin becomes less elastic making decisions on whether an elderly cat is dehydrated or not more difficult. The immune system also declines with a slower and less robust response to challenge (this does have the benefit of elder cats showing a decline in some immune-mediated diseases as they age such as atopy). There are also significant changes in body composition with a loss of lean body mass and gastrointestinal function (Burkholder, 1999) with reduced nutrient digestion and absorption.

The suspected causes of the decline in GI function include:

- changes in the composition of bile,
- decreased enzymatic secretion and activity,
- intestinal epithelial atrophy,

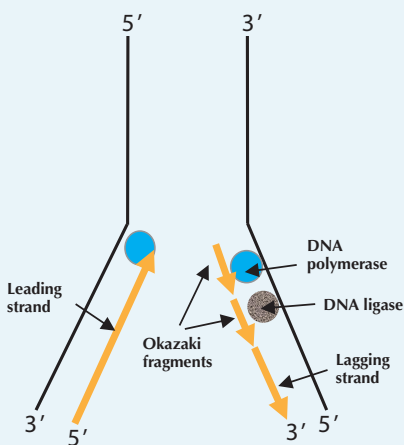


Figure 2. Process of DNA replication and telomere loss.

As a consequence of the way DNA replicates, cell division inevitably results in chromosomal shortening. In order to prevent loss of vital genetic code, the ends of chromosomes have repetitive DNA sequences called telomeres. Once this entire protective telomeric DNA has been lost the cell can no longer divide becoming senescent. DNA loss occurs because replication does not begin at either end of the DNA strand, but starts in the centre, and moves in the 5' to 3' direction creating a leading and a lagging strand. Forming a complementary DNA leading strand going from 5' to 3' end creates no issues. But to replicate the lagging strand, short sequences of RNA acting as primers have to attach a short distance ahead of where the initiation site was. The DNA polymerase can start replication at that point and go to the end of the initiation site. This causes the formation of Okazaki fragments. More RNA primers attach further on the DNA strand and DNA polymerase attaches and continues to make a new DNA strand. Eventually, the last RNA primer attaches and is converted to DNA. But, in order to change RNA to DNA, there must be another DNA strand in front of the RNA primer which is not present where the last RNA primer is attached. Any RNA left on the DNA is destroyed and thus, a section of the lagging strand 5' end telomere is lost.

- altered gastric emptying rates and gastrointestinal transit times.

Whilst energy requirements of cats tends to decline with age, reduced intestinal function (particularly fat digestion) may result in some older cats actually increasing their food intake to compensate for the reduction in the efficiency of digestion. Older animals are less able to adapt to a change in nutrition, even if this is ultimately beneficial so any change needs to be introduced slowly over 5-7 days. They also have a reduced sense of smell and taste so palatability becomes a more important factor as does the form of dietary carbohydrates as glucose regulation is poorer. Reduced sensitivity to thirst occurs in older patients; chronic dehydration can exist prior to any additional disease issues resulting in rapid clinical dehydration occurring when the patient becomes unwell. This puts added pressure of the cardio-renal system that may already have reduced reserve making early fluid intervention in our older patients an important part of therapy with careful consideration of the rate and volume required.

Activity and cognitive function also decline with age as cats sleep more and are less adaptable to changes within their environment.

2/ The senior health care plan (SHCP)

A) Why develop a SHCP?

The consensus opinion is that SHCPs are a good idea as it is hoped they will identify diseases sooner allowing more effective intervention. However any SHCP needs to be balanced with the potential anxiety that it may create in the clients and our current state of knowledge in terms of the most effective form of intervention in cats where disease has been identified early.

In some cases such as surgically amenable neoplastic disease, early intervention has repeatedly been shown to prolong survival although few of the published studies are in cats. Less clear are the benefits of early intervention where major organ damage is developing reflecting a lack of evidence-based studies in this area.

Figure 3. Incidence of feline odontoclastic resorptive lesions (FORL) (Ingham, 2001).

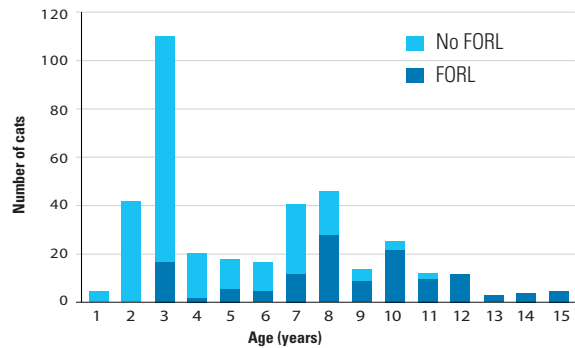
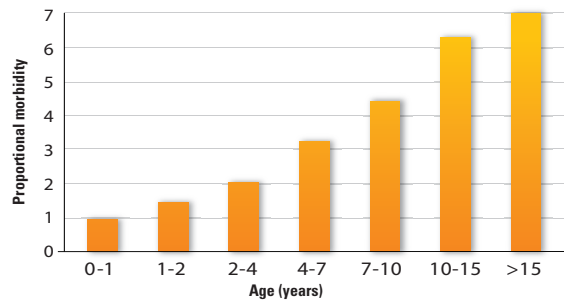


Figure 4. Prevalence of urinary tract disease in a survey of 670,000 cats (Lulich, 1996).



Despite widespread use of screening programs in man, the evidence as to their benefit is controversial. A number of studies suggest little or no benefit and some possible harm associated with screening programs for prostatic carcinoma as an example.

Overall SHCP are appropriate so long as each case is looked at as a risk-benefit equation for the pet (of undertaking the examination and any testing) and the owner (anxiety associated with the test and any abnormal parameters found).

From a practice perspective senior health care plans bond clients to the practice and address an area of concern of owners of older pets that are likely to account

for 15% of the practice patients but generate 35% of practice income (figures from United States).

B) What are the essential parts of a SHCP?

There are a number of decisions and processes that need to be made and adopted before introducing a senior health screening service into a practice (Davies, 2012). Most importantly, the service needs to be supported by all members of the practice and clear guidelines need to have been developed identifying the patient group being targeted, how each patient is assessed and the way in which abnormal findings are managed.

1) Which patients should be screened and what screening tests should be used?

Options

Which patients?	Which tests?
<ul style="list-style-type: none"> • Recommend to all patients over a specific age • Only screen patients prior to anaesthesia • Only screen upon owner's request • Actively discourage screening and manage clinically significant disease as it occurs 	<ul style="list-style-type: none"> • All patients get the same screening • Screening becomes more in-depth as the patient gets older • Targeted screening based on historical information

2) Developing the plan

- All members of the practice need to be comfortable with the service that is offered (Fortney, 2012).
- Clear written guidelines should be available for all staff to follow.
- Clients need to be informed of:
 - the existence of the plan,
 - what the plan offers – the pros and cons,
 - clear pricing of the various plans offered.

3) How do I start?

- Good waiting room-based information.
- Consider sending a mailshot targeted at owners with senior pets.
- All clients of senior pets asked to fill in a quality of life survey on arrival prior to consultation:
 - if specific SHCP consultations are arranged, consider sending quality of life survey (QOLS) to the client prior to consultation,
 - the survey should be tailored as far as possible to your patient demographics and disease prevalence of the clinic concerned.
- Issues raised by the QOLS further expanded during history taking.
- Full physical examination performed.
- A tailored health screen recommended.

4) Quality of life survey

Quality of life surveys (**Figure 5**) should be constructed so they can be filled in by an owner without assistance from veterinary clinic staff. They are valuable clinical tools as they can be:

- sent to clients in advance of a routine senior health care appointment allowing them to consider their responses as well as indicate important areas to monitor in an ageing cat,
- filled in by a client in the waiting-room to improve the focus of the subsequent consultation as well as allow the client to consider areas of their cat's health that they would like to discuss,
- allow the clinician in what is often a time limited examination to focus on specific areas of concern improving the outcome for the patient as well as client satisfaction.

5) Interpreting test results and developing action plans

Before interpreting the results of any test it is important to have an idea of the test's sensitivity and specificity as well as the prevalence of the disease in the tested population. Ideally a screening test should be sensitive and specific and used on a population where the disease prevalence is high. Use of even a sensitive test in a population in which the disease prevalence is low can lead to a high rate of false positives that drives further, often more invasive and costly, investigation. The examples on the opposite page clearly show the benefits of confining tests to the at-risk population with signs suggestive of that disease.

6) What about general screening tests?

Whether to screen older patients with no specific issues or low grade, non-specific signs is difficult. Offering the owner the choice is usually appreciated and helps the owner become part of their pet's health care planning. Following the quality of life survey, physical examination and weight check, a minimum initial screening should be quick, simple and of low cost. It is helpful if reception is primed to ask owners of older pets who are coming in for screening to bring a urine sample with them as this allows a more immediate result to be delivered and a plan to be discussed. For cats, sending out non-absorbable litter to allow urine to be collected will improve compliance. The minimum data base should include – urine dipstick and SG, PCV, total solids, urea and ALT. Blood pressure monitoring should also be considered. Thyroid hormone measurement is warranted if ALT is increased or there are historical and clinical indicators.

7) Communicating the result and dealing with owner anxiety

- It is important to appreciate that screening can create

anxiety for the owner if “abnormal” results are found (Clarfield, 2010; Lin, 2008).

- Reassurance should be given that is as clear and realistic as possible.

- Clear “what if” guidelines developed
 - If you measure a parameter such as blood urea you need to have developed a policy within the practice of an appropriate response if the result is abnormal.
 - Clients need to have any abnormalities found explained to them as to the significance and put into perspective.
- Information should be available to explain the abnormality, the likely disease process, how the issue is going to be monitored/managed and how/whether the problem is likely to progress.
 - Waiting is an acceptable response coupled with further screening at a time in the future, however if the response is always to wait and rescreen and to do nothing interventional until the patient becomes unwell then what is the point of screening?

Examples illustrating the importance of selecting an appropriate population on test sensitivity and specificity.

Example 1

We decide to test all elderly cats for feline leukaemia as part of a SHCP. ELISA based feline leukaemia virus (FeLV) tests have a sensitivity and specificity of around 99%. We are expecting a prevalence of FeLV of 1% in our elderly cat population. If we test 100 cats then we are expecting 1 true positive and we have a 99% chance of finding that cat. Of the 99 negative cats it is likely that 1 cat will give us a false positive. So from testing 100 cats we will have two positive results, half of which will be wrong.

Example 2

We decide to test all elderly cats for hyperthyroidism. Baseline T_4 measurement has an approximate specificity of 95% and a sensitivity of 91%. Prevalence of hyperthyroidism in cats over 10 years of age is approximately 4%. If we tested 500 cats we would expect 20 to be hyperthyroid and we would have a positive result in 18 of these so only 2 cats would go undiagnosed. However, 25 non-hyperthyroid cats would have results that were above the reference range giving a false positive rate of nearly 60%. If, however, we decided to test elderly cats with signs compatible with early hyperthyroidism such as weight loss, polyphagia, restlessness, we might expect 30% of these cats to be hyperthyroid so for 500 cats tested we would find 135 out of the 150 positives and 18 non-hyperthyroid cats. This gives a false positive rate of only 11%.

Figure 5. Quality of life survey.

Cat's name:				Date:	
Filled out by:	Owner	Neighbour/friend	Carer	Practice staff	

Please circle the number on the scale that best describes changes in your cat's current health status compared to 6 months ago or the last time you filled out a questionnaire.

	1 Yes – a lot	2 Yes – a little	3 Maybe	4 No change	5 Improved
General well-being and activity					
My cat is less active.	1	2	3	4	5
My cat is less agile.	1	2	3	4	5
My cat plays less with other animals or toys.	1	2	3	4	5
My cat has difficulty getting in or out of the cat flap.	1	2	3	4	5
My cat cries when being lifted or carried.	1	2	3	4	5
My cat is less able to jump up or down.	1	2	3	4	5
My cat shows signs of lameness or limping.	1	2	3	4	5
Mental status					
My cat is sleeping more.	1	2	3	4	5
My cat seems dull or depressed, not alert.	1	2	3	4	5
My cat cries out loudly for no apparent reason.	1	2	3	4	5
My cat appears forgetful or confused.	1	2	3	4	5
My cat is more withdrawn from me.	1	2	3	4	5
My cat lies in one place.	1	2	3	4	5
Appetite and water intake					
My cat is eating less food.	1	2	3	4	5
I frequently have to change my cat's diet.	1	2	3	4	5
My cat is drinking more water.	1	2	3	4	5
Hygiene					
My cat is grooming less.	1	2	3	4	5
My cat has accidents outside the litter tray (in the house).	1	2	3	4	5
My cat's coat smells.	1	2	3	4	5
My cat has diarrhoea.	1	2	3	4	5
General health					
Compared to last evaluation	1 Worse	2 A bit worse	3 Maybe worse	4 Same	5 Improved
Current quality of life	1 Very poor	2 Poor	3 OK	4 Normal	5 Good
Are you happy with your pet's quality of life?	1 Very unhappy	2 Unhappy	3 OK	4 Happy	5 Very happy

3/ The “what if” strategy

A) Managing the results of the QOLS and physical examination

1) Cats with weight loss

Many older cats will gradually lose weight overtime (**Figure 6**) and it is sometimes difficult to decide whether this weight loss is excessive. A general screening should be undertaken followed by more detailed testing based on results of the screening that is designed to specifically target common causes of weight loss in older patients (see **page 31**).

It is important to distinguish between cats that have weight loss in the face of a normal to increased appetite from those who are inappetent with weight loss. See **Chapter 3** for a suggested action plan.

2) Cats with heart murmurs

See FAQ on **page 58**.

Minimum database

- Urinalysis, BP, ECG, PCV and biochemistry, T₄.
- Cardiac troponin I (CTnI) is a biomarker that helps to evaluate cardiac myocyte damage. It is relatively stable in serum and starts to rise 5-7 hours after injury persisting for 1-2 weeks so, if elevated, it indicates recent muscular damage. CTnI can be elevated in non cardiac disease but usually those such as sepsis where there is secondary damage to the myocytes; it can also be elevated in renal disease. Levels have been shown to have a predictive value for mortality in cats (**Figure 7**). The highest values are seen with ischaemic injury or arrhythmias.

Figure 6. Changes in the proportions of over- and underweight cats with age.

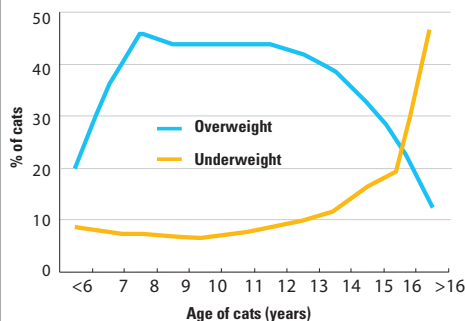
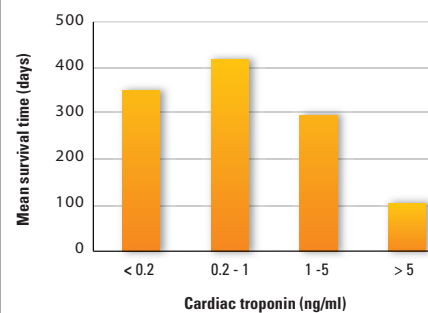


Figure 7. Mortality of cats with cardiac and non-cardiac disease (Ettinger, 2009).



- N-terminal pro brain natriuretic peptide (NT-proBNP) is produced primarily in response to left ventricular stretch. More stable in serum than the active C-terminal product it still requires careful handling to inhibit the action of proteases that will destroy the biomarker during transport. Pro-BNP tends to increase with age but also with stage of heart disease. It can also be valuable in

Table 1. Recommendations for interpreting NT-proBNP results in cats.

	NT-proBNP level (pmol/L)
Normal – low probability of significant heart disease	< 50
Elevated – possible heart disease as a cause	50-100
Heart disease is present with volume overload	100-270
Congestive heart failure	> 270

trying to distinguish between respiratory and cardiac disease (**Table 1**).

Action plan

For early disease, exercise reduction (rarely a problem in cats) and dietary management are the most appropriate intervention. As disease advances more aggressive drug therapy should be given. There is, however, considerable disagreement amongst cardiologists about which drugs to use and when to start using them particularly in asymptomatic heart disease in cats.

Therapy will need to be individualized depending on the cause of the HF, the dominant pathology and ease of medication of the patient

3) Cats developing polyuria/polydipsia

The differential diagnosis for PU/PD is extensive but in older cats the most likely causes are chronic renal disease, chronic liver disease, hyperthyroidism, diabetes mellitus and use of drugs that cause diuresis. Although there are set criteria for defining PU/PD (> 50 mL/kg/day of urine of > 100 mL/kg/day fluid intake [including the water content of food]), in the authors’ opinion any moderate to marked change in a cat’s level of water intake or urine production is significant and requires further consideration.

Investigation

- A minimum database is an appropriate initial screen - urine dipstick and SG, PCV, total solids, urea and ALT.
- Further investigation should include full urinalysis (urine protein:creatinine ratio, sediment examination and culture), full biochemistry with dynamic bile acid testing and T₄.

Suspected renal disease

Due to the large renal reserve, urea and creatinine do not begin to rise until there has been loss of more than 70-75%

of the renal mass. Urine concentrating ability may fall slightly in advance of increases in urea and creatinine. It can be difficult in patients with PU/PD and normal urea/creatinine and urine SG to exclude compensated chronic renal disease without more advanced testing such as measurement of glomerular filtration rate (GFR). Although sensitive at demonstrating changes in renal architecture, ultrasound is a poor predictor of disease severity, and mild changes on ultrasound are very common in older patients. If compensated chronic kidney disease (CKD) exists and is not recognised further diagnostic investigations of the PU/PD such as water deprivation can be dangerous.

Action plan for CKD

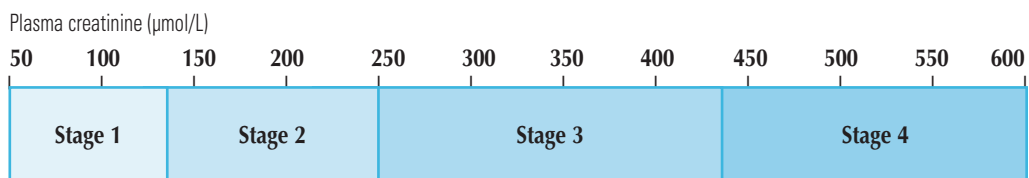
Management of CKD should be based on the IRIS classification (**Figure 8**) that can be used in stable patients to categorise the stage of renal disease based on plasma creatinine concentrations with secondary criteria of proteinuria and hypertension.

Management of IRIS stage 1-2 disease

- Minimise ongoing insults to kidney.
- Rule out treatable disease where possible.
- Fresh water available at all times with aggressive intervention if patient starts to dehydrate.
- Manage hypertension - ACEi; calcium channel blockers.
- Manage proteinuria by looking for concurrent disease and the use of ACEi and low dose aspirin.
- Manage hyperphosphataemia – target 0.9-1.5 mmol/L.
- Manage metabolic acidosis – target for total CO₂ > 16 mmol/L.
- Maintain potassium within reference range.

Diet can have a major role in maintaining target parameters within the suggested range. The value of dietary intervention prior to the development of hyperphosphataemia

Figure 8. International Renal Interest Society (2009) classification of feline chronic renal disease.



taemia is unproven but evidence is accumulating of potential benefit of dietary intervention in stage 2 disease.

4) Cats with poor coat condition

Generalised changes in skin and coat are usually immediately obvious but isolated lumps and bumps particularly in long-haired cats can be difficult to find. Owners should be encouraged to examine their cats regularly and make a note of any mass lesions found. Poor coat quality can be a sign of generalised poor health associated with poor nitrogen balance and energy intake or it can be associated with a specific nutritional deficiency or as a reflection of systemic disease. If the patient's nutritional intake is good and the nutritional balance appropriate then any drug therapy being given and the adequacy of ectoparasite control should be checked. If parasite control is good and no drugs likely to be causing skin changes are being given then further investigation looking for underlying systemic disease should be undertaken initially with full haematologic and biochemical screening searching for evidence of endocrine disease or systemic infection/neoplasia.

Cats with skin lumps and bumps

Any new or growing skin masses should be documented, measured and aspiration discussed. There are very few instances when morphological appearance or palpation are pathognomonic for a specific diagnosis. Aspiration carries a small risk of degranulating a mast cell tumour. The depth of a subcutaneous mass can be difficult to judge hence an ultrasound guided aspirate is preferable. When deciding upon an action plan, the diagnosis, site of the lesion, age and general health of the patient needs to be taken into account.

5) Cats with reduced activity

As cats age their activity levels decline. Trying to decide whether the decline represents an underlying pathology rather than expected ageing changes can be difficult; a questionnaire (**Figure 5**) can be helpful in this respect. In the majority of cases reduced activity is usually associated with pain or cardiovascular disease but if there are also signs of behavioural change then cognitive dysfunction should be considered.

Managing osteoarthritis

Different studies have reported that between 65% and 90% of cats over 12 years of age have degenerative joint

disease (Bennett, 2012). The diagnosis on physical examination can be challenging with cats frequently showing little evidence of gait abnormalities or pain on joint manipulation (although range of movement will be reduced). Nutritional modification and nutraceuticals (Lascelles, 2010) along with physiotherapy are recommended as initial therapy in cats with osteoarthritis. They are generally safe (unless nutraceuticals used at excessive dose rates) and minimally invasive. With more severe pain and dysfunction NSAIDs or surgery may become necessary.

Chronic use of NSAIDs – is it safe in cats?

There is much debate over NSAID safety particularly with long term use. Using COX-2 selective drugs (thought to primarily target prostaglandin production associated with inflammation) rather than NSAIDs that have significant activity on COX-1 pathways (involved in constitutive production) has been advocated. However, COX-2 selective drugs have been removed from the human market because of concerns about cardiovascular safety and COX-3 pathways are being investigated. Added to this the fact that non-Cox related activity may play an important role in the efficacy and safety of NSAIDs so the advice as to which NSAID is “better” is very unclear.

Concerns	Evidence
<ul style="list-style-type: none"> • GI ulceration and perforation • Renal damage associated with loss of renal autoregulation • Precipitation of cardiac failure 	<ul style="list-style-type: none"> • Meloxicam has been shown to be safe and effective for long term management of OA in cats • Meta-analysis has failed to demonstrate significant risks of increased adverse events in dogs given chronic NSAIDs (Innes, 2010) • In man, failure to manage osteoarthritic pain was associated with more rapid progression of disease

Cognitive dysfunction

There is increasing recognition of “senility” as a problem in older, particularly geriatric cats (Landsberg, 2010). Clinical signs can often be subtle and involve a number of

Table 2. Differential diagnosis of cognitive dysfunction.

Systemic illness	Structural brain disease	Reduced sensory acuity	Primary behavioural problem
<ul style="list-style-type: none"> • Hyperthyroidism • Pain • Chronic renal disease • Hepatic encephalopathy 	<ul style="list-style-type: none"> • Granulomatous meningoencephalitis • Neoplasia 	<ul style="list-style-type: none"> • Loss of hearing or vision • Reduced sense of taste and smell 	<ul style="list-style-type: none"> • Periuria • Aggression • Separation anxiety

changes in behaviour. It can also be difficult to distinguish early signs of cognitive dysfunction from structural disease affecting brain function (**Table 2**).

About 50% of cats over 15 years showing one or more signs of cognitive dysfunction. Additionally cats will sometime vocalise inappropriately producing a characteristic yowling sound.

Management is based on dietary manipulation increasing antioxidants, mitochondrial cofactors and co-enzyme Q, use of drugs such as selegiline or propentofylline and vitamins/nutraceuticals (vitamin E, pyroxidine, phosphatidylserine, *Ginkgo biloba*). The majority of studies have

been performed in dogs but a recent study in cats has also shown the potential benefits of dietary supplementation (fish oil, B vitamins, antioxidants and arginine) on cognitive ability (Pan, 2012).

B) Managing the results from the minimum database

1) ... the protein is low

Proteins should be monitored if total protein is > 5 g/L or albumin > 3 g/L below the reference range. Accurate measurement of albumin on in-house machines is difficult so a low albumin in the face of a normal total protein should be checked at an external laboratory. If hypo-

Can I effectively screen for neoplasia?

Cancer remains one of the major causes of death or euthanasia in older cats. Whilst management has improved, in many cases the tumour is advanced before clinical signs are apparent limiting options of treatment and making curative therapy unlikely. Much effort has been made in human medicine towards early diagnosis but results so far have been disappointing. Computed tomography or MRI are sensitive ways of looking for mass lesions associated with any type of tumour however, in man, 90% of lumps identified on CT screening are non-neoplastic. The availability and cost of CT/MRI and the need for general anaesthesia make this method of screening inappropriate for the majority of veterinary patients. Radiography is significantly less sensitive and abdominal ultrasound time consuming and very operator dependent. These factors have led to attempts to develop blood or urine screening as a method of early diagnosis but to be valuable for population screening tests need to be developed to identify common malignancies. As yet such tests are not available (Mian, 2006). Thymidine kinase has shown some value in differentiating intestinal lymphoma from IBD but not as a general screen for lymphoma (Taylor, 2008).

albuminaemia exists then this should be benchmarked and followed using the same assay techniques (preferably external laboratory).

With larger falls in proteins, 3 main causes are likely, urinary or GIT loss and failure of liver production. Less common causes of hypoproteinaemia include exudative skin disease, severe malnutrition (very low protein diets), compensatory associated with chronic effusions, hyperglobulinaemia, multiple myeloma and iatrogenic due to repeat drainage of effusions.

2) ... the ALT/ALP is high

- Alkaline phosphatase (ALP) is a sensitive but non-specific indicator of hepatobiliary disease because:
 - half life is short (\approx 6 hours),
 - cellular levels are relatively low,
 - there is no steroid induced isoenzyme.
- Alanine aminotransferase (ALT) changes are more similar to those that occur in dogs and primarily represent hepatocellular damage.
- Increased liver enzymes occur both in cases of primary hepatobiliary disease and secondary to extrahepatic disease most commonly hyperthyroidism, pancreatitis and hepatic lipidosis in older cats.
- Significant hepatobiliary disease may be present without increased liver enzymes particularly end-stage liver failure and slow growing neoplasms.

3) ... the PCV is low

Mild anaemia is common in older patients and is often a reflection of systemic disease elsewhere. Chronic, non-

regenerative anaemia can be very slowly progressive and cats can present with advanced disease yet have an apparently very recent clinical history. Including PCV as part of the general screening panel will pick these cases up earlier often before there are clinical signs.

The level of anaemia can be difficult to evaluate on physical examination with poor correlation between physical examination and measured PCV as high sympathetic tone can cause marked pallor in the presence of a normal PCV. If the PCV is less than 22% a full haematology including smear examination and reticulocyte count should be performed.

Conclusions

- Ageing is an inevitable biological event.
- We can positively intervene to identify early signs of age-related diseases and act appropriately.
- There is very little current evidence that such actions will increase longevity other than delaying the decision to euthanize – more research in this area is crucial. However, there is good reason to believe that early intervention will improve the quality of life of our senior pets.
- We may need to start planning for senior care at birth to maximise the benefits!

2. Elderly cats: getting the best from your consultation

> SUMMARY

- History taking is never a waste of time particularly in older cats.
- Depending on the lifestyle of the cat water consumption, food intake and often diarrhoea cannot always be accurately assessed by the owner.
- Cat-friendly handling can make a significant difference in the clinical examination.
- Thyroid palpation, careful cardiac auscultation, oral and abdominal palpation are crucial.
- Joint disease assessment in cats is often overlooked in general practice.



1/ History

History taking is the veterinary surgeon's first opportunity to try and identify changes that the owner attributes to just getting older as potentially indicating significant underlying disease. During the consultation, it is important to try and ask open-ended questions, such as "How has your cat been since your last visit?" or "Have you noticed any change in behaviour?" rather than closed questions such as "Is your cat drinking more?" Open questions give the owner greater scope for describing things that are concerning them and are usually a more honest description of changes.

Despite playing an essential role in clinical veterinary practice, history taking can be neglected when the duration of an appointment is short or when complementary tests are given too much importance. The use of a health questionnaire before the appointment will be beneficial as it will help to give clues to potential pro-

blems and allow focus in a short consultation period. A full discussion on history taking is beyond the scope of this article that will focus on key take-home points to remember when an ageing cat is brought for consultation.

A) Nutrition and hydration

Part of the history taking should cover the quantity, type and brand of food and frequency of feeding, as well as identifying any changes in the cat's preferences and the onset of any digestive problems following such changes. Elderly cats have a reduced ability to digest nutrients and so owners should be advised to give their cat three to four portions of food each day or feed *ad libitum* but monitor the amount that is eaten. In multicat households there are problems ensuring that every cat is fed properly, but different feeding times or separate feeding areas can be used. Changes in a cat's food preferences may be due to disorders that decrease the appetite (*e.g.* renal disease) or painful mouth lesions. It is also impor-

tant to find out whether the cat's appetite has increased recently, as this could indicate the onset of diseases such as hyperthyroidism or diabetes mellitus if accompanied by other suggestive clinical signs in general and weight loss in particular.

With changes in appetite, questions should be asked about whether the cat is vomiting and if so what is being vomited, how frequently vomiting is occurring and the relationship between feeding and vomiting. Many owners will not be concerned about their cat's vomiting habits because their cat has always vomited occasionally and may not have noticed that the cat is vomiting more often. Appropriate questions may help them realise that the cat is vomiting more than usual. Owners tend to be more likely to volunteer that their cat has diarrhoea compared to vomiting. However if the cat goes outdoors, diarrhoea may be present without the owner's knowledge.

To ensure that cats are well hydrated, all possible sources of water should be made available to encourage the cat to drink. Many owners turn a tap on for their cat (**Figure 1**) or use cat fountains and yet when asked how much their cat drinks, they do not think it is drinking any more than before. Other cats will drink from large receptacles (shared dog's water) or even from fish tanks (**Figure 2**) making it hard to assess how much water they are drinking. It is useful to know whether the cat's litter tray needs to be changed more often than before, which would increase the suspicion of polydipsia. Another strategy to detect polyuria in homes where there

are several cats is to use clumping litter. A polyuric cat's urine may produce a bigger clump of litter than a normal cat. Many if not most cat owners think it is good for their cat to drink a lot of water and so they will be quick to pick up on changes in the amount their cat drinks but many also don't consider the change to indicate that their cat has a problem. As polyuria drives polydipsia, it is important that cats already diagnosed with a disease that involves PU/PD are encouraged to take in adequate fluid. Owners should be encouraged to consider using water fountains, changing water frequently or even adding stock cubes to flavour the water to make drinking more appealing. Remember that only 30% of CKD cats are initially reported as PU/PD so diseases that result in PU/PD should not be excluded on history alone especially if the cat has outside access.

B) Other pointers

Other useful general history questions include:

- where the cat likes to rest,
- access to its litter tray,
- hideaways it uses if frightened by visitors,
- favourite places to "keep watch" on the outside world.

Even very observant owners may not notice that their cat has stopped climbing up to high places, but they will all be quick to ask why their cat is defecating outside the litter tray. Osteoarthritis may explain both these changes, which shows that a particular disease can often be suggested in different ways during history taking.

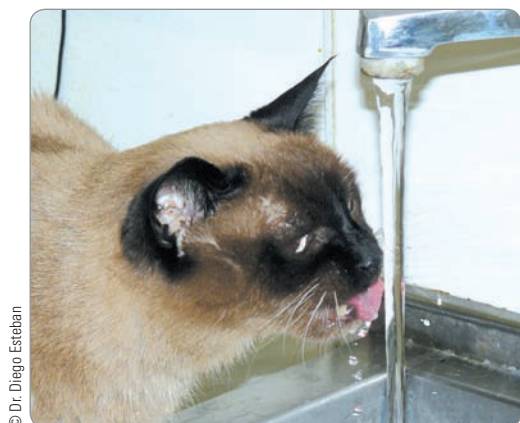


Figure 1. Cat drinking from the tap.



Figure 2. Cat drinking from a fish tank.

Veterinary surgeons know that even geriatric cats should be able to enjoy playing a game despite their age, but owners may actually stop playing with their elderly cats. Asking about playing habits during history taking will reinforce the message that owners should continue to play with elderly cats, as long as games are adapted to the cat's current disease status (**Figure 3**).

C) Other pets

Cats that live with other pets may be more susceptible to acquiring certain infections and infestations, especially if the other pet is a dog that is taken out for walks. It is important to coordinate parasite control among all pets in the household, and the owner should be asked which brand they use, and how often the pets are treated. The active substance in permethrin-based ectoparasite products for dogs may be fatal if used in cats. There is a potential risk of toxicity even if only the dog in the household has been treated (Boland, 2010). Compared to younger cats and kittens, elderly cats generally take longer to adapt to changes and this includes adjusting to the arrival of new pets in a household.

D) Clinical history and medication

Finally, history taking should include questions about past illnesses particularly if the cat has been seen at another veterinary clinic; details of any medication that has been previously prescribed and the patient's response should be recorded. If the cat is currently on medication the owner should be asked about how well the medication is being tolerated, how easy it is to give and how easy the owner is finding it to meet the prescribing directions as these questions will serve to assess compliance. Owners often mistakenly presume that cats have voluntarily eaten medication that has been mixed in food. The clinician should be aware of those drugs that benefit from being given with food improving efficacy or reducing side effects (*e.g.* most NSAIDs) and those that should not be given with food (*e.g.* ciclosporin). It is important to find out whether owners are giving the cat nutraceuticals, herbal remedies or alternative medicine as these are often not mentioned by the owner as they are considered safe "natural



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Figure 3. 17-year-old cat playing with a prey.

products" however, echinacea for example, can be toxic especially at higher dose rates.

2/ Clinical examination

By the time a full history has been taken the cat will have become more acclimatised to the consulting room making the physical examination easier. During the examination, every effort should be made to minimise further exacerbation of the stress associated with putting the cat into a carrier, travelling to the clinic and waiting to be seen. All aspects of good cat handling are amply covered in handbooks and guidelines issued by the International Society of Feline Medicine (ISFM), the AAFP and the CATalyst Council. Cat handling and cat friendly clinics is a very large subject area so only certain, important points will be discussed below.

A) Preparing for the visit: anxiolytics/antiemetics

At home, cats may actually use their carrier as a bed or hideaway, but as soon as the door is closed they become anxious, knowing that they are trapped inside. The carrier should be left where the cat can explore it and become familiar with it during the days preceding the visit. Apart from anxiety, many cats arrive at the clinic with clear signs of motion sickness (**Figure 4**). Unless the cat lives very nearby, the chances are that it will

arrive by car, public transport or even motorbike. The aforementioned guidelines recommend anxiolytics such as alprazolam to combat the anxiety caused by travel and the clinic visit. Alprazolam has a good anxiolytic and amnesic effect making a nervous cat's experience of visiting the clinic less stressful and reducing apprehension associated with subsequent visits (Note: this is an off-license drug in most countries and contraindicated if significant liver or kidney disease could be present in an older cat.) An anxiolytic should only be recommended if the cat has been recently seen (at least in the last 6 months). Where possible, a dose should be administered at home a few days before the visit to ensure that the patient in question does not suffer paradoxical excitatory effects that occur in some cats given benzodiazepines. Motion sickness can be treated prophylactically with maropitant (cerenia) but at a much higher dose than as an antiemetic. Other drugs such as selegeline (Note: this is an off-license drug for cats) or nutraceuticals like α -casozepine may be useful.

No anxiolytic will make up for poor animal handling, and so the veterinary surgeon should be familiar with all the strategies for improving a cat's visit to the clinic. Recent statistics have shown that one of the reasons that cat owners take their pets to the veterinary clinic less often than dog owners do, even in countries where the cat population is larger than the dog population, is the owner's negative experience at the clinic.

One of the most common errors committed during clinical examinations is immobilising a cat by the scruff of the neck. Although mother cats immobilise and transport their kittens using this technique, inhibiting normal cat behaviour, it is not a pleasant experience and there is some debate about whether it may actually be painful. It is only justified in cats that become so nervous that this is the only way that they can be examined properly without resorting to sedation. Using towels and careful handling, usually makes scruffing unnecessary even in nervous cats. One variation of this type of immobilisation is "clipnosis", which consists of applying bulldog clips to the skin on the cat's back (from the neck to the base of the tail) to grip and stretch the skin. Its use is only accepted as a resource at cat shelters, to bring down the cost of procedures that would otherwise require anaesthesia (e.g. blood draws). Some clinicians use it successfully, although not all cats show a positive response.

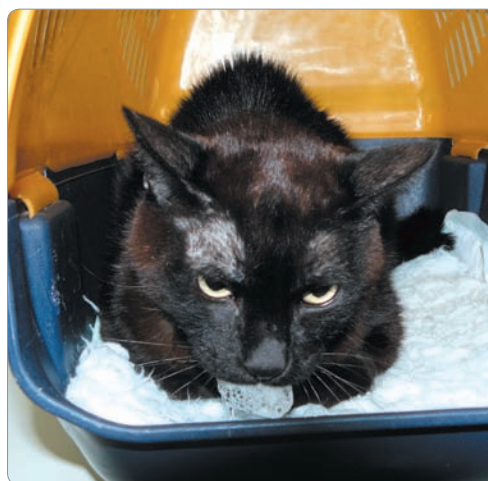
The use of synthetic pheromones in the clinic (fraction F3) or on the veterinary surgeon's hands (fraction F4) often helps to reduce feline stress. It is important to remember that pheromones should never be applied in the cat's presence as the noise of the spray usually frightens the patient. Pheromones will not produce a dramatic effect; an aggressive cat will continue to be so despite the use of pheromones, although they will probably give the veterinary surgeon a few extra seconds to perform a quick examination.

Adapting the waiting room is an important step in reducing the stress of visits to the clinic:

- Cats should never have to face another cat or dog whilst waiting.
- Facilities are available to place the cat's carrier on a shelf or table as cats feel more frightened at floor level.
- Specific hours are reserved for cat appointments.
- A cats-only area is provided in the waiting room.
- Reception staff are trained to identify problems related to cat visits (staff awareness).
- Keeping appointments to time as far as possible.
- Sound proofing and provision of windows with ledges in the consulting room.

B) Examination procedure

Carriers should be opened as soon as the cat arrives so the cat feels less trapped and has the opportunity to



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Figure 4. Cat presenting ptialism due to travel sickness.



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Figure 5. It is recommended to stand behind the cat when examining it because cats tend to be intimidated when approached from the front.



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Figure 6. Cat in a carrier base.

explore the consulting room if it wants to or stay in the carrier base (**Figures 5 and 6**). Examination is split between observational “hands-off” examination and the “hands-on” part involving palpation, auscultation and other procedures. The whole clinical examination is normally performed on the examination table but cats can also be examined on the floor, in the carrier base or on a lap. The aim is to find the place where the cat, clinician and owner are most comfortable.

Examiner’s position

During this stage, the “examiner’s position” is of utmost importance. Cats tend to feel intimidated if they are approached from the front, especially if there is eye contact. Therefore, it is recommended to stand behind them (**Figure 5**) and perform almost all of the examination from this position (except when using an ophthalmoscope).

“Hands-off”

Assessment of mental status, gait, posture and breathing

Normal cats usually will be actively listening when in the consulting room to pick up every sound that is made inside and outside the room.

More confident cats may be expected to start to explore the room during the history taking phase. Some diseases can alter mental status and although a cat may not be obviously dull, depressed or somnolent, it may simply be quieter than normal. Hepatic encephalopathy and diabetic ketoacidosis are two common causes of such behaviour. By contrast, hyperthyroidism may have the

opposite effect, and a cat will be more excitable and even have a characteristic facial expression (**Figure 7**).

Although cats do not usually feel like walking around the consultation room in a relaxed manner, it is worth observing the gait of elderly cats for signs of osteoarthritis or even the typical plantigrade posture of poorly controlled diabetes mellitus. Elderly cats with osteoarthritis will typically have rigid or stilted hind limb movement, with abducted elbows. A cat’s resting position may also provide information about the state of its joints. Where appropriate, giving the cat an opportunity to jump on/off a surface to assess their abilities can be of use.

Respiratory rate and character can be better assessed during this first stage, whilst the cat is minimally stressed. Movement of the rib cage can be observed using a bird’s-eye view to check for abdominal effort or increased respiratory rate (> 40/minute at rest). Tachypnoea is not always associated with cardio-respiratory disease, but can be observed in cats that arrive with severe motion sickness and/or anxiety or caused by anaemia, hyperthermia, abdominal enlargement, muscle weakness, thoracic wall trauma, acidosis or pain.

Weight and body condition

Weight is a true reflection of a cat’s health and even small variations should be noted because they are almost always significant. Precision (paediatric) scales with a small error margin are needed to take advantage of this valuable information. The error margin in paediatric scales is usually 5 to 50 g, whereas the scales that an



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Figure 7. Cat with hyperthyroidism with a facial expression proper to the disease together with hair loss, weight loss and a mild liver enzymes elevation.

owner uses at home will have an error margin of about 250 g. It is important that owners also understand that even apparently small weight variations are significant. To help get this message home, expressing the weight loss or gain as a percentage change and/or extrapolating the weight change to the equivalent for a person can also be helpful. A 300 g loss in a 3 kg queen may not sound much to a client but is a 10% weight loss for the cat and would be equivalent to a person losing 7-10 kg. If there are no scales for weighing a cat in the consulting room, weighing scales for dogs can be used, preferably as the client arrives and with the cat inside the carrier for security.

Different breeds of cats do not differ in weight as markedly as dog breeds, but it should be remembered that giant breeds such as Maine Coon or Norwegian Forest can weigh up to 9-10 kg are not comparable with some European cats that weigh as little as 2.5 kg. Weight distribution in cats is also different to that seen in dogs. For this reason, scoring systems have been designed, such as the Body Condition Score (BCS), to try and deliver a more objective assessment than weight alone. The BCS is a 9-point scale where 1 is an emaciated cat and 9 is an obese one (**Figure 8**). It evaluates quantity of body fat. Another measure is the Muscle Condition Score (MCS), which evaluates muscle mass. MCS scales are currently undergoing validation and are expected to be brought into clinical practice in the near future.

Nutritional assessment

In its Nutritional Assessment Guidelines, the World Small Animal Veterinary Association (WSAVA) adopted the

BCS and MCS as tools to monitor a cat's nutritional status. It also includes nutritional assessment as one of the five vital signs.

According to the WSAVA, these vital signs are:

- temperature,
- pulse,
- respiration,
- pain,
- nutritional assessment.

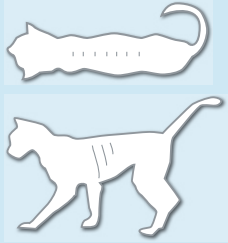
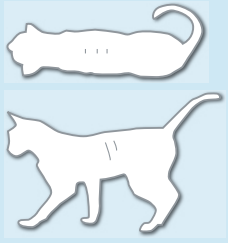

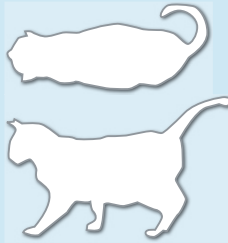
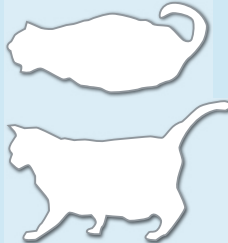
In the same guidelines, the WSAVA provides a useful list for nutritional screening during history taking to assess whether a cat has significant risk factors that may require nutritional intervention. These points are listed below:

- Historical findings:
 - altered gastrointestinal function (vomiting, diarrhoea, nausea, flatulence or constipation),
 - past or present diseases,
 - currently receiving medications and/or dietary supplements,
 - unconventional diet (raw, homemade, vegetarian),
 - treats, snacks or table food that account for more than 10% of total calories,
 - inadequate housing.
- Physical findings:
 - BCS < 4 or > 5,
 - MCS showing mild, moderate or marked muscle wasting,
 - unexplained weight change,
 - dental disease,
 - poor hair coat,
 - new diseases.

“Hands-on”

Ideally the physical examination should start with those procedures that will annoy/upset the cat least ending in procedures that are known/expected to be painful or upset the patient. Patients with chronic pain may change mood very quickly if the painful area is examined first. Although the logical examination order would be to start with the head, the mouth being one of the first parts to examine. If the cat has stomatitis it is advisable to leave this until the end. Similarly, in the case of severe osteoarthritis (OA), it may be preferable not to examine the joints until the cat is sedated.

Figure 8. Body Condition Score (adapted from the WSAVA nutritional guidelines).

TOO THIN	1	Ribs visible on shorthaired cats, no palpable fat; severe abdominal tuck; lumbar vertebrae and wings of ilia easily palpated.	
	2	Ribs easily visible on shorthaired cats; lumbar vertebrae obvious with minimal muscle mass; pronounced abdominal tuck; no palpable fat.	
	3	Ribs easily palpable with minimal fat covering; lumbar vertebrae obvious; obvious waist behind ribs; minimal abdominal fat.	
	4	Ribs palpable with minimum fat covering; noticeable waist behind ribs; slight abdominal tuck; abdominal fat pad absent.	
IDEAL	5	Well-proportioned; observable waist behind ribs; ribs palpable with slight fat covering; abdominal fat pad minimal.	
TOO HEAVY	6	Ribs palpable with slight excess fat covering; waist and abdominal fat pad distinguishable but not obvious; abdominal tuck absent.	
	7	Ribs not easily palpated with moderate fat covering; waist poorly discernible; obvious rounding of abdomen; moderate abdominal fat pad.	
	8	Ribs not palpable with excess fat covering; waist absent; obvious rounding of abdomen with prominent abdominal fat pad; fat deposits present over lumbar area.	
	9	Ribs not palpable under heavy fat cover; heavy fat deposits over lumbar area, face and limbs; distention of abdomen with no waist; extensive fat deposits.	

When examining elderly cats there are some general points that should be taken into account:

- reduced skin elasticity in geriatric cats – this can give the impression of dehydration,
- weight loss is usually better assessed along the back, where bony prominences will be more palpable, while inguinal fat takes longer to disappear,
- thyroid gland palpation should be a routine part of the examination (**Figure 9**).

Below is a review of some of the critical points when examining ageing cats, paying special attention to the most common areas that can be easily missed in clinical practice.

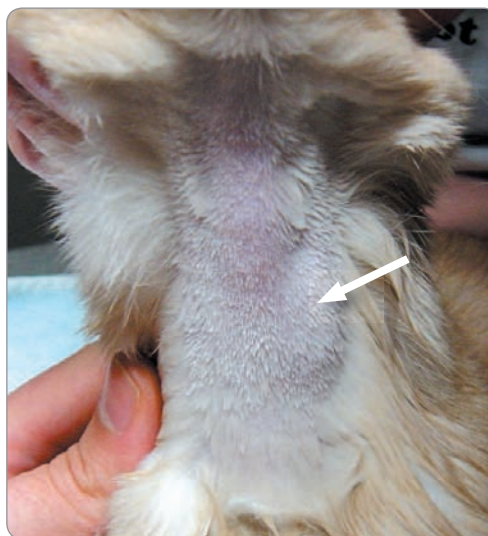
1. Mouth

Oral disease becomes increasingly common in cats over 6-7 years of age making oral examination a particular focus of the physical examination of older cats. The condition of the mouth will affect a cat's nutritional status but can also be a source of significant pain or even reflect primary diseases of other organs such as the kidneys or nasal cavity. Halitosis can occur secondary to a number of oral problems from gingivitis to uremic ulcers but can be present associated with non-oral disease such as pneumonia or gastrointestinal dysfunction.

Oral conditions encountered in older cats are most commonly inflammatory/infectious, neoplastic or metabolic.

The inflammatory/infectious group includes changes associated with excess tartar, gingivitis/lymphoplasmacytic stomatitis and periapical abscesses or fistulas. In the case of gingivitis associated with excessive tartar, it is important to probe below the gum line during dental cleaning in order to properly assess the extent of any lesions that could lead to premature tooth loss if not appropriately treated.

Differentiating neoplastic lesions from inflammatory lesions and vice versa can be difficult on visual examination. Cytology and/or histopathology are necessary in order to achieve a diagnosis. If diagnosed early, some oral cancers can be treated with aggressive surgery and adjuvant chemotherapy/radiotherapy making early diagnosis important. Other proliferative or inflammatory processes such as eosinophilic granuloma may actually look worse but carry a better prognosis. In the metabolic



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Figure 9. Thyroid hyperplasia/adenoma on the left side of the cat. It is not always necessary to shave the neck of the cat.

group, lesions described as uraemic ulcers are of particular importance. They are always associated with severe acute or acute-on-chronic renal disease requiring aggressive intervention. Uraemic ulcers need to be differentiated from other causes of tongue ulceration *e.g.* FCV. These lesions are sometimes located in the buccal mucosa but are more typically found under the tongue (**Figure 10**).

Feline odontoclastic resorptive lesion (FORL) could also be included under metabolic lesions although the exact cause of this condition is unknown. Lesions occur due to an error in odontoclastic function resulting in excessive destruction. FORL lesions are sometimes inaccurately referred to as “feline caries” because of the hole that occurs in the teeth.

2. Eyes

Ocular assessment is an important part of the clinical examination in older cats. Although the clinician may not be an ophthalmologist, certain changes should be easily detected once the clinician has become familiar with the normal variation in healthy patients.

Changes that are easy to detect include most retinal detachments and retinal changes associated with hypertension (ranging from mild haemorrhage to marked hyphaema) (**Figure 11**). Although cataracts are not very common in cats, nuclear sclerosis of the lens can be



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Figure 10. Uremic ulcer located under the tongue (cat with ureterolithiasis).



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Figure 11. Hyphema due to arterial hypertension.

found in senior cats. Another age-related change is the appearance of spots on the iris. Successful examination depends on good patient handling as outlined above. Pupil dilation may be needed if the “natural” catecholamine release does not cause sufficient mydriasis.

Technique

- Quiet well illuminated room that can be darkened.
- Bright focal light to examine the adnexa, anterior chamber and PLR, magnification preferable.
- Dilation of the pupil (mydriasis) if necessary to allow fundic examination – 1% tropicamide allow 20 minutes.

Direct ophthalmoscopy

- Distant direct – set at 0 or +1 looking for black opacities on the reflected path from the tapetum.
- Close direct – set at -2 to +2 to find and evaluate the optic disc and then the rest of the fundus. Then focus back through the anterior segment (lens about +10).

Indirect ophthalmoscopy

In its simplest form requires a light and a hand lens – start with the lens close to the patient’s eye and withdraw until the image fills the field of view. Keep the lens at 90° to the light beam.

3. Auscultation (see also FAQ Heart murmurs in old cats – are they significant?)

Cardiac auscultation of older cats should be used to detect murmurs and abnormal rhythms. In these cats, tachycardia, particularly if accompanied by a murmur or gallop rhythm, is often due to cardiac hypertrophy associated

with hypertension, hyperthyroidism or hypertrophic cardiomyopathy. If the patient does not have hyperthyroidism and is not hypertensive then further evaluation of the heart may be indicated with echocardiography being the highest yield procedure in cases with murmurs and ECG in cases with arrhythmias. Although pulmonary changes frequently lead to little discernible change on auscultation in cats, effusions can be detected associated with decreased intensity of heart sounds. Wheezing or crackles are indicators of severe bronchial disease (mild and moderate bronchial disease is rarely detected on auscultation in the absence of clinical signs). Auscultation may also reveal the presence of bowel sounds that might suggest an undiagnosed diaphragmatic hernia (some cats show very few clinical signs at the time the rupture occurs and the condition is only diagnosed at a later date).

4. Abdominal palpation

Other than in obese patients, it is relatively easy to distinguish different organs on abdominal palpation in cats. Mass lesions, localised pain and increased/decreased organ size can be detected.

Formed faeces are frequently present in the colon. Large quantities of faeces could indicate constipation or even megacolon in severe cases. Most cats that have faecal impaction have an associated disease that dries the stool (such as those that involve polyuria/polydipsia), involves anorexia (lack of eating leads to lack of bowel movement) or causes pain (spondylosis deformans). Diet and mass lesions can also result in constipation Apart from the quantity and consistency of the stool, and the

presence of air, palpation can detect increased intestinal wall thickness, with or without enlarged mesenteric lymph nodes.

Note – in thin old cats the small intestines often feel more prominent due to a loss of intra-abdominal fat and care needs to be taken not to over interpret this finding.

The kidneys are also easily palpable, and so their size, surface and symmetry can be assessed. Although radiography or ultrasound will often be needed, palpation will focus the diagnostic process and make it easier to explain the need for further tests to the owner. Of the diseases that involve renal asymmetry, ureterolithiasis deserves particular attention. It usually presents as big kidney/little kidney syndrome in cats with acute renal failure.

The big kidney is usually tender on palpation reflecting recent ureteric obstruction. The contralateral (small) kidney is a sign that ureteric obstruction has previously occurred with eventual fibrosis of that kidney. Often the cat will have shown few if any signs when the first kidney is affected as there is sufficient renal mass left on the other side to prevent azotaemia, it is only when the second kidney is affected that signs suddenly become obvious. An ultrasound will show hydronephrosis and hydroureter and radiography will reveal the location of the stone if it was not observed in the ultrasound.

At the end of the abdominal palpation the anal sacs should be checked to make sure they are empty and non-painful. The anal sacs should not be emptied in a conscious cat since it can be a very painful procedure even if there is no infection. If the cat is affected by another condition

that increases their sedative/anaesthetic risk a decision will need to be reached with the owner about emptying the glands with the cat conscious.

5. Joints (osteoarthritis)

It is estimated that up to 90% of cats over the age of 12 suffer from degenerative joint disease and/or arthritis. However, only 50% of cats with OA exhibit lameness. Most clinical findings related to OA refer to changes in the cat's mobility that an owner observes at home, not at the clinic. To diagnose OA, the sailing term "triangulation" is applied. This consists of assessing three bearings: the first is the information gathered from the presenting sign or complaint and the specific findings of complementary tests. The second refers to the physical examination, and the third covers a comprehensive and systematic review of behavioural changes observed outside the clinic setting. The presence of crepitus or limitation of movement are suggestive of OA, as are muscle atrophy and trigger points. Normal range of movement for cats is showed in **Table 1**.

Some authors recommend administering sublingual/intraoral injectable buprenorphine 30 minutes before examining the joints of cats with OA to reduce the discomfort of the procedure and improve compliance with the examination.

6. Skin and Hair Coat

Poor hair coat is one of the first visible consequences of any disease. Grooming for most cats is an important task. Cats that stops grooming themselves will present with knotted hair along their back, dermatitis on the skin under the knots, and accumulation of dirt in the perianal

Table 1. Normal range of movement.

	Flexion	Extension
Shoulder (relative to scapular spine)	60-70°	180°
Elbow	50-60°	80-90°
Carpus	130-140°	30-40°
Hip relative to axis of pelvis	50-60°	190-200°
Stifle	50-60°	90°
Tarsus	50-60°	90-110°



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Figure 12. When an ingrowing nail occurs, the paw becomes inflamed and infected, causing pain and lameness.

area with or without dermatitis. If there is oral disease, saliva staining around the cat's face and forelimbs will be evident in light coated patients. Likewise, with nasal conditions there will be evidence of discharge below the

nares. There are a number of potential reasons that a cat will stop grooming including general unwellness, metabolic disease, pain and oral disease.

The clinical signs of some cutaneous neoplasms differ between cats and dogs. The most notable difference is seen in mast cell tumours, they are less common and cats have compact or diffuse forms, with varying degrees of ulceration. However, it is usually well differentiated and after excision prognosis is good.

Ingrowing nails (**Figure 12**) are a common reason for cats being presented for consultation. Ingrowth is particularly common in older cats as the nails have grown long due to lack of activity and reduced scratching behaviours resulting in the nail tip curling and growing into the paw. If this is not recognised by the owner the paw becomes inflamed and infected, causing pain and the cat presents with lameness. Moving scratching posts in the house to sites that an older cat finds easier to access can reduce the recurrence of nail problems.

Rarely swelling, scabs or purulent discharge in a single toe may be due to metastasis from a bronchial carcinoma. Frequently, the cat will not have any respiratory symptoms and the disease is detected from the toe lesion.

3. Diagnostic testing of the thin ageing cat

> SUMMARY

- Weight loss is a common presenting complaint in many elderly cats.
- Weight loss is most commonly associated with reduced appetite or anorexia but in some cats the appetite can be normal to increased or variable.
- Routine blood tests, urine and faecal analysis are a common starting point when investigating such cases but need to be interpreted carefully to maximise their value.
- Additional blood tests such as pancreatic-specific lipase (fPLi); N-terminal pro-brain natriuretic peptide (NT-proBNP) or cobalamin serve as more specific secondary tests to further evaluate specific organs.
- Imaging and blood pressure measurement complement the results of blood work and help in establishing a diagnosis, directing treatment and determining the prognosis.

Introduction

Elderly cats are often presented with very non-specific clinical signs. These feline patients have one thing in common: they are not eating or are eating only small amounts and are losing weight. Older cats with weight loss and anorexia/inappetence are seen almost daily in most first opinion practices. On initial examination these cats show great similarity in their presentation. Depending on the individual case the weight loss and inappetence will be accompanied by other non-specific signs such as vomiting, diarrhoea, dehydration, muscle wasting and a poor coat. In those cases that also present with polyuria/polydipsia the list of differential diagnoses is more manageable (**Figures 1 and 2**).

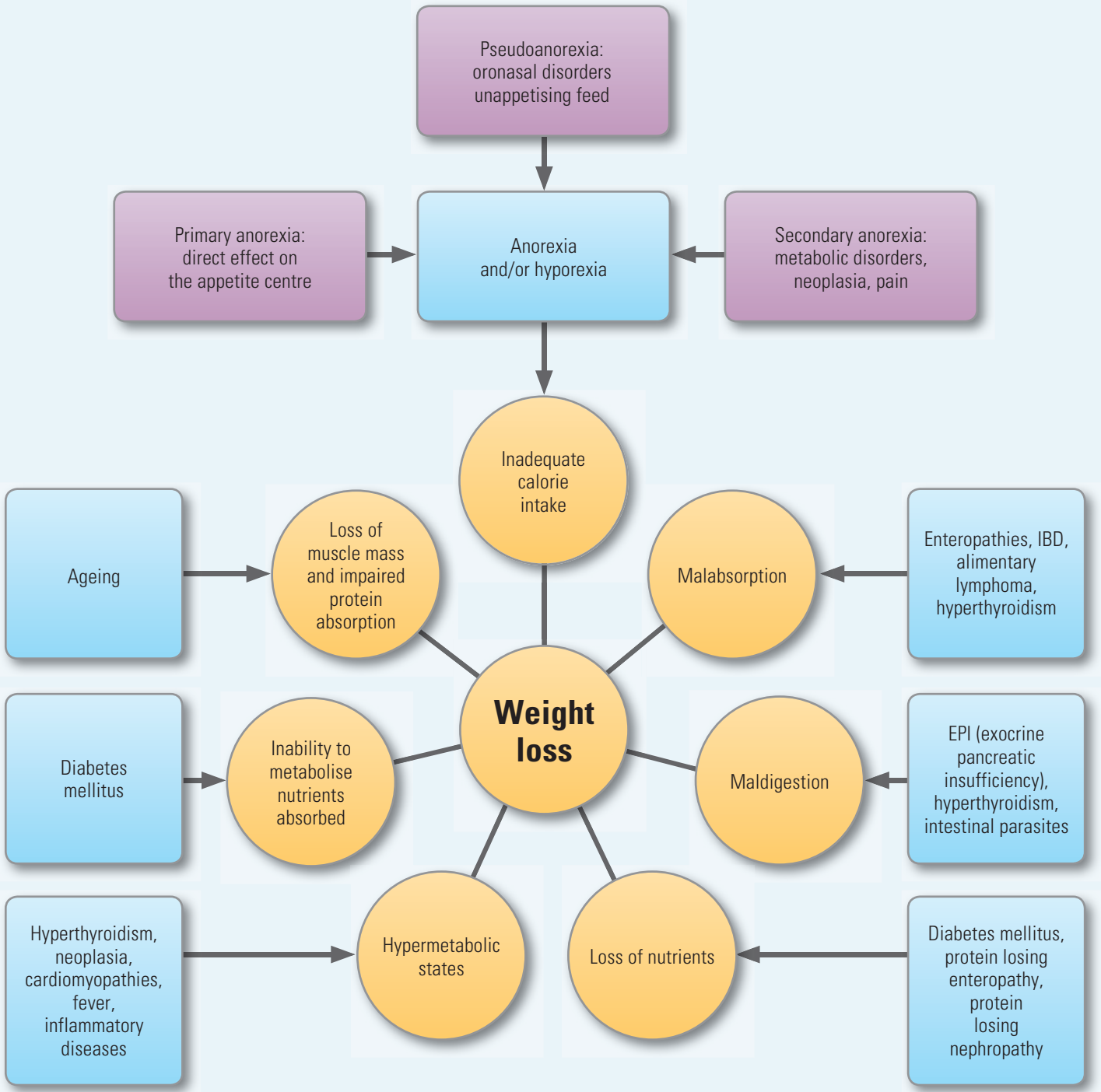
Apparently healthy older cats will not infrequently present for routine appointments such as vaccination but show clear weight loss. To their owners they do not appear unwell as their good to increased appetite, like poly-

dipsia, is interpreted as a sign of good health. In some cases increased appetite is maintained, in others there is a sudden transition to inappetence/anorexia and in some appetite waxes and wanes.

Before embarking on an investigation into the cause of the weight loss there are several important points that should be borne in mind. With age, cats (and humans) become increasingly susceptible to disease and illness. Statistically, the older a cat becomes, the more likely they are to have more than one age-related condition. In addition, coexisting diseases can result in exacerbation of clinical signs – for example, diabetes mellitus and other endocrine complaints such as acromegaly or hyperadrenocorticism or diabetic cats with chronic kidney disease. Another example is feline pancreatitis, which can be associated with cholangitis and/or inflammatory bowel disease. Where all three disorders are present, the term feline triaditis is used.

In contrast to human patients, veterinary surgeons often have only a very sketchy third-party medical history

Figure 1. Causes of weight loss and inappetence in cats.



(heteroanamnesis) similar to a paediatrician. Some elements of the history can be particularly scanty in free-roaming outdoor cats. To some extent missing information can be compensated for with multiple diagnostic tests.

History taking and clinical examination have already been discussed (see **Chapter 2**). This chapter will focus on interpreting laboratory findings, blood pressure measurement and imaging rather than individual diseases that can result in weight loss and anorexia. The degree of weight loss should be monitored and the appropriate level of investigation undertaken dependent on the degree and speed of weight loss. Some guidelines are given in **Table 1**.

In recent years, in-house laboratory equipment that can offer an increasingly wide range of diagnostic tests are becoming common place in small animal practices. External laboratories have also reduced turn-round times and improved the support that they can give in interpret-

ing results and case management. Many external laboratories offer ready-made geriatric profiles, which are more reasonably priced than requests for individual parameters. These profiles represent the initial database for investigating for cats with weight loss and are discussed below.

1/ Infection serology

Depending on individual risk factors for infection *e.g.* regional prevalence, an initial examination to check feline leukaemia virus (FeLV) and feline immunodeficiency virus (FIV) status may be appropriate. In many regions the prevalence of FeLV has decreased, lowering but not excluding the risk of an individual cat being infected. On the other hand general improvements in care have meant that FIV infected cats are living longer, increasing the likelihood of an elderly cat being infected.

Table 1. Action plan for weight loss.

Screen result	Action
Minimum database shows no significant weight loss.	Monitor weight monthly for next 6 months, if weight change remains < 2% no further action necessary.
< 2% weight loss from last measurement but significant inappetence.	Consider diet change to improve palatability, recheck patient in 2-3 months.
2-5% weight loss without changes on initial screening.	Increase calorie intake by 10-15%, consider change in diet to increase digestibility and institute monthly weigh-in.
2-5% weight loss with changes on initial screening but no localising signs.	Perform detailed screening – further investigation of changes found, plan will depend on disease process involved.
2-5% weight loss with changes on initial screening and significant inappetence.	Perform detailed screen and consider a more complete dental examination under anaesthesia including radiographs.
5-10% weight loss.	Perform detailed screen – further investigation of changes found; plan will depend on disease process involved.
10-20% weight loss.	Perform detailed screening and investigate changes found. If detailed screening is unremarkable extend screening further to include vitamin B12, fTLLi, fPLi, thoracic and abdominal imaging.
> 20% weight loss.	Accurate diagnosis becomes important, intestinal biopsies may become necessary.

2/ Haematology

Red blood count

The most common red blood count abnormality reported in ageing cats is non-regenerative, normocytic and normochromic anaemia. Frequently, it reflects chronic inflammation or neoplasia, a phenomenon occurring in nearly all chronic diseases. The anaemia can occur due to iron sequestration, chronic bleeding, erythropoietin deficiency or shortened red cell lifespan. Anaemia is usually mild to moderate. Macrocytic anaemia is also seen occasionally in ageing FeLV positive cats.

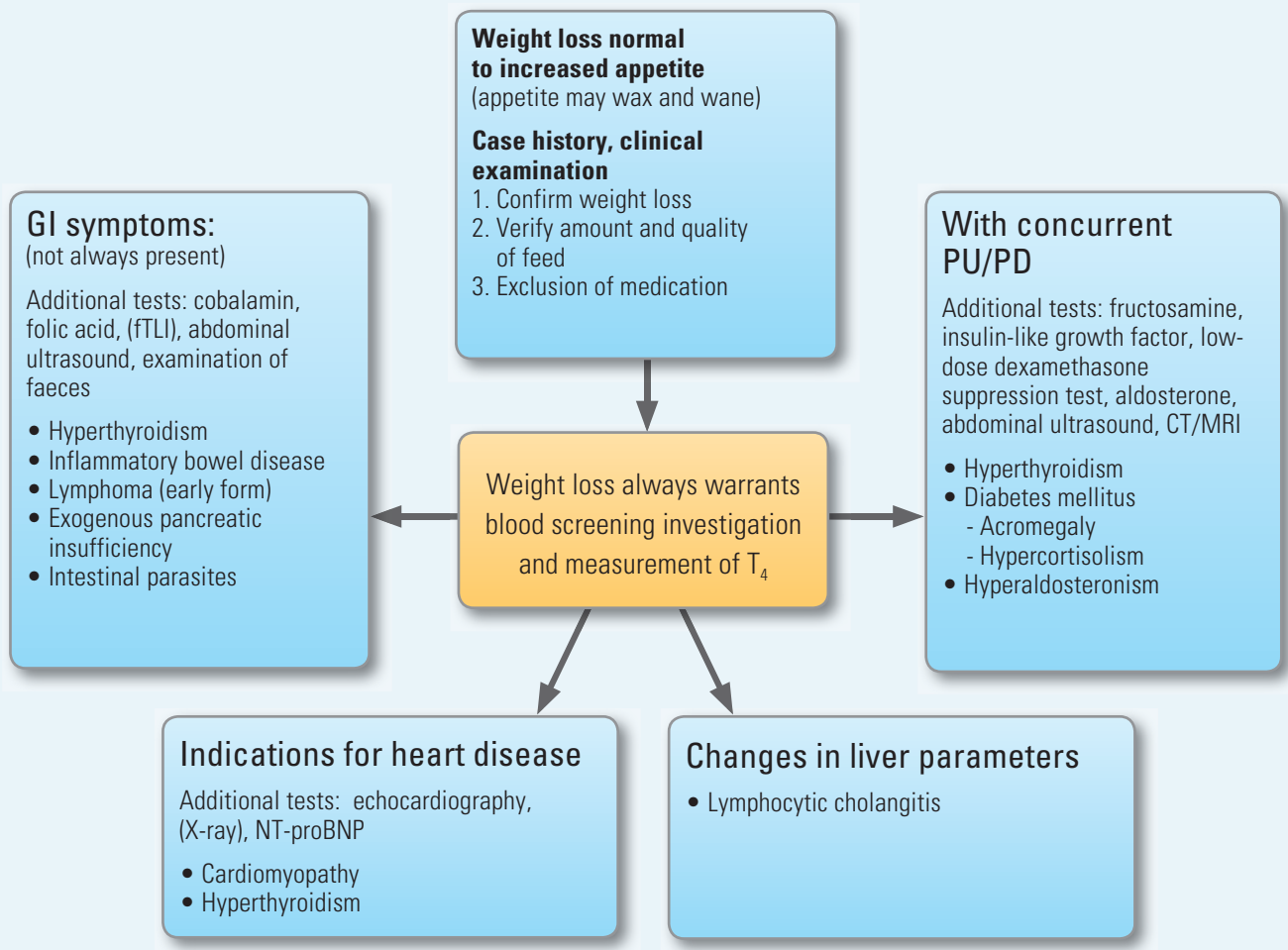
Mild polycythaemia is rarely seen in hyperthyroid cases but is of no clinical importance.

White blood count

In the authors' view the total white cell count is generally of limited value. Many sick ageing cats will have a lymphopenia and neutrophilia; as a result total count may be mildly elevated or fall within the reference range.

Lymphocyte counts in chronically ill cats are commonly around $1 \times 10^9/L$ ($1000/\mu L$) due to increased cortisol production secondary to an endogenous stress response. Lymphocyte values below $0.75 \times 10^9/L$ ($750/\mu L$) raise the

Figure 2. Approach to weight loss in cats with normal to increased appetite.



possibility of an interruption of lymphocyte recirculation that can be associated with lymphoma.

3/ Serum clinical chemistry

Total thyroxin (TT₄)

Total T₄ (**Table 2**) should be part of the routine laboratory assessment for cats over eight years of age. Hyperthyroidism (**Figure 3**) is common in elder cats and is the most common cause of weight loss with polyphagia. In approximately 10% of hyperthyroid cats, apathetic hyperthyroidism is present, differing clinically from the classic form. These cats are not underweight, tend to be sedentary, are mostly below the age of ten, show loss of appetite and in many cases have other associated disease typically congestive heart disease.

Hyperthyroidism is confirmed if the TT₄ value is significantly above the upper reference range. If the value is just above or below the upper reference value associated with a classic clinical picture, measurement should be repeated approximately 3 weeks later as TT₄ levels will fluctuate on a day-to-day resulting in the TT₄ value oscillating around the upper reference value. Many of these cats have not yet developed a clearly palpable goitre.

A TT₄ value in the region of the lower reference values is often present in sick cats. Clinically, this value can be used to gain some idea of how sick these cats are; the lower the value the more severe the underlying disease process is likely to be. Spontaneous hypothyroidism is very rare in cats.

Uncommonly a mid-range TT₄ level can be seen in a hyperthyroid cat that has another disease process that is driving TT₄ levels down; free T₄ estimation can be helpful in these cases as it is less affected by other disease processes.

Elevated TT₄ can have a significant impact on other organ systems. Hyperthyroidism can result in raised renal perfusion with increased glomerular filtration thereby masking a chronic kidney disorder. In the presence of diabetes mellitus, increased protein metabolism can lead to reduced fructosamine values and misdiagnosis. High levels of

thyroxin will cause elevations in liver enzymes suggesting a hepatopathy but this is not a primary disease and will resolve with treatment of the hyperthyroidism. Hyperthyroidism can also cause hypertension resulting in end organ damage particularly to the eyes, heart and kidneys.

Creatinine and urea

In addition to reflecting renal excretion, urea levels are affected by many extra-renal factors. Serum concentration is influenced by exogenous (*e.g.* recent feeding) and endogenous (dehydration, liver function) factors. Creatinine tends to be a more reliable parameter in evaluating GFR, so creatinine is used for IRIS staging of a chronic kidney disorder (see **page 14**). It should be noted here that the creatinine value for staging should only be used in a cat that is properly hydrated with stable disease.

Nevertheless, creatinine is a highly insensitive parameter for detecting the early stages of a loss of kidney function. Creatinine will only begin to rise when over 75% of nephrons have been lost. Sensitivity is further decreased in elderly cats as the reference range used is for younger cats with normal muscle mass. Elderly cats with muscle wasting and therefore a low basal creatinine can have substantial increases in creatinine that are still apparently within the reference range. Serial screening is probably our most sensitive monitor as a continuous rise in creatinine, even if it is within the reference range, can be a valuable pointer to developing loss of renal function.

In order to differentiate pre-renal from renal azotaemia, measurement of urine-specific gravity (USG) is essential. Cats with pre-renal azotaemia will generally have USGs of more than 1.045. A USG above 1.035 makes chronic kidney disease unlikely. Post-renal azotaemia is usually an acute presentation associated with lower urinary tract obstruction.

Liver enzymes

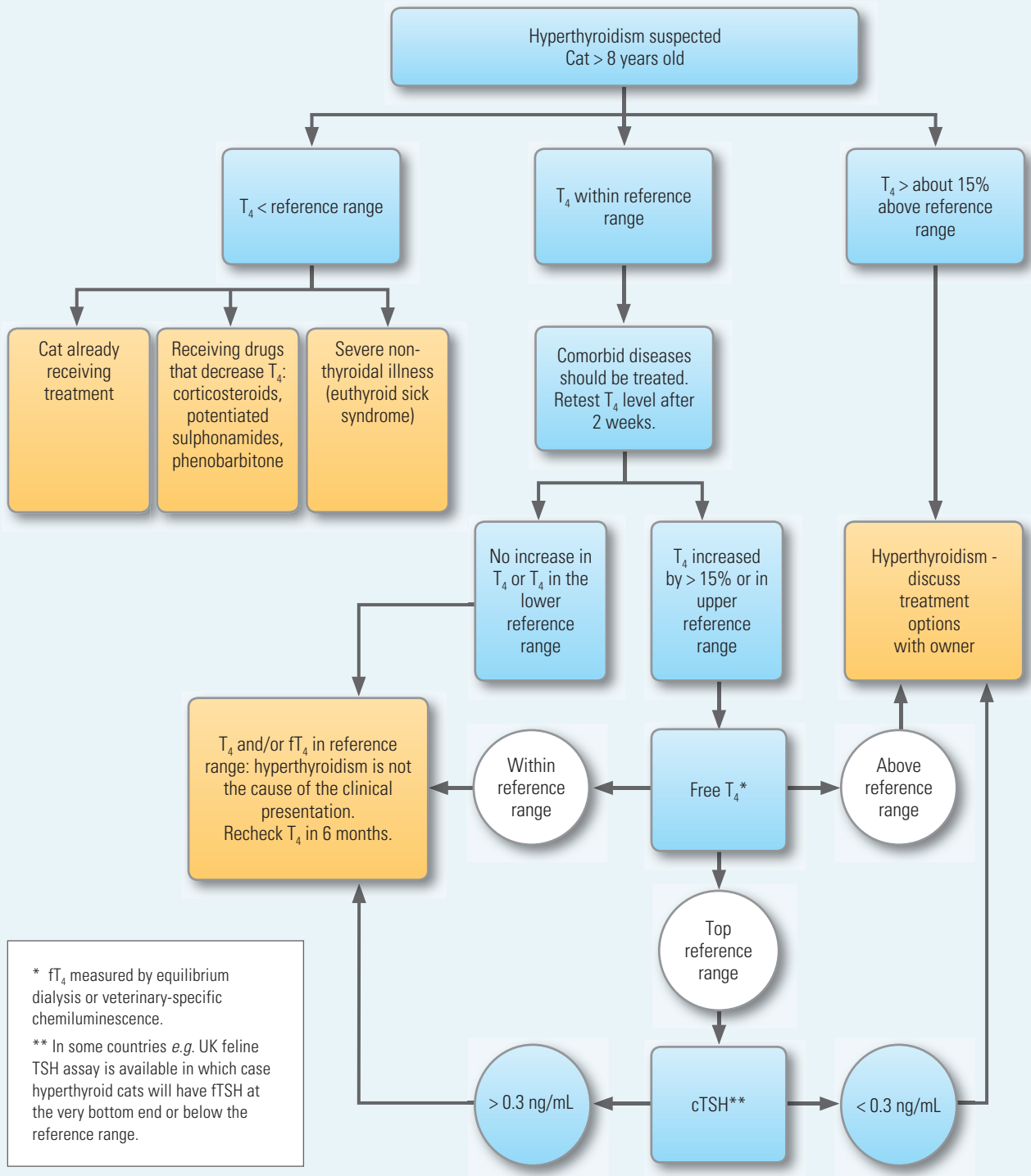
A variety of enzymes have been measured to aid assessment of hepatobiliary disease including alkaline phosphatase (ALP), alanine aminotransferase (ALT), aspartate aminotransferase (AST), γ -glutamyltransferase (GGT) and glutamate dehydrogenase (GLDH).

Lower cellular concentrations and shorter half-lives make even a 1.5-fold increase above the upper reference value clinically relevant in cats. This is particularly the case if

Table 2. Summary of common changes in blood parameters in elderly cats and interpretation.

PARAMETER	RESULT, COMMENTS & INTERPRETATION	
Infection/Serology		
FelV, FIV status	Status should be checked regularly: haematopoietic disorders are common in ageing infected cats.	
Haematology		
Red blood cells	Non-responsive, normocytic and normochromic anaemia	Anaemia of chronic inflammation and/or neoplasia
White blood cells	Lymphopenia 0.8-1.2x10 ⁹ /L (800-1200/μL)	Commonly seen in old cats with chronic disease as a result of chronic endogenous stress.
Biochemistry		
Thyroxin		See Figure 3 .
Creatinine and urea	Levels will only be increased when the GFR is reduced by more than 75%. Urine-specific gravity should always be checked if creatinine levels are elevated.	In the face of azotemia: USG > 1.045 pre-renal azotaemia USG > 1.035 CKD unlikely USG < 1.008 CKD unlikely Check for CKD if USG is between 1.008 and 1.035.
Liver enzyme	Clinical relevant when 1.5 fold increase above top of reference range.	
ALT	Cytosolic	Hepatocellular damage: ALT ↑↑↑, ALP ↑↑ Lipidosis: ALP ↑↑↑, ALT ↑↑, GGT ↑ Cholestasis: ALP ↑↑, GGT ↑↑ ALP is not steroid induced.
AST	Cytosolic and mitochondrial also in the muscles	
ALP	Membrane bound in hepatocytes, located in biliary ducts	
GGT	Located in biliary duct	
CK	Increased in severe muscle degeneration.	Check for starvation. Check for hypokalemia as causes myositis.
Lipase, amylase, LDH, GLDH	Not of clinical importance in old cat	
Bilirubin ==> jaundice	Pre-hepatic	Haemolytic anaemia – rare
	Hepatic	Lipidosis, lymphoma, cholangiohepatitis
	Post-hepatic	Cholangitis, pancreatitis, bile duct obstruction
	Other	FIP
Bile acid	Liver function test – sensitivity increased by using pre- and post-prandial levels	Increased if functional capacity reduced to < 20% Will increase with non-hepatic disease. Cannot be interpreted in the presence of jaundice.
Fructosamine	Less than 200 μmol/L	Check for hyperthyroidism or protein lost.
	Greater than 380 μmol/L	Check for diabetes mellitus.
Potassium	Hypokalemia	Check for PU/PD as induced by diuresis. Examples: diabetes mellitus, CKD, hyperthyroidism, fluid therapy or hyperaldosteronism.
Calcium	Hypercalcemia	Check for neoplasia. Can also occur in CKD.
Phosphate	Hyperphosphatemia is mostly the result of reduced GFR (pre-, post-, renal) or hyperthyroidism.	Check for CKD. Check for hyperthyroidism.
Glucose	Hyperglycemia can result from stress, diabetes mellitus and other diseases.	Check fructosamine to differentiate between diabetes and other causes. In hyperthyroid cats fructosamine is unhelpful in differentiating cause of hyperglycemia.
fPLi	Specific or not specific signs of pancreatitis	Rule pancreatitis in or out.
fTLI	Functional test for pancreatic enzymes release	Rule EPI in or out. Marked increase indication to run fPLi
Folate	Low	Check for disorders in duodenum and proximal jejunum.
	High	Check for dysbiosis and EPI.
Cobalamin (Vitamin B12)	Low	Check for disorders of distal jejunum and ileum, dysbiosis or EPI.
Insulin-like-growth factor (IGF)	Check in cases of poorly responsive diabetes mellitus. Increases may not be seen until at least 4 weeks after insulin therapy.	
Aldosterone	Check in cases of severe hypokalemia especially with hypertension.	

Figure 3. Algorithm for suspected hyperthyroidism.



* fT_4 measured by equilibrium dialysis or veterinary-specific chemiluminescence.
 ** In some countries *e.g.* UK feline TSH assay is available in which case hyperthyroid cats will have $fTSH$ at the very bottom end or below the reference range.

this increase is repeatable on more than one sample. ALT is a cytoplasmic enzyme, whereas AST is also found in the mitochondria. GGT is located in the biliary duct epithelia. ALP is also primarily associated with the biliary duct epithelia but is also found membrane-bound to hepatocytes. Cats do not have a steroid induced ALP isoenzyme as dogs do.

Enzyme patterns can be an aid to diagnosis: for this, the measured value is set with reference to the upper reference values and given as a multiple of it.

Where there is damage to the liver cells, the increase in ALT is generally greater than the increase in ALP and GGT. In the case of hepatic lipidosis, ALP increases many more times than ALT but there is, at most only a mild increase in GGT. With cholestasis, both biliary duct associated enzymes ALP and GGT increase many more times than hepatocellular ALT. GGT is the most important indicator of cholestasis in cats often increasing very sharply with cholangitis; the increase in ALP tends to be lower. It is important to remember that increases in liver enzymes reflect the number of cells involved rather than the severity of the damage.

Liver enzymes are increased in roughly 90% of hyperthyroid cases. AST can be raised due to increased liver perfusion and the associated increase in metabolic rate. The increase in ALP is a consequence of the direct influence of thyroxin on the isoenzymes from liver and bones.

In the authors' opinion, GLDH provides little additional diagnostic information in cats.

Bilirubin

The elderly yellow cat is not an uncommon clinical presentation. Haemolytic anaemia leading to pre-hepatic jaundice is rare in cats. In elderly cats both post-hepatic and hepatic forms of icterus occur commonly; unfortunately simple differentiation between the two forms with blood tests is rarely possible and often the disease process involves both systems to some level. While feline hepatic lipidosis and hepatic lymphoma tend more to lead to hepatic jaundice; cholangitis, biliary duct carcinoma and pancreatitis are initially post-hepatic. Ultrasound examination is the easiest way of evaluating the cause of jaundice. If the gall bladder is significantly enlarged or the bile duct is dilated, post-hepatic jaundice

should be assumed (**Figures 4**). Unlike dogs, gall bladder enlargement is not consistent feature of post-hepatic obstructive jaundice in cats.

Bilirubinemia without an increase in liver enzymes can be connected with cytokine-induced inflammation and can be associated with a variety of diseases such as pyothorax and in particular FIP.

Fructosamine

Fructosamines are produced from a non-enzymatic catalyzed attachment between glucose and the plasma proteins, principally albumin. This allows the glucose level from the past two or three weeks to be reviewed. They are essential in diagnosing and monitoring diabetes mellitus.

Various other factors can also influence fructosamine with both increased protein catabolism (as in hyperthyroidism) and protein losing enteropathies or nephropathies serving to reduce plasma fructosamine concentration. In non-diabetic hyperthyroid cats fructosamine is usually below 200 $\mu\text{mol/L}$. Haemolysis of the sample prior to analysis can falsely increase the level by up to 50%.

Additional enzymatic tests

Similarly to AST, increases in creatine kinase (CK) are associated with myositis or muscular trauma. Markedly elevated CK values are suggestive of severe hypokalaemia such as occurs in hyperaldosteronism.

Lipase and amylase have no clinical significance and there is little clinical value in assaying them. For the diagnosis of feline pancreatitis, see fPLI.

Additional substrates

Bile acids are measured before and two hours after a fat and protein-rich meal that is aimed at causing gall bladder emptying. Where bilirubin is normal, raised levels are indicative of hepatic dysfunction. There is no value in measuring bile acids in jaundiced cats as the results are not interpretable.

Electrolytes (Na, K, Cl)

Of the three electrolytes, generally potassium is clinically the most important in the ageing cat for a number of reasons. Potassium excretion increases when there is polyuria; any disorder accompanied by polyuria/poly-

dipsia will inevitably lead to increased potassium loss such as diabetes mellitus, hyperthyroidism and chronic kidney diseases. Aggressive intravenous fluid therapy can often lead to hypokalemia developing particularly if there is translocation of potassium into the cell associated with insulin secretion/therapy or resolution of acidosis. The clinical picture of a hypokalemia in the cat is muscle weakness particularly neck weakness with the cat adopting a sphinx-like pose. Worsening of the hypokalemia leads to gastrointestinal and cardiac signs.

Plasma sodium is commonly increased by dehydration or fluid therapy with high sodium fluids, and lowered in the case of diabetes mellitus. Vomiting and renal failure can lead to either mildly increased or decreased sodium depending on the disease process.

Calcium

Hypercalcaemia in ageing cats is more commonly associated with neoplasia (particularly in the case of lymphoma, squamous cell carcinoma and adenocarcinoma) than idiopathic hypercalcaemia. Hyper- and hypo-calcaemia

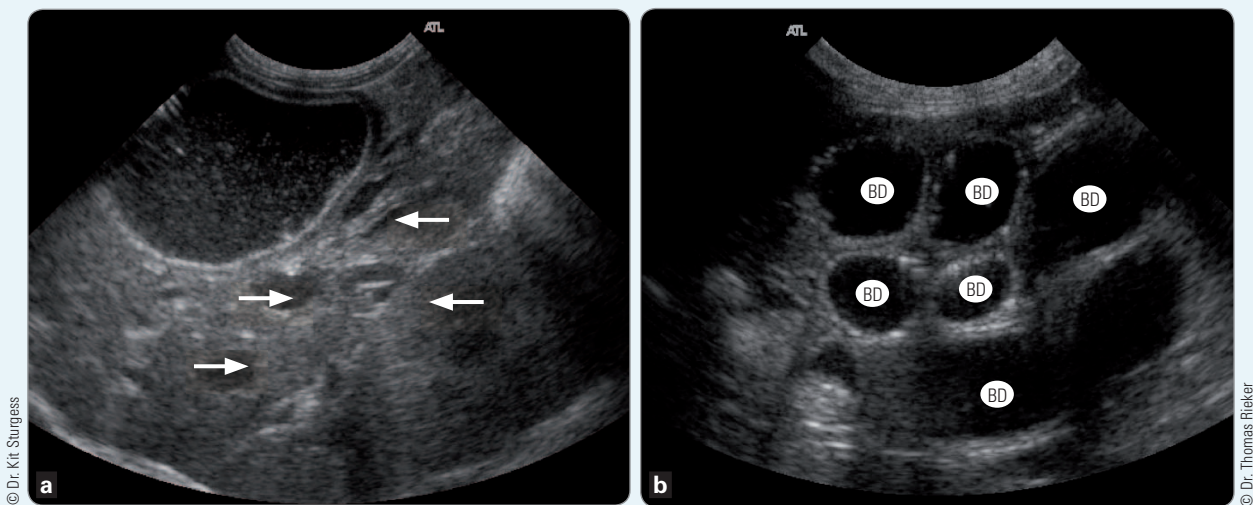
are seen with chronic kidney disease. There are however, significant discrepancies between measurement of total serum calcium (tCa) with free (biologically active) calcium (iCa). In almost half the cases of azotaemia, tCa does not correlate with the iCa. Hence the level of iCa cannot be inferred from tCa levels. This limits the diagnostic value of tCa in chronic kidney disease; iCa should be measured wherever possible.

In the event of acute pancreatitis, hypocalcaemia occasionally occurs as a result of a saponification by para-pancreatic fatty acids.

Phosphate

Hyperphosphataemia is frequently seen in ageing cats. The most common causes of hyperphosphataemia in old cats are reduced glomerular filtration rate usually associated with CKD and hyperthyroidism that results in increased bone metabolism. Pre- and post-renal disease will also reduce GFR and lead to phosphate retention but hyperphosphataemia will rapidly resolve with therapy hence azotaemia and hyperphosphataemia alone cannot

Figure 4.



a. 4-year-old, neutered male domestic short hair cat presenting with jaundice. The gall bladder is moderately full with echogenic sludge and wall thickening. The bile ducts (arrows) are dilated giving the appearance of “too many tubes”. Obstructive biliary disease caused by pancreatic inflammation.

b. Same cat, 3 months later, having developed severe secondary coliform infection of the biliary system. BD = bile duct.

be used to establish a diagnosis of CKD. Hyperphosphataemia is also a common laboratory artefact associated with sample haemolysis.

In cats with diabetic ketoacidosis, hypophosphataemia can be severe and, if not addressed, result in haemolytic anaemia.

Glucose

Stress hyperglycaemia is a species-specific problem in cats. In healthy cats, the glucose concentration usually needs to exceed 16 mmol/L (290 mg/dL) before glycosuria occurs. Nonetheless in some cats glycosuria will be detected at glucose levels as low as 11 mmol/L (200 mg/dL). In sick cats not suffering from diabetes mellitus, stress hyperglycaemia can result in blood glucose as high as 20 mmol/L (360 mg/dL) and occasionally higher. A single measurement of hyperglycaemia with glycosuria is not sufficient to make a diagnosis of diabetes mellitus; fructosamine determination is valuable as it demonstrates persistent hyperglycaemia.

Total protein, albumin and globulin

In combination, these three values are useful diagnostic aids, especially in elderly cats. Some external laboratories do not calculate globulin value and therefore do not use it when interpreting the blood work. In methodological terms, total protein (TP) results tend to be similar regardless of the assay method. This is not the case for albumin, with significant variations in the results occurring depending on methodology; in-house machines often have low accuracy when measuring albumin. Since globulin = TP – albumin, if albumin is underestimated this will lead to an overestimation of globulin and vice versa. If serial measurements of albumin are undertaken, the same methodology should be used.

Elevated albumin is an indication of dehydration. As albumin is synthesized in the liver, hypoalbuminemia can result if there is severe impairment of hepatic function and is usually associated with a fall in urea and glucose and an increase in bile acids. More commonly, hypoalbuminaemia results from protein losses through the intestines (usually together with globulin). Less commonly, renal loss can result in hypoalbuminaemia but globulin levels are not affected. Anorexia or inappetence can result in reduced albumin but in the authors' experience this reduction is only mild. Albumin is a nega-

tive acute-phase protein *i.e.* albumin can fall associated with inflammation as liver production is reduced in favour of production of acute-phase proteins (and globulins) mediated by inflammatory cytokines.

Hyperglobulinaemia with concomitant hypoalbuminaemia can frequently be seen in cats with FIP. Other inflammatory diseases can also be associated with a fall in albumin:globulin ratio (with or without a rise in TP) such as stomatitis, enteritis or lymphoma.

Triglyceride (TG)

Serum that is visibly lipaemic occurs when TG levels are high and is often the result of recent feeding. However, if the cat has been adequately starved (at least 8 hours), high TG can be associated with diabetes mellitus, hypercortisolaemia, pancreatitis and feline hepatic lipidosis. Low values occur with energy deficiency owing to increased consumption associated with reduced intestinal absorption or hepatic cycling.

Cholesterol

Hypercholesterolaemia does not cause lipaemic serum and often accompanies elevated TG. Significant alterations in serum cholesterol alone are uncommon in feline patients but can occur in obstructive biliary disease or nephrotic syndrome for example.

4/ Additional tests outside of a screening lab profile

Feline pancreas-specific lipase (fPLi)

The principle is based on a specific antibody that has been created to recognise the isoenzyme of lipase produced by the feline pancreas. In the case of pancreatitis, this enzyme is released into the blood in quantity and can be detected in the serum. The test method has good sensitivity and specificity. The test is available as an in-house semiquantitative ELISA (Idexx SNAP®) or as a quantitative ELISA/RIA measured at an external laboratory. Abnormal SNAP result should be quantified by an external laboratory.

Feline trypsinogen-like immunoreactivity (fTLI)

Low TLI serves as evidence of exocrine pancreatic insufficiency (EPI) that can occur in cats as the result of chronic pancreatitis leading to pancreatic fibrosis. Loss of

functional pancreatic cells results in a fall in the constant, small amounts of trypsin and trypsinogen that are normally released into the blood. In patients with weight loss, polyphagia and bulky stools, the test can be a very helpful rule-out for EPI. Marked elevation in fTLI can be associated with pancreatitis; in these cases an fPLI should be measured.

Folic acid

Serum folate levels are influenced by dietary intake and production by the intestinal bacterial flora. Cats naturally have high levels of small intestinal bacteria so the significance of elevated levels is unknown but may indicate bacterial dysbiosis in the small intestine. Significant proximal small intestinal disease can lead to reduced absorption and lowered serum values.

Cobalamin (vitamin B12)

Cobalamin uptake in cats is subject to a complex absorption mechanism in which binding proteins from the stomach, intestine and pancreas participate. Absorption itself takes place in the ileum. Lowered values are primarily seen with pancreatitis, EPI and ileal disease. Regardless of the cause, serum-cobalamin deficiency exacerbates gastrointestinal signs and reduces response to treatment; parenteral supplementation (initially at 20 µg/kg weekly) should be given. Elevated cobalamin has no clinical interpretation and is often the result of supplementation.

Cook (2010) demonstrated hypcobalaminaemia in cases of feline hyperthyroidism contributing to the maldigestion seen in these cats. In the authors' experience approximately half of all hyperthyroid cats have low cobalamin.

NT-proBNP

BNP is one of the natriuretic peptides and is released from the myocytes of the atrium and increases when ventricular volume or pressure load rises. Diagnosis of cardiac disease can be particularly difficult in cats especially early in disease or where echocardiography is not available. Many cats show no obvious clinical signs until late on in disease; minor reductions in activity often go unnoticed by the owner or are assumed to be a normal ageing process. Cardiac murmurs can be difficult to hear, intermittent or variable as well as having extracardiac causes, so a screening test can be of value in cats in which cardiac disease is suspected.

NT-proBNP can help assess the likelihood of heart disease in asymptomatic cats and can be used in dyspnoeic cats to aid differentiating pulmonary from cardiac causes. Sensitivity and specificity is reasonable but diagnosis should be confirmed with additional investigations.

Interpretation criteria for NT-proBNP concentration

For asymptomatic cats and cats suspected of having occult cardiac disease:

- < 100 pmol/L - Clinically significant heart disease is unlikely although cardiac disease may be present. Because heart disease can develop at any time, a single NT-proBNP below 100 pmol/L may not reflect cardiac health status in the future.
- ≥ 100 pmol/L - Clinically significant heart disease is likely. Additional diagnostics are recommended to determine severity. Serial measurement of NT-proBNP may help monitor progression of volume loading.

For symptomatic cats with respiratory signs:

- < 270 pmol/L - Respiratory signs are not likely secondary to heart failure. Where NT-proBNP is above 100 pmol/L additional diagnostics may be indicated to determine if the cat has concurrent heart disease.
- ≥ 270 pmol/L - Respiratory signs are likely secondary to heart failure. Additional diagnostics are recommended to evaluate the extent of cardiac dysfunction.

Insulin-like growth factors (IGF)

IGFs are primarily released by the liver and kidneys after stimulation with the growth hormone (released in the pituitary). In acromegaly, growth hormone release increases and IGFs increase correspondingly. Acromegaly causes insulin resistance resulting in diabetes mellitus that is very difficult to manage as the amount of growth hormones secreted vary. Insulin-like growth factor-1 is easier to measure than growth hormone itself hence it is used as a surrogate marker for growth hormone levels. IGF-1 levels may be low in untreated and short term treated diabetic cats and generally rises during insulin therapy hence if acromegaly is suspected, IGF-1 should be assayed 6-8 weeks after therapy has commenced. IGF-1 levels greater



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Figure 5. Urine collection by cystocentesis.

than 1000 ng/mL indicate acromegaly in about 94% of diabetic cats.

Aldosterone

Ultrasonographic changes in the adrenal cortex are not uncommon in older cats and are frequently an incidental finding which does not change adrenal function.

Functional unilateral masses are mostly adrenocortical tumours with varying degrees of malignancy. In cases of bilateral enlargement, hyperplasia leading to hyperaldosteronism is more likely. Ultrasound imaging of the adrenal glands in cats requires significant experience and appropriate equipment.

Hyperaldosteronism (Conn's syndrome) leads to marked hypokalaemia resulting in severe muscle weakness characterised by ventroflexion of the neck. Specialist advice is recommended prior to further investigation of such cases.

Examining faeces

Elderly cats show a degree of age-related resistance to round- and hookworm (see FAQ on **page 59**). Routine worming should be continued in outdoor cats. Giardia can be found in the faeces of older cats that show no evidence of intestinal disease; its significance is uncertain

but treatment may be worth considering if there is weight loss even in the absence of diarrhoea.

Examining urine

Wherever possible urine should be collected by cystocentesis: the technique can be learnt easily with a little practice. In many old, thin cats, the bladder can be easily palpated and immobilized against the lateral body wall with one hand. With the other hand, a 5 mL syringe fitted with a 23 G needle (0.65 mm diameter) is inserted at right angles through the body wall into the bladder (**Figure 5**). If the bladder has very little urine present when palpated or palpation is difficult due to obesity, ultrasound guided cystocentesis is recommended.

Urine-specific gravity (USG)

USG is measured with a refractometer. The physiologic range for USG in a cat is from 1.002 to 1.085 physiologically. Most healthy cats are generally between 1.030 and 1.065. Measurement of USG is critical for classifying azotaemia (see also creatinine). USG below 1.025 in a normal cat is unexpected unless the cat has recently taken a big drink or consumed a lot of wet food. Common diseases seen in elderly with a USG repeatedly below 1.025 are diabetes mellitus, hyperthyroidism, chronic kidney disease or long-term cortisone therapy. Such cats are at increased risk of bacteriuria. Kidney disease alone will not tend to cause the USG to drop below 1.008 as this indicates active excretion of water over solutes.

Urine test strip

Leukocyte test area: this test area should not be used to assess cat urine as it frequently gives a false-positive reaction owing to a significantly higher concentration of leukocyte esterase present in normal cats compared to humans.

Bilirubin test area: all positives in cats indicate underlying pathology unlike dogs.

Protein test area: reacts in particular to albumin but is highly susceptible and sensitive to influences such as pH and urine colour. The test result should always be correlated with the USG. 1+ protein can be physiological at a USG of 1.045 but may represent significant protein loss at a USG of 1.010. In general there is a poor correlation between the test strip result and measured urine-protein-to-creatinine ratio (UPCR). UPCR is therefore recommended for quantification purposes, particularly in cats with kidney diseases.

Glucose test area: blood glucose needs to exceed the renal threshold (see **page 38**) for glucose to be detected in the urine. However, glycosuria is not diagnostic of diabetes mellitus. Rarely, glycosuria can be present in the absence of hyperglycaemia due to renal tubular damage.

Ketone test area: beta-hydroxybutyric acid is the first ketone to be produced in diabetic ketosis but the test area reacts primarily to acetoacetone and to a lesser extent acetone. Rarely, in early ketosis, the test strip may therefore give a negative reaction.

Urine-specific gravity test area: inaccurate and is poorly correlated to the USG measured by refractometry.

Urine-protein-to-creatinine ratio (UPCR)

Urine protein is correlated with the urine creatinine (as an expression of urine concentration) allowing better assessment of urine protein loss. An increase in microalbuminuria can occur before any rise in serum creatinine is evident in cats with CKD but other inflammatory disease can also lead to renal proteinuria. Lower urinary tract disease such as infections or neoplasia will also increase proteinuria making sediment analysis essential before an elevated UPCR can be interpreted as indicating renal protein loss. Where possible samples for UPCR should be obtained by cystocentesis.

For IRIS subclassification (www.iris-kidney.com) and appropriate therapy (use of ACE inhibitors) for CKD, the UPCR needs to have been measured.

Sediment

Reference values for normal urine (less than 5 WBC or 5 RBC/hpf (x 400 magnification) are based on centrifugation of a standard 5 mL urine sample. The presence of white cells reflects evidence of inflammation that may be sterile or non-sterile. Inflammation may account for a positive dipstick reaction for protein. Where urine is dilute *e.g.* CKD or diabetes mellitus, fewer blood cells may be seen in the urine sediment because of the dilutional effect and increased frequency of urination despite the presence of inflammation/infection.

Bacteriological urine examination

A dip-slide paddle (Uricult®) can be used in-house as a rough indicator of the presence and type of urinary infection. Positive results should be confirmed and spe-

ciated at an external laboratory along with antibacterial sensitivity.

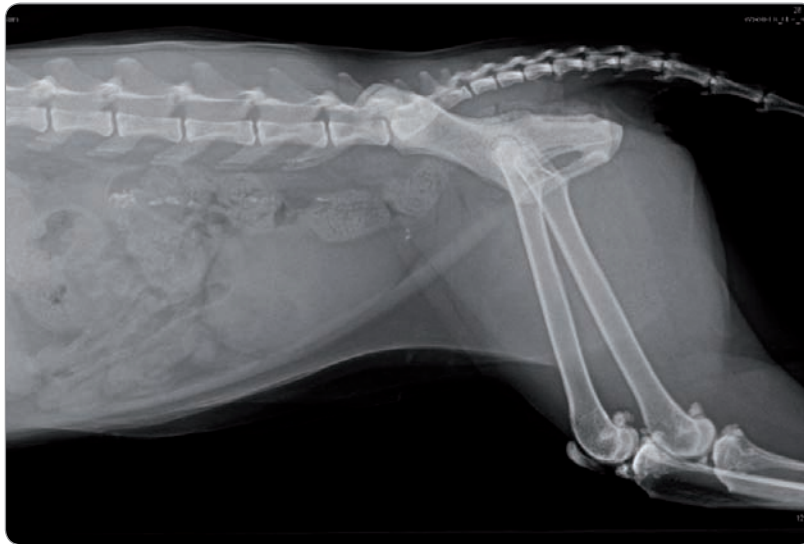
Urinary tract infection (UTI) is uncommon in cats under 12 years old but is more often present in older especially female cats. UTI is present in about 20% of cats with hyperthyroidism, chronic kidney disease or diabetes mellitus or on long-term cortisone therapy. In diabetic cats UTI is a common cause of apparent insulin resistance. Sterile urine collection is key in allowing interpretation of a positive urine culture.

5/ Determining blood pressure

Many practices regularly measure blood pressure (BP) in cats and have developed a lot of experience in obtaining a measurement. Staff experience and a calm ambience are probably as important to acquiring valid measurements as the measuring method itself. Some practices measure BP at every visit with the ulterior motive of getting the cat used to the procedure minimising the “white coat” effect over time. In so doing, a reference range is generated for the individual cat and for the practice’s feline population in general. It is generally appropriate to check BP in patients suspected of hypertension prior to general physical examination or any treatment to minimise the stress response present at the time of measurement.

In principle, three different systems are available for measuring BP in cats: Doppler (systolic only), oscillometric and high-definition oscillometric® methods. Currently, the authors use Doppler.

In elderly cats hypertension is most commonly associated with CKD, hyperthyroidism (including on therapy), diabetes mellitus and hyperaldosteronism. Hypertension will eventually lead to end-capillary damage in the retina, brain and kidneys as well as cardiac wall hypertrophy that compromises diastolic function. Ideally a diagnosis of hypertension should be based on repeated measurements on more than one visit in a minimally stressed cat (**Table 3**).



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Figure 6. Bobby - 13-year-old, neutered male cat, with degenerative joint disease (stifle) and oxalate nephro- and ureteroliths.

6/ Imaging procedures

In cat suspected of having thoracic disease radiography is valuable. Two, inspiratory, preferably orthogonal views (*e.g.* right lateral and dorsoventral) should be obtained in a still patient. Thoracic radiographs show pleural, pulmonary parenchymal, diaphragmatic and thoracic wall changes well but non-congested cardiac disease can be difficult to judge.

Where available, echocardiography is a better choice for evaluating heart function. Some abdominal diseases will

be clear on radiography such as radiodense ureteric, bladder or kidney stones. Ureteroliths are being increasingly recognised as a cause of CKD. In addition, radiography is very valuable in detecting degenerative joint changes (**Figure 6**) and evaluating dental disease. In general, ultrasound is superior to radiography for evaluating the abdomen.

Almost all parenchymatous organs can be assessed with ultrasound although the ureters are rarely detected in normal cats and the intrapelvic urethra is difficult to image. It is an invaluable aid in the diagnosis of cholan-

Table 3. Interpretation of the results of repeated blood pressure measurements in cats.

Risk category	Systolic blood pressure (mmHg)	Diastolic blood pressure (mmHg)	Risk of end/target organ damage (TOD)
I	< 150	< 95	minimal
II	150-159	95-99	moderate
III	160-179	100-119	distinctly increased
IV	> 180	> 120	high

Brown 2007

gitis, pancreatitis, kidney disease for example as well as allowing lymph nodes and adrenal glands to be examined. In addition, the gastrointestinal tract can be assessed enabling the five-layered parietal structure of the small intestine to be evaluated for example. Disease that can result in changes in the wall layering and thickness include T-cell lymphoma, eosinophilic IBD or FIP. However, significant GIT disease can exist despite ultrasound appearing normal.

Computed tomography (CT) or magnetic resonance imaging (MRI) procedures are required to assess intracranial changes. Craniofacial, nasal and paranasal sinus tumours are more clearly shown as well as demonstrating changes in the meninges and parenchyma of the brain including the pituitary gland (hyperadrenocorticism and acromegaly). In some cases, assessing the body cavities and bones with CT/MRT can be advantageous.

4. Therapeutics in ageing cats

> SUMMARY

- The fate and effects of a drug can be very different in elderly cats.
- Not all elderly cats should be assumed to have a significant reduction in renal function.
- The risk/benefit ratio of any prescription should be assessed and informed consent obtained from the owner.
- The likelihood of drug interactions should be taken into account in the event of multiple therapies being used.
- Drug therapy should be integrated within a global treatment strategy, including grooming and nutrition.
- Clinical monitoring should always be discussed so that appropriate treatment changes can be made as many of the diseases being treated are progressive.
- It is crucial that treatment is individualised for each patient and appropriate for the owner's needs.

Following diagnosis the next major challenge in elderly cats is the choice of treatment. There are four major issues surrounding treatment:

- The treatment is ineffective.
- A potential for iatrogenic harm:
 - secondary effects,
 - underestimation of comorbidity.
- The risk of adverse drug interactions - increased if there are multiple prescriptions.
- Non-compliance (owner or animal).

These issues will be discussed in the first section. Guidelines for prescribing and monitoring of therapy will be presented in the second and third sections respectively.

1/ Identifying therapeutic risks in the elderly cat

Risks associated with therapy are well documented in geriatric human medicine but are poorly described in small animals. However, clinical experience can be used to compile a list of guidelines for prescribing in elderly

cats. The guiding principle behind any prescription should be prudence, taking into account the individual response of each patient and the informed consent of the owner. In elderly cats, the two main iatrogenic risks are the onset of adverse effects (often associated with over dosage through slowed elimination of the active principle) or reduced efficacy. Moreover, dose calculation can be problematic because of reduced muscle mass that can affect drug metabolism or low body fat affecting drug distribution.

A) Effect of old age on drug pharmacokinetics and pharmacodynamics

Physiological changes can alter the pharmacokinetics (fate of the drug in the body) and pharmacodynamics (effect of the drug on the body) of a medication in elderly cats. Such changes, which are usually extrapolated from human medicine, are summarised in **Table 1**.

NB: It is important to avoid an empiric approach. For example, adjusting the dose rate of a medication that is

Table 1. Principal age-related physiological modifications and their pharmacological consequences.

		Physiological characteristics	Consequence
Pharmacokinetic modifications (fate of the medication)	Absorption	<ul style="list-style-type: none"> ↓ Gastric pH ↓ Gastrointestinal motility ↓ Surface area of intestinal absorption ↓ Cutaneous, muscular, and splanchnic blood flow 	Bioavailability via the intravenous route (=100%) ↓ Muscular and subcutaneous absorption Oral bioavailability often relatively unaltered
	Distribution	<ul style="list-style-type: none"> ↑ Percentage of body fat but potentially decreased fat mass ↓ Lean body mass ↓ Body water ↓ Serum albumin concentration 	Volume of distribution: - of hydrophilic molecules ↓ - of lipophilic molecules ↑
	Metabolism	<ul style="list-style-type: none"> ↓ Hepatic mass and blood flow ↓ Bile flow (not proven in cats) 	↓ Phase I reactions Phase II reactions unchanged
	Elimination	<ul style="list-style-type: none"> ↓ Renal blood flow ↓ GFR (studies have not yet been conducted to confirm this) ↓ Tubular secretion 	Major pharmacokinetic modification in man Do not automatically consider that all elderly animals suffer from subclinical renal failure, but there is an increased prevalence of CKD in older cats. Adjust the dose rate if no other alternative drugs available.
Pharmacodynamic modifications (effect of the medication)		Risk of overdose and accumulation of drugs and thus adverse effects, but also risk of pharmacodynamic modifications, independent of pharmacokinetic alterations	

eliminated by the kidneys should only be considered when reduced renal function has actually been detected; otherwise, there is a risk of under-dosing the patient.

B) Iatrogenic risk in the elderly cat

Decreased renal excretion is the major pharmacokinetic change affecting ageing humans. In cats, the influence of age on renal function is not known, but the prevalence of CKD is even greater than in the dog. With renal disease, the adverse effects of drugs may be exacerbated through defective elimination (non-steroidal anti-inflammatories). More rarely, decreased elimination can affect drug activity such as furosemide whose action starts after tubular secretion in the loop of Henlé. The dose may therefore need to be increased in cats with renal failure but this can result in systemic accumulation and potential toxicity

issues. Consequently, it is imperative to assess the probable effect of renal disease on the pharmacokinetic characteristics of any drug used in the treatment of a concurrent disease, especially if its elimination is predominantly renal.

Drugs known for their potential nephrotoxicity are rarely problematic in healthy patients except in the long term. In patients with renal disease they should be avoided or the cat monitored closely in hospital if their use is absolutely essential. Aminoglycoside antibiotics (neomycin, gentamicin, streptomycin, etc.), for example, should be avoided. Tetracyclines and sulphonamides may worsen pre-existing renal disease. The use of non-steroidal anti-inflammatories (NSAIDs) has the risk of adverse effects through reduced elimination (the dose rate should be adjusted) in addition to the effect of the NSAIDs themselves on the renal circulation. NSAIDs inhibit prostaglandin PGE2 production thus reducing renal

perfusion (by preventing vasodilation of the afferent arteriole) with the potential for increasing ischaemia in the papillary region, which is particularly contraindicated in the event of pre-existing renal disease. It is sometimes necessary to adjust the dose rate, although this can be difficult to implement.

For drugs with a long half-life, the standard dose rate can be maintained whilst prolonging the interval between doses. However, peak plasma concentrations may still reach toxic levels and this method is difficult to put into practice - how does one choose the right dosing interval?

For drugs with a short half-life, the dose can be reduced whilst maintaining the same dosing interval. Although more practical, this method carries the risk of reduced efficacy through under-dosage. Where the therapeutic effect is clinically apparent, it is always possible to increase the dose rate if the molecule is well tolerated but its effect is insufficient. Where possible therefore, using drugs with a short half-life is the recommended approach for everyday practice.

C) Non-compliance

Cats, by nature, are usually more independent and less docile than dogs, and the decision to start daily, sometimes lifelong, medication should not be taken lightly. The administration of medication can soon become a nightmare for the owner who will end up feeling discouraged. Medication should not become a source of such stress for the cat that it results in worsening of the disease being treated. To prevent this problem, the owner should be shown the best way to administer the treatment. Better client understanding of their cat's disease and its progression, the benefits of the various treatments prescribed, and the possible side effects that could arise will help to improve compliance.

Drug formulation can significantly affect ease of administration and therefore compliance so in some cases choosing a drug that is available as a paste may be better for that individual than choosing a similar drug that is only available as a tablet. In some countries reformulation of drugs *e.g.* into liquids or transdermal preparations is possible but care must be taken as reformulation can adversely affect bioavailability and pharmacokinetics of the drug.



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Figure 1. It is important to weigh the cat on an appropriate set of scales so that the prescribed drug can be adjusted accordingly.

2/ Prescribing in elderly cats

In view of the risks described above, a few prescribing rules should be followed to reduce the potential for adverse effects. The importance of precisely weighing the cat on an appropriate set of scales (one used for babies for example), so that the dose rate of the prescribed drug can be adjusted accordingly, cannot be over emphasised (**Figure 1**).

A) Principles of prescription in the elderly cat

Before prescribing any medications, it is advisable to:

- obtain a full history from the owner including all concurrent medications and any known drug intolerances in their cat. Prescribing a drug that the animal has reacted badly to in the past or that is incompatible with a current medication should be avoided,
- ensure that the treatment is indeed necessary and driven by as complete and rigorous a diagnostic work-up as possible. The indication for drug use must be clear and preferably made after a diagnosis has been established. If no precise diagnosis has been made or investigation is being undertaken but immediate treatment is considered necessary, treatment options should be thoroughly discussed with the owner,
- understand the drug and be familiar with prescribing it; obviously the cascade rules apply, giving precedence



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Figure 2. A pill dispenser can help improve treatment compliance.

to products that are licensed for veterinary use in cats. Particular care should be taken when prescribing new drugs since these have rarely been specifically tested in elderly patients,

- where possible, evaluate renal and hepatic functions, which will contribute to the metabolism and elimination of the active principles, before prescribing.

These precautions will enable you to obtain informed consent from the owner, as client cooperation is central to the success of the therapy (**Figure 2**). Informed consent is even more important with treatments that present a high iatrogenic risk, *i.e.* a questionable risk/benefit ratio (**Table 2**).

It is important to allocate some time at the end of the consultation to allow adequate discussion of therapy with the owner (**Figure 3**). This time is well spent promoting the benefits of seeking veterinary assistance and informing the client about the expected benefits and possible risks. A detailed summary for each drug prescribed should be provided as this will give the owner something to refer to once they are on their own back at home.

When prescribing drugs the rules below should be followed:

- Monotherapies are preferable, although this can be difficult in elderly patients (the risk of adverse effects increases exponentially with the number of drugs used). It is important to be aware that some adverse effects could be mistaken for the natural progression of the disease.



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Figure 3. You need to allocate discussion time with the owner at the end of the consultation to make sure he understands the importance of treatment compliance.

Table 2. Commonly used drugs with an increased iatrogenic risk in elderly cats.

Nephrotoxic drugs or those with an "increased renal risk"
NSAIDs Diuretics Antihypertensives Trilostane Gentamicin (and other aminoglycosides)
Molecules with a narrow therapeutic index
Anti-cancer drugs
Enzyme inducers
Phenobarbital Cimetidine
Others
Sedatives, anaesthetics Corticosteroids Ketoconazole/itraconazole Clomipramine

- Use the minimal effective dose and the shortest possible duration of treatment. However, this does not mean “under-treating”.
- Use the appropriate specific veterinary formulations, which are usually more palatable than the human equivalent, and minimise the number of daily doses. Administration of the treatment should not be a source of anxiety for the cat or the owner, otherwise compliance will be compromised.
- If polypharmacy is unavoidable, giving the owner an agreed timetable specifying the times of administration of each drug will improve compliance. A pill dispenser can be given as it will make administration easier in many cats. If possible, the whole treatment can be included in one capsule, to facilitate the administration. Clearly explain the reason that each medication is being given and their potential side effects. Do not hesitate to provide written advice separately or on the prescription as this may be the only documentation that the owner will have once they return home.
- In certain clinical situations *e.g.* dehydration, hypovolaemia, general anaesthesia, intercurrent disease, or with drug combinations that have similar potential side effects, it may be wise to allow several days to elapse before starting each successive treatment. This should improve compliance and, if adverse effects occur, will help identify the drug responsible.
- Give clear instructions about whether to administer the drug with or without food, and if drugs can be given together.
- Certain drugs such as clindamycin or doxycycline can cause oesophageal stenosis if there is prolonged contact with the mucosa. It is recommended to give 10 mL water with a syringe after such medications to ensure rapid transit into the stomach.

B) Advice on the use of specific drugs in elderly cats

This section is not intended to provide an exhaustive description of the treatments that could be prescribed to elderly cats, but concentrates on a few common clinical situations where there is a high iatrogenic risk.

Medium to long-term use of non-steroidal anti-inflammatories

The use of NSAIDs in elderly animals is always potentially problematic and appropriate precautions should be taken, notably low dose and short duration for acute conditions. The dose can then be increased or the prescription prolonged as a function of the response, tolerance, and needs of the sick animal. NSAIDs are highly plasma protein bound (albumin notably), there is therefore a risk of an increase in the active fraction with hypoalbuminaemia, thus increasing the risk of adverse effects. Where possible, serum protein levels should be measured in elderly animals before NSAIDs are prescribed. For the same reason, other substances that are strongly plasma protein bound could compete with NSAIDs for binding sites, thus increasing the potential for toxicity. All NSAIDs should be avoided in dehydrated, hypovolaemic, or hypotensive cats due to the increased risk of renal toxicity. These situations are not uncommon in elderly animals, owing to intercurrent disease or treatment (diuretics for example).

Irrespective of their mode of action different types of anti-inflammatories should not be used in combination (especially NSAIDs or corticosteroids) due to the increased risk of gastrointestinal ulcers and haemorrhage (additive toxicity).

Use of NSAIDs with heparin or other anticoagulants is generally contraindicated due to the increased risk of haemorrhage.

The use of diuretics (in particular furosemide) or NSAIDs and angiotensin converting enzyme II (ACE) inhibitors has the potential to cause acute renal failure, particularly in elderly or dehydrated animals and this combination should be used with care (**Figures 4 and 5**). When used, the drugs should ideally be introduced one at a time. Close patient monitoring is advisable (IV fluids and measurement of renal parameters) with the cat hospitalised if necessary.

Guidelines for the use of corticosteroids and corticosteroid-sparing therapy in elderly cats

Corticosteroids have numerous indications and sometimes long-term administration is required (dermatology, oncology, inflammatory gastrointestinal or respiratory disease) even in elderly cats. Side effects of corticoste-

roids can be significant and severe, especially with prolonged use. Adverse effects include:

- insulin resistance,
- iatrogenic Cushings,
- skin fragility,
- heart failure,
- hypertension.

Use of corticosteroids is incompatible with diabetes mellitus or arterial hypertension, which are often encountered in elderly cats. It is therefore advisable to try and use glucocorticoid sparing strategies if corticosteroid treatment proves necessary:

- Depending on the disease in question, consider complementary therapies rather than using higher doses of corticosteroids: for example topical skin care (shampoos, lotions) and hypoallergenic/novel protein

diets in cases of dermatological disease, specific diets for gastrointestinal disorders, etc. Such therapies serve to minimise the steroid-sensitive clinical signs reducing the required dose of corticosteroids.

- When steroids are unavoidable, route of administration can be important. For example, for some localised skin diseases, particularly in areas with little fur covering (lips, eyelids, anus, interdigital spaces, etc.), topical steroids can be used. Even with topical therapy significant systemic absorption can occur and the minimal effective dose should be used along with adjunctive therapies. Glucocorticoid diesters such as hydrocortisone aceponate seem to have very few systemic effects (degradation within the superficial dermis) whilst exerting a powerful cutaneous anti-inflammatory action. The major advantage of topical steroids is obviously to limit secondary effects (and lower costs). The prolonged use of fluorinated topical steroids can provoke

Effect of ACEI and NSAIDs on the renal blood flow.

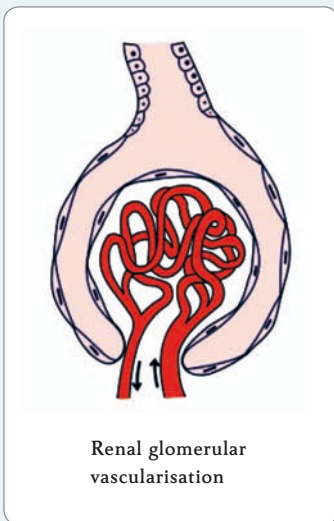


Figure 4. Normal renal blood flow.

The glomerular filtration rate is maintained thanks to the tone of the efferent arteriole under the influence of angiotensin II.



Figure 5. Association of ACEI/NSAIDs.

Afferent arteriole undergoes vasoconstriction following the inhibition of prostaglandins by the NSAIDs and the efferent arteriole undergoes vasodilation following the inhibition of angiotensin II by the ACEI. The theoretical result is a drop in the glomerular blood pressure and therefore glomerular filtration rate. Recent studies (Gowan, 2011 & 2012) with meloxicam show that it can be used over periods of 6 months, even in cats with chronic kidney disease (IRIS stages II and III) that are clinically stable. However, care should be taken over the increased risk of gastrointestinal toxicity in the event of slowed elimination with renal disease.



cutaneous atrophy, the appearance of comedones, or calcinosis cutis, and secondary infections. Tacrolimus, a T-lymphocyte inhibitor is an alternative topical skin treatment to corticosteroids. Use has primarily been described in dogs. However, its price is often restrictive for more widespread use. The use of inhaled corticosteroids is also strongly advised in the chronic treatment of feline asthma. These drugs need to be administered in conjunction with a spacer device such as “Aerokat” (Figure 6). Inhaled fluticasone has less systemic absorption than beclomethasone.

- With systemic corticosteroids, the clinician should always seek to find the minimal effective dose, which should reduce, or even eliminate, any secondary effects. It is standard practice once a therapeutic effect has been achieved, to progressively reduce the daily dose (after 3 to 10 days at the full dose) or to reduce the frequency of administration (alternate days, then 1 to 2 times per week, or administration of repeated courses of a few days per month for example). Swapping to another corticosteroid may also lead to fewer side effects. The onset of polyuria-polydipsia with prednisolone (0.5-1 mg/kg/day for general use and 1-4 mg/kg/day in the treatment of neoplastic or immune-mediated diseases) would be an indication for swapping to methylprednisolone (0.4-0.8 mg/kg/day), dexamethasone (0.04-0.1 mg/kg/day then twice weekly), or triamcinolone (0.08-0.2 mg/kg/day). Methylprednisolone has a less marked mineralocorticoid effect, thus provoking less polyuria-polydipsia.
- Alternatives to corticosteroids that have anti-pruritic, immunomodulating, or anti-neoplastic effects are available and should be considered (Olivry, 2003). For allergic pruritus or feline asthma, antihistamines can be used. Whilst response is variable, they can prove effective with a very good safety margin (41% improvement in pruritus in a recent study (Griffin, 2012) using cetirizine at 5 mg/cat/day). Corticosteroids form part of the treatment protocol in many neoplastic conditions, notably lymphoma and mast cell tumours, although the latter are less common in cats. However, they should not be used in cases of incompatible intercurrent disease, and in all cases, the dose rate should be progressively reduced after the induction phase. Treatment for mast cell tumours, for example, can also include conventional chemotherapy (lomustine, vinbla-



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Figure 6. Picture of an “Aerokat” used to administer drugs.

stine) or targeted therapies (masitinib, toceranib, both off-label in cats). The avoidance or at least reduction in corticosteroid use is therefore possible.

- Immunosuppressive corticosteroids (prednisolone 2 to 4 mg/kg/day) are typically the first choice therapy in the treatment of immune-mediated diseases (chronic intestinal inflammatory disease for example). Again, it is essential to aim for the minimal effective dose and to seek alternatives: the latter may replace corticosteroids altogether or enable a reduction in dose. The two main choices are:
 - **Chlorambucil** (2 mg/day every 48 hrs for cats > 4 kg; 2 mg/cat/day every 72 hrs for cats < 4kg), which has the advantage of being well tolerated in cats, even with prolonged use. It is primarily used to treat chronic intestinal inflammatory disease and low-grade gastrointestinal lymphomas. Splitting of tablets is not recommended other than by a compounding pharmacy.
 - **Ciclosporin** is another option, starting at 5 mg/kg/day for 4 to 8 weeks (onset of therapeutic effect can be quite slow) then progressively reducing the dose, to control immune-mediated inflammatory conditions. Ciclosporin is reputed to be far less toxic than corticosteroids, but it does have some significant side effects that should be monitored: gastrointestinal or eating disorders, weight loss, gingival hypertrophy, a few rare cases of resurgence of toxoplasmosis have been reported that can prove fatal. The gastrointestinal signs usually regress spontaneously within a few days, but may require temporary cessation of the medication or administration in the food.

Treatment of hyperthyroidism and kidney disease

Hyperthyroidism in cats is known to be capable of masking the clinical and biochemical signs of renal disease or even inducing renal damage. Consequently, normotensive cats may become hypertensive after the beginning of hyperthyroid therapy associated with progression of their renal disease. In a recent publication, the onset of hypothyroidism following treatment (irrespective of the treatment) can contribute to the onset of renal disease and the cats in question had a shorter lifespan.

These findings suggest that there is value in starting treatment of hyperthyroidism medically, which is reversible, to confirm the benefit of treatment, and ensure that it does not reveal significant renal failure, before proposing definitive treatment such as surgery or radioactive iodine.

Furthermore, with medical treatment, because hyperthyroidism is a chronic disease to which the cat has compensated, gradual rather than sudden reduction in thyroid hormone levels is likely to be preferable as it allows the patient to adapt to the changing physiology.

Grooming and nutrition

Medical therapies play an important role in the management of disease in elderly cats, but are part of a global treatment strategy that should include lifestyle and dietary measures. Grooming is a fundamental element in the quality of life and well-being of the cat and their owner. Cats are naturally very clean animals, but obesity and/or disease can hinder self-grooming, the owner should therefore help (brushing, bathing if necessary, cleaning the ears, etc.). The cat will feel better and likely to be stroked and cuddled more, which will strengthen the emotional bond between cat and owner.

Diet is also crucial in the treatment of the elderly cat, whether healthy or not. Diets aimed towards optimising nutrition for advancing age as well as many chronic degenerative and inflammatory disease are available. Awareness of such diets is important, as the impact of diet on the cat's health can be profound.

In cases of inappetence or anorexia, nutritional support is strongly recommended, preferably enterally. To stimulate oral intake, highly palatable and warmed foods are

preferred. Tube feeding may be necessary if oral intake is insufficient. Placement of a nasoesophageal tube is a good choice for short-term feeding but an oesophagostomy tube is better for long-term feeding. Energy requirements must be determined for each cat and an individual feeding plan developed.

3/ Monitoring therapy in the elderly cat

A) Frequency of check-ups

Irrespective of the treatment, it is advisable to schedule regular check-ups with the owner. These will reassure the owner and enable early intervention if there are any complications or a change in dose rate required (side effects, inefficacy of the treatment, unfavourable clinical progression, etc.). Depending on the client, some follow-up can be made over the phone or via e-mail, which can be quicker, less expensive for the client and avoid the necessity of travelling the cat.

- Perform regular monitoring, but not too often so that you do not overwhelm the owner (2 to 3 times per year if there are no specific issues).
- At each visit, go over the list of current medications again and evaluate their actual necessity depending on the cat's clinical response and the owner's evaluation.
- Do not hesitate to propose blood tests to monitor plasma concentrations where such tests are available (digoxin, phenobarbital, bromides, etc.).
- Do not stop treatment too early if it is working.
- Think of making a pharmacovigilance declaration if undesirable side effects occur or even if a treatment proves ineffective.

Educating the client is an important part of therapy. The requirements for monitoring should be outlined from the start to ensure the owner's compliance. This is especially important in terms of the financial and time constraints involved in regular visits to the veterinary surgery.

B) Evaluation of quality of life under treatment

Quality of life assessment is particularly important in oncology cases, and is the end point of any treatment protocol in elderly cats. Neoplasia often requires aggressive treatments with a significant potential for side effects that is a legitimate cause of concern for owners. It is the veterinary surgeon's responsibility to inform the owners of the potential risks and side effects and answer their questions as objectively as possible. Several owner satisfaction surveys (**Figure 7**) have been conducted that have shown the importance of good communication with the owner (Slater, 1996).

When the animal's well-being is satisfactory, potential side effects have been anticipated and understood by the owners, and the financial costs and necessity for repeat examinations and treatments have been communicated before the start of treatment, owners are generally very satisfied with anticancer therapies.

Factors for dissatisfaction essentially stem from the owner's overestimation of the life expectancy of their animal (30%), or an underestimation of the financial costs (27%), number of visits necessary (13%), or side effects (10%).

A study conducted with 27 owners of cats under treatment for lymphoma revealed that 78% were apprehensive about chemotherapy and that 85% were satisfied with it. 78% percent reported that chemotherapy required great availability of time and money, but 55% said that cost was not the limiting factor. Other studies also reveal a positive perception of chemotherapy by owners of cats under treatment for lymphoma. In some cases, the use of indwelling catheter can help by reducing the stress associated with the monitoring and administration of chemotherapy.

Quality of life during treatment is a critical factor for most owners. To this effect, two different attitudes are currently encountered. Some owners refuse conventional anticancer therapies for their animal due to:

- personal philosophy,
- ethical reasons (access and cost of these therapies in man),

- the fact that all therapies are palliative.

These owners however often demand "alternative" solutions; as they seek other ways of helping their pets. Phytotherapy, homeopathy, osteopathy, and acupuncture are possible solutions. Other owners are able to accept the advantages of conventional anticancer therapies in dogs and cats and the demands that accompany therapy. For these owners, biotherapies offer a supportive solution for the animal: improved immune defences, improved recovery from each chemotherapy and improved quality of life. This evolution towards preserving quality of life above all mirrors current trends in human medicine. In addition, veterinary surgeons also have the option to offer euthanasia if quality of life becomes too poor despite treatment.

C) Deciding when to stop treatment...

This involves knowing the point at which treatment has reached the limits of efficacy and/or difficulty of administration becomes a critical factor. The limit of effective treatment is extremely subjective and is defined by the onset of physical or mental suffering. This includes not only the cat, but also their owner and the whole family. In collaboration with the owner, the veterinary surgeon must try to evaluate the degree of patient suffering. The

Figure 7. Factors of dissatisfaction of the cat owner.

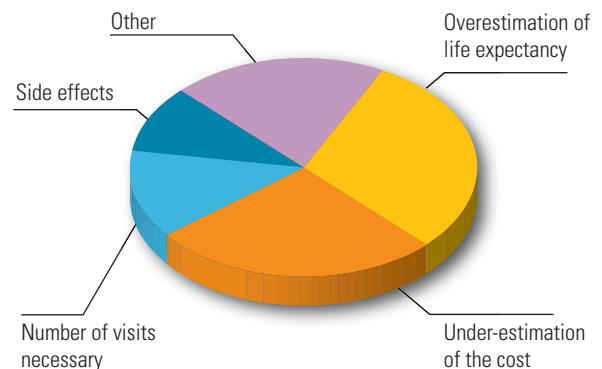


table below summarises the various criteria that should be taken into account.

Key criteria for decision making to cease treatment

- Poor short-term prognosis.
- Absence of additional therapeutic choices.
- Marked reduction in quality of life (appetite, sleep, alertness, cleanliness).
- Presence of pain-related behaviours.

Owners are often concerned that they will not recognise the moment when their pet starts to suffer. Specific questions will help you and the owner define the current quality of life their cat is experiencing:

- Are the good days more common than the bad?
- Does the cat still do things that gave it pleasure in the past?

- Could you describe a typical day for your cat?

This is where serial monitoring has its great strength and where the quality of life survey has real benefit to compare the owner assessment at the very beginning of the disease with their current assessment (see quality of life survey on **page 12**).

Conclusions

Changes in the pharmacokinetics and pharmacodynamics of drugs that occur with ageing necessitate a certain degree of caution when therapy is prescribed. However this principle of caution should not be abused and lead to hesitation in using a treatment that could be beneficial to the animal. The iatrogenic risk of the majority of veterinary drugs in elderly patients remains low. Altering the dose rate in elderly patients is generally not justified, with the exception of drugs with a narrow therapeutic index or where there is known intercurrent disease.

5. Frequently asked questions from vets and owners (FAQs)

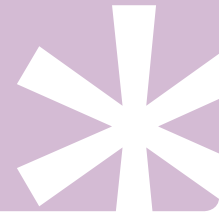
> SUMMARY

FAQs from vets

- A) Are infectious diseases important in ageing cats?
- B) Tips on sedating old cats
- C) How to improve the hospitalisation experience of an elderly cat
- D) What can we do for old cats with cancer?
- E) Heart murmurs in old cats – are they significant?

FAQs from owners

- A) Is it worth vaccinating and worming older cats?
- B) My cat urinates/defecates outside the litter tray. What should I do?
- C) How do I introduce a new cat to the household?



1/ FAQs from vets

A) Are infectious diseases important in ageing cats?

Infectious diseases can be a significant possibility in elderly cats as they have reduced immune function and often their vaccinations have lapsed as owners are not aware of the need to vaccinate an older cat.

Infectious disease more commonly affects younger cats especially those under 2 years of age but the following diseases should be considered in older cats.

Feline infectious peritonitis

There is a second age peak in cats over 10-years-old (Scherck, 2003). This can result in elderly cats, even if they have been kept indoors for years, presenting with

either the classical picture of a wet form or the various presentations of the dry form of FIP. The diagnostic approach is the same regardless of age.

Feline leukaemia virus infection and feline immunodeficiency virus infection

The prevalence of feline leukaemia, which is caused by FeLV, has clearly declined in Europe and the USA over the past two decades; in Germany from 6% to 1% between 1993 to 2002. However, there are considerable regional variations in prevalence; within Europe, between 1 and 15.6%. The reason(s) for this decline are unclear, but are likely to be due to increased screening for FeLV and the increased use of FeLV vaccinations. Variations in disease incidence can be very localised presumably reflecting an infected cat in a particular area that is efficiently spreading the virus.

Current data available on the prevalence of FIV infection is rather more difficult to understand with distinct

regional variation. Prevalence figures reaching almost 50 percent are quoted for individual populations. FIV infection has less influence on longevity than FeLV, and FIV-infected cats can live into old age hence FIV is more commonly diagnosed in the elderly cat population.

Irrespective of this, the FeLV/FIV status of each and every cat should be known. In free-roaming cats, their infection status can change over time. It would be desirable, as suggested by ABCD, to test cats yearly at vaccination; sadly, most owners are not prepared to do this.

It is difficult to distinguish the clinical signs associated with FeLV infection from those of FIV infection. Once a cat has become infected with a retrovirus, other co-infections can arise, for example with mycoplasma or toxoplasma. In the authors' experience, old cats infected with FeLV generally present with severe disease of the haematopoietic system.

In the case of sick animals, particularly free-roaming cats, the current FeLV/FIV status should be recorded during the initial examination. To detect both infections there

are handy ELISA/RIM quick tests, either for the p-27 antigen of FeLV or for the antibody test against FIV.

For both FIV and FeLV tests examinations:

- the less severe the patient's symptoms and the less widespread the prevalence of the infection, more likely the test will give a false-positive result,
- the lower the positive predictive value, the more important it is to request a confirmation test:
 - for a positive FeLV test, depending on the patient's symptoms, either the ELISA/RIM test should be repeated after four weeks or an immune fluorescence assay and/or PCR examination requested,
 - for a positive FIV test, PCR is the confirmation test of choice.

Feline haemotropic mycoplasma infections

Caused by *M. haemofelis*, *Candidatus M. haemominutum*, and *Candidatus M. turicensis*. Where infection leads to clinical signs, cats present with dehydration, anorexia, anaemia, intermittent fever, weight loss and apathy. Many cases are co-infected with FeLV or FIV. The test of choice is PCR. It is important to note that prior treatment

Table 1. Suggested drugs and dose rates suitable for sedation of older cats.

Agent	Dose rate	Route	Level of sedation and pain relief	Risks
Acepromazine + buprenorphine	0.01-0.02 mg/kg 0.01 mg/kg	s/c, i/m or i/v	Mild	ASA ⁽¹⁾ 1-3
Acepromazine + butorphanol	0.01-0.02 mg/kg 0.15-0.2 mg/kg	s/c, i/m or i/v	Mild	ASA 1-3
Acepromazine + methadone ⁽²⁾	0.01-0.02 mg/kg 0.2-0.3 mg/kg	i/m or i/v	Mild-moderate	ASA 1-3
Medetomidine ⁽³⁾ + ACP + opiate	5-10 mg/kg Can be repeated once	i/m or i/v	Moderate	ASA 1-2 Normal cardiovascular function
Midazolam + ketamine	0.15-0.2 mcg/kg 5 mg/kg	i/m or i/v	Moderate to marked	ASA 2-4 Not cats with HCM
Methadone ⁽¹⁾	0.2-0.3 mg/kg	i/m	Variable	ASA 4-5

(1) American Society of Anaesthesiologists - see Table on page 56 for ASA categorisation.

(2) Can substitute with slow i/v morphine 0.2-0.4mg/kg (excitement more likely).

(3) Use half the dose rate for dexmedetomidine.

with doxycycline or gyrase inhibitors leads to a reduction in the mycoplasmas found in the blood. The concentration of pathogens can drop below the limit of detection, in which case the PCR will give a negative result. Even in untreated cases, the number of mycoplasma present waxes and wanes so that antigen is not always detectable in the blood by means of PCR.

B) Tips on sedating old cats

Before sedating an elderly cat the clinicians should ask themselves the following:

- Is sedation my best option or would manual restraint or general anaesthesia be better?
- Would handling be improved in a quieter environment with the use of pheromones, wrapping or a cat muzzle and gentle but firm restraint such that sedation would become unnecessary?
- How long do I need the sedation to last?
- For what procedure am I sedating the cat?
- What route am I going to use?
- What is my plan if the sedation is insufficient for the procedure?

Specific issues of sedation in older cats

Older cats are more likely to:

- be underweight with reduced body fat affecting drug distribution and requiring relatively more sedation on a body weight basis,
- have renal and hepatic disease and low muscle mass that will affect metabolism and excretion of sedative agents,
- become hypothermic during sedation due to low body fat,
- be dehydrated that will:
 - affect s/c absorption,
 - cause hypotension,
- Have other intercurrent especially cardiovascular disease that will affect their response to sedation.

Which drugs should I consider?

See **Table 1** on **previous page**.

Sedation can be combined with local/regional anaesthesia.



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Figure 1. Provision of sufficient bedding within the cage improves patient comfort.

American society of anaesthesiologists (ASA) categories

1. Normal healthy cat.
2. Cat with mild systemic disease.
3. Cat with severe systemic disease that is not incapacitating.
4. Cat with severe systemic disease that is a constant threat to life.
5. Moribund cat not expected to survive 24 hours with or without operation.

C) How to improve the hospitalisation experience of an elderly cat

Hospitalising any cat is a challenge for the veterinary surgeon. It may seem an impossible feat to make a territorial animal feel comfortable outside its territory. However, there are several strategies that will help maximise their comfort:

- providing somewhere to hide (box or igloo),
- enough space for water, a litter box and the aforementioned hideaway,
- resting places at different heights (platform, box),
- use of synthetic pheromones (F3),
- Familiar items (owner's clothing, toys).

Generally, cats should not be placed opposite cages housing dogs, in noisy places or where clinic staff are constantly coming and going. Some cats need more attention than others and some even need someone to play with them regularly.

In addition to these environmental requirements, an elderly cat should be looked on as a patient that is predisposed to hypothermia (lower body weight; less fat and less muscle to generate heat) making it important to provide additional heat particularly in the postoperative period.

In the case of cats with osteoarthritis, the floor of the cage should be padded as much as possible (**Figure 1**) and the patient should be allowed out of the cage every day to exercise their joints. If this is not possible, the joints should be exercised passively with physiotherapy, inside the cage.

The need for analgesia should be considered in almost all older cats requiring hospitalisation. In general, opioids are safest, especially if the patient has renal disease. The nutritional intake of hospitalised elderly cats should also receive careful attention as the natural tendency of cats to refuse to eat whilst hospitalised is amplified by a reduced sense of taste and smell as well as reduced ability to cope with change. As many cats reduce a significant amount of moisture through their food and the ability of elderly cats to concentrate their urine may be compromised, poor nutritional intake increases the risk of dehydration developing.

In cats requiring multiple blood sampling during a hospitalisation period lasting several days, a central line is a good solution. This will avoid repetitive venipuncture and receive the accompanying stress suffered by the cat. It's important to consider whether placing both a central line and an oesophageal feeding tube are appropriate if the patient is being anaesthetised for other procedures.

Finally, patients receiving fluid therapy for a condition involving polyuria/polydipsia should be weighed regularly to adjust the infusion rate to the real fluid balance, and not a theoretical calculation. Fluid balance can be more difficult to achieve in patients with cardiovascular disease or hypoproteinaemia associated with gastro-intestinal, hepatic or renal disease as they may be more predisposed to oedema.

D) What can we do for old cats with cancer?

Tumours are one of the most common causes of death in cats (**Figure 2**). Lymphoma is the most commonly diagnosed tumour accounting for nearly two thirds of all neoplasia in the cat. Lymphoma is a group of malignant haematopoietic tumours that develop from within solid organs (unlike lymphoid leukaemias which originate in the bone marrow). The primary (thymus) and secondary haematopoietic structures (lymph nodes, spleen, intestinal lymphoid tissue) are the most common sites for neoplastic transformation. However, the tumour can also develop in any anatomical location containing lymphoid tissue.

As a result, the disease is polymorphic, and accompanied by a wide range of clinical signs. Lymphomas are thus a central issue in feline internal medicine and should be considered as a differential diagnosis in numerous different clinical presentations. Diagnosis can be confirmed by cytology or histology. Cytological diagnosis is achieved in nearly three quarters of cases, it is therefore worthwhile taking repeated fine needle aspirates of any suspicious lesions. Where possible, biopsy confirmation is recommended. The response to treatment is generally less satisfactory than in the dog (regardless of chemotherapy protocol, remission rates of 50-70% and median remission times of 4-6 months are reported in cats). How-



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Figure 2. Squamous-cell carcinoma of the frenulum of the tongue.

ever, in an individual case, it is impossible to predict and in some cases response can be excellent with cats in complete remission after induction for extended periods (several years). These unpredictable responses make it worthwhile trying to encourage owners to initiate treatment. Chemotherapy is well tolerated in most cases, and a decision whether or not to continue chemotherapy can be made after assessing the initial response. However, location and type of lymphoma might influence the prognosis.

Skin tumours are the second most common form of neoplasia, representing 20 to 30% of tumours in cats. Around 70% of these skin tumours are malignant; far higher than in the dog. The most common skin tumours in cats are fibrosarcoma complex and epidermoid carcinoma. Fibrosarcomas can be triggered by trauma to the subcutaneous connective tissue, justifying serious consideration of the risk/benefit ratio of any injections in the cat. Treatment has to be aggressive with wide, even radical, surgical excision together with adjunctive radiotherapy, and sometimes chemotherapy. The role of ultraviolet light in the development of epidermoid carcinoma has been clearly proven, thus cats with white or lightly pigmented coats are markedly predisposed. Pre-cancerous lesions of solar keratosis have been described, subsequently progressing towards carcinoma *in situ* (preserving the basal membrane) and thence to a highly infiltrative tumour, often resulting in a spectacular loss of condition. The treatment is primarily based on early and wide surgical resection as tumour spread is predominantly locally with distant metastases occurring in less than 10% of cases.

E) Heart murmurs in old cats – are they significant?

In old cats, heart murmurs are common and associated with changes in cardiac position (**Figures 3a & b**) and the frequency with which regional thickening of the interventricular septum occurs (**Figure 4**). Listen parasternally on the left.

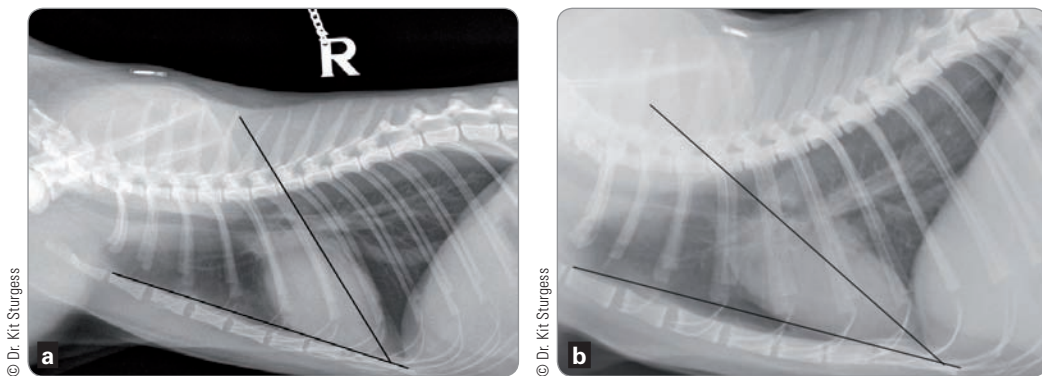
The intensity of the murmur can be rate-dependent, getting louder at faster heart rate.

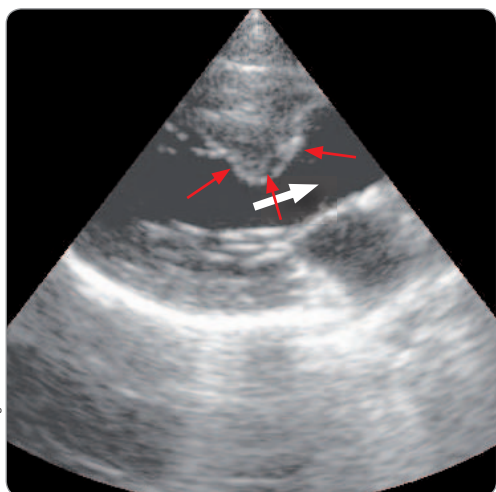
As cats are very secretive about their diseases, it can be very hard to assess the significance of a heart murmur, particularly in an older cat that may be expected to be less active, sleep more and find jumping more difficult.

Historical and physical finding that would increase the likelihood that a cardiac murmur is significant:

- tachycardia – rate above 200 bpm in the consulting room,
- presence of a gallop rhythm is more closely associated with significant cardiac disease than a murmur,
- presence of a rhythm disturbance,
- poor femoral pulse quality,
- mucosal pallor,
- reduced ability to exercise or increase in inactivity beyond normal for cat's age and previous history,
- hypotension,
- hypertension particularly associated with renal disease or hyperthyroidism,

Figure 3 (a). Relatively upright position of the heart in a young (18-month-old) cat compared to the cranial rotation seen in the heart of a geriatric (15-year-old) cat (b).





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Figure 4. Focal interventricular septal thickening (basilar septal bulge) (thin red arrows) common in old cats that can result in left ventricular outflow tract (thick white arrow) turbulence and a murmur.

- respiratory rate at rest persistently above 24/minute especially if gradually rising.

Investigation:

- low sensitivity – radiography (cat not in congestive failure), ECG, routine blood tests,
- moderate sensitivity – cardiac biomarkers (cardiac troponin I; NT pro-BNP [see page 13]), low BP,
- high sensitivity - echocardiography.

2/ FAQs from cat owners

A) Is it worth vaccinating and worming older cats?

Both Europe [European Advisory Board on Cat Diseases (ABCD)] and the US [American Association of Feline Practitioners (AAFP)] have produced consensus recommendations for feline vaccination although neither is specifically targeted towards elderly cats. Both groups define different needs according to lifestyle *e.g.* indoor vs. outdoor dividing available vaccines between core, non-core and not recommended. These guidelines are general and need to be tailored to individual patients taking into account their medical history, previous res-

ponse to vaccination and local disease prevalence to develop a risk/benefit matrix:

- potential for toxicity or adverse reaction,
- likelihood of infection – lifestyle, movement of cats into the household, local disease prevalence,
- consequences of infection,
- costs of vaccination – can be significant particularly in multicat households.

Vaccination

Many older cats have little or no contact with other cats. The consequences of low contact are:

- risk of meeting infectious disease is low,
- stimulation of the immune system by meeting low level wild-type infection is low so anamnestic response will be poor.

This low risk needs to be balanced against:

- infection in an older cat with age-related reduction in the immune response and potentially other intercurrent disease,
- risk of a significant adverse vaccine reaction (approximately 0.1-0.01%),
- the effect that not vaccinating will have on the frequency of routine check-ups.

On balance for the majority of cases:

1. Wholly indoor cats with a stable household of ≤ 3 cats that receive routine health checks the risks/costs probably outweigh benefits.
 - These cats are particularly vulnerable if a new cat, especially a kitten is brought into the household.
2. Indoor/outdoor cats and/or where new cats enter the household and/or multicat households, the benefits outweigh the risks/costs.

Worming

Older cats that no longer hunt with good flea control are at low risk of endoparasitism although in some areas parasite transfer can occur through eating flies and mosquitoes. A study by Coati (2003) in German and French cats that were housebound showed an 18% prevalence for roundworm.

Endoparasitism is rarely clinically significant unless burden is high or the cat has significant other disease issues.

Veterinary licensed parasiticides have low toxicity and adverse reactions are rare; cost is low to moderate with the European Scientific Counsel Companion Animal Parasites (ESCCAP) and the Companion Animal Parasite Council recommending three-monthly deworming.

B) My cat urinates/defecates outside the litter tray. What should I do?

When a cat urinates/defecates outside the litter tray, regardless of the severity of the underlying cause, this leads to a stressful atmosphere in the home that an owner should resolve as quickly as possible. In general terms, inappropriate urination/defecation can be caused by cognitive, behavioural or medical problems (**Figure 1**).

Cognitive problems are diagnosed after exclusion, and are difficult to manage; some improvement can be achieved with antioxidant therapy, environmental changes and potentially drug therapy (selegiline or propentofylline). Behavioural causes are treated according to the underlying drivers but there are some common points that apply to both inappropriate urination and defecation:

- The number of litter trays in the house should be equal to the number of cats, plus one.
- The litter tray should not be covered, and its size should be suited to the cat's size.
- Litter trays should always be placed away from the cat's food/water bowl and where they sleep. As far as possible, litter trays should be away from noisy or busy places.
- Use unscented clumping litter.
- Clean the litter tray every day. Once a week empty it, wash it with water and bleach and then add fresh litter.
- Clean any place that the cat has soiled with enzymatic



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Figure 1. Spondylosis deformans of the lumbar spine is the main cause of inappropriate defecation in old cats.

or oxygen-based products or washing-up liquid; never use bleach or ammonia.

- Do not punish the cat for urinating or defecating outside its tray as this will only increase the problem or create a new one.

The measures above will resolve the problem if the litter tray is in the wrong place, dirty or there are odours that the cat finds unpleasant. However, in elderly cats, additional strategies may be needed due to age-related mobility problems:

- If the house has several floors, make sure there is one litter tray per floor.
- Place a "step" beside the litter tray to help the cat get into it.
- Consider whether pain relief is necessary.

Analgesia can be very beneficial for cats that defecate outside the litter tray as osteoarthritis can cause so much pain that the cat will not posture to pass faeces resulting in constipation.

Finally, in cat with inappropriate urination, especially if this is associated with polyuria, a urinary tract infection and/or urolithiasis should be ruled out by performing appropriate imaging and a urine culture.

C) How do I introduce a new cat to the household?

The life of an elderly cat is often calm and organised into a regular daily schedule, the more so, the older they are. The arrival of another cat should be carefully thought through, as it could become a source of lasting stress for the elderly resident cat. The introduction will probably be simpler and more stimulating if it is a kitten whose behaviour can be shaped, although their antics can sometimes annoy an older cat. Cohabitation with another adult cat with their own set habits can be more challenging. If both are male cats, even castrated, territorial fighting is highly likely.

It is important to ensure the health status of the new arrival and quarantine them if necessary – as the new arrival could be a viral carrier or excretor; if the origin of

the new cat is unknown FeLV/FIV testing should be considered. The new arrival should first be allowed to acclimatise alone in one room of the house, whilst leaving the empty cat carrier available to the resident cat until they lose interest. The behaviour of the older resident cat around the door of the room housing the new cat should be observed, to assess the intensity of their hostile reactions towards the latter. The use of pheromones might help the process and in rare cases the use of anxiolytics may be appropriate.

Little by little, the cats can be introduced to one another. If they start to fight, it is best to separate them by making a loud noise rather than trying to pick them up. Complete acceptance can take several weeks or even months with patience is therefore essential. The possibility that the introduction fails completely should be considered before introducing the new cat and a response planned should this occur.

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