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Domestic cats are a unique species, who display a range of behaviours and characteristics that are different from other domestic species encountered in the veterinary practice. In the cat with emergency or critical illness, for example, will display clinical signs and symptoms quite separate from their canine counterparts with similar disease processes. Both veterinarians and veterinary nurses/technicians must be aware of the unique physiology and behaviours of the feline patient when assessing them for illness, as failure to do so may result in undiagnosed illness, delays in diagnostics and treatment, and prolonged morbidity and increasing mortality.

The major point to emphasize regarding cats, is that they are very subtle in their manifestations of critical illness or disease, necessitating a full assessment of vital parameters in any cat that is “not doing well” to avoid missing serious underlying problems.

What follows in this seminar is a brief outline of common clinical signs and symptoms of the cat with emergency and critical illness, and how these are different from dogs. We will conclude with a brief description of some common emergency illnesses of cats.

**Cats Are Not Dogs 1: Symptoms of Hypovolaemic, Septic and Distributive Shock**

Shock is a clinical condition that results from the presence of inadequate delivery of oxygen to body tissues. A myriad of receptors in the body, such as pressure receptors in the carotid arteries, chemoreceptors in the brain and osmoreceptors in the brain etc., mediate a series of physiological responses via the sympathetic nervous system and adrenal glands that trigger alterations in heart rate, cardiac contractility and blood vessel tone (among other things) to help temporarily restore tissue perfusion to the brain, lungs, heart and muscles.

- In the dog:
  - Hypovolaemic and distributive shock progresses through several stages
    - Stage 1 (compensated shock) – characterized by the “adrenaline rush” – resulting in increased heart rate and pulse quality, increased respiratory rate and depth, alert mentation, and mucous membranes that are bright pink, with short capillary refill time
    - Stage 2 (early decompensated shock) – characterized by poor tissue perfusion and vasodilation throughout the body. This results in clinical signs of weak pulses, tachycardia, depressed mentation, and pale mucous membranes with prolonged capillary refill time
    - Stage 3 (end-stage shock) – characterized by very poor blood flow through tissues that eventually results in tissue death in capillary beds. This results in what is termed a “no flow” of blood through tissues, and causes symptoms of severe depression, unresponsive to fluid therapy and oxygen supplementation, poor pulses, rapid or slow heart rate, low body temperature etc., among other symptoms such as vomiting, diarrhoea, poor urine production and death.
  - Septic shock
    - Early Septic Shock - is characterized in the dog by many of the symptoms described in hypovolaemic and distributive shock above, with the addition of
• Bright pink to (occasionally) red mucous membranes
• Bounding pulses
• A source of sepsis/infection such as a bite wound, pancreatitis, severe enteritis etc.
  ▪ Late Septic Shock – is characterized by poor vascular tone, and increased capillary permeability, leading to loss of fluid and protein from the systemic circulation into body tissues. Symptoms include the following
    • Tachycardia, often poorly responsive to IV fluid administration
    • Poor pulse quality
    • Pale mucous membranes
    • Dull mentation
    • Elevated or depressed body temperature
    • Coagulopathy/bleeding
    • Vomiting diarrhoea
    • The presence of oedema
      o Pulmonary – increased respiratory rate; rales and crackles on lung auscultation
      o Peripheral – subcutaneous fluid accumulation in gravity-dependent tissues and limbs

• In the cat:
  o Hypovolaemic shock, as well as other forms of shock such as septic shock and distributive shock result in a unique constellation of clinical signs that is quite different from those described above for dogs, that do not follow the classical “stages of shock” frequently described for dogs, and includes the following...
    ▪ Poor pulses
    ▪ Prolonged capillary refill time
    ▪ Cold extremities
    ▪ Hypothermia
    ▪ Tachycardia or...
    ▪ Bradycardia – this is a unique finding in cats, particularly in advanced hypovolaemic shock and in septic shock
    ▪ Abdominal pain – regardless of the presence or absence of abdominal disease
    ▪ Dull or quiet mentation
Cats Are Not Dogs 2: The Treatment of Shock

- Cats have a smaller blood volume as a percentage of bodyweight than dogs
  - Cats: 4-6%
  - Dogs: 6-9%
- Smaller blood volume means that the potential volume of fluid required to treat shock is smaller in cats than dogs – 40-60 ml/kg in the cat as opposed to 60-90 ml/kg in the dog.
  - Using bolus fluid therapy to treat shock in the dog, we use 10 ml/kg IV in 10 minutes (60 ml/kg/hr) repeated until clinical signs of shock resolve
  - Using bolus fluid therapy to treat shock in the cat, we use 7 ml/kg IV in 10 minutes (42 ml/kg/hr) repeated until clinical signs of shock resolve
  - If colloids such as hydroxy-ethyl starch are used as an adjunct to treating shock, the doses are different for dogs and cats too...
    - Dogs: 5 ml/kg IV over 10 minutes
    - Cats: 3 ml/kg IV over 10 minutes

Cats Are Not Dogs 3: Pulmonary Blood Pressure!

The feline lung is different from the canine lung in several key aspects regarding trauma and critical illness...

1. Pulmonary arterial blood pressures in healthy cats are between 5 and 15 mm Hg higher at rest than they are in dogs. Because of this, small increases in pulmonary arterial pressure rapidly result in the potential development of capillary wall damage, leading to inflammation, and extravasation of fluid into the pulmonary interstitium and alveoli. Increasing Starling’s forces, with the subsequent development of pulmonary oedema also contribute to the early development of respiratory compromise when compared to canine patients. Potential causes of elevated pulmonary arterial pressure include
   a. Excessive intravenous fluid therapy
   b. Increased sympathetic nervous system discharge due to hypoxia, seizure activity etc.

The physiology of the feline lung, and the increased likelihood of pulmonary interstitial and alveolar oedema development have led to the feline lung being described as a “shock organ” – not a particularly useful term – but one that describes the sensitivity of the feline lung to excess lung water in emergency and critical illness.

What does this mean for us as veterinary professionals when treating the cat with trauma or critical illness? In many textbooks, when talking about rates of intravenous fluid therapy to administer to cats with shock, or lung diseases such as pulmonary contusions, pneumonia etc., and in cats with seizures or neurogenic pulmonary oedema, the phrase “judicious use of IV fluids” is used to reflect a need to administer sufficient fluids to resolve shock, and restore normal tissue perfusion, but to avoid excessive fluid administration that may result in pulmonary oedema. This is usually done by following the following algorithm

   a. Manage shock using small volume resuscitation protocol as outlined above using lactated ringer’s solution 7 ml/kg IV over 10 minutes, followed by a single bolus of a synthetic, large-molecular weight colloid such as hydroxy-ethyl starch at 3 ml/kg IV over 10 minutes, followed by boluses of lactated Ringer’s solution to effect.
   b. After treatment of shock, reduce crystalloid fluid rate to maintenance rates to avoid excess fluid accumulation in the lung tissue. Addition of synthetic colloids such as hydroxy-ethyl starch at rates of 10 ml/kg/day may be used to provide colloid oncotic pressure in patients with trauma or inflammatory/infectious disease.
Cats Are Not Dogs 4: Respiratory Distress!

Cats are quite different to dogs when presenting with respiratory disease. Whereas dogs often display open-mouth breathing, loud respiratory noises, or profound behavioural changes – depending on the location of their respiratory disease, cats are much more subtle in the clinical manifestations of respiratory disease. Frequently, the only change noted – even in the presence of severe, life-threatening respiratory compromise – is an increased respiratory rate. Careful patient observation and assessment is often required in order to diagnose and manage the cause of the respiratory illness.

Typical clinical signs of cats with severe respiratory distress are as follows...

- Lethargy
- Sternal recumbency posture – with a reluctance to move
- Rapid breathing
- Shallow breathing
- Deep breathing/exaggerated chest wall movements
- Open-mouth breathing
- Violent posture changes
- Fluid present at the nares
- Cyanosis
- Respiratory sounds (occasionally)
- Respiratory failure and death when the patient is handled, manipulated or stressed

Cats in respiratory distress, despite the apparent subtlety of their clinical signs, will frequently rapidly decompensate, and may acutely die if handled or approached incorrectly. An approach to managing these cats is outlined in brief below...

1. Provide minimal restraint
2. Provide oxygen supplementation via fly by or oxygen cage for 10 minutes to allow the patient to recover from the stress of transport
3. Observe breathing pattern and effort
   i. Attempt to localise the disease to upper airway, lower airway (bronchi), pulmonary parenchyma or pleural space disease
      1. Prolonged or noisy inspiratory efforts are more commonly associated with upper airway disease
      2. Prolonged exhalation with crackles and/or wheezes +/- cough are commonly associated with lower conducting airway disease e.g. bronchial disease such as Feline Asthma
      3. Tachypnoea with increased lung sounds is usually indicative of pulmonary parenchymal disease e.g. congestive heart failure
      4. Tachypnoea with either deep or shallow breathing, +/- abdominal component, combined with reduced lung sounds is indicative of pleural space disease such as pneumothorax, diaphragmatic hernia or pleural fluid accumulation
   ii. Develop a “feline” differential diagnosis list for the airway breathing pattern
      1. Upper airway disease:
         a. Rhinitis – due to infections, foreign body, coagulopathy, dental disease (with oronasal fistula) etc.
         b. Nasal neoplasia or polyp
         c. Laryngeal paralysis
         d. Pharyngeal or laryngeal neoplasia e.g. squamous cell carcinoma, lymphoma
2. Lower airway disease (wheeze, cough)
   a. Feline asthma – is the most common cause of lower conducting airway inflammation

3. Pleural space disease
   a. Congestive heart failure (murmur or gallop rhythm is frequently auscultated) with pleural fluid accumulation
   b. Pyothorax
   c. Pneumothorax
   d. Chylothorax
   e. Haemothorax
   f. Diaphragmatic hernia

4. Pulmonary parenchymal disease
   a. Cardiogenic pulmonary oedema (congestive heart failure) – heart murmur or gallop rhythm is frequently auscultated
   b. Non-specific inflammatory lung disease (aspiration pneumonia is quite uncommon, but acute inflammatory pulmonary parenchymal lung disease is common in inflammatory diseases such as pancreatitis, sepsis, infection etc.)
   c. Neoplasia
   d. Atelectasis
   e. Near drowning
   f. Pulmonary contusions

iii. Acute Management of Respiratory Distress in the Cat
1. Upper airway disease
   a. Fly-by oxygen therapy
   b. Mild sedation with butorphanol 0.05-0.2 mg/kg SC or IV
   c. Endotracheal intubation under light anaesthesia
   d. Tracheostomy if intubation not possible

2. Lower airway disease
   a. Fly-by oxygen
   b. Mild sedation with butorphanol 0.05-0.2 mg/kg SC or IV
   c. Corticosteroid therapy: methylprednisolone sodium succinate 3-5 mg/kg IV, or inhaled corticosteroids (Fluticasone inhaler; 1 puff = 120-220 micrograms q 12 hrs.)
   d. Bronchodilatation: albuterol (inhaler; 1 puff = 100 micrograms) q 30 minutes; or Terbutaline 0.01 mg/kg IV/IM/SC q 8 hrs.

3. Pulmonary parenchymal disease
   a. Oxygen supplementation
   b. Mild sedation with butorphanol 0.05-0.2 mg/kg CS or IV
   c. Endotracheal intubation if SpO2 <90% whilst the patient is on supplemental oxygen, or if the patient is suffering severe dyspnoea
   d. Perform radiographs once the patient is stable to assist in diagnosing the underlying disorder
   e. If cardiac disease suspected
      i. Furosemide 2-4 mg/kg IV or IM q 4 hrs.
      ii. Glyceryl tri-nitrate oral spray: 1 spray PO q 1-2 hrs. PRN
      iii. ACE inhibitors e.g. benazepril
      iv. Beta blockers e.g. atenolol
   f. If pneumonia is suspected
i. Antibiotics: amoxicillin-clavulanic acid; ticarcillin/clavulanic acid
ii. Bronchodilator therapy (controversial): Terbutaline
iii. Mucolytic therapy (if patient is coughing): acetylcystiene

g. Pulmonary contusions
   i. Oxygen therapy
   ii. Analgesia
   iii. Judicious use of IV fluids

h. Smoke inhalation
   i. Oxygen therapy
   ii. Bronchodilators
   iii. Ventilation therapy

i. Parasitic pneumonitis
   i. Fenbendazole
Diagnostic Flow-Chart for Feline Respiratory Disease

Cat with Respiratory Distress

Loud Sounds?

- Yes: Upper Airway Disease Most Likely
- No: Increased Lung Sounds, Crackles or Wheezes?
  - Yes: Low Temperature, Gallop Rhythm?
    - Yes: Likely Heart Disease
    - No: Airway or Non-Cardiogenic Disease Most Likely
  - No: Dull Lung Sounds; Abdominal Effort in Breathing?
    - Yes: Pleural Space Disease
    - No: Airway or Non-Cardiogenic Disease Most Likely
Cats are Not Dogs 5: Thoracic Radiographs!

Cats’ lungs are unique – especially when imaged with radiography. The classical peri-hilar alveolar-interstitial densities seen in dogs with congestive heart failure, for example, are rarely identified in cats, among several other unique features of the cat lung. Below is a short description of radiographic findings in the most common feline respiratory conditions observed in the emergency centre...

1. Cats with pulmonary parenchymal disease typically have combinations of interstitial and alveolar abnormalities on thoracic radiography. The distribution of these non-specific infiltrates, however, may assist in determining the cause of respiratory distress.
2. Diffuse or caudo-dorsal infiltrates: viral pneumonitis or neurogenic pulmonary oedema
3. Cranio-ventral infiltrates: bacterial bronchopneumonia
4. Nodular or military (multiple small nodules) infiltrates: fungal pneumonia
5. Mediastinum shifting to the left or right: lobar consolidation due to lung disease
6. No specific signs and a history of trauma: pulmonary contusions; frequently associated with pneumothorax, fractured ribs, diaphragmatic hernia etc.
7. Normal lungs in a patient with respiratory distress localised to pulmonary parenchyma: pulmonary thromboembolism; frequently associated with a heart murmur or gallop rhythm
8. Patchy, diffuse interstitial lung pattern: congestive heart failure; often associated with engorged pulmonary veins

Cats are not Dogs 6: Cardiac Emergencies

Whereas dogs with cardiac disease may frequently present with a history of gradual exercise intolerance, soft cough on mild exertion – with or without a terminal retch, etc., that progresses to increased respiratory distress, cyanosis, productive cough, collapse and death, cats with cardiac disease usually present with a per-acute onset of symptoms of decompensation.

Typical symptoms of cats with cardiac emergencies include the following...

- Acute respiratory distress – characterized by marked tachypnoea, occasional open-mouth breathing; haemoptysis (coughing up blood), exaggerated chest wall movements, and orthopnoea (postural changes made by patients in respiratory distress, such as abduction of the elbows, extending of the neck, abdominal efforts during inhalation and exhalation).
  - Note that many cats with acute congestive heart failure may have significant pleural effusion, which may cause symptoms of increased respiratory rate and effort, associated with dull or absent lung sounds, and muffled heart sounds.
- Syncope – although relatively rare, occasionally cats will develop syncope if cardiac arrhythmias (including severe tachycardia) occur in association with advancing cardiac disease
- Hindlimb paresis – secondary to thrombosis of the aortic trifurcation, which results in acute onset of hindlimb paresis, often associated with vocalization and severe tachypnoea and/or dyspnoea, aggression, and open-mouth breathing/panting

In addition to the difference in symptoms observed in cardiac disease in cats, it can also be difficult to diagnose heart disease in the cat, if the traditional canine paradigm’s used in interpretation of thoracic radiographs, or thoracic/cardiac auscultation are followed. Some examples follow...

- Detection of murmurs, gallops and other physical examination findings of early or mild heart disease in cats can be challenging
Thoracic radiographs are relatively insensitive in detecting heart enlargement in cats, with most changes being quite subtle in nature. Because of the high sympathetic tone in the cat, almost all forms of heart disease in the cat are associated with diastolic heart failure — that is — the heart rate becomes too rapid to allow left ventricular filling, decreasing cardiac output.

Treatment of heart failure in the cat is similar in many ways to the dog, with a few key exceptions. In general, regardless of the cause of the underlying heart disease, emergency treatment of the cat with acute heart failure involves the following...

1. Oxygen therapy
2. Diuretic therapy: furosemide given at 1-2 mg/kg q 2 hrs., or 2-4 mg/kg q 4 hrs. Response to diuretic therapy involves assessing respiratory rate - with a lower respiratory rate being associated with resolution of respiratory distress and pulmonary oedema.
3. Thoracocentesis: to remove pleural fluid, using a 21-23 G butterfly catheter placed in the 7th intercostal space, will result in improvement in respiratory reserve, tidal volume and relief of stress.
4. Dilated cardiomyopathy – is relatively uncommon in cats, but may be seen occasionally. Dilated cardiomyopathy is associated with poor systolic function secondary to poor myocardial contractility, and can be managed somewhat by administering dobutamine at a dose of 2-5 micrograms/kg/min by constant rate infusion. Taurine supplementation @ 250-500 mg/cat Q 12 hrs. may also be recommended for cats with dilated cardiomyopathy
5. Hypertrophic cardiomyopathy – is a common cause of heart failure in cats, and can be managed by
   a. Furosemide 1-2 mg/kg PO q 12 hrs.
   b. ACE inhibitors: benazepril @ 0.25 mg/kg PO q 24 hrs.
   c. Atenolol 6-10 mg/cat PO q 12-24 hrs.

Cats are not Dogs 7: Pharmacology!

Cats have a unique physiology that renders them susceptible to many acute drug toxicoses when compared to their canine counterparts. Here are some examples...

1. Paracetamol
2. Lidocaine
3. Diazepam
4. Permethrin

Cats that have been exposed to ingested toxicants may require gastrointestinal decontamination. However, whereas in dogs, administration of emetic agents such as Apomorphine can result in reliable emesis, the same is not true for cats. In fact, induction of emesis in cats with xyalzine (the most reliable emetic drug in cats) is associated with emesis in only 50% of cats, necessitating anaesthesia and gastric lavage to remove ingested toxicants in most cats.
Cats are not Dogs 8: Acute Abdominal Pain

The acute abdomen refers to a rapid onset of abdominal pain. Acute abdominal pain is often associated with severe, life-threatening intra-abdominal disease in both the dog and cat, but may also be associated with disease outside the abdominal cavity, such as spinal disease, body wall injury etc.

Dogs with abdominal disease frequently present with obvious abdominal discomfort – making it relatively straightforward to embark on a diagnostic pathway to investigate potential causes of the pain. Cats, on the other hand, frequently do not display signs of overt abdominal discomfort, even in the presence of severe intra-abdominal illness, making abdominal assessment critical to embark on in most cases of feline illness, in order to avoid overlooking potentially serious disease.

Abdominal disease in cats can arise from any abdominal structure, as well as the abdominal wall, spine or extra-abdominal disease. A list of possible causes of abdominal discomfort in the cat is listed below...

<table>
<thead>
<tr>
<th>Causes of Abdominal Pain in Cats</th>
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</thead>
<tbody>
<tr>
<td>Gastrointestinal disease</td>
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<tr>
<td>• Foreign body</td>
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<tr>
<td>• Intestinal perforation</td>
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<tr>
<td>• Intestinal obstruction</td>
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<tr>
<td>• Ischaemia of the intestines</td>
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<tr>
<td>• Neoplasia</td>
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<tr>
<td>• Gastroenteritis, colitis</td>
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<tr>
<td>• Intussusception</td>
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<tr>
<td>• Intestinal ileus</td>
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<tr>
<td>Hepato-biliary disease</td>
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<tr>
<td>• Cholangiohepatitis</td>
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<tr>
<td>• Biliary obstruction</td>
</tr>
<tr>
<td>• Cholecystitis</td>
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<tr>
<td>• Hepato-biliary neoplasia</td>
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<tr>
<td>Urogenital system</td>
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<tr>
<td>• Urethral or ureteral obstruction</td>
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<tr>
<td>• Urinary tract rupture</td>
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<tr>
<td>• Pyelonephritis</td>
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<tr>
<td>• Urolithiasis</td>
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<tr>
<td>• Acute renal failure</td>
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<tr>
<td>• Renal neoplasia</td>
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<tr>
<td>Pancreas</td>
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<tr>
<td>• Pancreatitis</td>
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<tr>
<td>• Pancreatic neoplasia</td>
</tr>
<tr>
<td>Pyometra</td>
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<tr>
<td>Body wall</td>
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<tr>
<td>• Body injury</td>
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<tr>
<td>• Abdominal wall hernia</td>
</tr>
<tr>
<td>Peritoneal disease</td>
</tr>
<tr>
<td>• Septic peritonitis</td>
</tr>
<tr>
<td>• Haemoperitoneum</td>
</tr>
<tr>
<td>• FIP</td>
</tr>
<tr>
<td>• Disseminated neoplasia</td>
</tr>
<tr>
<td>Referred pain</td>
</tr>
<tr>
<td>• Intervertebral disc disease</td>
</tr>
<tr>
<td>• Spinal neoplasia</td>
</tr>
<tr>
<td>• Pelvic trauma</td>
</tr>
</tbody>
</table>
Appropriate diagnostic work-up for an acute abdomen (or unwell cat with no abdominal pain) should include the following:

- **Blood tests:** haemogram, serum biochemistry and electrolyte panel, coagulation panel and glucose
- **Urine analysis:** urine specific gravity, chemistry, sediment evaluation, +/- culture and antibiotic sensitivity
- **Radiography of the abdomen**
  - Radiography of the thorax is indicated in patients with concurrent abdominal and respiratory symptoms
- **Ultrasonography of the abdomen**
  - Any free fluid found within the abdominal cavity should be collected for analysis using fluid biochemistry and cytology analysis
- **Surgical exploration of the abdominal cavity**
  - Indicated in patients with undiagnosed acute abdominal discomfort
  - Biopsies of the gastrointestinal tract, liver etc. should be obtained in patients in which a “negative” finding in an exploratory laparotomy is encountered, as neoplastic lesions, inflammatory bowel disease and pancreatitis, hepatopathy etc., may all be diagnosed on biopsy
An Approach to the Acute Abdomen in the Cat

(Modified from Drobatz/Costello “Feline Emergency and Critical Care Medicine”)

Abdominal Pain

Patient Assessment and Stabilisation

Blood and Urine Analysis

Radiography of the Chest and Abdomen

Definitive Diagnosis

Abdominal Ultrasound

Abdominal Effusion

Fluid Collection and Analysis

Definitive Treatment +/- Exploratory Laparotomy

No Definitive Diagnosis

Radiographic Contrast Study

Definitive Treatment +/- Exploratory Laparotomy

No Abdominal Effusion

Definitive Treatment +/- Exploratory Laparotomy
Cats are not Dogs 9: The Urinary Tract!

Cats have a number of unique features in their urinary tract that are important to know – as they have impacts on clinical pathology, reactions to drugs, and on what can go wrong! Here’s a short-list…

1. Cats have less nephrons than dogs: Nephrons – the individual units that make up the filtering, excretion and concentrating function part of the kidney are critical to patient survival. The kidney is unable to re-grow nephrons once they are damaged, making preservation of nephrons extremely important if our patients are to avoid developing renal failure. Because cats have less nephrons than dogs, they are more susceptible to many agents that can damage the kidney, including non-steroid anti-inflammatory drugs such as meloxicam, carprofen etc., anaesthetic agents, and some antibiotics (such as the amino-glycosides). This sensitivity necessitates that we as veterinary professionals ensure the following…
   a. That cats are well-hydrated prior to administration of any potentially nephron-toxic drug
   b. That cats who are anorexic, be placed on intravenous fluids to provide hydration prior to any potentially nephron-toxic drug administration e.g. anaesthesia for teeth cleaning, radiography, ultrasound etc.
   c. That the doses of potentially renal toxic drugs be reduced if appropriate in cats with advancing age, or who have clinical or biochemical evidence of renal insufficiency
   d. That cats be regularly monitored for the development of renal disease if they are elderly, or if they have illness that may result in dehydration, reduced renal function (such as urethral obstruction for example), through the use of serum biochemistry and urine analysis

2. The most common cause of acute renal failure in cats is urethral obstruction: Urethral obstruction is common in cats – being one of the most common presentations for urinary tract disease in the emergency setting. Urethral obstruction is a nephro-toxic event – because urine flow through the kidneys slows, reducing glomerular filtration, eventually causing renal tubular damage. This makes appropriate management of the patient with urethral obstruction extremely important – with attention being paid to the following
   a. Ensuring blood volume restoration and rehydration occur rapidly
   b. Using anaesthetic drug protocols that minimise hypotension (avoiding high doses of isoflurane, high dose propofol etc.)
   c. Avoiding the use of non-steroid anti-inflammatory drugs such as meloxicam until patients are well-hydrated, and urinating normally
   d. Ensuring that patients are maintained on intravenous fluid therapy at higher-than-maintenance rates (unless cardiac or other disease limits tolerance of IV fluids) until they are eating normally, and beginning to voluntarily drink to avoid post-relief of obstruction.

3. Cat urine has the following unique properties when analyzed…
   a. It is more concentrated than dog urine – with urine specific gravity values less than 1.035 representing sub-optimal concentration
   b. Struvite crystals can be a normal finding in cat urine. Large quantities of crystals, in the presence of clinical signs of lower urinary tract disease, however, are supportive of urinary disease, including infection
   c. Stress can elevate serum glucose concentrations above the normal threshold, leading to glycosuria – meaning that not all glycosuria is caused by diabetes mellitus!
Cats Are Not Dogs 10: The Neurological System

The neurological system is complex, and controls everything from mentation and posture to heart rate and bowel regulation. Examining the neurological system is complex too. The neurological evaluation of dogs and cats involves a complex assessment of reflexes, responses to stimuli, and posture assessment, mentation assessment, among other, more involved tests.

Cats are unique creatures to conduct a neurological examination on, in that they frequently will display either a lack of tolerance to repeated examinations, becoming aggressive, or difficult to handle, or will adopt a more submissive posture during evaluation, that results in the appearance of loss of some reflexes or responses, despite them actually being present!

The following short list outlines some helpful tips in regards to the neurological cat that will assist you in avoiding errors in judgment of your neurological examination findings

- The neurological examination in the cat should be carried out in an efficient and well-planned manner, interspersed with pauses, if the patient becomes uncooperative or stressed
- Repeated neurological evaluations are likely to provide a more accurate assessment of the true neurological function rather than a single examination
- Neurological deficits in the limbs are best assessed using the hopping reflex, rather than placing or knuckling reflexes
- Idiopathic epilepsy is uncommon in the cat when compared to the dog – meaning a cat that presents with seizures should be evaluated for extra-cranial (toxic, metabolic causes) and intra-cranial (meningitis, neoplasia etc.) early following presentation

With regards to management of patients with neurological emergencies such as altered mentation, seizures etc., the following points are worthy of note...

- Cats may develop an acute hepatopathy with oral doses of diazepam. For this reason, oral diazepam is not recommended in cats
- Rectally administered diazepam is not reliably absorbed
- Starvation or reduced food intake can result in fatty deposits within the liver, (called hepatic lipidosis) which can result in reduced liver functionality, and the development of bizarre neurological signs ranging from behaviour changes such as excessive salivation/ptyalism to depression or seizures – so-called hepatic encephalopathy. Treatment of hepatic encephalopathy is complex, and involves (among other things)...
  - Enteral feeding
  - Antibiotic therapy with amoxicillin or metronidazole
  - Lactulose administration PO +/- retention enema
  - Evaluation of coagulation status, etc. and management as required
- Cats that are anorexic for several days (more than 203 days), or who eat an all-fish diet can develop clinical signs of neurological dysfunction, including depression, seizures etc. Cats with a history of anorexia or fish-only diet should receive thamine supplementation @ 50-100 mg/cat IM or SC q 12-24 hrs as part of their disease management
Conclusion:

Cats are unique animals with peculiarities of great medical importance. There are many more unique features of the emergency cat than are presented here, and astute patient observation, repeated examination, and detailed investigations are frequently required in order to both achieve diagnoses in cats with emergency illness. Furthermore, the physiology of the cat is such that drug therapy, fluid therapy and other interventions need to be tailored specifically for the cat – rather than the cat being considered an extension of the spectrum of therapy applied to their canine counterparts in veterinary medicine and surgery.

References:


Team Based Veterinary Practice

Janet Molyneux

Introduction

As veterinary nurses no matter whether we are employed or self-employed we can’t work on our own and by default work as part of a team. That may mean we enter and leave a number of teams, small or large, as a locum or it may mean we are a permanent part of a team but either way how we, and that team, function is a vital part of our work enjoyment and practice success.

My aim as you read these notes is not to teach you about good teams; my aim is to challenge you to think how you and your team can keep doing better and as a team deliver excellence in what you do.

What is team base veterinary practice or care?

In human healthcare team based care has been discussed and consider for a number of years and one definition is "a dynamic process involving two or more healthcare professionals with complementary backgrounds and skills, sharing common health goals and exercising concerted physical and mental effort in assessing, planning, or evaluating patient care”¹

The study that developed this definition concluded that teamwork is one of the most important steps in achieving positive, cost-effective outcomes, with significantly positive effects on promoting job satisfaction and staff retention as well.

A 1994 study attributed 70–80% of healthcare errors to human factors associated with poor team communication and understanding.²

History tells us the word team (originally teme) starts with very early references to draft animals yoked together to achieve a collective effort greater than that of a single animal. It is not until 16th century that it became relevant to humans and took the meaning of ‘a group of people working together’. Dictionary definitions describe team as:

- a group of players forming one side in a competitive game or sport
- two or more people working together:
- two or more animals, especially horses, in harness together to pull a vehicle:
- A group organized to work together.

² (Schaefer et al. 1994)
So discussion of the value of teamwork is not new and most of us have probably heard and said things like “many hands make light work” or “the sum is greater than the parts” many times but have we really focussed on the power leveraging off the individual strengths of each and every person in your practice as a team brings to the service you deliver to clients and their pets, companions or animals? We are I hope all good at our jobs but I expect that we are also ‘great’ at different aspects of that job. A successful team based practice delivers excellence to their clients by leveraging off those areas of excellent across their team so they can play to the strengths of all of the team and through this deliver excellent, efficient, focussed and empathic service to their customers.

The veterinary industry and our client ‘spending’ habits are changing: the number of pets per household is dropping and the average spend per pet is increasing. The expectations and pre-formed knowledge of our clients is also changing so the service we offer to clients has to evolve and adapt to match. We work in a world where we need our clients to return to our practice throughout the lifetime of their pet and where the care we provide even at the end of their pets life is so good that they would think of going nowhere else when they get another pet. To achieve this we have to nurture their trust and loyalty. “The need for trust is particularly important when the outcomes are not completely under the control of the service provider and when the customer is not in a position to assess the service provider’s knowledge or skills by benchmarking them to skills they themselves have.”

Adopting an approach where your practice sees delivery of veterinary care as being delivered through a web of interrelated relationships and responsibilities which ensures the needs of patients and clients are pursued in a prudent, caring, responsible and ethical manner supports the development and most importantly maintenance of trust and in turn bring all the members of that team of feeling of personal satisfaction and well-being that comes from a doing a job well and feeling like we are helping others through doing the best we can.

**Conclusion**

Studies have shown that for healthcare professionals, teamwork leads to:

- job satisfaction;
- recognition of individual contribution and motivation;

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• improved mental health.
• improved quality of care;
• value-added patient outcomes;
• satisfaction with services.
• cost control; and
• workforce retention and reduced turnover.

These notes started by asking you to challenge yourself and your team to keep doing better and to finish I would like to remind us all that “none of us is as smart as all of us.” (Ken Blanchard)
NUTRITIONAL MANAGEMENT OF IMPAIRED MOBILITY IN DOGS
S. Dru Forrester, DVM, MS, DACVIM
Global Scientific Affairs, Hill's Pet Nutrition, Inc

This presentation includes a multimodal therapeutic approach for successful management of dogs with impaired mobility and pain due to osteoarthritis. Emphasis will be on role of weight management, use of supplements, and therapeutic arthritis foods. The evidence supporting commonly recommended treatments will be reviewed.

Weight Management
Weight reduction alone may result in substantial improvement and should be a fundamental part of managing all patients with OA. This is best achieved by an individualized weight management program using foods designed for weight loss. Although calorie restriction is important, successful weight loss generally requires participation in an appropriate exercise program. Frequent, mild, weight-bearing exercise over an extended period has been shown to help patients reduce body weight, increase joint mobility, reduce joint pain, and strengthen supporting muscles.

One long-term study has documented that prevalence and severity of OA is greater in dogs with increased body condition scores. Over the lifespan of these same dogs, mean age at which 50% of dogs required long-term treatment for OA was significantly earlier (10.3 years, p < 0.01) in overweight dogs compared with dogs of normal body condition (13.3 years). Other studies have shown that weight loss is associated with clinical improvement in overweight dogs that have arthritis. Based on all findings to date, it is reasonable to recommend weight management to both decrease occurrence of OA and improve clinical signs once OA exists.

Supplements

Glucosamine is a precursor of glycosaminoglycans, a major component of joint cartilage. Supplemental use of glucosamine has been recommended to help rebuild cartilage and results of in vitro studies support this. Three randomized, controlled clinical trials evaluating a product containing a combination of glucosamine and chondroitin in dogs have been published. One study incorporated both subjective and objective force plate gait analysis evaluation of 71 dogs over a 60-day treatment period. Force plate gait analysis improved in the carprofen and meloxicam groups but not the glucosamine/chondroitin group. Neither veterinarians nor owners detected significant subjective improvements in the glucosamine/chondroitin group. In the two studies using owner and/or veterinary subjective evaluation, one documented no improvement after 12 weeks in any parameters while the other found a statistically significant improvement in subjective scores for pain, weight-bearing and severity of the condition by day 70 (P < 0.001) but no change in lameness or joint mobility for the duration of the study. As expected, the onset of significant response was slower for GS/CS than for carprofen-treated dogs.

Green-lipped mussel (Perna canaliculus) has been evaluated in three subjectively assessed studies. Compared with placebo, improvement was noted when dogs with presumed arthritis were treated with green-lipped mussel (GLM) extract in one study. In another study, treatment with GLM for 12 weeks did not result in differences in owner and veterinary subjective evaluation among treatment groups (placebo, GLM and glucosamine/chondroitin sulfate).

Another study incorporated both subjective and objective force plate gait analysis to compare GLM, negative control (placebo) and positive control (carprofen). After 8 weeks, the placebo group showed a 20-30% improvement in pain, veterinary mobility
index, locomotion, and force exerted by the most affected leg. The pain score improved by 67% with GLM and 86% with the carprofen. Carprofen was also more effective than GLM in improving the force exerted by the affected leg (67% carprofen vs. 47% GLM; placebo 27%). GLM and carprofen caused similar improvements in chronic pain (80%; placebo, 20%) and the veterinary mobility index (67%; placebo, 26%).

**Therapeutic Arthritis Foods**

*Hill’s® Prescription Diet® Canine j/d™* contains high levels of omega-3 polyunsaturated fatty acids as the active ingredient and is supplemented with glucosamine and chondroitin. While glucosamine and chondroitin sulfate are often found in pet foods, including those formulated specifically for OA, the beneficial effects of these foods are not likely due to presence of these ingredients. The mechanisms of action of omega-3 fatty acids, specifically eicosapentaenoic acid (EPA) include controlling inflammation and reducing the expression and activity of cartilage degrading enzymes. In vitro studies have documented that EPA is selectively stored in canine chondrocytes. As a result, EPA replaces arachidonic acid in the inflammatory cascade significantly reducing the production of pro-inflammatory mediators. In addition to its role in controlling inflammation, EPA is the only omega-3 fatty acid shown to inhibit the aggrecanase enzymes responsible for cartilage degradation in dogs. This inhibition occurs at the level of the mRNA, an example of a nutrient (EPA) influencing gene and protein expression to promote health. Glucosamine and chondroitin increase proteoglycan production by chondrocytes and inhibit inflammatory mediators.

Effectiveness of *Hill’s® Prescription Diet® Canine j/d™* is supported by three randomized, controlled clinical trials in client-owned dogs with OA.\(^1^0\)\(^-\)\(^1^2\) One study evaluated Prescription Diet Canine j/d by both subjective owner and veterinary evaluations and objective force plate gait analysis in 38 client owned dogs in a 90 day trial.\(^1^1\) The change in mean peak vertical force between days 90 and 0 was significant for the test-food group (5.6%) but not for the control-food group (0.4%). Improvement in peak vertical force values was evident in 82% of the dogs in the Prescription Diet j/d group, compared with 38% of the dogs in the control-food group. In addition, according to investigators’ subjective evaluations, dogs fed Prescription Diet Canine j/d had significant improvements in lameness and weight bearing on day 90, compared with measurements obtained on day 0.

Clinical signs of OA were evaluated subjectively by owner questionnaire and veterinary evaluation in 127 client owned dogs in a 24-week study.\(^1^2\) Dogs fed Prescription Diet Canine j/d had a significantly higher serum concentration of total omega-3 fatty acids and a significantly lower serum concentration of arachidonic acid at 6, 12, and 24 weeks. According to owners, dogs fed Prescription Diet j/d had a significantly improved ability to rise from a resting position and play at 6 weeks and improved ability to walk at 12 and 24 weeks, compared with control dogs.

The third study evaluated the synergistic effect of feeding Prescription Diet Canine j/d on the dose of carprofen necessary to control clinical signs in dogs with OA.\(^1^0\) At 12-week study evaluated 109 client owned animals randomly assigned to receive either Prescription Diet Canine j/d or control food. Significantly greater reductions in NSAID dosage were possible in dogs receiving Prescription Diet Canine j/d compared to control dogs (P<0.025). The mean decrease in NSAID dose was 25% in the
control dogs (P=0.025). The mean decrease in NSAID dose was 25% in the Prescription Diet j/d group. These studies provide high-quality data that illustrate the benefits of incorporating the feeding of Hill’s® Prescription Diet® Canine j/d™ in the multimodal approach to management of OA. Specifically, nutritional management with Prescription Diet j/d helps improve clinical signs of osteoarthritis in dogs as evaluated by owners or as measured by clinical orthopaedic examination and gait analysis of

[2]

ground reaction forces. The NSAID Study found that nutritional management using Hill’s® Prescription Diet® Canine j/d™ dog food helps improve the clinical signs of canine osteoarthritis and often results in reduced doses of the NSAID carprofen.

ROYAL CANIN Veterinary Diet MOBILITY SUPPORT JS 21™ contains green lipped mussels as the active ingredient. The mechanism of action of GLM was discussed previously. Two clinical studies support the use of GLM in a food; however, neither of these studies used the final formulation of MOBILITY SUPPORT JS 21™ as the test diet. As discussed previously when GLM was incorporated into a food using a low temperature application process at a final inclusion level of 0.3%, fifty percent (7/14) of dogs in the group consuming GLM incorporated into food vs. none of the control dogs had a 30% or greater improvement in total arthritic score.7 In a similar study 31 dogs from the same shelter were randomized to control or GLM food for a 6 week trial. Dogs fed the test diet with GLM for 6 weeks did not show a significant improvement in walk, trot, or climbing stair scores as compared with controls. Furthermore, the change in mean mobility score was not significantly different between the test and control groups after 6 weeks of treatment. Mean joint pain and joint swelling scores were significantly improved (P < .05) in the test group, as compared with the control group, after 6 weeks of treatment. Joint pain and swelling scores in the control dogs worsened when compared with their baseline scores. The mean change in joint crepitus score was not statistically significant at 6 weeks between the groups. Significant differences were not observed in range of joint movement scores between the test and control groups after 6 weeks of treatment.13

Purina Veterinary Diets ® JM Joint Mobility® also contains n-3 PUFAs as an active ingredient. There are no published peer reviewed studies supporting effectiveness of this food. There is information on an unpublished open label study on the Purina website. In this uncontrolled study, 146 dogs diagnosed with OA and not currently receiving NSAIDs were fed JM for 2 months. At the end of the study 88% of owners reported their dog showed improvement and 91% of veterinarians were likely to recommend JM to other patients based on the improvement they saw.

Summary

OA is a multi-factorial disease and patients are most likely to benefit from multimodal therapy including nutritional management (weight management, some nutraceuticals, and therapeutic arthritis foods). There is evidence that returning dogs with OA to an ideal body weight improves clinical signs and it is likely that weight reduction would be beneficial in obese cats with arthritis. There are several therapeutic foods available for managing dogs and cats with OA. Ideally, foods designed for patients with OA should supply age-appropriate nutrition and specific nutrients to help reduce inflammation and pain, enhance cartilage repair, slow the degradative process, compliment prescribed medications, and provide tangible improvement in clinical signs of OA.
References


[4]
Multimodal Management of Feline Arthritis

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**ABSTRACT**

Arthritis in cats has only recently been recognized as a widespread clinical disease. Several recent studies suggest that recognizing behavioral and lifestyle changes may be the most sensitive method of diagnosing impaired mobility in cats. Recognizing altered behavior requires an understanding of normal feline behavior. Once diagnosed, therapies for arthritis in cats include NSAIDs, chondroprotectants, nutraceuticals, physical rehabilitation and therapeutic foods. To date, there are published studies documenting efficacy for NSAIDs and therapeutic foods in cats with naturally occurring disease.

**DIAGNOSIS**

It is essential that veterinarians educate cat owners in the recognition and management of pain in their cats. Since cats in the wild can be both predator and prey, most cats have a remarkable ability to hide signs of illness. Therefore, any change from normal behavior must be considered as a possible sign of pain, discomfort or disease. To maintain the optimal health and welfare of our feline patients, veterinarians and their staff must be proactive in inquiring about any changes in behavior at every veterinary visit. Since the presence of behavioral signs can be indicative of a wide range of medical problems including pain, early identification and diagnosis is essential to the pets health and welfare. In addition, early intervention to manage or improve both pain and illness serves the cat’s interest and also helps to strengthen the human-animal bond by improving social interactions and behavior.

With respect to degenerative joint disease (DJD), a thorough orthopedic exam should be performed on all cats suspected of having arthritis; however, owner observations of activity and behavior have been shown to be a more sensitive indicator of impaired mobility and response to therapy. In fact, numerous studies have found that radiographic osteoarthritis is not necessarily associated with pain in cats. In one study, 90% of cats older than 12 years had radiographic evidence of degenerative joint disease while only 4% had altered mobility or lameness. Conversely, joints that appear to be painful on palpation may be radiographically normal. A recent study suggests that about a third of cats will have radiographic changes without clinical signs of pain, a third will have clinical signs of pain without radiographic changes and a third will have both (Figure 1).

![Figure 1. Radiographic changes and clinical signs of pain are not always concurrently present in cats with degenerative joint disease.](image)

Studies have consistently shown that owner assessment of changes in their cats’ behavior is important for identifying pain. However, owners need to be educated on how to assess their cat’s mobility. Unlike dogs, cats with arthritis rarely present with overt lameness. Activities such as willingness to jump (up or down), height of jump, general movement, ‘grumpiness’ on handling and seeking seclusion are more commonly observed in affected cats (Figure 2).

<table>
<thead>
<tr>
<th>Mobility</th>
<th>• inability to jump as high</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>• reluctance to jump</td>
</tr>
<tr>
<td></td>
<td>• changes in toileting</td>
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</table>

<table>
<thead>
<tr>
<th>Activity</th>
<th>• changes in sleep patterns</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• decreased play/hunting</td>
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</tbody>
</table>

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<thead>
<tr>
<th>Grooming</th>
<th>• decreased grooming</th>
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<tbody>
<tr>
<td></td>
<td>• decreased scratching</td>
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</table>

<table>
<thead>
<tr>
<th>Temperament</th>
<th>• avoids contact with owner or other pets</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• hiding</td>
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</tbody>
</table>

![Figure 2. Clinical signs of altered mobility in cats can be divided into four general categories.](image)
A recent study used an accelerometer as an objective measure to document that owners can detect when their cats are more or less mobile. In this study owners were allowed to select the specific activities they felt were impaired in their cat. Of those they picked, the following showed improvement when cats were administered an NSAID: jumping (up/down), playing (toys/cats), running (to food/from dog), lying down, moving up stairs, walking, sharpening claws, grooming, using litter tray and hunting.

In order to identify pain, owners should consider what is normal behavior for their cat. Pain might lead to an alteration in demeanor, decreased activity, hiding, altered sleep habits, less play, a decrease in scratching or stretching behavior, or increased avoidance of, or aggression to humans or other pets. Vocalization, resentment or even aggression may be seen when the cat is stroked, brushed or handled in an area of the body that is painful. Also be aware of changes in coping strategies to deal with pain such as where and how the cat climbs, perches or jumps, or the cat’s posture and body position when sitting or lying down. Pain can also lead to litter box avoidance and house soiling if it becomes uncomfortable to access the litter box or to get into a comfortable position to eliminate. A decrease in activity, climbing and play, decreased grooming and scratching, altered sleep and appetite, and decreased interest in social interactions can have further detrimental effects on mental and physical health.

Since standardized and validated pain assessment scoring for cats is lacking, and with the wide individual variability in how cats express pain, the diagnosis should focus on identifying any change from normal behavior and any alterations in mobility combined with an orthopedic examination including radiographs where indicated. A therapeutic response trial can then be implemented to determine if there is any measurable improvement in mobility and for improvement or “normalization” of behavioral signs.

Diagnosing arthritis in cats can be challenging.

Identify changes in mobility and normal behavior.

Therapy is aimed at improving mobility and “normalizing” behavior.
BEHAVIORAL THERAPY

Reduction and control of pain should improve or resolve most of the behavioral signs. In fact, monitoring for behavioral improvement is an important means of confirming the diagnosis and determining response to therapy. Attention to environmental enrichment can serve to encourage increased mobility and physical activity, which may be beneficial in the rehabilitation process, may increase calorie expenditure where weight control is an issue, and can reduce stress and maintain mental stimulation. Play toys, interactive play sessions and climbing activities should be tailored to optimize physical fitness while working within the limitations of the pet. Hiding, perching and resting places may need to be altered to allow for any limitations in mobility. For details on environmental enrichment see proceedings notes on Multimodal Management of Obesity and Multimodal Therapy for Cats with Idiopathic Cystitis. Even with effective pain control, some behavior problems may persist. This may be the case when a pet has begun to eliminate outside the litter box and new location and surface preferences develop, especially when medical problems cannot be entirely resolved. Providing more litter boxes in more readily accessible locations, and modifications to the litter or the box, may also be necessary to encourage use. More details on litter box management can be found in the proceedings for Multimodal Therapy for Cats with Idiopathic Cystitis. In cases where pain has led to alterations in social relationships with people or other pets, pain management may not necessarily result in the resolution of behavioral signs. When fear and anxiety persist, behavior therapy will also be needed to gradually reestablish a positive association with the person, action or situation (desensitization and counterconditioning) and anxiolytic medication or supplements might also be a consideration.

MEDICAL THERAPY

Management of arthritis in dogs is dominated by the use of NSAIDs. There are numerous products approved for the management of acute and chronic pain in dogs. Not so in cats. The paucity of licensed NSAIDs for cats may relate to challenges assessing pain and increased risks of toxicity. NSAIDs should be used with caution in cats because of their low capacity for hepatic glucuronidation, the primary mechanism of metabolism and excretion for this class of drugs. A recent review documents the available evidence supporting the safety and efficacy of NSAIDs in cats. Therapeutic foods can be defined as any food or food ingredient that may provide a health benefit beyond the traditional nutrients it contains. The introduction of iodine to Morton Salt in 1924 was instrumental in eradicating goiter from the U.S. population. It was also the birth of ‘functional foods’; the first time a food company purposely added a medically beneficial ingredient to a food. In recent years there has been renewed interest in therapeutic foods both in human and veterinary medicine.
NSAIDs

There are no NSAIDs labeled for long-term use in cats in the U.S. Tolfenamic acid and ketoprofen are labeled for up to five days’ use, and carprofen and meloxicam are labeled for preoperative use in some countries. However, in practice, many cats have benefited from NSAID therapy for months to years. Six recent studies demonstrate the safety and efficacy of three NSAIDs (meloxicam, ketoprofen and robenacoxib) for the management of acute and chronic mobility impairment in cats.\textsuperscript{3,5,7-9} However, it is important to note that in a review of reported adverse drug events in the U.S., the FDA identified many cases of kidney failure and death in cats associated with repeated use of Metacam\textsuperscript{®}. As a result of this review, the FDA asked the manufacturer to add the following warning to the product label.

\begin{center}
Warning: Repeated use of meloxicam in cats has been associated with acute renal failure and death. Do not administer additional doses of injectable or oral meloxicam to cats. See Contraindications, Warnings and Precautions for detailed information.
\end{center}

This warning does not affect the approved indications for a single use of Metacam Solution for injection in cats for the control of postoperative pain and inflammation associated with orthopedic surgery, ovariohysterectomy and castration when administered prior to surgery. Indications for acute and chronic use in dogs remain unchanged.

The use of meloxicam in cats with mobility impairment has been evaluated in five studies ranging from 5 days to 5.8 months duration.\textsuperscript{3,5,7-8} In all of these studies both owners and veterinarians were able to detect significant changes in mobility/activity after treatment. One study used activity monitors to objectively document increased activity.\textsuperscript{5} The doses cats received in these studies ranged from 0.01-0.03 mg/kg orally once daily for 1 to 6 months to 0.05-0.1 mg/kg orally once daily for 5 days. Side effects were uncommon and included vomiting, diarrhea and decreased appetite. Based on these studies the recommended dose for chronic administration of meloxicam is 0.1 mg/ kg PO or SC on day 1, followed by 0.05 mg/ kg for 1–4 days; then reduce rapidly to the lowest effective dose (0.025 mg/ kg every 24 or 48 hours) monitoring closely for side effects.

Robenacoxib has been evaluated in one short-term study.\textsuperscript{9} Cats with acute pain and inflammation associated with musculoskeletal disorders received either 1.0 to 2.4 mg of robenacoxib/kg, q 24 h or q 12 h and were compared to cats receiving a positive control (ketoprofen 1mg/kg q 24 h). Robenacoxib administered once or twice daily was shown to be as effective as ketoprofen for controlling acute pain in cats. No significant side effects were reported in this short-term study. Ketoprofen (1 mg/kg q 24 h) has been used as a positive control in two studies.\textsuperscript{8,9} In both short-term studies ketoprofen was effective in controlling clinical signs but was considered less palatable.

It is preferable to administer NSAIDs that are licensed for use in cats for the labeled indications because there is evidence to support their use. If NSAIDs are used off-label the owner should be made aware of this fact and of the potential risks and benefits. Owners should be informed of the possible side effects both verbally and in writing. This should include clinical signs to look for and an indication of when to call the veterinarian and stop treatment (e.g., vomiting, inappetence, bloody stool).
THERAPEUTIC FOODS: FELINE

Currently, there are two therapeutic foods indicated for management of cats with osteoarthritis. Royal Canin® Medica® Mobility Support™ is available in Canada and the United States. The active ingredients are green-lipped mussel powder, glucosamine and chondroitin. The efficacy of this product is supported by one randomized controlled clinical trial. In this study, cats fed Mobility Support had greater objectively measured activity than cats eating the control diet; however, subjective evaluation by owners and veterinarians were not significantly different between the groups.

Hill’s® Prescription Diet® j/d® Feline Mobility is available in the United States and Europe. The active ingredients include high levels of n-3 polyunsaturated fatty acids (DHA), natural sources of glucosamine and chondroitin, methionine and manganese. High levels of n-3 PUFAs control inflammation in cats as in dogs. Unlike dogs, in cats DHA (rather than EPA) inhibits the aggrecanase enzymes responsible for cartilage degradation (Figure 3). Natural sources of glucosamine and chondroitin increase proteoglycan production by chondrocytes and inhibit inflammatory mediators. Methionine and manganese enhance chondrocyte viability, provide building blocks and act as a sulfur donor for the production of proteoglycans.

Figure 3. High levels of DHA control inflammation and slow the progression of arthritis in cats.
The efficacy of Prescription Diet j/d Feline is supported by three studies from one to three month duration. In the open label study, 70% of veterinarians (33/47) and 96% owners (45/47) reported improvements in mobility of cats after one month of therapy. In a randomized controlled clinical study, Prescription Diet j/d Feline was fed to 41 cats with moderate to severe arthritis. Alterations in both the ability to jump and the height of jump were the most frequent signs of disease. After one month of therapy, 61% of owners (25/41) reported improved in their cat's clinical signs.

Subjective veterinary evaluation and objective evaluation with activity monitors were used to assess Prescription Diet j/d Feline in a crossover study. Changes in cartilage biomarkers and metabolomic profiles were also evaluated. Activity monitors documented significant (49%) increases in activity, which correlated with significantly improved orthopedic evaluations in the cats while receiving therapy. While being fed j/d Feline, arthritic cats also had decreased biomarkers and metabolic markers of inflammation and cartilage degradation. Results of these three studies are similar to improvements seen in cats receiving meloxicam for chronic pain.

**SUMMARY**

Careful assessment of client-specific outcome measures is an important diagnostic tool for cats with impaired mobility. Therapeutic nutrition provides an effective and safe way to manage both dogs and cats with osteoarthritis. Foods with high levels of n-3 fatty acids have the dual benefit of controlling inflammation and cartilage degradation in cats with arthritis without the risks associated with long-term use of nonsteroidal anti-inflammatory drugs.

**References**

Prevalence and Recognition of Mobility Limiting Feline Degenerative Joint Disease

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Degenerative Joint Disease in Cats — Prevalence and What the Radiographic Signs Mean

Prevalence  Beadman et al performed the first extensive radiographic evaluation of degenerative joint disease (DJD) of the feline axial skeleton. Since then, the studies that have been performed suggest that the most frequent site of axial skeleton DJD is the area T7-10. The most severe lesions appear to be in the lumbar or lombo-sacral area. The incidence of axial skeleton DJD is markedly different between the different studies, likely due to axial skeleton DJD increasing in frequency with age.

Appendicular  The available information suggests the appendicular joints most commonly affected by DJD are the hip and elbow, followed by stifle or possibly tarsus. However, no studies have been published that evaluate every joint in a randomly selected population of cats to ascertain the prevalence of DJD in cats. One problem with the published information is that, as with the axial skeleton lesions, there are differences between the studies in how DJD is defined. Hardie et al claimed that all joints with radiographic signs of DJD were osteoarthritic, but Clarke et al attempted to distinguish between radiographic signs of DJD, such as enthesiophytes and soft tissue mineralization (which may not represent osteoarthritis) and osteoarthritis. So far, no studies have evaluated the radiographic appearance of joints and compared these findings to histological appearance of these joints. However, a soon to be published study has found that relatively minor radiographic changes of meniscal calcification are predictably associated with medial compartment cartilage degeneration in the cat. This work is needed to better define what is being evaluated radiographically in cats, and also to address the suggestion that feline DJD may be associated with less of a tendency to form new bone.

Because no comprehensive studies evaluating the prevalence of feline DJD have been performed, we performed a cross-sectional study that was designed to evaluate the prevalence of feline appendicular and axial skeleton DJD. Using a database of 1,640 cats from a single practice (Morrisville Cat Hospital, Cary, NC), a population of 100 cats, equally distributed across four age groups (0-5; 6-10; 11-15 and 16-20 years old), was randomly selected (regardless of health status) to participate in the study. A thorough evaluation of orthogonal radiographs of every appendicular joint and every part of the axial skeleton showed that 91% of the 100 randomly selected cats (with ages equally distributed across the age range from 6 months to 20 years old) had at least one appendicular joint with radiographic DJD (Figure 1). The most frequently affected joints were hip, followed by stifle, tarsus, then elbow (Figure 2). Fifty-five percent of the cats had axial column DJD. The thoracic segment was the most frequently affected, followed by the lumbo-sacral area. Much of the DJD seen was mild and the radiographic appearance often differed from that seen in the dog. Only age was significantly associated with the presence of DJD. Body weight, body condition score and sex were not significantly associated with the presence of DJD. This study indicates that the prevalence of DJD in domesticated cats is high. Further work is required to understand the histological significance of the radiographic features of DJD seen and to understand the clinical significance of these features. This work is soon to be published in the journal *Veterinary Surgery*.10
Figure 1. Prevalence of appendicular and of axial radiographic DJD in cats in different age ranges. Twenty-five cats were evaluated in each age range.

Figure 2. The most frequently affected joints and spinal areas

<table>
<thead>
<tr>
<th>JOINT</th>
<th>NUMBER OF JOINTS AFFECTED (% OF TOTAL NUMBER OF JOINTS EVALUATED)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hip</td>
<td>131 (65%)</td>
</tr>
<tr>
<td>Stifle</td>
<td>102 (50%)</td>
</tr>
<tr>
<td>Tarsus</td>
<td>85 (40%)</td>
</tr>
<tr>
<td>Elbow</td>
<td>69 (35%)</td>
</tr>
<tr>
<td>Carpus</td>
<td>32 (15%)</td>
</tr>
<tr>
<td>Shoulder</td>
<td>28 (14%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SPINAL SEGMENT</th>
<th>PERCENTAGE (% OF CATS AFFECTED</th>
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<tbody>
<tr>
<td>Thoracic</td>
<td>43</td>
</tr>
<tr>
<td>L-S</td>
<td>29</td>
</tr>
<tr>
<td>Lumbar</td>
<td>26</td>
</tr>
<tr>
<td>Cervical</td>
<td>20</td>
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</table>

For each joint N=200
Are radiographic features of DJD associated with pain? In the study by Hardie et al., although 90% of the cats evaluated had radiographic evidence of axial and/or appendicular skeleton DJD, only 4% had any mention of arthritis or problems with mobility in the medical records. The records being evaluated were referral hospital records, and the cats were not primarily referred for mobility problems. It is not known for how many of these cases the referring veterinarians' records were also available for review. In the study by Godfrey, approximately one third (21 out of 63) of the cats with radiographic appendicular joint osteoarthritis had clinical signs of mobility impairment, and in fact were radiographed for that reason (l lameness, stiff gait, difficulty jumping, hindlimb weakness, shuffling forelimb gait and inactivity). In another retrospective radiographic study of the prevalence of DJD in cats, 16.7% of the cats with radiographic signs of DJD were reported to be lame. However, the authors suggested that lameness per se may not be the most obvious clinical sign associated with feline DJD. In contrast to this, several studies have indicated that there exists a population of cats with radiographic DJD who are mobility impaired, and that this mobility can be significantly improved following administration of an NSAID analgesic drug. However, there appears to be a mismatch between the radiographic findings and the clinical examination findings. In the study by Clarke and Bennett, the presented data suggests that 34% of joints assumed to be painful on manipulation during a clinical examination did not have any signs of radiographic osteoarthritis. In another recent study where every joint was radiographed and also evaluated by careful physical examination in the fully conscious cat, there was only moderate overlap between the parameters of 'radiographic DJD' and 'pain on manipulation'. In that study, 55 joints had radiographic signs of osteoarthritis (as defined radiographically in dogs), but only 18 (33%) of these were painful on manipulation. This appears to support the notion that not all radiographic osteoarthritis is painful in cats.

Degenerative Joint Disease in Cats — Assessing the Feline DJD Patient

The following information outlines how to approach diagnosing DJD-associated pain in the feline patient. The description follows the clinical approach to a patient — gathering history, performance tests, orthopedic examination, radiography and other diagnostic tests.

History of impaired mobility and activity

In order to guide owners in their assessments of their cat’s mobility, we need to know what activities are altered by DJD-associated pain. A recent study of 28 cats with osteo-

arthritis showed that overt lameness was not the most common clinical feature. Instead, features like jumping up, jumping down, height of the jump, general movement, 'grumpiness' on handling and seeking seclusion were found to be behaviors that may better indicate mobility impairment due to DJD-associated pain. Another recent study used an objective measure of activity, an accelerometer, and concluded that owners do know when their cat is more or less mobile. In this study, owners were allowed to pick what activities they felt were impaired as a result of the DJD. Of those they picked, the ones that showed an improvement when the NSAID was administered compared to the placebo were:

- Jumping up/down
- Playing (toys, cats)
- Running (to food; from dog)
- Lying down
- Moving up stairs
- Walking
- Sharpening claws
- Grooming
- Using litter tray
- Hunting

More recent work by the same authors has shed more light on activities that may be appropriate to ask owners about when assessing DJD pain in cats. This work is soon to be published in the American Journal of Veterinary Research. These are presented below and will be discussed.
Table 1. Activities that owners considered to be significantly impaired in cats with DJD compared to cats without DJD.12

These activities can be graded or scored by owners to determine the level of mobility impairment and to follow the efficacy of treatment. These activities have not been validated as being appropriate activities to assess, although ongoing work is being performed to evaluate these activities, as well as some other activities and behaviors considered possibly consistent with DJD-associated pain.

<table>
<thead>
<tr>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walking</td>
</tr>
<tr>
<td>Running</td>
</tr>
<tr>
<td>Ability to jump up</td>
</tr>
<tr>
<td>Ability to jump down</td>
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<tr>
<td>Climbing stairs</td>
</tr>
<tr>
<td>Descending stairs</td>
</tr>
<tr>
<td>Playing with other pets</td>
</tr>
<tr>
<td>Rising from a resting position</td>
</tr>
<tr>
<td>Chasing objects</td>
</tr>
<tr>
<td>Ability to stretch</td>
</tr>
<tr>
<td>Eating</td>
</tr>
<tr>
<td>Seeking seduction</td>
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<tr>
<td>Height of jumping up</td>
</tr>
<tr>
<td>Height of jumping down</td>
</tr>
<tr>
<td>Sleeping</td>
</tr>
<tr>
<td>Playing with toys</td>
</tr>
</tbody>
</table>

Performance tests DJD-associated pain results in impaired mobility. This can be evaluated through performance tests. This is difficult to do in the clinic with untrained cats, but some simple tests are:

- Place the cat down and allow it to move across the room
- Encourage jumping off an exam table or chair
- Encourage jumping up to get into a carrier

For example, a cat with painful elbows may be very reluctant to jump down, resisting all attempts to encourage this (Video).

Video: This cat refused to jump down from the examination table. It would jump down from the exam table to a chair and then to the floor. Note also the 'ungainly' landing on the chair and floor. This cat (the same one as in Figure 3) was found to have elbow DJD, as well as stifle and hip DJD.
Orthopedic examination  An important and often omitted part of the orthopedic examination is to get a good overview of the animal from the point of view of how it moves, relative muscling of different parts of the body, and how it negotiates obstacles and the environment. For example, when the cat in Figure 3 was observed while on the floor, it was clearly seen that it had very poor muscling over the hindquarters.

Guidelines on how to perform a productive orthopedic examination in dogs are scarce, and virtually nonexistent for cats. A few pointers:

- Be prepared to spend some time on the examination
- Have a calm, but confident approach
- Have technical help who is calm and confident with cats (Figure 4)
- Handling cats should be performed with only the amount of restraint that is necessary (Figure 4)
- Use a room that is:
  - quiet
  - away from noisy dogs
  - does not have ‘hiding places’ where a cat can get lodged in
- Use a surface that is soft and will not slip around (for example, a soft pad over a piece of thin yoga matting)
- Minimize restraint unless absolutely necessary

- Perform the examination in the position the cat is comfortable in (e.g., standing, lying, or in the owner’s arms)
- Be willing to ask the owner to leave while the examination is being performed. Depending on the owner, the cat may be more calm if the owner is not present
- Try to keep one hand in contact with the cat continuously
- The examination should include every joint, and the whole axial skeleton and pain elicited on manipulation of each joint/part of the axial skeleton should be recorded (Figure 5)
- In uncooperative cats, start with the areas suspected to be affected first
- Be willing to perform the examination in ‘stages’ — i.e., start, then come back to complete it later

Figure 4. Having a technician who is calm and confident with cats is a tremendous help. Cats do not respond well to heavy-handedness and fear. Additionally, remember that most cats that are considered ‘fractious’ are actually painful, and minimizing forceful manipulations or restraint techniques that stimulate these areas will help in facilitating a general and orthopedic examination.
Pain scale based on palpation

0 No resentment; normal amount of movement or wriggling
1 Mild withdrawal; mildly resists
2 Moderate withdrawal; body tenses; may orient to site or vocalize
3 Orient to site; forcible withdrawal; may vocalize, hiss or bite
4 Tries to escape/prevent manipulation; bite/hiss

Obtaining radiographs  Orthogonal views of painful joints should be obtained. However, if radiographic signs consistent with degenerative joint disease are not seen, DJD should not be ruled out. There appears to be only moderate overlap between the joints that appear painful clinically, and those that have radiographic signs of degenerative joint disease. At the moment, the reasons for this are unclear, but the mismatch between clinical signs and radiographic features is well known in other species.

To obtain radiographs, the author most commonly uses a sedative cocktail of:

- 5 mg/kg ketamine (maximum of 20 mg)
- 0.4 - 0.5 mg/kg butorphanol
- 10 mcg/kg dexmedetomidine

This is dosed on lean body weight, and administered intramuscularly. These doses are altered on an individual basis as determined through a physical examination and evaluation of blood work when available. This combination will provide for approximately 45 minutes of good sedation. In cats with clinically detectable cardiac disease, a combination of acepromazine (0.05 mg/kg) and buprenorphine (20 mcg/kg) administered IV would be a better choice. There are many methods for sedating cats, and the clinician should use the drugs and combinations they are most familiar with.

Figure 5. An example of a basic (non-validated) scale for the evaluation of joint pain associated with manipulation of joints during the orthopedic examination.


The radiographic features of DJD of the main joints will be presented (e.g., Figure 6).
Figure 6. This VD pelvis shows bilateral DJD, with significant new bone on the cranial effective acetabular rim, and apparently shallow acetabulum bilaterally, and possible new bone formation at the attachment of the joint capsule on the neck of the femur (possibly similar to the ‘Morgan Line’ seen in dogs). Note there is relatively little osteophytosis of the femoral neck or other areas of the acetabulum — signs frequently seen in dogs with hip DJD.

Summary
Currently, a diagnosis of painful degenerative joint disease should be based primarily on owner assessed activity impairment, supported by painful joints on examination that have, or do not have, radiographic signs of degenerative joint disease. Radiography should be performed in all cases, and appropriate minimum database obtained prior to initiating treatment.

References


How to get better owner compliance

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Introduction:

The word ‘compliance’ is defined as the act of complying with a wish, request or demand. In medical dictionaries it is defined as the *willingness* to follow a prescribed course of treatment. For us in the veterinary field compliance means that clients are following and accepting our recommendations for diagnostic tests and treatment for their animals.

Clients have stated five main reasons for not complying with recommendations made to them during visits to the practice:

1. The practice never recommended a certain treatment or test.
2. They didn’t understand the recommendation.
3. They didn’t understand the importance of the recommendation.
4. The clients felt complying with the recommendation was too difficult.
5. The client forgot what was recommended.

Client adherence is directly related to our communication skills. The Four Habit Communication Model used by our medical counterparts form a helpful back bone on how we can improve communication with our clients and in return create better compliance. The Four Habits are: 1. Invest in the beginning 2. Elicit the client’s perspective 3. Demonstrate empathy and 4. Invest in the end. *Ref: [http://xnet.kp.org/permanentejournal/fall99pj/habits.html](http://xnet.kp.org/permanentejournal/fall99pj/habits.html)*

Veterinary nurses and technicians form a vital part of the health care team and is often the first and last encounter a client has with a veterinary practice. Clients’ impressions are influenced by their entire visit to the practice and all the members of the team they interact with. And this lasting impression relates directly to their inclination to comply with our recommendations. You are more inclined to follow recommendations made by someone you respect and that you know cares for your wellbeing and that of your pet.

Clients often see nurses and technicians as less threatening and are more likely to communicate openly and truthfully with you. It is difficult to change an impression, once formed (not impossible, but difficult). Think of your own likes and dislikes in all aspects of your life and when that dislike or like was created – often at first interaction.
The presentation will focus on the Four Habits of Communication and how we, as veterinarians, nurses and technicians can incorporate them into our daily interaction with our clients. The desired result being to create greater all-round compliance from our clients. For some this may already be second nature – for others it may provide helpful and practical ways to improve your communication skills with clients.

Habit 1: Invest in the beginning

First impressions are lasting. The first few moments of an encounter with clients are often overlooked by us as a pleasantry, but they are important for establishing a trusting relationship and often will affect the outcome of the entire visit as well as the future relationship with the client.

It is important, in the first few seconds, to establish a welcoming atmosphere. If it is a new client you are meeting for the first time then a handshake during introduction indicates an equal stance and initiates touch. Ask the names of all parties present and their relationship to the pet as this creates a personal connection. Thus you can give vital information in advance to the veterinarian before he or she meets the clients. Also, if possible, try and be on the same eye level as the clients. (I will often kneel to be at eye level with a client sitting on a chair if one is not available for me to sit on).

Before talking to the clients make sure you are familiar with their pet’s history, or condition if available. A medical study showed that patients rated medical physicians who were unfamiliar with their cases, or repeatedly referred to the chart during the consultation, as less professional and as providing less satisfying care. We all get confused with whether or not a patient is male or female but this can be a crucial break in trust/communication with clients if we get it wrong. Make sure you know the pet’s detail prior to chatting to the client. If you are not sure how to pronounce a pet’s name you can ask a simple question: “Wow, that is an interesting name – how do you pronounce it? Does it have any special meaning?” This again provides a personal touch and conveys that you care about the connection of the pet with the owner.

I stated earlier that first impressions are lasting…. Get into the habit of not judging your clients on how they present themselves physically, for example, how they are dressed, or their mental attitude. Remember that a lot of times the clients are stressed and emotional when they arrive at the practice and this may not be a true reflection of them. Do not judge a person by his or her clothing. The old idiomatic expression “Clothes make the man” does not hold water in this day and
age. It also helps to embrace the owner’s idiosyncrasies – what makes us all unique and create a different experience with every consultation or the interaction we have with clients. Even the most intelligent/intellectual people can forget sense and appear irrational where their beloved pets are concerned.

The second part of initial contact should be eliciting the full spectrum of concerns the clients may have whether they are having a consultation with the veterinarian or visiting their pets in hospital. It is important to actively listen to the clients – Make notes of their concerns and use vocalisations such as “I see”, “Go on,” or “I’ll make a note of that for the vet,” as well as non-verbal communications such as head nodding, etc. These small gestures will make clients feel at ease and they are more likely to elaborate on their concerns. By fully understanding what is on clients’ minds and how they value their pet will help later in the visit with the compliance of all recommendations made. The key ingredient is to be sincere, a theme that runs throughout this whole presentation.

**Habit 2: Elicit the client’s perspective**

This habit is important in creating trust and showing respect to the clients and animals. By eliciting the clients’ perspectives it helps to assess their requests for care; what impact the animal’s illness has on the clients as well as the value of the pet to the clients.

*For example: Sometimes by asking the client: “What do you think is the problem or what may have caused it?” – may give some insight on whether they feel responsible/guilty. “What are you worried about most?” Many of us forget why the client initially brought the pet to us, especially if we find a more serious problem during consultation or discussion. It is of course important to address the new, more serious issue, but it is equally important to address the original presenting complaint even if it involves telling the client “Mrs Jones, I know Fluffy was brought in for his itchy ears, but you mention that he is drinking a lot more than usual and this may be indicative of a more serious condition. Once we have found the cause of his abnormal drinking behaviour we will then sort out the ears for you as well. Unmet expectations occurred in about 18% of visits in one veterinary study conducted. Most of the dissatisfaction was due to the presenting complaint not being addressed. This “habit” is more the veterinarian’s responsibility but sometimes we all need reminding why a pet presented to us in the first place. You can assist the veterinarian by eliciting the clients’ perceptions of what the perceived problems are. Again people are often more open and honest with veterinary nurses and technicians than with the veterinarians. This also gives you a chance to evaluate the clients’ understanding and knowledge of the presented condition and also enables the veterinarian to judge*
how much information they need to give to the clients at the end of the visit. Clients are more likely to adhere to what the veterinarian or nurse recommends if they understand the condition their pet has, the way to diagnose and manage it and what can be done to prevent or stop it from progressing. A good example is heart failure due to mitral valve regurgitation. If a client understands the physiology behind the formation of lung oedema and that we are not fixing the leaky valve they are more likely not to just stop the medication because their pet is looking better.

Habit 3: Demonstrate Empathy
"... to know and understand, obviously is a dimension of being scientific; ... to feel known and understood, is a dimension of caring and being cared for." (Engel, 1988).

Stewart, et al, showed that medical physicians who are sensitive to and explore patients’ emotional concerns take a mean of only one minute longer to complete visits when compared to physicians who do not do so. In other words – empathy does take time, but the rewards far outweigh that extra minute it takes. Put yourself in the clients’ shoes. If it was your pet or family member that was ill – I am sure you would like that same empathy from your veterinarian or physician. Be sincere – clients know when we are faking it, in the same way you know when someone is not being honest with you. It is often the so-called ‘gut’ feeling.

It is important to create a safe environment for clients during this time. If a client is upset it may be worth taking them to a more private area (consult room). Let them talk and ask them if there is anything you or the veterinarian can do to help. Give them reassurance that it is ok and normal to be emotional or upset and that it is nothing to be embarrassed about. Allow them the space to interact as a family, or with their pet, be it singing to it, reciting poems or just the time to cuddle and reassure the animal. (I have had personal experience of all of these in my consultation rooms and here we do need to embrace people’s idiosyncrasies).

Habit 4: Invest in the End
Habit four is the direct link to better compliance. At the conclusion of the visit it is crucial to make sure the clients understand what has transpired.

Make sure that they have the necessary information and knowledge of the diagnosis and plan before they leave. A good place to start is by involving the clients in the decision making. Part of this should be done in conjunction with the veterinarian. A number of studies have shown that by increasing
patient participation in the decision making leads to better compliance. The importance of checking client comprehension cannot be overemphasised. One of the biggest barriers to client compliance is our assumption that they understand what we are talking about. Client communication is incomplete without comprehension. It helps to give clients written information as they often retain very little of what is said in a stressful situation, especially what is discussed after the diagnosis is given. An American Animal Hospital Association survey suggests only 10% is recalled of which only half is recalled accurately. As many as 80% of clients indicate they wanted information in both verbal and written forms. The written information should briefly summarise the diagnosis; treatment plan or diagnostic recommendations and the rationale behind them as well as prognosis and follow-up plan. It also helps to put in writing what signs will show either progression or improvement of the condition. Client information sheets for most of the common conditions/procedures are available on the internet and can be easily adapted to suite the practice you are working in. It is a good idea to get some pre-approved by your veterinarians for the most common conditions. They can be kept in a folder and handed out at the end of the visit to the clients. It helps if you had time to discuss the case with the veterinarian before speaking with the clients – to make sure everyone is on the same page and to avoid confusion.

Another part of compliance is that clients often perceive that nothing is working and they feel out of control, as pets cannot communicate if they are alright, or not. Another way to involve clients and give clients some control and commitment is for them to keep a diary. For itchy pets a diary may provide some clues on potential triggers; for a cancer patient it may indicate a decline in quality of life and that euthanasia should be considered. For chronic coughing or diarrhoea it may show which medications and diets are effective or not. If clients can see the difference medications or diet recommendations are making then they are more inclined to persevere and comply with future recommendations.

Do not discourage the use of the internet – as the saying goes: “If you can’t beat them join them.” The internet is an integral part of our community and rather create an environment where the client will trust you and bring the information they have found on the internet to your or the veterinarians’ attention for evaluation. I will often tell clients to let me know if they found something on the internet they want to explore. This way I can at least make sure it will cause no harm.

At the end of the visit ask clients if they foresee any potential problems with regards to complying with the recommendations or treatment plan given. Reasons often provided for non-compliance
include concerns about costs; time management, or even the fear or lack of skills (e.g. insulin injections). By knowing this prior to the client leaving, we can try and address the issues. Provide support and do not judge the clients. Acknowledge the difficulty in following the plan and try and provide a plan or resolution to the concern. This might entail having the client return to do the procedure, or give the injection in your presence. Our nurses will always get the clients to inject sterile water to mimic insulin injections to help get the client over the initial fear and also to make sure they know the correct dose and are safe in handling the needles and syringes. We will recommend that the first couple of days they can return and do it in front of a nurse if they are unsure if they are doing it correctly – free of charge. Encourage the client to telephone or e-mail if they are uncertain or just in need of support. Clients are more at ease phoning a nurse or technician without feeling that they are “bothering” the veterinarian with non-essential questions. These are often very essential questions for all parties concerned.

Book a follow-up visit or make a time for telephonic update prior to the clients leaving. It is useful to encourage clients to write down any questions or concerns they may have prior to the follow-up visit if they had not already called or e-mailed. Personal contact is, and will always remain the best form of communication.

When the visit has been completed it is important to walk the client back to reception or the front door if possible and even to open it for them. It may take an extra minute but it shows a caring attitude that is not time driven.

Summary:
It is our responsibility (veterinarians, nurses and technicians) to educate our clients. At the end of a visit make sure they understand what disease their pet has or are at risk for; how the diseases are diagnosed; how they are treated and if they can be prevented. The more clients understand why we recommend certain things the more they will be inclined to comply. This will lead to a much happier and healthier relationship between clients and your practice and it creates greater job satisfaction for you.

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Introduction

Feline lower urinary tract disease (FLUTD) is a term used to describe any disorder affecting the urinary bladder or urethra of cats. It is a common reason for hospital visits and veterinary evaluation of our feline patients. Regardless of underlying cause, FLUTD is characterized by dysuria, pollakiuria, stranguria, hematuria, and/or periuria (urination in inappropriate places). It is important that veterinary technicians are aware of signs and symptoms of FLUTD when talking with clients.

Over the past 10 years, knowledge of specific causes of FLUTD has increased in the veterinary profession. This has allowed diagnostic and therapeutic efforts to be directed toward identification and elimination of specific underlying disorders. The most common cause of FLUTD in cats < 10 years of age is feline idiopathic cystitis (FIC), followed by uroliths, and urethral plugs. A diagnosis of FIC is made by excluding all other causes of FLUTD. In older cats (> 10 years), urinary tract infection and/or uroliths are the most common cause of FLUTD.

In 1981, 78% of feline uroliths were composed of struvite and only 2% were calcium oxalate. In the mid to late 1980s, the occurrence of calcium oxalate uroliths began to increase. Between 1994 and 2002, approximately 55% of uroliths were calcium oxalate and only 33% were struvite. Since 2001, however, the number of struvite uroliths has continued to increase while occurrence of calcium oxalate uroliths has decreased. Based on 13,991 feline uroliths analyzed at the Minnesota Urolith Center in 2012, the most common mineral types were struvite (45%) and calcium oxalate (42%), followed by purine (5%) and other (6%). In 2012, 92% of urethral plugs evaluated at the Minnesota Urolith Center were composed of struvite; 4% were matrix and 1% was calcium oxalate.

Veterinary technicians play a crucial role in aiding the veterinarian with diagnosis and treatment of FLUTD. The information discerned from owner evaluations aids in the diagnosis of FLUTD. The discussion of the treatment plan with the client is crucial to the client’s understanding and compliance with the veterinarian’s recommendation; and ultimately, the health of the pet.

Diagnostic Evaluation

Diagnostic evaluation of cats with recurrent or persistent lower urinary tract signs should include a urinalysis and diagnostic imaging. If there is a history of urinary tract manipulation (e.g., urethral catheterization), evidence of urinary tract infection (e.g., pyuria, bacteriuria, malodorous urine), or the cat is older (usually > 10 years), a urine culture should be done. More advanced procedures (e.g., contrast radiography) are appropriate in some cases.
Urinalysis is an important part of evaluating patients with signs of lower urinary tract disease. Ideally, the veterinary technician should perform the urinalysis in-house since fresh urine samples analyzed within 30 minutes of collection are preferred. Urine specimens evaluated after this time may form crystals that are not present in the patient. Samples may be refrigerated for up to eight hours and then evaluated (after the sample has returned to room temperature). This method is not best for evaluating crystalluria and should be avoided as much as possible by the veterinary technician.

Although it may be tempting to only perform dipstick analysis, measure urine specific gravity, and omit urine sediment examination, it is very important to perform a complete urinalysis. The only way to accurately detect pyuria, hematuria, bacteriuria, and crystalluria is by sediment examination. You cannot rely solely on urine dipstick analysis. Results for detection of pyuria are often false positive in cats, and the occult blood reagent pad on the dipstick is not specific for hematuria (in addition to red blood cells, it also becomes positive with hemoglobin and myoglobin). Pyuria (> 5 WBCs/hpf) indicates inflammation and it may be caused by several disorders (urolithiasis, bacterial infection); it is less commonly observed in cats with FIC. If you see increased numbers of white cells, you should look carefully for bacteria. Take care not to misinterpret the presence of cellular debris and Brownian motion as bacteriuria. It is the veterinary technician that has an impact on this portion of the FLUTD evaluation!

Several different types of crystals may be identified on urine sediment examination, but typically struvite (triple phosphate) and calcium oxalate are the most common. The presence of crystals indicates that the urine is supersaturated with that substance and the patient is at risk for forming uroliths. Remember that cats also may have crystals and never develop uroliths. In the absence of other findings such as uroliths or urethral plugs, the presence of crystals alone is not diagnostic of urolithiasis or struvite disease. Struvite crystals may be present in normal cats and cats with struvite uroliths (sterile or infection-induced), non-struvite urolithis (including some cats with calcium oxalate uroliths), urethral plugs, or other urinary disorders such as FIC.

Survey radiographs are helpful for identifying radiopaque uroliths and crystalline-matrix urethral plugs. During positioning, remember to include the caudal abdomen (urethra) in the radiograph, or you risk missing potentially important information. Normal survey radiographs do not exclude FIC, radiolucent uroliths (urate/purine), small uroliths (< 2 mm), neoplasia, blood clots, or anatomic defects. Abdominal ultrasonography and/or contrast urethrocystography is helpful in these cases. If no cause is identified after thorough diagnostic evaluation, a diagnosis of FIC is very likely.

Treatments of Cats with Feline Idiopathic Cystitis

The goals of managing cats with FIC are to decrease severity of clinical signs and increase the interval between episodes of lower urinary tract disease. Over the past 40 years, many different treatments have been recommended to control signs in cats with FIC, yet only a few have been evaluated in clinical trials of cats with FIC.²

Nutritional Management

It has been found that feeding moist food (>60% moisture) has been associated with a decreased recurrence of clinical signs in cats with FIC. During a one-year study, clinical signs recurred less often in cats with FIC when fed a moist food compared with cats fed the dry formulation of the same food.³ Beneficial effects have been observed in cats with FIC when
uropathy. The most frequent clinical signs include pain, restlessness, panting, and costal or flank pain. 

In the absence of dehydration, treatment of uropathy should focus on maintaining adequate urine output and urinary pH. Therapies commonly used include administration of alkalizing agents (e.g., sodium bicarbonate) to increase urinary pH, providing increased fluid intake to produce adequate urine output, and dietary modification to reduce urine specific gravity. Veterinary technicians should be aware of and discuss with clients additional methods for increasing water intake (e.g., adding broth to foods, placing ice cubes in the cat’s water, and providing water fountains), as these may be useful for some cats.

Increasing salt content of food can cause urine dilution in cats, but the potential for adverse effects should be considered. At this time, there are differing opinions regarding role of sodium in cats with kidney disease. In a recent study, the effects of high-salt [1.2% sodium, dry matter basis (DMB)] intake for 3 months were evaluated in 6 cats with mild azotemia due to naturally occurring chronic kidney disease. These cats had progressive increases in BUN, serum creatinine, and serum phosphorus compared with consumption of food with 0.4% sodium (DMB). Based on all findings to date, further study is needed to better determine the role of sodium in healthy cats fed long-term as well as cats with hypertension, chronic kidney disease, and calcium oxalate uroliths. Pending further studies, it is sensible to avoid high-salt foods in cats with chronic kidney disease and monitor kidney function when high-salt foods are fed to cats at risk for kidney disease.

A new study using nutrition to manage FIC was recently presented at American College of Veterinary Internal Medicine Forum (ACVIM). The study evaluated the efficacy and safety of a therapeutic urinary food, enriched with omega-3 fatty acids (EPA & DHA) and antioxidants, for preventing recurrent episodes of FIC. The study design was male or female neutered cats with clinical signs of FIC were recruited for the study at Michigan State University and the University of Minnesota. Cats lived indoors and ranged in age from 1-8 years. They were considered for inclusion in the study if they had experienced an acute episode of ≥ 2 lower urinary tract signs (hematuria, dysuria, stranguria, pollakiuria, and/or periuria) in the past seven days. A thorough diagnostic evaluation (history, physical examination, CBC, serum chemistries, urinalysis, urine culture, survey abdominal radiography, and/or abdominal ultrasonography) was performed to exclude systemic illnesses and other causes of lower urinary tract disease. Cats were excluded from the study if: they lived in multi-cat households (> 2 cats) and owners could not comply with feeding exclusively the test or control foods; had major organ disease or lower urinary tract disease other than FIC (e.g., uroliths, urinary tract infection); had received antimicrobial therapy within the past seven days; had recently consumed urolith dissolution foods; or had been treated with any drug or supplement that could potentially affect expression of FIC signs (e.g., antihistamines, antidepressants, anti-inflammatories, glycosaminoglycans, or nutritional supplements).

Owners could choose whether they wanted to feed wet or dry exclusively and then cats were assigned randomly to either the test or control food groups. Investigators and pet owners were masked to treatment groups for the duration of the 12-month study. The test food was commercially available Hill’s™ Prescription Diet™ c/d™ Multicare Feline Bladder Health formula. The control food was formulated to meet, or exceed Association of American Feed Control Officials (AAFCO) requirements for adult cats, with mineral concentrations and target urine pH designed to mimic common selling grocery brands. Compared with the test food, the control food contained substantially lower concentrations of antioxidants and omega-3 fatty acids.

The primary endpoint measured was the number of recurrent episodes of FIC signs within 12 months. A recurrent episode of FIC was defined as presence of ≥ 2 clinical signs (hematuria, dysuria, stranguria, pollakiuria, and/or periuria) on a single day. An episode was
considered to have been resolved when there were two consecutive days with ≤ 1 clinical sign. Because certain behaviors (e.g., periuria) may be acquired as a result of lower urinary tract diseases and persist despite resolution of the underlying disease, this definition of episode resolution was chosen to minimize potential bias of acquired persistent behaviors on outcome assessments. Owners were instructed to return to the veterinary hospital should a recurrence of clinical signs occur and also for scheduled rechecks at one, three, six, nine and 12 months. Using a standardized report form, owners recorded food consumption, signs of other illnesses, any treatments administered and any environmental changes. They also were asked to maintain a daily log of clinical signs throughout the entire study period. At the end of the 12-month study, cats returned to the veterinary hospital for a physical examination, urinalysis, urine culture, serum chemistries and diagnostic imaging of the lower urinary tract.

A total of 25 cats were included in the study with 11 cats in the test food group and 14 cats in the control food group. There was no statistical difference in recurrence of lower urinary tract signs between the dry and wet formulations, therefore, data from cats in the dry and wet groups were combined and comparisons were made between nutritional profiles (test food vs. control food).

The study found cats consuming the test food had a significantly lower proportion of total days with ≥ 2 clinical signs and total episodes of FIC signs ($P < 0.05$) with 4/11 (36%) test food group cats and 9/14 (64%) control food group cats exhibiting ≥ 2 clinical signs on at least one occasion during the 12-month study. At least two clinical signs were observed on any particular day; 13 times in the test food group and 152 times in the control food group. The rate of recurrent episodes of FIC signs was 5/3904 days (1.28/1000 cat-days) in the test food group and 47/4215 days (11.15/1000 cat-days) in the control food group. This represents an 89% lower rate of recurrent episodes of FIC signs in cats fed the test food (Hill's™ Prescription Diet™ c/d™ Multicare Feline Bladder Health) consistently for 12 months compared with the control food group. This is the first study to definitively show that foods of different nutritional profiles impact the expression of acute FIC signs in cats. Investigators determined that consistent feeding of c/d™ Multicare to cats with FIC resulted in decreased recurrence of episodes of FIC signs during a 12-month randomized, controlled, double-blinded clinical study.

Environmental Enrichment

In addition to nutritional management, the currently recommended treatment for cats with FIC also includes environmental enrichment and stress reduction. This is a crucial component in an FIC treatment plan and one that the veterinary technician should be readily able to discuss with the client.

A recent prospective study evaluating effects of multimodal environmental modification was reported in 46 client-owned cats with FIC. The findings showed significant reductions in lower urinary tract signs, fearfulness, and nervousness after treatment for 10 months. With cats that are suffering with FIC, stressful situations (e.g., conflict with other cats in the home) should be avoided or minimized. Owners should provide opportunities for play/resting (horizontal and vertical surfaces for scratching, hiding places, and climbing platforms). Any changes (e.g., switching to a new food) should be made gradually so the cat has adequate time to adapt and avoid becoming stressed.
Another critical component of managing cats with FLUTD, especially FIC, involves appropriate use and maintenance of litter boxes in the home. The majority of cats prefer clumping, unscented litter; however, it may be necessary to give cats several choices and let them select their preference. It may be possible to have cats within the home that prefer different types of litter or litter boxes. In general, uncovered litter boxes are recommended because they are less likely to trap odors inside. For older cats with mobility issues, the owner should select a litter box with low sides to facilitate the cat getting in and out of the box. Litter boxes should be scooped daily and washed every few weeks with warm soapy water. Because plastic can absorb odors over time (months to years), owners should consider replacing litter boxes with new ones periodically. Finally, there should be an adequate number of litter boxes (the 1 + 1 rule = 1 more than the number of cats) in the home and they should be located on multiple floors where cats can enter and exit readily.

More detailed information about environmental enrichment and litter box management is available.\textsuperscript{7-10} It may be helpful to encourage owners to read this additional information, because their involvement is critical for a successful outcome. Finally, health care team members, especially technicians, play a crucial role in educating cat owners about the importance of environmental enrichment and litter box management.

**Managing Cats with Struvite Uroliths or Urethral Plugs**

Treatment options for cats with struvite uroliths include physical removal of uroliths or dissolution via nutritional management. For cats with suspected struvite uroliths, it is appropriate to transition to feeding a canned or dry calculolytic food over a seven-day period. Cats should be re-evaluated every 2-4 weeks (urinalysis and abdominal radiographs). Urine pH should remain < 6.1 and specific gravity should be < 1.040 if canned food is being fed exclusively. Nutritional management (dissolution) should be continued one month beyond radiographic resolution of the urolith.

After dissolution or removal of struvite uroliths or urethral plugs, nutritional management should continue to prevent recurrence. There are several commercially available foods for struvite prevention. A dissolution (calculolytic) food is appropriate for initial management (1-3 months) after relieving urethral obstruction. This should be followed by feeding a struvite preventive food indefinitely, with the cat being evaluated routinely by the veterinary healthcare team.

**Managing Cats with Oxalate Uroliths**

The treatment of choice for calcium oxalate urolithiasis is urolith removal, followed by methods to prevent recurrence. At present, the standard of care for preventing calcium oxalate urolith recurrence is to feed moist therapeutic food and encourage water intake. There are several commercially available canned and dry therapeutic foods for prevention of calcium oxalate uroliths in cats.

All cats should be monitored for recurrence including urinalysis every three months to detect calcium oxalate crystalluria and diagnostic imaging every six months to detect uroliths. If uroliths recur, less-invasive procedures such as voiding urohydropropulsion are more likely to be effective when uroliths are smaller.
Summary

Increased understanding of specific causes of FLUTD has allowed diagnostic and therapeutic efforts to be directed toward identification and elimination of the underlying disorders. The most common cause of FLUTD in cats < 10 years of age is feline idiopathic cystitis (FIC), followed by uroliths, and urethral plugs. A diagnosis of FIC is made by excluding all other causes of FLUTD. In older cats (> 10 years), urinary tract infection and/or uroliths are the most common cause of FLUTD. It is imperative that veterinary technicians have a thorough understanding of FLUTD and how the various treatments affect the different types of FLUTD.

Veterinary technicians play a critical role in the treatment of FLUTD. The history obtained from discussions with the owner aids in the diagnosis of FLUTD. The technicians’ discussion of the treatment plan with the client is crucial to the client’s understanding and compliance with the veterinarian’s recommendation, and ultimately, the health of the pet.

References/Suggested Reading

9. The Indoor Cat Initiative (www.vet.osu.edu/indoorcat).
How Clean is Clean?
The Truth About Disinfectants and Sterilization in Your Practice

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Carol has extensive experience managing the Central Sterilising Section, the Small Animal and Equine Operating Theatres as well as training undergraduate veterinary students in aseptic technique, operating room etiquette, basic surgical skills and sterilising processes at the University of Melbourne’s Veterinary Teaching School, Werribee for the past 32 years.

In 1997 she was the first veterinary nurse to successfully undertake Certificate III in Sterilizing and Processing Techniques. A certificate normally reserved for human hospital nurses or technicians. She also attained her Certificate IV in Assessment and Workplace Training through the University of Melbourne in 2004.

Carol completed her MSc Veterinary Education (Associate) through the Royal Veterinary College of London (RVC) in 2013.

For 15 years, Carol had been facilitating surgical workshops for Sydney University’s Post Graduation Foundation, working with surgical icons, Bruce Christie, Glenn Edwards and Wing Tip Wong in continuing education in the surgical discipline. Participants include veterinarians from all around Australia, NZ and Asia.

Carol is a popular speaker, presenting for the VNCA, TAFE Colleges and the University of Melbourne (Faculty of Veterinary Science) nursing conferences.

Carol has been involved in educational media for undergraduates, postgraduates and nurses, including visual media in topics such as; Preparation of the Surgical Team, Instrument Care, Packaging, Sterilizing, Patient Preparation, Gloving, Gowning, Draping and is a co-author of the software package “Virtual Surgery”, an online learning tool for veterinary undergraduates and nurses.

She is currently the Clinical Skills Centre Manager/Nurse Educator for the University of Melbourne’s Veterinary Faculty, teaching the fundamentals of surgery and assessing DVM students in clinical skills.

Publications
- Research – Vascular prosthesis, conduits & pumps.

Awards
- Sydney University Post Graduate Foundation, Significant Achievement Award, 2005
- Acknowledgement – Hungerford Award 2007, University of Sydney Postgraduate Foundation
INTRODUCTION – WHAT HAS CHANGED?

Historically veterinary practice has relied on a poor imitation of sterilizing protocols in the human field as well as relying on the steam autoclave to “sterilize” their instruments contributing to a lack of close attention to this discipline because of the low number of post-operative infection rate records. This number may be in part, due to the current low level of antibiotic resistant bacteria within the field of veterinary medicine.

Since the advent of HIV and MRSA (Methicillin-Resistant Staphylococcus Aureus), however, the general public has become far more aware of the post-operative risks of surgical intervention, hospital processes and particularly those processes within the realm of infection control.

As instrument cleaning, disinfection and sterilisation comes under the scope of Infection Control Practice it stands to reason that Veterinary Practice now finds itself under closer scrutiny in regards to infection control processes and practices.

Whilst there are many veterinary text books and research papers with a broad overview of sterilizing practice, including a nominal mention within the AVA standards, there are no compelling guidelines on sterilization practices for Veterinary Hospitals in Australia.

In veterinary practice, oversight of instrument care, sterilizing and disinfection is often left up to a senior veterinary nurse or practice manager who may have gained basic knowledge through various veterinary nursing education providers. There is however a lack of in-depth knowledge equivalent to our human veterinary nursing counterparts and a reliance on anecdotal practices.

CURRENT GUIDELINES

Guiding bodies such as the Australian and New Zealand Standards have recognized a need for Veterinary Practices inclusion in written national guidelines. A start has been made in the AS4187-2003, Cleaning, disinfecting and sterilising reusable medical and surgical instruments and equipment, and maintenance of associated environments in health care facilities[1], where specific mention is made in Section 1.1 Scope of the document, “The standard may be suitable for application to the instruments and equipment used exclusively on animals in veterinary practice”.

Whilst the standard is not a legally binding document, it is recognized as an industry guideline and discusses potential best outcomes for veterinary practices engaging in elective and emergent surgical procedures.

In the United States there is a plethora of information, guidelines and standards available, most notably the Center for Disease Control (CDC), the Association of Perioperative Registered Nurses (AORN), Healthcare Infection Control Practices Advisory Committee (HICPAC) and the American Journal of Infection Control.

As a medical profession, it is incumbent upon veterinary practice staff to be able to defend their infection control processes within the clinic or hospital, and to recognize correct instrument processing and sterilisation as a part of the positive outcome for their patients.
Disinfection or Sterilization?

So how do we determine what treatment contaminated instruments and equipment require for effective processing?

In 1968 Earle Spaulding devised a rational approach to disinfection and sterilization. This is commonly referred to as Spaulding’s classification. Spaulding believed that instruments and equipment should be cleaned and reprocessed according to the level of risk associated with their intended use.

Even though Spaulding’s Classification was devised in 1968, it still is as relevant today as when Spaulding introduced it.

Spaulding’s Risk Classification within Veterinary Education appears to [2, 3] be gaining recognition as a starting point in determining the appropriate process for decontamination and sterilization.

<table>
<thead>
<tr>
<th>Category of Risk</th>
<th>Application</th>
<th>Example of items</th>
<th>Process to be used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critical</td>
<td>Entry or penetration into sterile tissue, a cavity or bloodstream.</td>
<td>Surgical instruments, Surgical Implants</td>
<td>All items must be sterile</td>
</tr>
<tr>
<td>Semi-Critical</td>
<td>Contact with intact non-sterile mucosa or non-intact skin.</td>
<td>Flexible Endoscopes, Anaesthetic equipment.</td>
<td>Sterilization is preferable where possible, otherwise high level disinfection is required.</td>
</tr>
<tr>
<td>Non –Critical</td>
<td>Contact with intact skin</td>
<td>Exam tables, BP cuffs.</td>
<td>Clean as necessary with detergent and water.</td>
</tr>
</tbody>
</table>

Flexible endoscopes come under the semi-critical category and can be sterilized in Peracetic acid (Steris) however these units are rare in veterinary practice.

Additionally steam sterilization isn’t suitable for flexible endoscopes due to their heat sensitive nature, therefore at a minimum they should be subjected to high level disinfection[1].

As ET tubes come into contact with intact non-sterile mucosa, they should be sterilized however many plastic or vinyl endotracheal tubes in veterinary practice can’t be sterilised therefore they should be subjected to high level disinfection, thoroughly rinsed and dried before use. If either of these processes aren’t possible, thorough cleaning with an enzymatic detergent and total drying should be completed before re-use.

There is still ongoing doubt and controversy regarding rigid endoscopes used in laparoscopy or arthroscopy however as these instruments penetrate sterile tissue[4], according to Spaulding’s Classification they must be sterilised prior to use.

On reflection I believe the ongoing discussion as to whether high level disinfection or sterilization ought to be used is associated with the older model of rigid endoscopes that could not be subjected to steam or high temperatures. These telescopes flooded the veterinary market as the uptake of newer sterilizable models increased in human hospitals. If a practice owns an older style endoscope then high level disinfection must take place.

No matter which process you select, the prerequisite is CLEANING, CLEANING, CLEANING.

**You can clean without sterilization but you can’t sterilize without thorough cleaning!**
HOW CLEAN IS CLEAN?
Most references and texts recommend effective or thorough cleaning must be performed before sterilization of surgical instruments that enter sterile tissue however there is no current testing mechanism available in the clinical setting to give "real time" verification of bio burden after the cleaning process[5].

It’s been reported that thorough cleaning can remove up to 99.9% of gross bio burden[6], therefore each individual instrument or environmental surface should be closely inspected to ensure all visible gross organic material has been removed.

Cleaning does not require a disinfectant solution.

WHY DO WE CLEAN?
Simply put, biostatics or biocidal agents require complete access to all surfaces of the instruments or equipment we are processing. The presence of blood, pus, serum or faecal matter interferes with this process, effectively protecting potential pathogenic material and acts as a physical barrier to the disinfectant or biocide.

WHEN BIOBURDEN IS LEFT BEHIND
Any bio burden left on improperly cleaned instruments or surfaces may lead to pathogenic material being left behind and can lead to its survival despite being subjected to sterilization. If an improperly cleaned instrument is subjected to high temperature steam sterilizing, the bio burden can create a protective covering film “a micro scab”, effectively protecting the pathogenic material within it. It’s reasonable to extrapolate that when the “contaminated” instrument is introduced to the sterile tissue of a patient, the natural body defenses liberates the material, thus potentially causing an infectious process.

The old adage still stands that “what you CAN'T see CAN hurt you”

In addition to enabling proper disinfection or sterilization, effective cleaning contributes to the reduction of any potential damage to an instrument, particularly in the joints and crevices where large particles can cause misalignment or warping.

INSTRUMENT CLEANING BEGINS IN THE OPERATIVE FIELD (POINT OF USE)
Before attending to any instrument cleaning, the staff member should be wearing appropriate PPE, such as nitrile gloves, eye protection, mask and a water impervious gown.

Gross blood and body fluids left to dry on surgical instruments causes pitting and staining therefore cleaning begins at the operative field.

The surgical assistant can assist with the cleaning process by wiping bloodied and dirty instruments with a clean swab moistened with sterile water as the procedure is in process. Saline should never be used, as this solution can cause corrosion and surface rust.

Diathermy tips should be cleaned of any eschar build up to ensure the electro-cautery current is working effectively as the debris can cause tissue tearing thus failing to seal the site of the bleeding.

When cleaning the tip, ensure it is well away from the incision site to prevent any debris entering the surgical wound.
TRANSPORT OF CONTAMINATED INSTRUMENTS AND LINENS

Before transportation can occur, all sharp items such as scalpel blades and suture needles must be discarded into the appropriate container. Additionally biological waste such as single use drapes, gowns, gloves, swabs etc. should be contained within the surgical suite or disposed of appropriately. Re-usable linen should be bagged for transportation to the laundry facility.

Whilst it’s ideal to rinse instruments with cool running water at the point of use[7], many veterinary practices are unable to facilitate this step due to time constraints or room design. Therefore a light weight, puncture proof transportable container with a secure lid can be used. Within the container it’s highly recommended to have a perforated tray in which to place the instruments to facilitate the cleaning process.

Instruments should be loaded according to weight, heaviest at the bottom, light delicate instruments at the top and micro instruments segregated. They should be fully opened and/or dismantled in preparation for cleaning.

If there is to be any delay in processing instruments, a towel moistened with clean water laid over the top can prevent blood and debris from drying onto the instruments. Alternatively a Clinipak water soluble protection sheet or bag can be used.

APPROPRIATE CLEANING DETERGENTS

Household dishwashing detergents or surgical scrub solutions must not be used as these contribute to instrument corrosion, instrument staining and potential tissue toxicity. Additionally antiseptics should not be used as a cleaning agent.

Household dishwashing detergents create a lot of foam and are difficult to remove during the rinsing process. Additionally they contain brighteners, dyes, perfumes, thickeners and preservatives.

Chlorhexidine scrub solution contributes to instrument corrosion and damage of the passivation layer.

A dedicated surgical instrument detergent containing a mild alkaline detergent solution in the pH range of 8.0 – 10.8 is often recommended because these solutions normally provide good soil removal[8]. However some studies have indicated that a neutral detergent is less corrosive on aluminium containers hence I tend to follow the recommendation of a neutral pH 7-8 solution.

The manufacturers MSDS document should be read before use of any solution.

The ideal surgical instrument cleaning detergent[8] should be:-

- Biodegradable
- Non-corrosive
- Non-toxic
- Non-abrasive
- Low foaming
- Free rinsing
- Preferably liquid
- Neutral or mild alkaline formulation
Precautions

- Strictly follow manufacturer’s directions for dilution.
- Do not mix solutions unless indicated.
- Have an MSDS available, including first aid instructions.
- Store appropriately.
- Dissimilar metals should not be cleaned or sterilized together as this may cause electrolytic corrosion.
- Use a water miscible oil or lubricant recommended by the manufacturer.
- Sodium Chloride (Saline) damages stainless steel instruments.
- Iodine and bleach will stain, pit or damage.
- Engraving instruments damages the passivation layer.
- Instrument colored tape isn’t recommended.
- Instrument milk should be allowed to air dry on the instruments.
- Instrument milk will not fix a damaged or inferior instrument.
- Mineral oil or silicone lubricants should not be used because they can harbor microorganisms, prevent biocidal access.
- Air powered or electrical instruments should be lubricated according to the manufacturer’s recommendations.

MANUAL CLEANING METHODS

As previously stated, the aim of cleaning is to remove all organic, inorganic and microbial material.

In the vast majority of veterinary practices in Australia, manual cleaning of surgical instruments is still the method used to achieve this.

Washer/disinfectors are more widely used in human hospital Central Sterile Supply Departments (CSSD). Washer/disinfector units are often subject to colonization and formation of biofilms if not routinely cleaned[8].

Manual cleaning of instruments should follow the rigid steps of a pre-clean rinse, soaking in an appropriate detergent, post-clean rinsing then thorough drying.

PRE-CLEAN RINSE

Rinse the instrument set under cool running water. This will remove the initial gross blood and soil. (Avoid hot water as this will bake the blood and soil onto the surface of the instrument which will make it very difficult to remove as well as interfering with the sterilising process).
INSTRUMENT SOAK
Soaking and cleaning in a deep sink of warm water (45°) mixed with an appropriate cleaning detergent. Adherence to the manufacturer’s instructions, particularly for soaking times and dilution rates is critical. Instruments must be scrubbed under the water, so that aerosols are contained to avoid contaminating the environment or adversely affect the staff member.

Careful cleaning of serrations and box joints should be achieved by use a soft brush. Harsh scouring pads or pastes can damage the passivation layer of instruments, leaving them vulnerable to damage, rusting or pitting.

Mechanical Cleaning
Mechanical cleaners include ultrasonic cleaners or washer/disinfector machines. I will only be discussing ultrasonic cleaning machines, as these are more commonly used in Veterinary Practice.

Ultrasonic cleaners are primarily used for stainless steel instruments with joints or serrations whereas absorbent materials such as plastic and rubber cannot be cleaned in these units as they absorb the vibrations, preventing the oscillation process. Lensed equipment such as endoscopes are damaged by this process. For safety reasons, staff should not place their hands into the unit whilst its oscillating as this may damage joints.

Take note that due to the fine vibrations of an ultrasonic cleaner, a slight blunting of sharp instruments may occur.

The mechanical method employs the use of an ultrasonic cleaning machine. These machines are available as a bench top or a stand-alone model and are of particular value when cleaning large numbers or difficult to clean instruments.

Ultrasonic machines clean by a process called cavitation. This process creates waves or oscillations within the water tank as a sound wave, well above the normal hearing range at 20,000 cycles per second. These sound waves create millions of sub-microscopic bubbles that collapse beneath the dirt and debris, imploding it from the surface of the instrument.

A low-foaming, neutral or mild alkaline detergent must be used. Normal detergents create excessive bubbles when the machine is oscillating and interferes negatively with the cleaning process.

Before use, the ultrasonic cleaning should be de-gassed (this removes dissolved oxygen in the solution). If de-gassing isn’t performed prior to use, it prevents the bubbles from imploding, resulting in a poor cleaning process.

Degassing is completed by filling the unit with fresh water and detergent. The machine is then run without instruments in the unit to remove all gases.

Instruments should be placed in an ultrasonic basket or perforated tray and should not lay on the floor of the unit. Tanks should be emptied and cleaned daily or when the solution becomes visibly soiled.
HOW DO YOU KNOW IF YOU’RE ULTRASONIC CLEANER IS ACTUALLY CLEANING?

Ultrasonic cleaners ought to be tested for its cleaning performance on a daily or weekly basis to ensure the unit is working correctly otherwise instruments may not be cleaned appropriately.

The easiest and most common method of testing is to use aluminum foil (approximately .025mm thick) purchased from the supermarket.

Testing Procedure:
1. Cut a section of aluminum foil to suit the dimensions of the tank, with extra depth to hold onto but small enough not to touch the sides or bottom of the tank.
2. Immerse the aluminum foil into the tank water, holding in a vertical position.
3. Operate the ultrasonic machine for 10-15 seconds
4. A consistent pattern of perforation should result with varying sizes of holes.

If the foil has any blank spots without holes or wrinkles, this indicates a problem with the cleaner and a service is required.

Once the test is completed, the water should be drained and replaced with fresh water and cleaning solution, to ensure no foil residue is left in the cleaning tank.

If your foil looks like this after the test, then you have an acceptable result.

POST CLEAN RINSE
Once clean, rinse the instruments thoroughly, in warm to hot running water to remove all chemical residues. Using hot water facilitates the sanitation process and aids in subsequent drying of the instruments.

DRYING OF INSTRUMENTS
Instruments should be dried thoroughly within a drying cabinet or manually dried individually with a lint free cloth prior to assembling and packaging. Drying cabinets are rare in veterinary hospitals, hence manual drying is commonly performed.

Drying is an important step in reducing the potential of re-contamination during inspection and assembly as well as avoiding rusting, staining or steam quality problems.

Instruments that have any residual moisture may contribute to some common problems such as, wet loads, wet steam and perforation of paper packaging material.
SORTING

The facility should have checklists (SOP’s – Standard Operating Procedures) available for identification and numbers of surgical instrument in sets. A copy of the checklist can be included in the instrument set for the surgeon to check off.

Assemble instruments in similar groups on instrument stringers, (the old commonly used instrument pins make it difficult to keep instruments open for processing).

Whether an instrument has been used or not during the procedure, it should be considered contaminated and processed accordingly with the rest of the set.

An instrument set ought not to be sterilized unless it is complete.

WRAPPING

What’s the purpose?
The intention of packaging is to protect the sterilized articles from contamination until they are ready to be used or aseptically delivered to the sterile field.

Selection Criteria
There are many types of packaging materials on the market today, making selection difficult. When selecting packaging material the following criteria ought to be considered:

- Must be compatible with the sterilizing process being used.
- Must be able to be adequately closed or sealed.
- It must be permeable to air, steam and allow removal of same.
- Must be resistant to penetration by micro-organisms following sterilization.
- Free from loose particles and fibres.
- No toxic ingredients or fast dyes in their manufacture.
- Perforation, damage and tear resistant when handled.

There are five types of packaging commonly used in the Veterinary setting.

- Paper bags
- Laminate packs
- Linen
- Synthetic materials
- Aluminum trays and boxes
1. **Paper bags** - Useful for small light, non-sharp items such as swabs or cotton buds; they’re cheap and easily obtained. Disadvantages are; they are easily perforated when wet, items can’t be visualized and heavy items can break through. Double bagging is required.

![Paper bags image]

2. **Laminate packs/window packs** are a combination of transparent heat stable plastic film laminated to treated paper. These are multifunctional, relatively cheap, come in pre-cut sizes or in rolls of various widths. You can fit several small items in them and instruments can be identified through the window side. However due to the paper side they have similar disadvantages as outlined above. Double bagging is required.

Nylon packaging is known for its retention of air and should not be used.

![Laminate packs/image]

3. **Linen material** - Often referred to as muslin or linen is usually a 50% Polyester, 50% Cotton blend and comes in a variety of colors, the most common color used is “forest green”. The green is chosen for its clinically proven aesthetic soothing effect on the eyes. Typically used for wrapping instrument sets, drape or gown packs.

Wide weave materials are unacceptable as an effective barrier, e.g. tea towels

When utilizing linen as a wrap, it should be used an inner wrap only, with a water resistant, single use wrap as the outer layer. Linen material as a stand-alone barrier wrap is no longer the material of choice for sterilising.

Wraps should not to be too tightly wrapped or too dense as this will impede steam penetration into the centre of the bundle.

Linen that has been treated with a water resistant chemical is also available for drape and gown manufacture however validation from the manufacturer of its performance for steam penetration and drying qualities should be ascertained prior to its use. Chemically treated linen is limited in the number of launderings it can undergo before the barrier qualities are lost. Tracking of the number of launderings is required.

![Linen material/image]
4. Synthetic materials

Synthetic disposable material has superior barrier qualities compared to the others mentioned above. They will have varying degrees of moisture resistance, depending on which product you buy.

Real time cost comparisons often show disposable materials can be cheaper than the laborious task of purchasing, making, repair, washing, folding and sterilising of reusable linen.

Reusing **single-use** packaging is not an acceptable practice and should be discouraged as the material’s integrity cannot be relied upon.

5 Instrument Containers

Aluminum and stainless steel instrument containers are used for storing or autoclaving a wide range of surgical instruments, particularly orthopaedic implants, rigid endoscopes etc.

**WRAPPING METHODS**

Wrapping techniques are designed to protect the sterile instruments until use as well as reducing the risk of contamination when opening or delivering to the operative field.

A parcel, envelope or modified parcel pack configuration ought to be selected as the wrapping method.

A sequential wrap, (a package within a package) can be a combination of one linen and one disposable sheet (with the disposable being the outer wrap), or two disposable sheets.

Or either of the above folded non-sequentially (wrapped at the same time).

Avoid any gapes or wrapping too tightly as this may hinder steam penetration.

Failure to wrap appropriately subjects the sterile articles to potential contamination.
SEALING PACKAGES
Packages must be sealed completely to protect the sterilised instrument from contamination.

Whilst heat sealing is the best method for securing contents in paper bags and laminates, autoclave tape may be used. When using tape, begin by folding the corners of the open bag or laminate inwards, followed by three width wide folds of the entire width of the open end. Secure the full width with autoclave tape.

Large bundles are secured by four generous length strips of tape on each side.

Self-sealing pouches or bags should be used in accordance with the manufacturer’s instructions.

Heat sealers are applied to paper (medical paper bags) or film to paper (window packs/laminates).

After sterilisation the heat seal may be slightly weakened. The seal will become robust again once cooling occurs.

LABELLING REQUIREMENTS

- Never use ball point pens as the tip may penetrate the wrapping material; use indelible non-toxic felt tipped pens, e.g. skin marking pens instead.

- Always write on the steriliser indicator tape or on the clear side of laminate packs. Don’t write on paper packaging as the ink may bleed or leach onto your sterilised instrument which could be transferred to your patient during surgery.

- Include content information; date of sterilisation, instrument type and staff member initials.
STERILIZING METHODS

Gas plasma (hydrogen peroxide) – Sterrad System

- Hydrogen peroxide vapor and low temperature (42°C)
- Kills by causing irreversible cell damage.
- Useful for heat and moisture-sensitive instruments such as endoscopes, cardiac catheters, plastic, rubber, some implants and electronic circuitry.
- Unable to process paper, linen, powders, liquids, long narrow lumens (scopes over 40cm length & under 3mm diameter, or dead-end lumens.
- No toxic residues.
- Processing time approximately 55 minutes.

Gamma irradiation

- Radioactive isotope Cobalt 60. Gamma rays are electromagnetic radiation of very short wave length, similar to UV.
- Kills by breaking down bacterial DNA and inhibits bacterial division.
- Operated by large commercial enterprises.
- Useful for heat sensitive equipment.
- Unable to process Teflon, cotton, some plastics and rubbers. Clear glass items may turn a dark color.
- Lethal to living beings.

Ethylene Oxide Gas

- Kills by changing the chemical structure of cell components.
- As for Gas Plasma EO is useful for heat and moisture-sensitive instruments such as endoscopes, cardiac catheters, plastic, rubber, some implants and electronic circuitry.
- EO can penetrate medical packaging and some plastics.
- Very toxic and flammable.
Peracetic Acid - Steris System

- Liquid Chemical Sterilant
- Kills by disrupting the cell membrane and denaturation of cells.
- Developed for sterilizing endoscopes.
- Good penetration of medical packaging and some plastics.
- Useful for heat sensitive equipment that are able to be immersed in liquids, such as plastic, rubber or instruments with lumens (the space within tubular structures).
- Also useful for any medical device that can withstand liquid immersion
- Peracetic Acid sterilization is for immediate use of items and not applicable for items requiring packaging or storing.
- Cycle time is approximately 30 minutes.

Dry Heat

- Elevated temperature in dry heat oven (160-180°C)
- Kills by oxidation (turns into vapour) of cells.
- Useful for micro cutting instruments, suture needles, waxes, petroleum jelly, glassware and powders.
- Cycle time 1-2 hours.
- Materials that could burn can’t be sterilized in dry heat ovens.

Steam under pressure (Autoclaves)

- Steam sterilizers are cheap to run.
- Non-toxic, safe and simple to use.
- Effective.
- Can be used for wrapped and unwrapped items.
- Temperatures selected are usually 121 or 132°C.
- Heat sensitive items can’t be sterilized in steam.
- The most commonly used sterilizing process in veterinary practice.
THE MICROBIAL TARGET

There are five groups of microorganisms we need to consider, Algae, Protozoa, Fungi, Viruses & Bacteria, however it’s the reproductive spore of bacteria that is targeted for sterilization because of its high resistance to destruction.

The image above shows a scanning electron micrograph of Clostridium tetani at a magnification of x 11,200. Both vegetative and spore stages are shown. The spore forms are the ones with the big bulges. There are faint blue strands which are flagella on the vegetative cells.

STERILIZATION

It’s relatively easy to kill most bacteria at temperatures 100C in boiling water for one minute but the spores produced by the gram-positive Bacillus and Clostridium bacteria are very resistant and require much higher temperatures to achieve total destruction.

Sterilization is an absolute state, there is no such thing as almost or sort of sterile. It either is or isn’t.

The FDA and associations such as Association of periOperative Registered Nurses (AORN) and the Association for Professionals in Infection Control (APIC) define a sterilized device as having been processed in a system that delivers a sterility assurance level at $10^{-6}$. This is a 1 in a million chance of a non-sterile occurrence.

STEAM UNDER PRESSURE STERILIZATION

Bacterial and spore destruction is accomplished by coagulation. Similar to the way an egg is poached

Boiling water at atmospheric pressure, at sea level, will have a measured temperature of 100C. This boiling water vaporizes and turns into steam. However if you subject that steam to pressure in a pressure vessel, the temperatures attained are much higher. These higher temperatures are the ones we require for sterilization.

Pressure vessels (commonly called autoclaves or sterilizers) are used to achieve high temperatures with dry saturated steam. Dry saturated steam refers to steam that does not produce water droplets and the condensate is in equal balance with evaporation. Dry saturated steam has a 97% dryness factor with a 3% water vapor.

Sterilization takes place when the dry saturated steam under pressure, condensates on to the load, where it gives up its latent heat and transfers that extra heat onto the load within the sterilizer chamber.
TYPES OF STEAM STERILISERS

There are four types of steam sterilizers commonly seen in practice.

1) Pre-Vacuum for porous and cannulated loads,
2) Downward Displacement for porous loads only
3) A bench top displacement type with drying capacity
4) A bench top displacement type without drying capacity (commonly used as a flash sterilizer)

STERILISING TIME

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Chamber Pressure</th>
<th>Holding Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>121°C</td>
<td>101 Kpa</td>
<td>15 minutes</td>
</tr>
<tr>
<td>132°C</td>
<td>203 Kpa</td>
<td>4 minutes</td>
</tr>
</tbody>
</table>

Holding times are for unwrapped articles. Consideration must be given for the time it takes for steam to penetrate through the packaging material. (*Penetration time will depend on the type and thickness of wrapping used).

The formula is - **Sterilizing time + safety margin time + penetration time** = Total holding (sterilization) time. Your drying time is then added on.

E.g. 4 minutes + 2 minutes (safety margin time) + 16 minutes (penetration time) = 22 minutes sterilizing time. Add on the average 25 minutes drying time = 47 minutes total sterilizing and drying cycle.

- Penetration times can be determined by your service provider by performing a thermocouple test.

LOADING THE STERILIZER CHAMBER

When loading the sterilizer it’s essential that steam can penetrate all articles. Incorrect loading allows air to become trapped within the packages or chamber. Any air trapped within the chamber will inhibit effective steam penetration, rendering the entire load “non-sterile”.

- Articles should be loaded vertically.
- If mixed loads of metal items and linen are sterilized together, the linen is placed on the upper shelf and the metal items on the lower.
- Goods should not touch the side of the chamber walls.
- Bowls and hollow equipment should be placed upside down.
- Laminate packs should be on edge or flat with the paper side down.
- It’s better to have less in the chamber than to pack it too tightly.
UNLOADING

- The sterilized load should be warm but dry to the touch when the cycle is completed.
- Use protective thermal gloves.
- Packs should be allowed to return to normal room temperature before handling otherwise condensate can be created allowing contaminants from your hands to wick through to the contents.
- Minimize handling of sterilized packs so packing material isn’t damaged.
- Don’t carry packages under the armpit or close to the body.
- Store as soon as possible after cooling.
- Any item dropped on the floor ought to be considered contaminated and should be repackaged with new wrap and re-sterilized.

MONITORING OF STEAM STERILIZER LOADS (What’s your evidence?)

There are three methods of monitoring: - Chemical, Physical and Biological.

Chemical Indicators: - Are divided into internal or external indicators and graded into 6 classes. Class 1 being the most basic and Class 6 the most complex.

Class 1 - Chemical indicators are the least reliable type as they are a simple paper product impregnated with dye. They have no relevance to the verification of the sterilising process, except to indicate the item has been subjected to a heat source. The most common Class 1 chemical indicator is autoclave tape or internal indicators that are small strips placed inside packs that turn from white to black.

Class 2 - An example of a Class 2 indicator is the Bowie Dick used in steam sterilizers, to test for presence of air in the sterilising chamber. These should be used every day to test the chamber before a load is processed.

Class 3 - Are single parameter indicators. They react to a chosen parameter such as time or temperature but not both.

Class 4 - Will react to 2 or more parameters, typically, time and temperature.

Class 5 - Referred to as an Integrator. They can be used in gravity and pre-vacuum sterilizers with a reliable response to all critical variables required. These are the chemical indicator of choice if biological spore testing is not available.

Class 6 - Are an emulating indicator and responds to all critical variables required with a slightly higher reliability than the Class 5. More suited to Pre-vacuum sterilizers.

Physical parameters: - Are those attached to your machine e.g., temperature, jacket pressure and chamber pressure gauges.

Close monitoring of these should alert you to any potential problems. For example at a temperature of 132°C, the pressure correlation is 203kPa and a temperature of 121°C will require a 101kPa. If there is a discrepancy between the two readings further investigation is required.
Biological testing: - Is comprised of a biological test vial containing bacterial spores. These are placed in your largest bundle within the most centred point of your sterilizer chamber.

Another spore vial is incubated (not sterilized) and used as a control, to measure against the sterilized vial. Incubation takes a minimum of 1 hour. As described in AS 4187, Bacillus Stearothermophilus, a very hardy spore, is the organism of choice when monitoring steam sterilization.

**TROUBLE SHOOTING**

Wet Loads after sterilization
The steam required for correct sterilization is *dry saturated steam*, (steam without droplets of moisture). Dry saturated steam is considered of a high quality when it is within the range of 97%-100% dryness. Anything under 97% will produce excess moisture, whilst anything over 100% will produce excess heat.

Excess moisture in the sterilizing chamber, contributes to a process called “Wet Steam”, it produces a fine mist of water droplets. In other words, it’s ‘too wet’ to reach the high temperatures required for sterilization.

Wet loads hinder the drying process leaving the packages moist at the completion of the cycle. The moist pack is then subjected to microscopic contaminants when the chamber door is opened or by a wicking effect if laid on a bench.

<table>
<thead>
<tr>
<th>Causes of Wet Steam</th>
<th>Overloading of the chamber</th>
<th>Have less rather than more, items should not touch the sides of the chamber.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overloading of the chamber</td>
<td>Excessive amounts of metal items in the load</td>
<td>Mix the load and have instruments below linen</td>
</tr>
<tr>
<td></td>
<td>Instruments/equipment not dried prior to packing</td>
<td>Dry all items before packaging</td>
</tr>
<tr>
<td></td>
<td>Water retained within coiled tubing or lumen</td>
<td>Tubing and fine lumens may not be suitable for steam sterilizing</td>
</tr>
<tr>
<td></td>
<td>Blocked steam trap</td>
<td>Regularly clean the steam trap filter</td>
</tr>
</tbody>
</table>

**Superheated steam**
Is heat added to steam without relative moisture. This kind of steam cools without condensate and lacks the ability to penetrate and transfer its latent heat. Therefore sterilisation may not take place.

Linen material and paper may burn or desiccate in the steriliser due to dehydration.

<table>
<thead>
<tr>
<th>Causes of Super-Heated Steam</th>
<th>Excessive dryness of the load within the chamber</th>
<th>Ensure linen always go through a washing cycle before being sterilized</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steam jacket is holding a higher temperature than chamber or there is a pressure drop in the steam supply</td>
<td>Sterilizer requires a service</td>
<td></td>
</tr>
</tbody>
</table>
STORAGE

Requirements for storage
If sterile goods are incorrectly stored, there is a potential for contamination, rendering the instruments or equipment non-sterile.

An ideal storage room/area would have controlled air conditioning with low turbulence, minimal traffic and separate from other activities.

The area must be dry, with humidity in the range of no less than 35% and no more than 70%. Temperature should be no higher than 23 degrees Celsius.

Sterile stock should be free from direct sunlight, dust, dampness, insects, vermin and constant handling.

Most human hospitals and larger veterinary sterile store areas will have wire rack compactor storage systems however these are only suitable within a controlled environment.

Closed cupboards or shelving systems should be designed with shelving 50mm-75mm away from the wall, 20-25cm sitting above the floor and 45cm-50cm away from the ceiling.

Smooth washable surfaces are recommended for ease of cleaning. Routine cleaning of all surfaces should be undertaken.

Sterile items must be kept away from water pipes, and not stored under sinks.

Cardboard boxes are not recommended as storage containers for sterile goods as they are porous, cannot be cleaned and potentially harbour contaminants.

Food, drink or non-sterile goods must not be stored with sterile items.

HOW LONG DOES A STERILIZED ITEM REMAIN STERILE ON THE SHELF?

Many text books recommend a period of time for sterility depending on the type of packaging, however this is not quite accurate.

As an example, if an item is wrapped in a laminate pack and the recommendation is that this should be sterile for a period of two weeks, it is easily debunked if I were to pour a cup of coffee all over it. Therefore the two week timeframe has no relevance!

Shelf life is dependent on external events that compromise the integrity of the protective barrier of the sterilized item, such as choice of packaging material, correct sterilization process, handling and storage, rather than a given time frame. Therefore, shelf life is event related not time related (Gardner & Peel, 1998).

Historically many hospitals and veterinary practices would routinely re-sterilize all items not used within the “standard” time frame however evidence suggests this does not offer any additional assurance. On the contrary it suggests a compromised package may not be re-sterilized until the given timeframe has been completed.

It is still standard practice to avoid prolonged storage by ensuring sensible stock levels and efficient rotation of stock.
DISINFECTION
Pathogen resistance
Microorganisms differ in the levels of methods for inactivation or kill. There is a standard recognition of pathogens in decreasing order of resistance. The following chart is indicative of the pathogen involved and resulting disease with recommended sterilization or level of disinfection required. Please note this chart does not include all pathogens or diseases commonly seen in veterinary practice.

Decreasing order of resistance of microbes to biocides & Sterilization or Disinfection Levels Required for Pathogens

- **Prions**
  - Prolonged sterilization
  - Bovine spongiform encephalopathy (mad cow)

- **Bacterial Endospores**
  - Requires sterilization
  - Clostridium perfringens
  - Example - Tetanus

- **Mycobacteria**
  - Intermediate disinfection
  - Example - *Mycobacterium bovis/Mycobacterium Avium/Mycobacterium paratuberculosis (Johnes disease)

- **Non Lipid Viruses (non-enveloped)**
  - Low level disinfection
  - Example - Parvovirus

- **Fungal Spores**
  - Low level disinfection
  - Examples - Micosporum (ringworm)/Aspergillus

- **Vegetative Gram negative bacteria**
  - Low level disinfection
  - Examples - E. Coli, Salmonella spp, Pseudomonas aeruginosa

- **Vegetative Gram positive bacteria**
  - Low level disinfection
  - Examples - Streptococcus, Staphylococcus (MRSA)

- **Lipid Viruses (enveloped)**
  - Low level disinfection
  - Examples - Fading puppy syndrome/Newcastle disease

* Virtually eradicated in Australia.
CHEMICAL DISINFECTANTS

Disinfectants are for use on inanimate objects and should not be used as an antiseptic. Its intention is to reduce the number of microbial contaminants on instruments, equipment or environmental surfaces.

Cleaning with a detergent, followed by rinsing and drying must always precede disinfection.

Disinfectant solutions may be classified as high, intermediate or low level. Choosing the level required is determined by referring to Spaulding’s Risk Classification and the items intended use.

High level disinfectants are primarily reserved for instruments or devices entering sterile tissue however remember high level disinfection is not a sterilization process.

High level disinfection should not be used as part of a routine environmental cleaning process.

If a disinfectant doesn’t state it has the capability of a sporicidal kill of one in 1 million, by definition it is not a Sterilant.

FACTORS IN DISINFECTANT EFFICACY

It’s well documented that efficacy of disinfectants is highly reliant on pre-cleaning but in addition, contact time is crucial together with accurate concentration, water(for dilution) quality and temperature.

Many manufacturers will also state or list different contact times to treat different microorganisms however unless you have evidence of the pathogens you are dealing with, it is unlikely you will know what contamination level you have; therefore as a rule of thumb, it’s suggested you use the longest contact time recommended by the manufacturer.

Interestingly enough, many popular disinfectants require long contact times, conversely some studies suggest that the disinfectant solution dries out before the full recommended contact time has been completed, and consequently there may be a failure to achieve the stated biostatic or biocidal outcome.

Therefore the general recommendation, when choosing a disinfectant is that it ought to have a fast biocidal action.

Solutions should be freshly made for use unless specified by the manufacturer.

Disinfectants should never be mixed with another solution without the manufacturer’s explicit recommendation.
PURCHASING DISINFECTANTS

As mentioned above manufacturers state a multitude of activity claims, making it very difficult to select an appropriate disinfectant fit for the purpose.

Considerations when selecting a chemical disinfectant

What level of decontamination is required according to use, Critical, Semi-Critical or Non-Critical?
What level of disinfectant do you require, low, medium or high?
Is it for instrument/equipment or environmental cleaning?
Is it TGA or FDA approved?
Does it list the pathogens its active against?
Is it compatible to the item you want to disinfect?
Does the product have independent studies for efficacy?
Is it user friendly?
Is it cost effective?

THE IDEAL DISINFECTANT

- should be broad spectrum for gram negative and gram positive bacteria
- Fast acting with a rapid kill
- Kills viruses (non-enveloped and enveloped)
- Active against multi drug resistant organisms.
- Have activity against pathogenic fungi (i.e. Candida spp)
- Be active in the presence of organic matter
- Non toxic
- Environmentally friendly

Currently there is no one “ideal” disinfectant for all circumstances therefore selection should be based on which targets have to be met and which compromises can be agreed on.

SELECTION OF ENVIRONMENTAL CLEANING & DISINFECTION METHODS

Within the Veterinary Practice, cleaning and disinfection methods can be categorized into those that have low levels of contamination or high levels of contamination.

Typically surfaces with low level contamination such as reception desks, offices, walls, doors, windows, do not require disinfection unless they are visibly soiled with faeces, urine or body fluids. These can be cleaned with water and detergent.

Surfaces with potential high level contamination will include areas such as animal housing, exam tables, operating tables or floors (subject to soiling), will require at a minimum thorough cleaning, followed by drying then a low level disinfectant applied according to the manufacturers guidelines at the longest contact time recommended.

Intermediate level disinfection or (sterilization if appropriate) should be selected if a Mycobacteria pathogen is suspected.
### ACTIVITY LEVELS OF CHEMICAL DISINFECTANTS

<table>
<thead>
<tr>
<th>Common Disinfectants</th>
<th>Activity Level</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Alcohol</strong>&lt;br&gt;Most effective at 70%</td>
<td>Intermediate</td>
<td>Bactericidal, fungicidal, variable virucidal &amp; mycobactericidal&lt;br&gt;Fast acting&lt;br&gt;Easy to use&lt;br&gt;Used to disinfect small surfaces such as tops of vials&lt;br&gt;No toxic residue&lt;br&gt;May be used as an instrument grade disinfectant if labeled accordingly by manufacturer.</td>
<td>Not sporicidal&lt;br&gt;Affected by organic matter&lt;br&gt;Has no detergent or cleaning properties&lt;br&gt;Hardens rubber and deteriorates glue&lt;br&gt;Flammable&lt;br&gt;Evaporates rapidly&lt;br&gt;No residual action</td>
</tr>
<tr>
<td><strong>Aldehydes</strong>&lt;br&gt;Ortho-phthaldehyde (example OPA)</td>
<td>High</td>
<td>Mycobacterial, bactericidal, virucidal, fungicidal,&lt;br&gt;&lt;em&gt;Sporidic with long contact times &gt; 10 hours&lt;/em&gt;</td>
<td>Requires 12 minutes exposure for high level disinfection.&lt;br&gt;Must be thoroughly rinsed in sterile water before use.&lt;br&gt;Stains protein residue grey.&lt;br&gt;Not to be used for environmental disinfection.</td>
</tr>
<tr>
<td><strong>Biguanides</strong>&lt;br&gt;(Chlorhexidine)</td>
<td>Low</td>
<td>Bactericidal, fungicidal, virucidal (enveloped), less efficacy against non-enveloped viruses, some activity against protozoa</td>
<td>Should not be mixed with other chemicals or detergents.&lt;br&gt;Primarily used as an antiseptic.&lt;br&gt;Active in the presence of organic material.&lt;br&gt;Effective for up to 6 hours&lt;br&gt;In low aqueous concentrations &lt;0.05% is susceptible to pseudomonas growth.</td>
</tr>
<tr>
<td><strong>Hypochlorite’s</strong>&lt;br&gt;(Bleach)</td>
<td>Low - Intermediate</td>
<td>Broad spectrum bactericidal, fungicidal &amp; virucidal&lt;br&gt;Mycobactericidal at (.5%) 5000ppm, No toxic residue&lt;br&gt;Fast acting&lt;br&gt;Inexpensive&lt;br&gt;Unaffected by water hardness&lt;br&gt;Reduces biofilm of surfaces&lt;br&gt;Identified by having a tuberculocidal activity on label.</td>
<td>At 5% can cause eye irritation, oropharyngeal, oesophageal and gastric burns&lt;br&gt;Corrosive to metals over 500 ppm&lt;br&gt;Inactivated in organic matter&lt;br&gt;Discolours fabrics&lt;br&gt;Releases a toxic chlorine gas when mixed with acid or ammonia&lt;br&gt;May only be used on instruments if the manufacturer recommends it.&lt;br&gt;Do not mix with other detergents or disinfectants.</td>
</tr>
<tr>
<td><strong>Idophors</strong>&lt;br&gt;Povidone-Iodine</td>
<td>Low-Intermediate</td>
<td>Bactericidal, poor mycobactericidal, fungicidal, virucidal.</td>
<td>Inactivated by organic matter.&lt;br&gt;Requires a long contact time to kill fungi&lt;br&gt;Not sporicidal&lt;br&gt;Defends silicone&lt;br&gt;Usually used as an antiseptic not a disinfectant.&lt;br&gt;Stains instruments and some materials.</td>
</tr>
<tr>
<td><strong>Phenolics</strong></td>
<td>Low</td>
<td>Bactericidal, tuberculocidal, fungicidal, variable mycobactericidal &amp; virucidal&lt;br&gt;Inexpensive</td>
<td>Adsorbed by porous material and irritates tissue, Stains&lt;br&gt;Slow acting&lt;br&gt;Toxic to neonates.&lt;br&gt;Can have a pungent odour.</td>
</tr>
<tr>
<td><strong>Quaternary</strong>&lt;br&gt;Ammonium Compounds (QACs/Quats)</td>
<td>Low</td>
<td>Bactericidal, fungicidal, virucidal (enveloped viruses)&lt;br&gt;Good cleaning agents&lt;br&gt;Surface compatible.</td>
<td>Not sporicidal but may be sporostatic&lt;br&gt;Not tuberculocidal, mycobacteria or virucidal (non-enveloped)&lt;br&gt;High water hardness and cotton/gauze reduces effectiveness.&lt;br&gt;Affected by organic matter.&lt;br&gt;Inactivated by detergents.</td>
</tr>
</tbody>
</table>

*Modified Table from W.A. Rutala, D.J. Weber/American Journal of Infection Control – Disinfectants used for environmental disinfection and new room decontamination technology*
## COMMON CHEMICAL DISINFECTANTS IN AUSTRALIA

<table>
<thead>
<tr>
<th>Brand Name</th>
<th>Activity</th>
<th>Comments</th>
</tr>
</thead>
</table>
| **F10 (QAC & Biguanides)**  
*Low to intermediate level* | Bactericidal, mycobacterial, fungicidal & virucidal. Surface compatible. Has claims as a sporicidal (B. subtilis), 30 minute contact time required. | Suitable for disinfecting surfaces. Not tuberculocidal or non-enveloped virucidal High water hardness and cotton/gauze reduces effectiveness. Affected by organic matter. Inactivated by detergents. Newer generation of QAC. |
| **TriGene[11]**  
*Low-Intermediate level[12]* | Bactericidal, mycobactericidal, tuberculocidal, fungicidal and virucidal. Has claims as a sporicidal (B. subtilis), 10 minute contact time required. | Suitable for disinfecting surfaces. Not to be used on surgical instruments or surfaces likely to come in contact with broken skin. Claims not to be a QAC. |
| **Ethyl Alcohol**  
*Most effective at 70%-90% Intermediate* | Bactericidal, tuberculocidal, fungicidal, mycobacterial & virucidal  
Fast acting  
Easy to use  
Used to disinfect small surfaces such as tops of vials. | Not sporicidal  
Affected by organic matter  
Has no detergent or cleaning properties  
Hardens rubber and deteriorates glue  
Flammable  
Evaporates rapidly  
No toxic residue. No residual action. |
| **Microshield 5 Concentrate**  
*(Chlorhexidine) Low* | Bactericidal, poor fungicidal, virucidal (enveloped), less efficacy against non-enveloped viruses, poor mycobacterial, some activity against protozoa. | Should not be mixed with other chemicals or detergents. Primarily used as an antiseptic. Active in the presence of blood & organic material. Effective for up to 6 hours In low concentrations <0.05% susceptible to pseudomonas growth. |
| **Chlorine (Bleach)**  
*0.1% (1000ppm) 1:50 Intermediate* | Broad spectrum bactericidal, mycobacteria, fungicidal, virucidal  
No toxic residue  
Fast acting  
Inexpensive  
Unaffected by water hardness  
Reduces biofilm of surfaces  
Identified by having a tuberculocidal activity on label. | At 5% can cause eye irritation, oropharyngeal, oesophageal and gastric burns  
Corrosive to metals over 500 ppm  
Inactivated in organic matter, prior cleaning must occur.  
Discourages fabrics.  
Inactivated with soaps.  
Releases a toxic chlorine gas when mixed with acid or ammonia  
Offensive smell. Most effective disinfectant. |
| **Virkon S**  
Fast acting, Active in the presence of blood, Cleans and disinfects  
Safe on intact metals, may corrode non-intact metals.  
Active on M. Tuberculosis at 3%  
Can leave a white residue due to using too much solution (easy to remove with paper towel). Irritant if powder is inhaled. Face mask is recommended. Very effective disinfectant. |
| **Ortho-phthaldehyde (OPA)**  
*High level* | Mycobacterial, bactericidal, virucidal, fungicidal, *Sporicidal with long contact times > 10 hours* | Requires 12 minutes exposure. Must be thoroughly rinsed in sterile water before use. Stains protein residue grey. Should not be used for environmental cleaning |

*The author does not endorse any product or image mentioned in this document*
CLEANING THE OPERATING ROOM

Daily Cleaning

At a minimum wear nitrile gloves for the cleaning process.

Before the first surgical case of the day, all equipment, furniture and surfaces, (particularly horizontal surfaces), should be damp dusted using a lint free cloth or microfiber, moistened in a TGA approved detergent. Use a separate lint-free cloth to dry all surfaces then apply a low-level disinfectant solution.

Dry dusting or vacuuming (unless you are using a vacuum cleaner fitted with a particulate-retaining filter [14]) should not be used in the operating room because it raises dust that may contain bacteria.

Establish and follow a defined order when damp dusting furniture.

Start with the tallest equipment, e.g. operating lights and work down since this method helps the settling of airborne microorganisms.

Mop the floor using a detergent/low-level disinfectant and allow it to dry before using the room.

Large surfaces such as floors and walls have not been directly associated in the spread of staph or MRSA.

In-between surgical Cases

Operating rooms must be spot cleaned after each procedure using a TGA or FDA approved detergent/disinfectant. Spot cleaning is confined to around the immediate area of the operating table, making sure all blood spills or spots, tissue or body fluids are removed from the table, operating lights, floor and any equipment in the vicinity.

Terminal Cleaning

After the last surgical procedure of the day, mop the floor using a hospital grade TGA approved detergent or low-level disinfectant. Ensure dilution recommendations are followed correctly.

In Conclusion,

Although there is a myriad of products on the market, it is up to the user to ensure that the correct solution is chosen on evidence based information, not a sales representative trying to sell a product.

Selection should be based on the fastest acting broad spectrum disinfectant that has viral activity (non-enveloped) as a minimum.

The author firmly believes that the key to successful infection control is effective cleaning, ensuring mops, buckets and cleaning cloths or microfibers are also kept free of microorganisms, and whilst the routine use of disinfectants can still be contentious they have value in high level contaminated areas, whilst in low level contamination, detergent cleaning is adequate.