Special issue: Health care for kittens

Volume 2 • Issue 7 • July 2016

feline focus

The International Society of Feline Medicine
Journal for Veterinary Nurses and Technicians

State of the art
Infectious disease in kittens

Clinical nursing
Anaesthesia of paediatric patients

How to...
Hand rear kittens successfully

Back to basics
Nutrition for kittens

icatcare.org/felinefocus
NUTRITION for incredible kittens

To find out more, visit vetportal.royalcanin.co.uk or speak to your ROYAL CANIN® representative
Welcome to July's Feline Focus: all about kittens! Cute and fluffy they may be, but kittens are also especially vulnerable to various problems such as infectious disease. Kerry Simpson takes a look at the infectious diseases that affect kittens and how these can be treated. Kelly Foltz then focuses on the challenges of anaesthesia in kittens; something we all need to know about given the recommendations to reduce the age of neutering. In the next article, Laura Woodruff describes her experience of hand rearing as tiring but rewarding, as she discusses the difficulties of ‘playing mum’ to a litter. Finally, what advice do you give new owners about feeding their kittens?

Overweight young cats are more likely to be obese adults so we need to take this opportunity to educate our clients.

This month we have not one, but two webinars for you — one on cat friendly handling and the other on pain recognition and management. Have a look and register at www.icatcare.org/nurses.

Best wishes,

Sam Taylor, Veterinary Editor

Contents

187 State of the art
Infectious disease in kittens

195 Clinical nursing
Anaesthesia of paediatric patients: meeting the age and size challenges

201 How to...
Hand rearing kittens successfully

209 Back to basics
Nutrition in kittens: what to feed and when
Experience the difference in your home with FELIWAY®

Comforts cats in the home meaning less hiding away and more time to play! FELIWAY also helps stop unwanted behaviours such as spraying, scratching and helps during stressful events such as moving home, redecorating and travelling.

PROVEN RESULTS IN 9 OUT OF 10 CATS*

*Source: Mills 2001. Evaluation of a novel method for delivering a synthetic inovest of feline facial pheromone (Feliway®) to control urine spraying by cats.

feliway.co.uk
Infectious disease in kittens

Infectious disease is a common cause of kitten mortality. Maternally derived antibody from colostrum protects kittens until 3–4 weeks of age, after which they become more vulnerable. Viral disease is particularly common, but bacterial and parasitic infection can occur. Young kittens are prone to volume deficits as they cannot concentrate their urine, and hypothermia may cause ileus which can result in sepsis. Treatment priorities include management of hypothermia, hypoglycaemia, fluid therapy and nutrition. Nurses can play a vital role in the critical care of sick kittens.

There isn’t a great deal of information documenting the causes of kitten mortality; yet the loss of a kitten or multiple kittens within a litter can be a distressing issue. Fortunately, neonates can decompensate rapidly, and frequently die without diagnostics being performed.

A questionnaire-based study collating data from 1056 litters of 14 different pedigree breeds, documented 7.2% of all kittens were stillborn, and overall the mean mortality between birth and 8 weeks of age was 9.1%. However, a post-mortem study investigating the age and cause of death in 274 kittens found that the mean age at death was younger in non-pedigree kittens than pedigree kittens.

That study also demonstrated that 55% of all kittens which died were diagnosed with infectious disease. Congenital, traumatic or nutritional abnormalities accounted for the majority of the remaining deaths (see Table 1).

Consideration of likely causes

When considering illness in kittens it is useful to take into account the age of the kitten. Kittens which are stillborn, or which die in the...
**State of the art**

**Table 1: Causes of death in kittens by age**

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Total</th>
<th>Perinatal &lt;1 day</th>
<th>Neonatal 1–14 days</th>
<th>Pre-weaning 15–34 days</th>
<th>Post-weaning 35–112 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feline parvovirus</td>
<td>69</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>66</td>
</tr>
<tr>
<td>Inconclusive</td>
<td>44</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>35</td>
</tr>
<tr>
<td>Enteritis</td>
<td>25</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>21</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>18</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td>14</td>
</tr>
<tr>
<td>Feline infectious peritonitis</td>
<td>17</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>17</td>
</tr>
<tr>
<td>Feline herpesvirus</td>
<td>14</td>
<td>0</td>
<td>9</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Feline calicivirus</td>
<td>7</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Heart failure*</td>
<td>14</td>
<td>0</td>
<td>2</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Septicaemia</td>
<td>10</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Congenital†</td>
<td>7</td>
<td>0</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Traumatic</td>
<td>4</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>229</strong></td>
<td><strong>4</strong></td>
<td><strong>25</strong></td>
<td><strong>28</strong></td>
<td><strong>172</strong></td>
</tr>
</tbody>
</table>

Modified from Cave et al (2002)²

*Including 7 cats with congenital cardiac disease and 7 with idiopathic cardiac disease

†Excluding 7 cats with congenital cardiac disease

Perinatal (<1 day) period are generally found to have traumatic injury or idiopathic death. As the kitten ages, there becomes a greater likelihood of them developing illness due to infectious disease (Table 1).

**Susceptibility to infectious disease**

Neonatal kittens have immature immune systems, receiving only about 5% of their required maternally derived antibody (MDA) transplacentally. In order to gain protection from infectious disease there must be transfer of MDA from the colostrum ingested in the immediate postnatal period.³ The ability of neonates to absorb MDA begins to decline from 6 h after birth, stopping after about 48 h. The protective effect of systemically absorbed MDA usually begins to wane from 3–4 weeks of age (but may wane as early as 2 weeks in some instances) (Figure 1). A kitten’s natural immunity is still developing at this time and, since most vaccination regimes begin at 8 weeks of age, this can leave a period

**Figure 1:** A queen with two foster kittens. The brown tabby (Alley) was found at 10 days old and fostered without incident. The black and white kitten (Tiny; second from left) was found as a newborn, and while she was fostered she suffered repeated infections, having never received adequate colostrum. She died at 12 weeks.
of time when the kittens are particularly at risk from infectious diseases.

Assessing kittens for signs of ill health can be challenging. As the cardiovascular system, nervous system, urinary and gastrointestinal (GI) tracts mature there are marked changes in physiological parameters (Table 2).

**Viral disease in kittens**

Viral disease is particularly prevalent within the kitten population (Figure 2), with 71% of deaths being attributed to viral infection. Common viruses isolated include feline herpesvirus (FHV), feline calicivirus (FCV), feline coronavirus (FCoV) (and, therefore, feline infectious peritonitis [FIP]), feline panleukopenia virus (FPV), feline leukaemia virus (FeLV) and feline immunodeficiency virus (FIV).

The kitten’s background may help determine the likelihood of viral disease; cats born to vaccinated queens and reared in a hygienic environment are unlikely to contract FPV, whereas kittens born to free-roaming or unvaccinated queens,

---

**Box 1: Blood testing kittens**

- Blood can be drawn from the jugular vein using a 1 ml syringe and a 25 or 26 gauge needle. This should be aspirated very slowly to avoid venous collapse.
- A small volume (0.5 ml) of blood can be used for the most critical tests.
- The maximum that should be taken is 4 ml/kg/week, as this represents 7.5% of the total blood volume.
- Biochemistry and haematology values for neonates differ from those for adults, normalising at 4 months. Therefore, age-specific references should be consulted.
- Kittens born to FIV-infected queens may test seropositive as a result of passively acquired MDA. Retesting such kittens at 16 weeks will allow MDA to decline in the majority of cases (some cats will remain positive until 6 months). If an earlier result is required, PCR can be used to detect virus-negative kittens (only if the queen is carrying a strain detected on PCR).[^5]

**Tip**

Prioritise the most important tests to avoid taking too much blood and causing iatrogenic anaemia.

---

**Table 2: Normal physiological values for neonatal kittens**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Normal values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth weight</td>
<td>Domestic shorthair/longhair: 90–110 g Pedigree breeds may vary, eg, 73 g (Korat) to 116 g (Maine Coon)</td>
</tr>
<tr>
<td>Rectal temperature</td>
<td>Newborn: 36–37°C (97–98°F) 1 month: 38°C (100°F)</td>
</tr>
<tr>
<td>Heart rate</td>
<td>First 2 weeks: 220–260 beats/min</td>
</tr>
<tr>
<td>Respiratory rate</td>
<td>Newborn: 10–18 breaths/min 1 week: 15–35 breaths/min</td>
</tr>
<tr>
<td>Urine</td>
<td>Specific gravity: &lt;1.020. Urine output: 2.5 ml/100 g body weight</td>
</tr>
<tr>
<td>Water requirement</td>
<td>13–22 ml/100 g body weight/day</td>
</tr>
<tr>
<td>Calorie requirement</td>
<td>15–25 kcal metabolisable energy/100 g body weight/day</td>
</tr>
<tr>
<td>Stomach capacity</td>
<td>4–5 ml/100 g body weight</td>
</tr>
</tbody>
</table>

[^5]: Data from Little 2013[^4]
State of the art

and exposed to a contaminated environment can easily succumb to infection with FPV. In contrast, pedigree cats from a breeding colony are at a far greater risk of contracting FCoV and therefore FIP. Cave et al² demonstrated that FHV was most prevalent in neonatal kittens (2–14 days old); whereas FPV and FIP were most prevalent in the post-weaning period (35–112 days). FPV was more common in cats from shelter environments, whereas FIP was more common in cats from private homes.²

Treatment of viral disease in kittens

There is no specific treatment for the majority of viruses and management is challenging. Neonates infected with FeLV, FIP or FPV are unlikely to survive. The mainstay of any treatment is good nursing care. The age of the kitten should be considered when administering systemic medications.

Key point

Young kittens are prone to fluid volume deficits as they cannot concentrate their urine, or respond to volume losses by increasing their heart rate.

Fluid therapy

Kittens cannot concentrate their urine until around 10 weeks of age.⁶ Therefore, if they are losing fluid via vomiting or diarrhoea, or have a decreased fluid intake, they may become hypovolaemic. Unfortunately, the higher water content of the skin makes hydration status hard to assess, with a skin tent only noticed when the kitten is markedly dehydrated.⁷ Furthermore, the sympathetic nervous system is not fully mature until approximately 8 weeks of age and, therefore, young kittens cannot respond to volume deficits in the same way as an adult (ie, the heart rate will not increase).⁶

Gaining intravenous (IV) access can be problematic. However, kittens under 12 weeks will have an intact scruff reflex. That is not to say that cats should be picked up by their scruff, but rather gently pinching the back of the neck between a finger and thumb will elicit a docile (often floppy) reaction in the kitten which can greatly aid IV access. If IV access cannot be gained, intraosseous (IO) cannulation is as effective. This can be achieved by placing an 18–25 gauge hypodermic needle into the proximal humerus or femur. Ideally, this should be removed after 2 h when adequate fluid has been given to allow IV access. In certain instances, IO cannulation can remain in place for up to 24 h; although this can hinder turning of an obtunded patient.⁸

The volume of fluid required to rehydrate is higher than that required for an adult. Kittens' bodies contain a larger percentage of water; additionally they have less body fat and a higher metabolic rate. However, the skin is more permeable to fluid and they have a high surface area to volume ratio; all-in-all increasing the maintenance
State of the art

requirement for a neonate. It is advised that the daily fluid requirement for a young kitten is 80–100 ml/kg/day with further adjustments added for ongoing losses (ie, vomiting or diarrhoea).4,6

Nutrition

Kittens with vomiting, diarrhoea, sepsis, hypothermia or inadequate nutritional intake are at risk of developing hypoglycaemia. This can occur rapidly as kittens do not have mature hepatic function, and rapidly deplete their glycogen stores.7 Hypoglycaemic kittens will become weak, lethargic and can become anorectic and hypothermic.

If a kitten has developed hypothermia, this should be addressed prior to providing nutrition per os as ileus or delayed GI motility are a consequence. Delayed gastric emptying is associated with a high risk of regurgitation and resulting aspiration pneumonia (the gag reflex is not present until around 10 days post partum).

Clinical hypoglycaemia develops when the blood glucose drops below 3 mmol/l (54 mg/dl) and depression will progress to collapse, coma and ultimately death. Therefore, it is important that adequate nutrition is provided; how this is achieved will depend on the age of the kitten.

Pre-weaning

In a young kitten that is hypoglycaemic, but not hypothermic or dehydrated, a stomach tube (see Box 2) can easily be placed (as the gag reflex is not present in kittens under 10 days).

In critically ill neonates, a bolus infusion of 12.5% dextrose IV or IO (0.1–0.2 ml/100 g or more) may be required. This can be followed by a constant-rate infusion of 1.25–5% dextrose in a balanced electrolyte solution to prevent ongoing hypoglycaemia.4,6

If oral feeding can be tolerated (Figure 3), meal size should be limited to about 4–5 ml/100 g body weight, as this is the maximum

Box 2: Stomach tube feeding in pre-weaned kittens

With the kitten in sternal recumbency, and the head elevated, a lubricated, soft 5–8 Fr tube (pre-measured from the nose to the last rib) can gently be passed down the left side of the mouth into the oesophagus.4,6 This can then be used to periodically administer 5–10% dextrose orally at 0.25–0.50 ml/100 g body weight until the kitten is stronger and oral administration is then continued until the kitten is normoglycaemic.7 The tube should be occluded prior to withdrawal to ensure the stomach content isn’t aspirated.

Tip

Correct hypothermia prior to supplying oral nutrition as hypothermia may cause reduced GI motility.
stomach capacity for a kitten. Food should be introduced gradually to avoid re-feeding syndrome. (See Hand rearing kittens successfully on page 201 of this issue for more information).

During this time, the maintenance water requirement is relatively high, approximately 18 ml/100 g body weight per day (range 13–22 ml/100 g body weight per day); therefore, if IV fluids are not being given, the water content of the food should be calculated to avoid dehydration.

**Post weaning**

Kittens which have a reduced sense of smell, due to upper respiratory tract disease, tend to decrease their food intake. Cleaning any nasal discharge, and moistening the airway using nebulisation or steam inhalation can increase food intake. Providing warmed, strongly scented foods can also encourage food intake in kittens with upper respiratory tract congestion — eg, blend sardines in tomato sauce (ensure that there is no onion/garlic) and warm water.

If cats cannot be encouraged to take adequate nutrition orally, a feeding tube can be placed (oesophagostomy tubes are well tolerated, wider bore and avoid the nasal cavity).

In addition, micronutrients will rapidly deplete in inappetent or diarrhoeic kittens. B vitamin supplementation can encourage healing of the GI tract and is considered beneficial in sick animals. This can be administered in the IV fluids as a B vitamin combination or a rehydration, electrolyte and micronutrient solution.

### Bacterial infection in kittens

While bacterial infections may be secondary to viral infection, some will occur as a primary complaint. Bacteria typically originate from the queen’s birth canal (beta haemolytic Streptococcus species [Strep G infection]), GI tract (Escherichia coli, Salmonella species, Campylobacter species, many normal enteric bacteria) or respiratory tract (Bordetella species, Pasteurella species, Mycoplasma species). Clinical signs will vary depending on the site and type of infection, but can include diarrhoea, coughing, dyspnoea, polyarthritis, omphalophlebitis, or dermatitis, as well as the less specific signs more typical of fading kittens.

Ultimately, many of these infections may result in septicaemia and death. Kittens have an increased risk of sepsis, especially if there has been

---

**Box 3: Antiviral medications**

Both recombinant feline interferon-ω and human recombinant interferon-α have been shown to inhibit FHV-1 replication in vitro. However, when they are administered parenterally, topically (for keratitis), and orally to cats with FHV-1 infection clinical responses to treatment are variable, and controlled clinical trials are lacking.

Specific viral infections may have specific treatments; ie, famciclovir (40–90 mg/kg PO q h) is the most potent and safe antiviral drug for FHV, and is well tolerated when administered orally to kittens.

**Key point**

Secondary bacterial infections are common in kittens with viral infections and therefore antibiotics may be indicated (eg, broad-spectrum antibiotic cover with good penetration of the affected tissue).
inadequate colostrum intake, or failure of passive transfer of MDA. As previously mentioned, neonates have a propensity to develop hypoglycaemia and hypothermia, both of which predispose to the onset of intestinal ileus. If ileus develops there is significant risk that bacteria will translocate from the GI tract and enter the bloodstream. Clinical signs can occur very rapidly, or the disease may run a more protracted course. Severe cases will present with bradycardia, dyspnoea, dehydration, weakness, crying, seizures, coma or death. The most common causes of sepsis are Gram-negative bacteria, but can include; *Streptococcus*, *E coli*, *Staphylococcus*, *Klebsiella*, *Enterobacter*, *Enterococcus*, *Pseudomonas*, *Clostridium*, *Bacteroides*, *Fusobacterium*, *Pasteurella* and *Salmonella* species.

**Treatment of bacterial infections**

Kittens in septic shock will present with a bradycardia, hypotension and hypothermia. It is important that volume depletion is addressed prior to warming, as warming a volume-depleted, hypotensive animal will increase peripheral circulation and result in a decrease in central blood pressure, which is highly negatively correlated with survival. Therefore, IV or IO fluids should be provided and the circulating volume normalised prior to warming (which may not be necessary once volume depletion has been adequately addressed). Hydration and nutrition should be managed (see previously).

**Key point**

Hypothermia and hypoglycaemia will result in ileus, allowing bacteria to translocate from the gut and cause sepsis. Management of these treatable conditions is therefore a priority.

<table>
<thead>
<tr>
<th>Box 4: Antibiotic considerations in kittens</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data sheets should be consulted prior to any antibiotic use in kittens.</td>
</tr>
<tr>
<td>• <strong>trimethoprim-sulfonamide combinations:</strong> reduce dose and avoid in kittens with anaemia or leukopenia;</td>
</tr>
<tr>
<td>• <strong>aminoglycosides:</strong> avoid as linked to renal damage and ototoxicity;</td>
</tr>
<tr>
<td>• <strong>tetracyclines:</strong> may bind to bone and cause dental damage;</td>
</tr>
<tr>
<td>• <strong>chloramphenicol:</strong> avoid as linked to bone marrow suppression;</td>
</tr>
<tr>
<td>• <strong>fluoroquinolones:</strong> may cause cartilage damage;</td>
</tr>
<tr>
<td>• <strong>macrolides (erythromycin, clindamycin, lincomycin) and metronidazole:</strong> use with caution in kittens with hepatic impairment.</td>
</tr>
</tbody>
</table>

**Antibiotics**

Antibiotics are ideally selected according to culture and sensitivity results, but empirical antibiotic treatment is appropriate before results become available. The penicillins are often the first choice, as they are generally less toxic than most other antibiotics. However, if these are administered per os they can alter the GI flora and cause diarrhoea. In general, the parenteral administration of antibiotics is preferred because oral medications may not be absorbed efficiently. Cephalosporins are often used as a second choice. See Box 4 for more information.

**Parasitic infections in kittens**

When a queen is not wormed adequately, kittens may succumb to substantial parasite infestations. This can result in poor body condition, soft or bloody stools, lack of appetite, a pot-bellied appearance, weight loss, and occasionally death. A severe flea, tick or hookworm infestation can
result in significant anaemia. Gut parasites, such as *Giardia* species, *Trichomonas foetus*, *Isospora* or *Cryptosporidium* species, may cause diarrhoea and a failure to thrive. *Toxoplasma* species infection may result in abortion, stillbirths and fading kittens.

**Treatment of parasitic infections**

*Toxocara* species can be transmitted transplacentally. Infected kittens can be treated with either pyrantel pamoate or fenbendazole as early as 2–3 weeks of age, and this can be repeated every 2–3 weeks until at least 12 weeks of age.7 *Giardia, Trichomonas* and *Coccidia* species may cause diarrhoea in young animals. Giardiasis can be treated with either metronidazole, or fenbendazole. *T foetus* may be treated with ronidazole (not licensed); while coccidial infections may be treated with toltrazuril or trimethoprim/sulfonamide and improved sanitation. *Toxoplasma* species infections may be treated with clindamycin or azithromycin.

External parasites may cause severe debilitation in young animals. Some flea and tick products should not be used in nursing animals. However, fipronil can be used to treat fleas and lice in neonates from 2 days of age. Bedding should be washed or discarded and a flea comb can be used to remove dead/dying fleas.

In some cases, parasite infestation is so severe that anaemia can develop (Figure 4) and a blood transfusion is required. Iron supplementation should be given following transfusion in cases of anaemia involving blood loss.

**Conclusions**

Kittens are susceptible to infectious disease. Care of the queen, maximising colostrum intake, hygiene and good nutrition can reduce the risk. Nurses and technicians can help recognise sick kittens and provide the substantial care that can mean a full recovery.

**References**


Anaesthesia of paediatric patients: meeting the age and size challenges

Paediatric patients may require anaesthesia for routine pre-pubertal neutering, or for other surgery or diagnostic tests. Important differences in size and physiology mean nurses and technicians need to be prepared and anticipate potential complications such as difficult vascular access, hypothermia, bradycardia and hypoglycaemia. Understanding these unique challenges facilitates safe anaesthesia of these patients.

With the popularity of early spay/neuter programmes and shelter programmes that require gonadectomy prior to adoption, the anaesthesia of paediatric kittens has become the norm (Figure 1). Research has indicated that neutered animals live longer and have a reduced incidence of specific reproductive cancers, making early life spay/neuter valuable from a whole health perspective while also reducing nuisance behaviours and limiting pet overpopulation.¹

Kelly Foltz obtained an Associate of Applied Technology degree in veterinary technology in 2006, having previous earned a BA in English. She became member of the Academy of Veterinary Emergency and Critical Care Technicians (AVECCT) in 2012. Kelly has worked as an adjunct instructor for two fully accredited veterinary technology programmes, hosted rounds on the Veterinary Support Personnel Network (VSPN) and mentored AVECCT candidates. She currently works in the Critical Care Department of the Auburn University Wilford and Kate Bailey Small Animal Teaching Hospital in Auburn, Alabama, USA.

Paediatric patients may also require anaesthesia for other reasons, such as diagnostic tests or surgery for traumatic or congenital conditions, or in an emergency or critical care situation.

It is important for nurses and technicians to understand the anatomical and physiological differences between paediatric patients and adults, and to anticipate the unique challenges and risks that come with general anaesthesia in this species and life stage.
Although there is some variance, most sources agree that kittens are considered ‘neonatal’ beginning at birth and up to age 4 weeks; and ‘paediatric’ between ages 4 weeks and 6 months and ‘juvenile’ thereafter. Some authors further break the life stages into infant, weanling and young adult, but for the purposes of this article, any kitten under the age of 4 weeks is considered neonatal and those under 12 weeks will be considered paediatric. The greatest risks to paediatric kittens undergoing general anaesthesia are directly related to their size and the immaturity of their body systems.

**Concerns related to size**

**Temperature regulation**

Hypothermia contributes to bradycardia, ileus, and delayed anaesthetic recovery and should be avoided at all costs. Paediatric kittens have a greater body surface area to body volume ratio. This predisposes them to hypothermia; in addition, they have less insulating subcutaneous fat than adult animals. Although shivering for warmth is a reflex present approximately 6 days after birth, shivering efficiency may be altered by anaesthetic drugs and is not as effective as shivering in adults. Neonatal rectal temperature is lower than that of older animals, with a temperature of 95–98°F (35–36.6°C) for the first week of life and a core temperature of 97–100°F (36.1–37.8°C) for the first month of life. In effect, very young kittens are poikilothermic and similar to reptiles, relying on their environment for thermoregulation. Paediatric patients do not have the thermoregulatory mechanisms of adults (not present until 28 days of age). Anaesthesia should not be undertaken without supplementary warming devices such as the ‘Bair Hugger’ (hot air warming device, Figure 2), ‘Hot Dog’ (electrical warming blankets), warm fluids, warm towels, or warm water bottles. Warm water bottles or gloves filled with warm water should be wrapped in towels to protect the immobilised patient from burns. The ambient environment can also be warmed during recovery by placing the kitten in an Isolette/incubator that provides both heat and increased humidity. Slow warming is preferable to over-rapid warming that can increase metabolic and respiratory demands past the point of compensation.

**Dead space and resistance**

Adult-sized respiratory circuits create a vast amount of dead space
that the patient’s immature intercostal muscles must breathe against.\(^{1,4}\) Fatigue of the respiratory muscles, including the diaphragm, can contribute to hypercapnia. In addition, indwelling resistance in the circuit from the machine’s valves, filters, and potentially tortuous tubing, increases the work of breathing. For these reasons, non-rebreathing or paediatric breathing circuits should be used.\(^{5}\) Adjustments in monitoring equipment, such as side-stream capnography or specialised paediatric or exotics adaptors that will minimise dead space, are recommended. Because tidal volumes are very low in small patients and fresh gas flow rates for non-rebreathing circuits are increased, capnography results should be interpreted with caution.

**Vascular access**

It can be challenging to establish vascular access in small kittens. If cephalic or saphenous intravenous catheterisation with a 24 or 22 gauge unit is unsuccessful, the jugular vein can also be used. Intraosseous (IO) catheterisation of the greater trochanteric fossa of the femur is also possible (Figure 3), but should only be used if no other vascular access is available due to risks of bone infection and fracture.\(^{7}\) An IO catheter should be considered in very small patients, those with hypotension/vascular collapse, or those with wounds, thrombosis or skin infections at the proposed intravenous catheter site.\(^{7}\) Alternative IO catheter sites include the wing of the ilium, the proximal humerus, or tibial tuberosity of the forelimb.\(^{7}\) Fluids (colloid and crystalloid), blood products, drugs, and intravenous nutrition can be administered via the IO route but the diameter of the unit and patient comfort may limit the administration rate.\(^{7}\) Conventional vascular access should always take precedence over IO catheterisation due to risks associated with the procedure.

**Intubation**

If the kitten is too small to be intubated with a cuffed tube, small diameter uncuffed avian tubes are available. A secure airway is always preferable.\(^{1}\)

**Challenges related to age**

Challenges related to immature cardiovascular, pulmonary, renal, and hepatic systems are numerous, but should not deter knowledgeable nurse anaesthetists. It is important for nurses to understand that paediatric patients do not have adult responses to volume depletion, volume overload,

---

**Figure 3:** The intraosseous route can be useful in young kittens when peripheral veins cannot be catheterised. (Photograph courtesy of Emily Thomas)

---

**Tip**

Dead spaces should be avoided when choosing anaesthetic circuits for small kittens; use a non-rebreathing or paediatric circuit and adaptations such as side stream capnography.
Clinical nursing

bradycardia, hypoxaemia and blood loss.

**Haematopoietic system**

Kittens under 12 weeks of age are undergoing a transition from fetal to adult haemoglobin and refining their haematopoiesis, making them less tolerant of blood loss than adults. Surgical blood loss should be limited to approximately 4%. Nurses should calculate exactly how much blood is needed for pre-anaesthetic laboratory tests and limit sampling to only those tests that are needed.

**Cardiovascular and respiratory system**

Paediatric kittens can only increase cardiac output through increased heart rate. Adult mechanisms of altered contractility, stroke volume, adjustable vascular tone, and sympathetic response do not exist in very young animals. Bradycardia is a significant concern and should be avoided because it is directly linked to decreased cardiac output, hypoxia, poor perfusion, and hypotension. Ventilatory ability is also altered, so special care should be paid to monitoring respiratory rate, effort, mucous membrane colour, pulse oximetry, and capnography. These patients have fixed tidal volume and greater oxygen demand in comparison with mature cats; an increased respiratory rate is required to meet their increased oxygen needs. For this reason, paediatric kittens should always have supplemental oxygen supplied while under anaesthesia. Anaesthetic drugs that cause respiratory depression coupled with immature lungs and immature autonomic nervous system responses predispose these patients to apnoea, atelectasis, and hypoxia.

**Urinary system**

Although it takes some time for the lungs to mature, feline kidneys are anatomically complete at birth but functionally immature in paediatric kittens. Not only is their renal drug metabolism altered, but their ability to concentrate urine and adapt to fluid challenges is not the same as an adult’s. Total body water is about 80% in these patients and hydration can be difficult to assess, yet paediatric patients have an increased maintenance fluid requirement. The best practice is to adjust fluid rates based on the

---

**Key point**

Paediatric patients rely on heart rate to increase cardiac output, so avoid drugs that can cause bradycardia in very young patients.
needs of the individual patient and the fluid delivery route, understanding that subcutaneous fluids may not efficiently support the patient’s intravascular volume. Ideally, a fluid pump is used as the rate and volumes required are small (Figure 4). Serial body weight on a gram scale (two or three times a day) is a common method to monitor hydration.

Liver
Like the kidneys, the liver is fully developed at birth but does not function like that of an adult cat until the kitten is almost 3 months old.2 In particular, kittens are prone to hypoglycaemia due to reduced glycogen synthesis and storage.1,4

For kittens 6–8 weeks old, pre-anaesthetic fasting should be limited to 2–3 h and blood glucose should be closely monitored.2,4 Ear or paw pad pricks can be used for sampling if necessary. Normal blood glucose for a 4-week-old kitten is about 6.1 mmol/l (110 mg/dl) and dextrose supplementation is necessary if peripheral blood glucose is less than 4.5 mmol/l (80 mg/dl).2,6 If anaesthesia is necessary for kittens less than 6 weeks of age, they should be allowed to nurse/be fed until anaesthetic induction.2 Older patients that are systemically healthy and undergoing elective surgery should not be fasted for more than 4–6 h.1,2,4 All paediatric kittens should be offered food as

Table 1: Anaesthetic, analgesic and sedative drugs for kittens

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose (per kg) (lower for patients &lt;4 weeks old)</th>
<th>Route</th>
<th>Dosing interval (h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acepromazine</td>
<td>0.01–0.025 mg</td>
<td>IM, SC</td>
<td>q2–6</td>
</tr>
<tr>
<td>Buprenorphine</td>
<td>10–20 μg</td>
<td>SC</td>
<td>± q6</td>
</tr>
<tr>
<td>Butorphanol (analgesic)</td>
<td>0.2–0.4 mg</td>
<td>IV</td>
<td>q1–4</td>
</tr>
<tr>
<td>Butorphanol (opioid antagonist used to reverse the effects of pure opioids)</td>
<td>0.1–0.2 mg to effect</td>
<td>IV, IM, SC</td>
<td>q1–4</td>
</tr>
<tr>
<td>Diazepam</td>
<td>0.05–0.1 mg</td>
<td>IV</td>
<td>q6 or greater</td>
</tr>
<tr>
<td>Fentanyl</td>
<td>1–5 μg</td>
<td>IV</td>
<td>Per hour/continuous infusion rate</td>
</tr>
<tr>
<td>Hydromorphone</td>
<td>0.05–0.1 mg</td>
<td>IV, IM, SC</td>
<td>q2–6</td>
</tr>
<tr>
<td>Methadone</td>
<td>0.1–0.5 mg</td>
<td>IV, IM, SC</td>
<td>q1–4</td>
</tr>
<tr>
<td>Oxymorphone</td>
<td>0.05–0.1 mg</td>
<td>IV, IM, SC</td>
<td>q2–4</td>
</tr>
<tr>
<td>Reversal agents</td>
<td>Dose (per kg)</td>
<td>Route</td>
<td>Dosing interval (h)</td>
</tr>
<tr>
<td>Flumazenil</td>
<td>0.08–0.2 mg</td>
<td>IV</td>
<td>As needed/q1</td>
</tr>
<tr>
<td>Naloxone</td>
<td>0.004–0.04 mg (Can mix 0.05–0.1 ml in 10 ml 0.9% NaCl for ease of titration)</td>
<td>IV</td>
<td>As needed to effect</td>
</tr>
</tbody>
</table>

Adapted from Mathews 20053
soon as they are alert following an anaesthetic event.\textsuperscript{4}

\textbf{Drug metabolism}

A different dose of anaesthetic drugs may be needed in these young patients due to altered renal and hepatic drug metabolism; some drugs may actually be cleared more rapidly than in adult animals (as is the case with human children).\textsuperscript{1-4} Reversible/partially reversible drugs are useful.\textsuperscript{4} The best practice may be to administer injectable drugs to effect rather than adhering strictly to a calculated dose.\textsuperscript{3}

Truly neonatal animals require different dosing regimens than paediatric animals, although their nociception of pain is well documented.\textsuperscript{3,6} Analgesia in very young kittens should not be overlooked. Multiple safe analgesic drugs are available (see Table 1), but some are not recommended. Due to their potential effect on immature kidneys, non-steroidal anti-inflammatory drugs (NSAIDs) are contraindicated in kittens younger than 6 weeks.\textsuperscript{3} Sedative drugs, such as phenothiazines, should be used with caution in animals under 12 weeks of age due to their propensity towards peripheral vasodilation and central nervous system depression.\textsuperscript{3} Alpha-2 agonist drugs can cause profound bradycardia and should be used with caution in kittens, particularly those under 8 weeks.\textsuperscript{2,4}

\textbf{Conclusions}

With prior planning and diligent preparation, veterinary technicians and nurses can mitigate the risks associated with paediatric anaesthesia in kittens. It is essential that they understand how paediatric physiology differs from adult physiology, particularly in regard to renal, pulmonary, hepatic, and cardiac function. They should also be prepared to adjust drug protocols and monitoring as needed to accommodate the specific needs of these patients.

\textbf{References}


\textbf{FREE WEBINARS}

All ISFM veterinary nurse and technician members can access the ISFM online library of free webinars at:

\url{www.icatcare.org/nurses}

The International Society of Feline Medicine (ISFM) is the veterinary division of International Cat Care.
Hand rearing kittens requires considerable time and dedication from the caregiver. An appropriate environment should be provided to avoid hypothermia and kittens should be regularly weighed. Hygiene is important and kittens should be stimulated to eliminate. Kittens should be fed a cat milk replacer from a bottle regularly according to age and size. Exposure to humans and other animals during the critical socialisation period between 2 and 8 weeks of age is important to avoid problem behaviours later on.

Normally the queen takes care of all of her kittens’ needs, but in cases of maternal illness or death, hand rearing is required. This is a time-consuming, yet rewarding, experience in most cases. This article discusses the specifics of hand rearing, and provides a guide for caregivers faced with caring for very young kittens.

First, it is necessary to assess what type of support the kittens require:

- **temporary feeding:** if the queen becomes temporarily ill, and while she is recovering, the kittens will need to be hand fed.
- **supplementary feeding:** with large litters, the queen may not be able to provide sufficient milk for all of the kittens, or not

The best alternative to maternal care would be fostering the kittens with another lactating queen, but this is rarely feasible. Hand-reared kittens require around-the-clock care. They need to be kept warm, safe, dry and

---

**Key point**

A kitten reared in isolation from other cats is at risk of developing psychological abnormalities, such as nervousness or aggression. Kittens hand reared in the presence of other cats are less likely to be affected.

---

Laura Woodruff studied veterinary nursing at The Royal Veterinary College, UK, where she qualified in 2010. She then worked in first opinion practice and as an emergency nurse in an out-of-hours clinic. She currently works at The Animal Health Trust, UK, as a ward nurse and recently completed her ISFM Diploma in Feline Nursing.

Laura Woodruff
RVN ISFMDipFN

all of the kittens are able to feed. Usually it is the smaller kittens which get pushed back by larger, stronger kittens and thus have reduced opportunities to feed, or are left to feed only on nipples which are producing less milk. These kittens may require only ‘top-up’ or supplementary feeding.

- **hand rearing:** orphaned or abandoned kittens, or kittens born to very unwell queens require complete care, including feeding.

The best alternative to maternal care would be fostering the kittens with another lactating queen, but this is rarely feasible. Hand-reared kittens require around-the-clock care. They need to be kept warm, safe, dry and
clean. They need to be fed a suitable diet, with appropriate frequency of feeding throughout the day and night, and must also be stimulated to pass urine and faeces.

If the queen is still alive, and it is safe to do so, the kittens should be kept with her. The queen can supply them with warmth, keep them clean and stimulate elimination after each feed. Queens which are well enough to do so, and are not lacking normal maternal instincts, should still be able to provide their kittens with this level of care even if they are unable to feed them themselves.

Environment
Hand-reared kittens should be kept in an appropriate environment. Until the kittens are about 3 weeks old, a small cat basket, or a clean cardboard box (Figure 1), can be used to house the kittens. As they grow, they need to be moved into something bigger such as a children’s playpen. It is important that whatever is used to house the kittens is covered with a safety net to prevent them from climbing and falling out. Soft bedding and a cuddly toy (Figure 2) can be used for them to snuggle up to if the queen is not present. Bedding material should be readily washable or disposable. The bedding should not shed if the kittens suck on it as fibres may be swallowed and result in gastric foreign bodies.

Newborn kittens cannot regulate their own body temperature. Under normal circumstances they would get heat from direct body contact with the queen. It is important that hand-reared kittens are kept warm but that they do not overheat. The best way to monitor this is by taking the kittens’ rectal temperature.

During the first week, a kitten’s temperature should be between 36–37°C (97–98°F); in the second and third week it should be 36.1–37.7°C (97–100°F). At 4 weeks of age the kitten should have reached normal adult range of
between 37.7–38.9°C (100–102°F).
(See Table 2, page 189 of this issue for normal physiological variables.)

If a kitten’s temperature drops below 34.4°C (94°F) the kitten could die. In this situation, rapid warming of the kitten may also be fatal, so its core temperature must be bought up slowly and veterinary attention sought.

The kitten box environment should be maintained at a temperature between 29.5°C and 32°C (85–90°F), although this can be lowered for larger litters where they will be able to huddle with one another to maintain heat. The humidity in the kittens’ environment should also be monitored. Low humidity can increase the risk of dehydration; 55–65% would be the ideal.

The temperature of the kitten box can be maintained using circulating hot water blankets, hot water bottles or heat lamps. Heat pads are not recommended because they may heat unevenly and cause burns. Dry, clean and warm blankets should be used alongside any warming device. At no time should any warming device be extremely hot or make direct contact with the kitten as this will cause burns. All warming devices in the kitten box should be wrapped in a blanket or its own fitted cover and hot water bottles should be checked for leaks. The bed must be checked regularly for warmth and cleanliness. A non-heated area should be provided to allow the kittens to move themselves away from the heat source if they get too hot. Radiating heat lamps, hanging over the kitten box, are also safe to use but, again, an area that is not heated must be available for the kittens to crawl to, to prevent them over-heating.

As the kittens grow, the environmental temperature can be reduced, as they are more mobile and become able to regulate their own body temperatures.

**Hygiene**
It is very important to maintain a high level of hygiene, as hand-reared kittens are more vulnerable to infections, especially if they have not received colostrum from the queen. Maintaining clean bedding and strict hand hygiene is crucial. If in a veterinary environment, the kittens should be barrier nursed, with the caregiver washing his/her hands and putting on an apron before touching the kittens.

**Elimination**
Kittens less than 3 weeks of age cannot voluntarily pass urine and faeces. Usually the queen would stimulate the kittens by licking the perineum, so if the queen is not present, a caregiver will need to stimulate elimination after every feed. To do this, a damp cotton wool ball should be rubbed with gentle pressure over the kitten’s anogenital region. Although the voiding reflex usually starts at around 2 weeks of age, it may be necessary to do this up to 4 weeks of age, when most will eliminate independently.

**Feeding**
Hand-reared kittens should be fed a specially formulated cat milk replacer. These are designed to
How to...

Weighing

When the kittens are born they should be weighed accurately on a gram scale, and this weight recorded. It may be that all the kittens look similar, for example, if they are all black, but it is important to be able to tell them apart so their weight, food intake and elimination can be individually monitored and concerning trends noticed promptly. Painting their claws in different coloured nail polishes can easily differentiate similar-looking kittens.

Key point

Kittens should be weighed twice daily until 2 weeks of age, then daily, gaining 10–15 g/day. After 7–10 days they should weigh approximately twice their birth weight.

closely mimic the queen’s own milk and provide the kittens with the correct nutrients. Milk from other species may result in illness.

The milk replacer should be reconstituted and stored as directed by the manufacturers. The amount of milk supplement to be given will also be stated within the manufacturer’s instructions, usually according to weight. Kittens should be weighed daily to ensure they are receiving their daily energy requirement. A weight gain of 10–15 g/day indicates adequate feeding.

In general, kittens in the first week of life require a volume of milk replacer equal to 10–15% of their body weight daily, increasing to 20–25% from 1 week to 4 weeks of age.¹

Over-feeding kittens can cause diarrhoea. The volume stated over a 24 h period should be divided into the appropriate number of feeds which is dependent on the kitten’s age (see Table 1).

As the kittens grow, their overall milk requirement will increase. Smaller, weaker kittens are likely to need smaller, more frequent meals. Equally, if the kittens are still partially feeding from the queen, smaller, less frequent meals will be necessary. A well-fed kitten will have an abdomen that feels full but not distended.

Before feeding, milk should be warmed to body temperature (35–38˚C/95–100˚F). The caregiver should test the temperature by placing a couple of drops on their forearm. Microwave heating can over-heat the milk replacer, or cause ‘hot spots’, which could burn the kitten’s mouth. Instead, heat the milk, in bottles, slowly in a bowl of hot water. If milk replacer is being reconstituted, use boiled water cooled to body temperature.

Along with excellent hand hygiene, all feeding equipment and bottles must be sterilised between feeds by boiling them in water, or using a commercially available baby bottle steriliser. If milk replacer is to be reconstituted, no more than a 24 h supply should be prepared at any one time and it should be refrigerated until ready for use. Discard reconstituted milk replacer that has been at room temperature for more than 1 h.

Table 1: Feeding frequency according to age

<table>
<thead>
<tr>
<th>Age</th>
<th>Feeding frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 1 week</td>
<td>Every 2 hours</td>
</tr>
<tr>
<td>1–2 weeks</td>
<td>Every 3 hours</td>
</tr>
<tr>
<td>2–4 weeks</td>
<td>Every 4 hours</td>
</tr>
<tr>
<td>4–5 weeks</td>
<td>Every 5 hours</td>
</tr>
</tbody>
</table>

Key point

When the kittens are born they should be weighed accurately on a gram scale, and this weight recorded. It may be that all the kittens look similar, for example, if they are all black, but it is important to be able to tell them apart so their weight, food intake and elimination can be individually monitored and concerning trends noticed promptly. Painting their claws in different coloured nail polishes can easily differentiate similar-looking kittens.

Kittens should be weighed twice daily until 2 weeks of age, then daily, gaining 10–15 g/day. After 7–10 days they should weigh approximately twice their birth weight.
Feeding methods

Bottle feeding allows the kittens to satisfy their need to suckle (Figure 3). To feed, a kitten should be held in sternal recumbency with its head held up (Figure 4). It is very important that the hole in the nipple is the correct size. When the bottle is turned upside down a drop of milk should be released after a gentle squeeze. The tip should be gently inserted into the kitten’s mouth to allow it to latch on, and the bottle must be positioned to avoid air getting into the nipple and being ingested.

If the hole is too big, milk will be released too quickly, which can result in aspiration pneumonia. If the hole is too small, the kitten may tire from suckling before it has consumed sufficient milk. Bottle-fed kittens can control their own milk intake, preventing over-feeding.

Another method of feeding is via an orogastric tube, but to do this competently requires training. Potential risks of inadvertent tracheal intubation and over-feeding mean this method is not commonly used.

Other possible feeding techniques include spoon-feeding, or the use of eye-droppers or syringes. There is a high risk of aspiration pneumonia with these techniques and thus they are not recommended.

Hypothermic kittens (rectal temperature less than 35°C [95°F]) should not be fed before they have

Key point

It is important to monitor the kittens for hypoglycaemia, caused by inadequate feeding, which presents with depression and muscle twitching. If this is suspected, place a drop of honey on the kitten’s tongue and seek veterinary attention immediately.
How to...

Laura's case study: raising Jay and Bob

My two cats, Jay and Bob, were hand reared. Their mother was a free-roaming cat that lived near one of our receptionists. We had been trying to catch the queen to neuter her, as she had been seen with many litters — none of which survived. When we finally trapped her she was heavily pregnant. Knowing her history for raising kittens and lack of handleability, we decided to perform a caesarean section and ovario-hysterectomy. Two other nurses and I volunteered to hand rear the nine kittens we were surprised to find! We split the litter and took turns to care for the kittens overnight. The queen was released and continued to be monitored.

The first night Bob would not take any milk at two of his feeds; he was also the smallest of the litter and I was very concerned he would not survive, but by his 4am feed he developed an appetite and went on to gain weight as quickly as his siblings.

Apart from the very occasional night off when another nurse would look after them, I cared for the litter for 6 weeks. I had little sleep from feeding or worrying about them!

Outcome
All nine of the kittens survived. I kept two and the rest were rehomed.

Conclusions
Hand rearing kittens is an enormous undertaking, requiring the caregiver’s time around the clock, commitment and hard work. Sadly, hand rearing kittens is not always successful and some kittens may not survive. Despite the difficulties, and

been slowly rewarmed, because hypothermia causes ileus and increases the risk of aspiration pneumonia. Veterinary attention may be required for hypothermic kittens.

Weaning
Weaning can start from 3–4 weeks of age, by offering reconstituted milk replacer on a flat plate and allowing the kittens to lap from it. This should then progress to offering kitten food soaked in the milk. Both dry and wet food should be used to introduce the kittens to different textures of food. The amount of milk added to the kitten food should be gradually reduced until the kittens are solely on solid food. This process usually takes about 2 weeks, and during this time supplementary bottle feeds will still be needed. It is advisable to offer the weaning food before offering a bottle feed.

Weaning is very messy! The kittens will walk through the food and cover themselves in it, but this is important, as they learn the taste of the food by licking it off themselves.

Outcomen
All nine of the kittens survived. I kept two and the rest were rehomed.

Conclusions
Hand rearing kittens is an enormous undertaking, requiring the caregiver’s time around the clock, commitment and hard work. Sadly, hand rearing kittens is not always successful and some kittens may not survive. Despite the difficulties, and
Socialisation

A kitten is most receptive to learning about its social world (people, cats, other animals) during its socialisation period which occurs approximately between 2–8 weeks of age. During this time it is, therefore, really important that kittens have positive exposure to a variety of people (men, women, children under supervision) and such exposures should also include gentle handling. Involving lots of people in the care of hand-reared kittens can help them to be friendly and confident around people in adult life. During these early life experiences, kittens also learn a lot about being a cat from both their mother and their siblings. This is lacking considerably in hand-reared kittens, and particular concern is given to singleton hand-reared kittens which have neither mother nor siblings to interact with. A lack of such early cat–cat interactions could lead to future problem behaviours including aggressive or bullying behaviour towards other cats. Exposure to other cats is therefore important and should include opportunity to view, interact and play with kittens and adult cats (10 days after first vaccination).

Further reading


lack of sleep, hand rearing can be a very rewarding experience.

Feline Nursing
Distance Education Courses

ISFM is pleased to offer two qualifications in feline veterinary nursing:

ISFM Certificate in Feline Nursing

ISFM Diploma in Feline Nursing

❖ Do you want to be a feline friendly nurse?
❖ Do you want to learn more about cats?
❖ Do you want to study from home?

Now you can!

The courses are online with workbooks to complete and marked by our experts.

For full details go to:
www.icatcare.org/learn

Modular assessment. No final exam. No panic.
No reason not to enrol!
Pain recognition study

cat facial images needed

The University of Lincoln, UK, has launched a new campaign aimed at improving the early detection of pain in cats, and is asking vets, nurses and technicians to get involved. Specifically, it is seeking help with gathering images and videos of cats for their research.

The research team explains:
We are seeking to identify reliable early signs of pain in cats, focusing in particular on their faces, to allow computer-aided recognition. We are in the process of developing analytical techniques to facilitate rapid and reliable detection of pain, with the purpose of supporting the timely delivery of necessary treatments, as well as their improved efficacy.

Which of these cats is in pain?

We have just launched a big data collection initiative, where we will be asking vets and nurses to provide us with short 30 second videos and/or photos of cats that are considered to be in pain, and then again (where practical) at a time when the same cat is considered to be pain free. We are also seeking video and stills from cats that have been certified as pain free, eg, following a health check prior to vaccination.

Getting involved:
Any vets or nurses interested in taking part in this initiative should get in touch in the first instance with Lauren Finka at the University of Lincoln — finka@lincoln.ac.uk. They will be sent a small pack including all the information needed in relation to collecting footage and pictures for the project.

Prize draw
There will be a prize draw to thank those who have provided data. Prizes include an iPad, iPods and Kindles. The more usable data contributed, the greater the number of entries an individual has in the draw and so a better chance of winning a prize.

Daniel Mills and Lauren Finka
Understanding Cat Pain Project
University of Lincoln, UK
Website: ucpproject.co.uk
Nutrition in kittens: what to feed and when

Kitten clinics are an ideal opportunity to discuss nutrition with owners. A nutritional assessment should form part of the physical examination, including weighing and assessment of body condition score. Kittens have a high requirement for protein to maintain growth, but excessive calories risk adult obesity. Post neutering, kittens should be monitored for appropriate weight gain; however, if neutered pre-puberty they should stay on a kitten diet. Offering food ad libitum may result in over-eating. Ideally, daily energy requirements should be carefully calculated.

The unique metabolism of cats reflects them being obligate carnivores, and highlights the importance of gaining specific nutrients from their diet. Dietary advice for owners is important to ensure good nutrition during the growth phase. Seeing kittens for kitten clinics can help bond clients to the practice, and also help educate owners about preventive medicine and nutrition (Figure 1).

Nicola Ackerman
BSc(Hons) RVN CertSAN CertVNECC
VTS(Nutrition) HonMBVNA

Nicola Ackerman works as the head medical nurse at The Veterinary Hospital in Plymouth, UK. She graduated from Hartpury College, UK, with an honours degree in equine science, and subsequently qualified as a veterinary nurse in 2002. Nicola is past officer of the British Veterinary Nursing Association (BVNA) and past editor of the Veterinary Nursing Journal. She sits on the Veterinary Products Committee for the Veterinary Medicines Directorate and has written articles for many veterinary publications as well as textbooks. Nicola won the BVNA/Blue Cross award for animal welfare in 2010.

Figure 1: Kitten clinics are the perfect opportunity to perform a nutritional assessment and discuss diet and feeding practices. (Photograph courtesy of Richard Murgatroyd)

Key point
A nutritional assessment should be performed and diet and feeding methods discussed in kitten clinics to get owners off to a good start with their new pet.

Nutritional assessment
While seeing kittens, discussing diet and body condition score (BCS) at each visit is important. Guidance on good nutrition will help enhance the
cat’s quantity and quality of life. The World Small Animal Veterinary Association (WSAVA) has developed a global initiative which recommends that nutritional assessment is incorporated into the standard physical examination for all small animals. The WSAVA defines the five vital signs as:
• temperature;
• pulse;
• respiration;
• pain assessment; and
• nutritional assessment.

The nutritional assessment is a two-part process (Figure 2), and can be easily incorporated into all consultations, including nursing clinics. The assessment can be broken down into:
• screening evaluation: performed on every patient. Based on this screening, pets that are healthy and without risk factors need no additional nutritional assessment (the extended evaluation).
• extended evaluation: performed when one or more nutrition-related risk factors are found or suspected based on the screening evaluation.

Part of the nutritional assessment is to weigh the pet at each visit to the practice, and to perform a body condition score (BCS). If required this can be extended to a muscle condition score (MCS) in the extended nutritional assessment. Use of growth charts can help to monitor growth rates in kittens.

The normal birth weight of kittens is 90–100 g. The growth rate is exceptionally rapid for the first 3–4 months, and kittens gain 50–100 g/week. The growth rate begins to plateau at 150–160 days of age, and growth is usually completed within 200–220 days.

**Nutrition**

**Weaning**

Kittens can be weaned onto a proprietary kitten or growth diet, either wet or dry, directly from lactation. There is no requirement to have intermediate diets or home-cooked foods. Feeding regimes and
behaviours surrounding food are established during the juvenile period and can have a large impact later on in life. Observing the mother eating the diet is important, and will encourage the kittens to start lapping. When eating their first solid food, kittens do not choose the most palatable food according to innate criteria. They will choose what their mother eats, even if the food is unusual.³ Weaning can start and be completed between 6 and 8 weeks of age (Figure 3). In the majority of cases, the queen will wish to spend less time nursing, and may start to get annoyed or frustrated at the kittens when they try to suckle.

**Growth diets**

Kitten diets or growth diets can vary depending on the manufacturer. The National Research Council (NRC) recommends minimum, and in some cases maximum, levels of the nutrients in diets (Table 1).⁴ Interpretation of food packaging and labels can be very difficult, and it should be remembered that the digestibility and the bioavailability of the nutrients in the diet might not equate to what is on the labels.

Optimal diets for growing kittens should contain at least 24–28% metabolisable energy (ME) as protein or 30% protein as dry matter (Association of American Feed Control Officials [AAFCO] guidelines),⁵ or 45 g protein/1000 kcal ME (NRC guidelines). Optimal diets for adult cats should

**Table 1: NRC nutrient requirements for kittens after weaning⁴**

<table>
<thead>
<tr>
<th>Nutrient (amount/1000 kcal ME)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Recommended allowance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein (g)</td>
<td>45</td>
<td>56.3</td>
<td></td>
</tr>
<tr>
<td>Arginine (g)</td>
<td>1.93</td>
<td>8.75</td>
<td>2.4</td>
</tr>
<tr>
<td>Histidine (g)</td>
<td>0.65</td>
<td>&gt;5.5</td>
<td>0.83</td>
</tr>
<tr>
<td>Isoleucine (g)</td>
<td>1.08</td>
<td>&gt;21.7</td>
<td>1.4</td>
</tr>
<tr>
<td>Leucine (g)</td>
<td>2.55</td>
<td>&gt;21.7</td>
<td>3.2</td>
</tr>
<tr>
<td>Lysine (g)</td>
<td>1.70</td>
<td>&gt;14.5</td>
<td>2.1</td>
</tr>
<tr>
<td>Methionine (g)</td>
<td>0.88</td>
<td>3.25</td>
<td>1.1</td>
</tr>
<tr>
<td>Phenylalanine (g)</td>
<td>1.75</td>
<td>&gt;7.25</td>
<td>2.2</td>
</tr>
<tr>
<td>Phenylalanine + tyrosine (g)</td>
<td>3.83</td>
<td>17</td>
<td>4.8</td>
</tr>
<tr>
<td>Threonine (g)</td>
<td>1.30</td>
<td>&gt;12.7</td>
<td>1.6</td>
</tr>
<tr>
<td>Tryptophan (g)</td>
<td>0.33</td>
<td>4.25</td>
<td>0.40</td>
</tr>
<tr>
<td>Valine (g)</td>
<td>1.28</td>
<td>&gt;21.7</td>
<td>1.6</td>
</tr>
<tr>
<td>Glutamic acid (g)</td>
<td></td>
<td>18.8</td>
<td></td>
</tr>
<tr>
<td>Taurine (g)</td>
<td>0.080</td>
<td>&gt;2.22</td>
<td>0.10</td>
</tr>
<tr>
<td>Fat (g)</td>
<td></td>
<td>82.5</td>
<td>22.5</td>
</tr>
<tr>
<td>Linoleic acid (g)</td>
<td></td>
<td>13.8</td>
<td>1.4</td>
</tr>
<tr>
<td>α-Linolenic acid (g)</td>
<td></td>
<td></td>
<td>0.05</td>
</tr>
<tr>
<td>Arachidonic acid (g)</td>
<td></td>
<td></td>
<td>0.05</td>
</tr>
<tr>
<td>Eicosapentaenoic + docosahexaenoic acid (g)</td>
<td>0.025</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Minerals**

<table>
<thead>
<tr>
<th>Mineral</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Recommended allowance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium (g)</td>
<td>1.3</td>
<td>2.0</td>
<td></td>
</tr>
<tr>
<td>Phosphorus (g)</td>
<td>1.2</td>
<td>1.8</td>
<td></td>
</tr>
<tr>
<td>Potassium (g)</td>
<td>0.67</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Sodium (mg)</td>
<td>310</td>
<td>350</td>
<td></td>
</tr>
<tr>
<td>Chloride (mg)</td>
<td>190</td>
<td>225</td>
<td></td>
</tr>
<tr>
<td>Magnesium (mg)</td>
<td>40</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Iron (mg)</td>
<td>17</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Copper (mg)</td>
<td>1.1</td>
<td>2.1</td>
<td></td>
</tr>
<tr>
<td>Manganese (mg)</td>
<td></td>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td>Zinc (mg)</td>
<td>12.5</td>
<td>18.5</td>
<td></td>
</tr>
<tr>
<td>Iodine (μg)</td>
<td></td>
<td>450</td>
<td></td>
</tr>
<tr>
<td>Selenium (μg)</td>
<td>30</td>
<td>75</td>
<td></td>
</tr>
</tbody>
</table>

**Vitamins**

<table>
<thead>
<tr>
<th>Vitamin</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Recommended allowance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin A (retinol equivalents)</td>
<td>20,000</td>
<td>250</td>
<td></td>
</tr>
<tr>
<td>Cholecalciferol (μg)</td>
<td>0.70</td>
<td>188</td>
<td>1.4</td>
</tr>
<tr>
<td>Vitamin E (α-tocopherol, mg)</td>
<td></td>
<td>9.4</td>
<td></td>
</tr>
<tr>
<td>Vitamin K (menadione, mg)</td>
<td></td>
<td>0.25</td>
<td></td>
</tr>
<tr>
<td>Thiamine (mg)</td>
<td>1.1</td>
<td>1.40</td>
<td></td>
</tr>
<tr>
<td>Riboflavin (mg)</td>
<td></td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Pantothenic acid (mg)</td>
<td>1.15</td>
<td>1.43</td>
<td></td>
</tr>
<tr>
<td>Niacin (mg)</td>
<td></td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Pyridoxine (mg)</td>
<td>0.5</td>
<td>0.625</td>
<td></td>
</tr>
<tr>
<td>Folic acid (μg)</td>
<td>150</td>
<td>188</td>
<td></td>
</tr>
<tr>
<td>Vitamin B12 (μg)</td>
<td></td>
<td>5.6</td>
<td></td>
</tr>
<tr>
<td>Choline (mg)</td>
<td>510</td>
<td>637</td>
<td></td>
</tr>
</tbody>
</table>

ME = metabolisable energy
Back to basics

contain about 20% ME as protein or 26% protein as dry matter (AAFCO guidelines), or 40 g protein/1000 kcal ME (NRC guidelines). Growing kittens are more sensitive to the quality of dietary protein and amino acid balance than are adult cats. Protein suitable for cats must supply >500 mg of taurine/kg diet dry matter. Unless synthetic essential amino acids are added, some animal protein is necessary in the diet to prevent taurine depletion and development of feline central retinal degeneration or dilated cardiomyopathy.

Without sufficient energy from dietary fat or carbohydrate, dietary protein ordinarily used for growth or maintenance of body functions is less efficiently converted to energy. Too little high biological value protein in the diet, relative to the energy density, can cause an apparent protein deficiency.

Prepubertal neutering and diet

There have been changes to the age in which some charities and veterinary clinics are neutering cats; from 6 months down to 16 weeks of age or younger. Neutering has large effects on the metabolism of cats, and this is the same when neutering occurs at a younger age. If neutered at 6 months of age, changing to a lifestage diet aimed at neutered young adults is recommended. For those that are neutered at a younger age, they need to remain on a growth diet until 3 months.

Alexander et al (2011) found that neutered kittens store more energy and have lower energy requirements than entire kittens. In a further study it was found that these neutered female colony cats had lower energy requirements than reported in the previously published literature.

Early neutering may decrease maintenance energy requirements even further than neutering of adults. In cases where early neutering has occurred it would suggest that close monitoring of weight and BCS is important in helping to prevent an above ideal BCS and potentially obesity.

Key point

Prepubertal neutering is becoming more popular. These young kittens still need to eat a complete kitten diet.

Feeding schedule

The way in which the cat consumes its diet does have an impact on many different elements of its life. There are three basic methods of feeding cats:

• free choice (or ad libitum);
• time limited; or
• food limited.

All have their advantages and disadvantages, and will suit different animals on an individual basis.

Free-choice feeding

This method of feeding does tend to suit those animals that will eat only what is required to meet their energy requirements. Over-consumption can lead to obesity, and in growing large-breed cats could predispose to developmental

Key point

After neutering, kittens should still be monitored for weight and body condition score. Nurse clinics are the perfect place to follow growth into adulthood.
orthopaedic disorders. This method of feeding has been shown to be a risk factor for obesity. Other disadvantages include food wastage, especially if feeding a moist diet, and competition from other animals in the environment could lead to both over- and under-eating.

Advantages may include a more constant blood level of nutrients and hormones, and it may be more behaviourally appropriate for cats to eat several small meals a day, mimicking consumption in free-roaming cats hunting rodents. Timid cats may be more likely to eat, as there are periods of access to the food without other animals present.

With free-choice feeding it is still important to monitor the amount of food consumed within a 24-h period in order to prevent over-eating, and to be able to notice under-eating. Importantly, cats gaining excessive weight as kittens are more likely to become obese adults, so their BCS should be monitored as they mature.

**Time-limited meal feeding**
In time-limited meal feeding the animal is allowed free access to the food for a set period of time each day. This is usually 10–15 minutes, once or twice daily. This can be a disadvantage in small cats and kittens, due to their limited stomach size; insufficient food may be consumed in order to meet their nutritional requirements. Over-consumption can easily occur when using this feeding method, if the animal is greedy. In these cases reducing the amount of time that the animal has access to the diet, or feeding a diet of a lower energy density is required.

**Food-limited meal feeding**
This method requires either calculating the DER of the animal (see box), and thus the quantity of diet that needs to be fed, or following the manufacturer’s recommendations on the food packaging. The calculated DER is then divided by the energy density of the diet in order to calculate the quantity of food that should be fed.

The advantage of this method is that when using a complete balanced diet, the animal is receiving the correct amount of nutrients. The disadvantage is that all animals are individuals with differing metabolisms and energy expenditure, and when initiating this feeding method reassessment of the quantities fed should be made according to BCS, weight and general health.
Conclusions
Giving advice on the feeding of kittens is exceptionally important in helping to maintain good health throughout the cat’s lifetime. Guidance should be given not just on the diet being fed, but on feeding methods and prevention of obesity.

References
5 Association of American Feed Control (AAFCO) guidelines. http://www.aafco.org/publications