Birds of prey are commonly presented to veterinary surgeons in practice and typically comprise injured wild birds, individuals kept for falconry, zoo and conservation exhibits, and captive breeding birds. Injured wild birds have already ‘failed the fitness for life test’, and should be carefully assessed for pre-existing injuries, infections or disease, which will preclude them from return to the wild. In the authors’ opinion, (unless the species is genuinely very rare), as soon as one is aware that a compromised wild bird will be unable to be released successfully, they should be euthanased.

Birds of prey should be considered to be wild animals. They do not demonstrate signs of illness until extremely sick, they have a faster metabolic rate than mammals, so they progress from sick to critical and then death more rapidly than mammals. For this reason sick or injured birds of prey require prompt attention with stabilisation, fluid and nutritional support, appropriate hospitalisation and protection of plumage. A specific diagnosis with appropriate therapeutics, e.g. analgesia, antibiotics and parasiticides, is required, if possible, on day one of presentation.

Clinicians should be confident in basic diagnostics such as blood sampling. In raptors blood samples are commonly collected from the superficial ulnar vein, on the medial surface of the proximal ulna, under general anaesthesia. In smaller birds, where large volumes are required or in field situations where anaesthesia is not possible the left jugular vein is also accessible. It is ideal to process samples in house as results are often required rapidly, though haematology must be done manually due to nucleated erythrocytes present in birds preventing standard haematology machine analysis. Many commercial laboratories process avian samples and will also provide interpretation which is especially useful where in house facilities are not available, or if clinicians are not familiar with avian parameters. Interpretation of results is crucial in both diagnostics and assessing requirements for stabilisation of avian patients.
FEEDING THE SICK RAPTOR
Raptors in the wild generally eat whole carcass meals (i.e. fur/feather, meat, bone and prey gut contents) once daily. The indigestible fur and feather is referred to as ‘casting’ and is regurgitated as a ‘casting or pellet’ 12-18 hours after feeding. One should never feed a bird again before it has cast its pellet, for fear of the subsequent meal forcing the casting into the small intestine and resulting in a blockage. Hospitalised birds should be fed a ‘complete diet’ (i.e. bone and meat, such that the Ca:P ratio is correct), but casting can be withheld. This is done by skinning the prey before offering it as food. If casting is withheld, as soon as the crop (food storage organ on the front of the bird’s neck) is emptied, the bird can be fed again without any risk of blockage. Regular small meals of highly digestible food is essential for sick birds to maintain a positive energy balance. The most suitable diets at this stage are skinned day old chicks (if the bird is eating voluntarily), or convalescent diet by gavage e.g. Hills a/d, Lafeber or Oxbow Carnivore Care diets. Gavage feeding is typically given via soft tubing at 20ml/kg, repeated 4-6 times daily but can be as frequent as every 2hrs. All foods and fluids should be warmed prior to administration.

Gastrointestinal Disease in Raptors

Enteritis
Clinical signs of enteritis predominately involve abnormal color or consistency of urates or faeces. Normal cloacal voiding comprises a coloured (green, brown or black) faecal element, a white urate part and an aqueous part. The normal faecal (‘mute’), appearance of raptors does vary, in particular between hawks, falcons, eagles and owls as well as within each group with respect to dietary volume and composition. The owner should be able to inform the clinician if the mutes appear different to normal and if so in what way. Other signs of enteritis are vomiting or regurgitation, increased or reduced appetite, altered food conversion efficiency, diarrhoea, melaena, haematochezia, undigested food in the faeces, reduced faecal volume and anorexia.

Causative factors include:
- **Bacterial** – typically due to proliferation of bacteria present in food. Food should always be fresh, or quality frozen carcasses from a reputable source to prevent this. Frozen carcasses should be defrosted in a hygienic way and once defrosted should be fed immediately and all food removed if not eaten within 4hrs to prevent bacterial proliferation. At no stage of the food preparation process, from killing, freezing, transport, thawing and feeding, should food be left out at room temperature, as this will facilitate bacterial proliferation. Contamination of food with soil prior to or at feeding can result in *Clostridial* spp. Infection. Wernery (2000).
- **Viral** – most commonly adenovirus, cases may present with haematochezia or just sudden death. Paramyxovirus is also seen, and is especially common where raptors are housed with or fed on fresh pigeons.
- **Fungal** – usually secondary to antibiotic therapy.
- **Endoparasitic** -Typically nematodes in particular *Capillaria* spp.
- **Toxicosis** –salt, nitrate, lead intoxication
- **Other:** Neoplasia, inappropriate diet, foreign bodies, medication effects or trauma are seen less commonly.
The diagnostic approach typically involves faecal analysis (salt floatation, cytology and culture if indicated), crop cytology, radiography (with barium contrast where necessary), haematology, biochemistry (including lead assay if required). It is important to maintain hydration and to meet energy requirements while a diagnosis is investigated and specific treatment instigated. Any sick or anorexic bird should be considered 10% dehydrated and supplemented accordingly with parenteral fluid therapy. Daily water requirement is taken as 100ml/kg/day for avian species and this maintenance level should be provided along with replacement of 50% of the fluid deficit over 24 hrs and the remaining deficit corrected over a further 48hrs. The fluid provided may be as intravenous fluids (via an indwelling catheter), subcutaneous fluid (administered dorsally between the scapulae). Birds with enteritis may be inappetent, have increased nutritional needs and may be suffering for malabsorption (due to blocking or dysfunction), hyper or hypomotility so enteral fluid replacement is not ideal. As with all sick birds, the clinician must ensure that the bird is eating appropriately. Gavage supplementation is usually provided until the clinician is certain that voluntary intake is sufficient to maintain bodyweight and hydration status. The bird must be weighed daily while hospitalised to ensure this is the case.

**Sour Crop**

Raptors typically tear pieces of meat from their quarry, swallowing them into the crop. The crop is a simple storage organ, with no acid or enzyme to aid digestion or prevent putrefaction. Here the food is maintained at body temperature (41°C) until it ‘passes over’ into the proventriculus, where digestion commences, some 2-6 hours later.

If for any reason there is a delay in the crop emptying, the meat will rapidly putrefy, resulting in toxaemia and a sick bird. The most common reasons are an existing crop infection, caustic or irritant food, dehydration, low body condition, or an over full crop.

Patients may appear bright initially but with a distended crop and foul smelling breath, or more typically, collapsed, in shock and requiring immediate aggressive therapy to survive. This is a condition that always merits immediate veterinary intervention as it progresses to toxaemia and death rapidly.
As a priority the putrid meat must be removed from the bird. Due to shock, toxaemia and compromised metabolic state birds are poor anaesthetic and surgical candidates but failure to remove the food will invariably result in death of the bird. The bird should be anaesthetised and entubated immediately with the head maintained elevated above the level of the crop at all times. An intravenous catheter should be placed and appropriate fluid therapy administered (crystalloid, colloid or colloid mixed with hypertonic saline, depending on the bird’s status). The food may be massaged back into the mouth and retrieved, or it is often quicker and less traumatic to surgically incise, empty and flush out the crop. Non steroidal anti-inflammatory and antibiotic medication should be administered. In high risk patients the crop incision may be left opened and closed the next day, for fear of unreasonably extending the anaesthetic duration. In very debilitated patients, or where there is significant crop necrosis, an ingluviostomy tube may be placed.
Sour crop can generally be avoided by preventing the over filling (gorging) of the crop, especially when the bird is in low body condition. This occurs most commonly when a bird has been lost for a few days and returns very thin, or when a bird is completing initial training and has made its ‘first kill’ and then in either situation is over fed as a reward.

**Endoparasites**

Endoparasites are common in free living adult raptors, with up to 80% prevalence, but usually cause minimal clinical disease, unless the bird is suffering concurrent illness, nutritional shortage or trauma. These birds and their parasites exist in harmony and are not confined to a limited physical space, so their immediate environment is not subjected to an escalating level of contamination. In contrast, captive raptors are commonly maintained in a limited space, such that any infected raptor host will constantly contaminate their immediate environment. When the infestation involves parasites with direct life cycles or where intermediate hosts (e.g. snails, arthropods or earthworms) are present within the bird’s environment, then life cycles can be completed, and endemic high levels of parasitism and clinical disease are common. Keepers must therefore test for, treat, control and prevent an environmental build up of such parasites.
Antiparasitic medications should not be given unless required as adverse effects are reported, particularly with fenbendazole suspensions, and parasites should be identified so that the correct treatment is given and husbandry can be altered to prevent re-infection. The authors recommend testing raptor faeces for parasites twice annually (at the end of the flying season and again after the moult, before the start of training for the new season.

**Helminths**

*Capillaria* spp are a particular problem and the commonest nematode parasite of captive raptors. They have both a direct life cycle but also an indirect life cycle with earth worms as the intermediate host. Raptor species which commonly eat earthworms (e.g. kites, buzzards etc) are most commonly infected. The 1-5cm long thread like worms are located in the oropharynx or intestine of infected birds.

Clinical signs include head or food flicking (with oropharyngeal lesions), diarrhoea, weight loss, inappetance or lethargy and poor flight performance.

![Figure 12 Lingual plaques caused by Capillaria infection in a common buzzard](image)

Diagnosis is made by observation of the characteristic bioperculate, lemon shaped (55-70 x 24-35 um) ova on faecal examination.
Fenbendazole is efficacious for nematode infections, with repeat faecal testing 3-4 weeks later being indicted to confirm elimination.

**Protozoa**

*Trichomonas gallinae* protozoa invade the mucosa of the oropharynx, oesophagus and crop, as well as on rare occasions the intestines, orbital sinuses and even viscera. Raptors are most typically infected after eating fresh (warm) pigeon. Disease can be avoided in captive raptors, by always freezing pigeon, prior to thawing and feeding it.

The disease may be suspected on clinical appearance with characteristic white or yellow necrotic lesions within the mouth. Differential diagnoses are candidiasis, capillaria, pox virus or bacterial stomatitis. Such birds may hungry but demonstrate oral pain on eating, or may head flick in an effort to clear their mouths during or after eating. Diagnosis must always be confirmed by microscopic examination of a re-suspended oral swab in warm saline. Characteristic flagellated ovoid direction swimming motile protozoa will be seen. The preferred therapy is Carnidazole (Spartix, Harkers), as a single dose or a course of metronidazole if this is not available.
Coccidia – *Eimeria, Sarcocystis, Frankelia* and *Caryospora* (four different coccidial genera), have all been reported in raptors. Of these only *Caryospora* is of major clinical significance but has only been identified in owls and falcons, almost exclusively in captive birds. In captive reared birds, in UK, central Europe, the Middle East and America, 60-65% of all young falcons tested are shown to be infected. Clinical disease is only of clinical significance in young birds or in immunologically naive adult birds. Merlins suffer peracute disease and tend to simply be found dead, whilst other species are more likely to be noticed off colour, with weight loss, fluffed up, inappetant, they may vomit or pass bloody diarrhoea, or they may appear to suffer from extreme abdominal pain or cramps. These clinical signs can be present for 48 hours prior to the shedding of faecal oocysts. Oocysts are of similar or larger size to other coccidia and typically ¼ of the size of most nematode ova.

![Figure 14 Caryospora oocyst present on a faecal flotation](image)

The most effective therapy is Toltrazutil though resistance has been reported infrequently.

**Ectoparasites**

Hard ticks (Ixodidae) may feed on birds in the UK and soft ticks may be found on newly imported birds. Large numbers may cause irritation, debility, anaemia and death, or transmit haemoparasites (Kurtenbach et al 1999). Tick bites have also been associated with an intense and often fatal reaction. This may be due to an injected toxin, tick-borne infection, or a hypersensitivity reaction. The majority of cases occur in August and September, although they
can occur in any month of the year. Incidence is accompanied by environmental changes, particularly weather, and cases tend to occur simultaneously across wide geographic areas.

The ticks are easily seen on birds, usually on the head, but may be very small when first attach. When one case of tick attachment occurs at a site, all other birds on the same site will be at risk at the same time and should be treated topically with Fipronil to prevent further bites and the potentially fatal response. Environmental control with can be achieved with “Indorex” spray (Virbac). Whilst the potential pathogen transmitted has not been identified, responses to therapy have been dramatically improved by the systemic treatment with oxytetracycline.

Respiratory Disease

Aspergillosis
Aspergillosis occurs due to colonisation of the respiratory tract with fungal hyphae of the genus *Aspergillus*. Infection is typically *Aspergillus fumigatus* but *A. terreus, A. flavus, A. niger* and *A. nidulans* are reported infrequently. *A. fumigatus* spores are ubiquitous, and clinical infection results from either exposure to overwhelming quantities or immune suppression (typically caused by stress). Some species are more susceptible, especially Northern Goshawks, Sparrow Hawks, Gyr falcons, Golden Eagles and Snowy Owls. If stress is anticipated in these species prophylactic antifungal therapy should be provided for two weeks before to two weeks after the stressful event (Forbes 1996).

Aspergillosis is not a communicable disease, but can occur as a flock problem where husbandry conditions predispose multiple birds to disease. Disease can result from exposure to decomposing organic material, in particular hay, compost and wood, but can also result from travelling within mouldy wooden transport boxes. Mixing of groups of birds, isolation of social animals or the onset of training leads to stress in multiple birds. In any of these situations the stress can result in an immune-suppression, such that the bird can no longer cope with the normal environmental level of spores which would otherwise not be a problem.

Aspergillosis may cause disease in one or more anatomical sites: syrinx, lung or air sacs.

**Syrinx:** Birds present with a change or loss of voice, progressing to inspiratory and/or expiratory stridor. Diagnosis is by tracheoscopy demonstrating fungal granuloma. Treatment is by removal of the lesion with endoscopically guided suction, curettage or surgical removal at tracheotomy, followed with prolonged antifungal therapy.
**Lung:** Birds present with severe dyspnoea and rapid onset cyanosis on handling. Diagnosis can be achieved on radiography and confirmed with endoscopy. Prognosis is typically hopeless and euthanasia is often the most humane approach as treatment is unlikely to be successful.

**Air sacs:** Clinical signs can be non-specific, including poor response to training, lethargy, weight loss despite good appetite, increase biliverdin in the faeces, gastrointestinal signs and polyuria/polydipsia documented. The air sacs are not involved in gas exchange so respiratory symptoms are not seen and most clinical signs relate to hepatic damage secondary to aflatoxin production. Diagnosis is often suspected from radiography and confirmed by endoscopy. Treatment involves extensive medical therapy, and can be supported by spraying the lesion at endoscopy with a suitable anti-fungal solution. Depending on the site, endoscopic removal after a week of medical therapy may be useful.

*Figure 3b Tracheoscopy showing almost complete syringeal obstruction by an aspergilloma*
Medical treatment for aspergillosis: Itraconazole has been considered the drug of choice, but more recently Voriconazole has been trialled and appears to have greater efficacy leading to improved survival rates although cost is significantly higher. Amphotericin B is not routinely used due to the risk of nephrotoxicity but has shown improved efficacy in conjunction with voriconazole. Due to the azole group’s fungistatic rather than fungicidal action, prolonged treatment of at least 8 weeks duration is needed to prevent relapse.

Nebulisation can be a useful adjunctive therapy. F10 disinfectant at 1:250 concentration is recommended due to this agent’s antifungal properties and high safety margin in vertebrates.

Ophthalmic Trauma
Ophthalmic injuries are seen in 30% of wild raptor trauma cases presented for veterinary care. 70% of these only have damage to the posterior segment which is not detected without a complete ophthalmological examination. Pecten injury is the most common finding in these cases. The pecten is a mobile vascular structure in the posterior chamber responsible for diffusion of nutrients from the blood to the avascular retina, visible as a dark wave-like process on ophthalmoscopy. Blunt trauma to the head commonly results in contra coup traction of the attachment of the pecten to the retina, resulting in haemorrhage above or below the retina. Posterior segment haemorrhage carries a grave prognosis for complete return to vision due to loss of nutrition to the retina with pecten damage, obstruction of the visual axis and potential retinal detachment following clot contraction. Tissue Activating Plasminogen
can be injected into the anterior chamber to stimulate clot breakdown but is expensive and preparations are unstable once opened.

Veterinarians working in general practice are not expected to maintain specialist knowledge of birds of prey, but an appreciation of the management, common conditions and first aid treatment is recommended. Common causes for presentation of captive and wild birds have been detailed which should enable practitioners to approach sick birds of prey with a basic understanding of common pathologies and recognise when treatment is applicable and when referral to specialist centres is required.

<table>
<thead>
<tr>
<th>Agent</th>
<th>Dosage</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ANTIBIOTICS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enrofloxacin</td>
<td>5-10mg/kg twice daily PO IM</td>
<td>Subcutaneous and intramuscular injection can cause localised necrosis</td>
</tr>
<tr>
<td>Amoxycillin-clavulanate</td>
<td>125mg/kg twice daily PO IM</td>
<td></td>
</tr>
<tr>
<td>Oxytetracycline</td>
<td>25-50mg/kg twice daily PO IM</td>
<td>Use prophylactically for 5 days following tick bite</td>
</tr>
<tr>
<td><strong>ANTIFUNGAL AGENTS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Itraconazole</td>
<td>5-15mg/kg twice daily PO for 6-8 weeks</td>
<td>Can be used for shorter periods as a preventative treatment</td>
</tr>
<tr>
<td>Voriconazole</td>
<td>10mg/kg twice daily for 6-8 weeks</td>
<td></td>
</tr>
<tr>
<td>Amphotericin B</td>
<td>1.5 mg/kg IV three times daily for 3-7 days</td>
<td>Rarely used due potential for nephrotoxicity</td>
</tr>
<tr>
<td><strong>ANTIPARASITIC AGENTS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fenbendazole</td>
<td>25mg/kg once daily for 5 days PO</td>
<td>Recommended for nematodes, including capillaria. Ensure suspension is properly mixed before administration</td>
</tr>
<tr>
<td>Carnidazole (Spartrix, Harkers)</td>
<td>50mg/kg once PO</td>
<td></td>
</tr>
<tr>
<td>Metronidazole</td>
<td>50mg/kg once daily PO for 5 days</td>
<td>Resistance reported</td>
</tr>
<tr>
<td>Toltrazuril (Baycox 2.5%)</td>
<td>25mg/kg PO once weekly for three doses</td>
<td>Baycox is highly alkaline so must only be administered after mixing with an equal volume of acid solutions such as carbonated soft drink</td>
</tr>
</tbody>
</table>
Fipronil (Frontline spray)  
3ml/kg topically  
Apply under the wings, 'spot-on' formulations are not suitable

<table>
<thead>
<tr>
<th>ANTI-INFLAMMATORY AGENTS</th>
<th>0.2mg/kg once daily PO</th>
<th>Ensure adequate hydration before use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meloxicam</td>
<td>2mg/kg once daily IM</td>
<td>Ensure adequate hydration before use</td>
</tr>
</tbody>
</table>

| Table 1. Formulary of medications |

**References**


