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International Journal of Avian & Wildlife Biology

Review Article
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Preventive medicine programme manual for Dubai safari park animals; benefits, challenges and strategic approach

Abstract

A well-implemented Preventive Medicine Programme is the foundation of any zoological park, as it is difficult to perform diagnostic tests or treat sick wild animals successfully. Many wild species are adept at hiding signs of illness and their behavior in captivity may not always reflect the typical signs of illness; and disease outbreaks can have devastating population effects. This article discusses the advantages, challenges, and strategies approach for the preventive medicine program in a multi-species environment, particularly in Dubai Safari Park. Preventive medicine programme become critical and challenging in such complex and diverse facilities. The unique requirements of individual species add to the complexity of this programme.

Keywords: wildlife, captivity, animals, management, disease screening

Volume 9 Issue 1 - 2025

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Received: February 10, 2025 | **Published:** February 24, 2025

Introduction

A sound preventive medicine program is the foundation of an animal health program because it is difficult to perform diagnostic tests or treat sick animals successfully; wild animals often mask signs of illness until late into the disease process; and disease outbreaks can have devastating population effects.[1] At Dubai Safari Park, our top priority is the health of our resident animals, A comprehensive preventive medicine programme is being followed to prevent any kind of potential illness in our animals and keep them healthy and fit. It is a proactive approach taken to maintain the health and well-being of the animals. This programme includes:

a) Stock selection from renowned sources

b) Quarantine of new arrivals

c) Periodic fecal examinations and treatments for parasites

d) Annual booster vaccinations

e) Health screening procedures

f) Newborn treatment

g) Nutrition evaluation and formulation of diet

h) Necropsy examination of deceased specimens

i) Pest control programme

The goal is to minimize the chance of developing health problems and maximize the chances of early detection of diseases in animals. Benefits of Preventive Health Programme:

Disease control and prevention

Preventive programme like vaccination and regular deworming are important tools to control disease in animals. Regular fecal examinations and health checkups further increase the chances of early detection of disease. The following points were kept under consideration while developing the vaccination programme at Dubai Safari Park:

a) Species of the animal to be immunized

b) History of infectious disease in the species or the facility

c) Potential risks versus benefits of each type of vaccine

d) Updated information on the disease susceptibility of various species

e) Safety and efficacy of the available vaccines

f) Recommended vaccination intervals

g) Federal and State regulations

h) Regional endemic pressure

Along with deworming protocols with broad-spectrum anthelmintics and antiprotozoals to ensure that the diseases do not spread.

Improved reproductive health

Regular checks on hormonal levels, reproductive organs, and overall health play an important role in ensuring that an animal is fit for a breeding programme. Nutrition management, which often

includes dietary supplementation, helps in ensuring animals get the necessary vitamins, minerals, and nutrients to support reproduction and gestation. Regular check on fecal progesterone levels, which is a non-invasive and effective method to diagnose pregnancy, helps to modify care and management strategies, ensuring pregnant animals receive appropriate nutrition, veterinary care, and a stress-free environment. Detecting pregnancy in the early stages plays an important role, especially in species like elephants, giraffes, and rhinoceros. It enables us to prepare for birth by preparing a calving pen and arranging neonatal care and helps the veterinary team to prepare in advance for potential complications like dystocia and make necessary adjustments.

Improved quality of life

Routine health check-ups, dental examinations, blood tests, fecal examinations and imaging allow early detection of health problems like periodontal disease, parasites, digestive health, tumors and skeletal abnormalities. Regular blood tests from animals help in the detection of organ dysfunction as kidney failure is one of the most common health issues in geriatric carnivores.[2] Early detection of such issues helps veterinarians to start timely treatment like dietary adjustments, fluid therapy and medication which improves the animal's quality of life and potentially expands its life span.

Reduction in mortality rate

It is attributed to preventive strategies that include routine parasite control, dietary supervision, and immunization through vaccinations and supplements. The implementation of pest control such as rodents and other predators enables the zoo to reduce greatly the risk of predation on neonates and birds, plus cut down the transmission of diseases from pests to the captive population. All these combined actions have an essential effect on creating a safer habitat and lowering the mortality rates.

Enhance animal welfare

Designing a habitat that mimics the natural environment with vegetation, varied terrains, and water features and allowing animals to climb, forage, and other species-specific requirements helps to create a more calming environment, Providing stimuli like toys and puzzles to engage animals mentally and physically along with stress reduction techniques like eliminating loud noise and minimum human interaction help to reduce the stress in animals, while proactive health measures like regular hoof care to the elephants and mountain animals like ibexes, as they are adapted to uneven and rocky terrains, are more prone to the hoof problems, particularly in dry, hot, and flat terrains typical of Dubai. Treating abnormal feather growth in birds and skin infections helps to reduce discomfort in birds.

Conservation of endangered species

Wildlife reserves, zoos, and safari parks play an important role in conservation of endangered species by providing a safer environment for breeding, research, and education. The Preventive medicine programme is important in protecting the health of endangered species by providing proper captive breeding conditions, regular health screening, vaccination, and parasite control to keep the breeding population healthy.

The recovery of Arabian Oryx is a prime example of how preventive medicine contributes to conservation, a species that was declared extinct in the wild in the early 1970s. Arabian Oryx Reintroduction Programme of His Highness Sheikh Mohamed bin Zayed Al Nahyan, President of the United Arab Emirates, was established in 2007.[3] In 2011 IUCN reclassified Arabian Oryx from endangered to vulnerable.[4]

Public Safety

A sound preventive medicine programme plays an important role in preventing the spread of zoonotic diseases and protecting animals, human staff, and visitors. Regular monitoring, and vaccination for rabies, leptospirosis, tetanus, avian influenza, etc. ensures a safe environment for humans and animals.

Complications and Strategies

Stress associated with medical procedures

Performing routine health checkups or administering vaccines can be stressful procedures. Particularly deer, antelope, gazelle, zebra, birds, lions, tigers, cheetahs, and even chimpanzees and gorillas are also susceptible to stress.

Strategies to overcome stress

Procedures like vaccination and routine health checkups are implemented during the winter season in Dubai Safari Park; additionally, early morning hours are preferred for these operations to reduce heat-related issues. Ungulates are particularly more vulnerable to stress/capture myopathy due to their strong flight response. To minimize the risk, the following strategies are used:

Boma technique: animals like gazelle, impala, and springbok are guided through funnel-shaped temporary barriers into the confining area in a quiet and controlled environment. In this way, it becomes easier and less stressful to capture the animal, as this method minimizes the chase and panic among animals. Post-captured animals are allowed to rest under sheds and given access to water.

For larger species of ungulates like Scimitar horned Oryx, Addax, Elephants, giraffes, zebra etc. the darting technique is used for vaccination from a safe distance after confining them into a holding. Elephants and rhinoceros at Dubai Safari Park are trained using positive reinforcement techniques to cooperate for procedures like blood collection and hoof trimming via protected contact. Hippopotamuses are also trained to open their mouth voluntarily for the dental examination, which reduces the risk of sedation and ensures regular health monitoring.

Chemical immobilization is used for hoof trimming, bio sampling or any other medical procedures in species that possess a high risk for physical restraining like Common Eland, Sable antelope, Greater kudu, addax and nilgai. Carnivores like lions, tigers, cheetahs, hyenas, and bears are also susceptible to stress; hence positive reinforcement training for blood collection helps to minimize the stress and risk of sedation and ensures regular health monitoring.[5] Annual vaccination in carnivores is done via darting as it minimizes direct human-animal interaction, therefore reducing the risk of stress.

Other unavoidable surgical procedures or routine procedures like X-rays, ultrasounds, dental examinations are performed every 3-5 years in carnivores under general anesthesia using an anesthetic dart or done opportunistically when sedated for other manage mental event like transfer to other area/location (Figure 1).

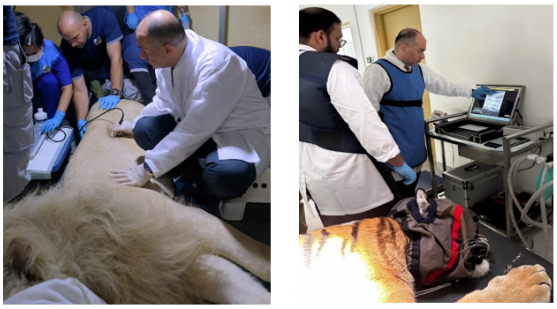

Figure 1 Opportunistic ultrasound and radiographs from big cats during sedation for transfer.

Birds are susceptible to stress or capture myopathy and fractures of bones if not handled carefully during capture. Gentle and proper handling techniques using proper restraining devices specific to the bird species, for example parakeets require different handling techniques compared to ratite. The use of towels or cloths for wrapping the bird, minimizing handling duration, and a quiet environment help reduce the chance of injury and minimizing stress. Chemical sedation is used for birds, which are more susceptible to stress due to physical restraining. For prolonged and invasive procedures like surgery or endoscopy, chemical sedation is used. Birds are mostly managed with gaseous anaesthesia for short medical procedures.

Species-specific health requirements

A wide range of species, including mammals, birds, reptiles, and amphibians from diverse ecosystems coexist in Dubai Safari Park. Each species has its own unique health requirements depending on physiology, environmental requirements, and disease susceptibility. A comprehensive preventive medicine programme is designed based on species-specific health requirements.

Carnivores like tigers, lions, and cheetahs are more likely to get kidney diseases and dental issues like tooth fractures and periodontal diseases. Therefore, these animals are screened regularly for serum BUN, Creatinine and SDMA levels and require routine dental check-ups (Figure 2).[2]

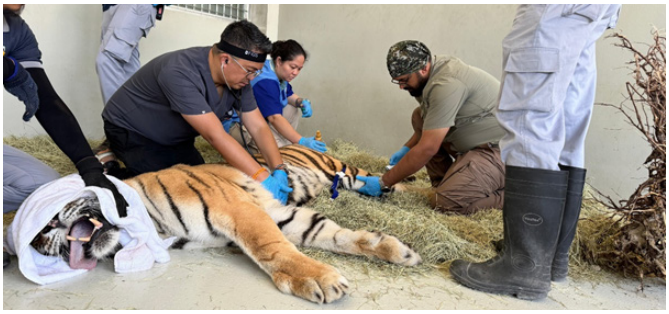

Figure 2 Opportunistic blood sampling from an adult tiger during sedation for transfer.

Ungulates like elephants and giraffes are more prone to hoof problems due to their heavy weight and prolonged walking on hard surfaces; therefore, require regular foot care and hoof trimming. Due to the size and strength of these animals, the use of positive reinforcement techniques is very helpful in performing regular health examinations, which thereby reduces the risk of sedation and anesthesia.

Primates like chimpanzees and gorillas are more prone to boredom, which can lead to stress-related behaviors like over-grooming, aggressiveness, and self-harm. Enrichment is critical for their mental well-being. They are highly susceptible to zoonotic diseases. Therefore, strict biosecurity measures like using face masks, foot baths, minimum human-primate interaction and regular health screening of animals, and caretakers are critical.

Birds like ostriches, raptors, macaws, flamingos, and ducks have different health requirements. They are prone to different diseases like Trichomoniasis, Beak and Feather disease, avian influenza, avian pox, Newcastle's disease, etc. Birds can quickly spread diseases in aviaries. Strict quarantine protocol and regular screening programmes help prevent disease outbreaks in bird populations. Birds are prone to respiratory infection, so it is crucial to house them in a dust-free, well-ventilated place, and regular environmental monitoring is required. Vitamin and mineral supplementation are required in birds to ensure proper feather growth and skin health.

Reptiles have slower metabolic rates and specific temperature-humidity requirements and are prone to metabolic bone diseases. Sun basking and calcium - vitamin D supplementation is important in reptiles, especially in snakes, lizards, and tortoises, to prevent metabolic bone disease. Reptiles are prone to both internal and external parasites. Therefore, it requires regular check-ups and treatment. Maintaining optimum environmental conditions is crucial in the reptile section, as improper humidity or temperature will lead to digestive and respiratory diseases (Figure 3).

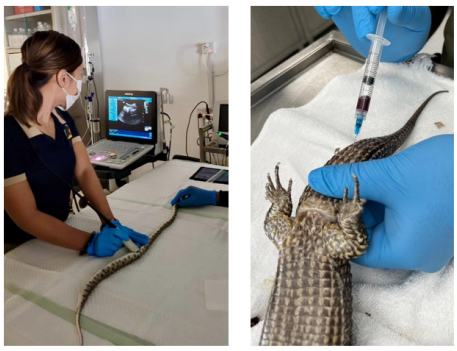

Figure 3 Ultrasound and blood sampling from reptiles for diagnostic purpose.

Logistical and resource allocation

To manage logistical and resource management in a zoo is a challenging task as each species may require distinct vaccination, diet, diagnostic tests, and treatment protocols. Acquiring a specific vaccine, medicine or supplement for exotic species can also be a challenging task based on availability or strict import regulations of the country. Record keeping and data management for large number of animals with varied preventive care schedules can be overwhelming, accurate record-keeping is essential to track vaccination schedules, health screening, and treatment records.

Strategies

1. Building good relationships with multiple suppliers and planning medical supply purchases in advance to prevent delays.
2. Partnership with veterinary pharmaceutical companies and other institutes to create custom supply arrangements and for the training of veterinarians and other zoo staff on a regular basis.
3. Digitizing/Electronic health record systems specially designed for zoos like ZIMS 360 can streamline the record-keeping, and Zootrition can review and help in formulating diets for different species in a zoo.

Preventive Medicine Programme at Dubai Safari Park

Pre-shipment examination/ stock selection

Zoo animal collections are dynamic, and animals are often shipped between zoos for social or genetic exchange. Therefore, it is very important to evaluate the health status of the collection on a regular basis, and to have proper pre-shipment and quarantine procedures in place to avoid disease outbreaks. Animals should be evaluated to ensure their health complies with local, state, and federal health requirements before shipment to other zoos or before release in managed reintroduction programmes. Pre-shipment evaluations can also be used as an opportunity to assess the overall health status of the group in which the animal has been living.[6]

a) Blood evaluation (CBC, biochemistry, viral and parasitic serology)

b) Fecal culture (Salmonella sp., Campylobacter sp, Shigella sp, etc.)

c) Fecal examination for parasites

d) Testing for *Mycobacterium* sp. (skin test) in hoof stock, elephants, and primates

e) Additional special tests for certain species (brucellosis for hoof stock, Coggin's test for equids, etc.)

f) Vaccination(s)

Quarantine procedures

All incoming animals to Dubai Safari Park undergo complete heath screening and observation to period of time to make sure they do not carry any infections disease to the healthy animal collection. Health screening with recommended test based on the species of the animal and the quarantine period of that animal. Quarantine for all species should be under the supervision of a qualified veterinarian and consist of 30 up to 90 days (depend on the origin and species of the animal). Quarantine period will be longer if there is some symptomatic clinical sign on the animal or additional animal in the same order are introduced into a designated quarantine area will make quarantine period must begin over again. The quarantine procedure consists of

a) Selection of healthy animals at the source along with collection of identification numbers (microchip number/leg ring/ear tag etc.)

b) Verification of health status and vaccination status of the animals at the source

c) Strict quarantine procedure after arrival in the facility

d) Different animals handling team and veterinary staff for the quarantine facility

e) Immunization with necessary vaccines after arrival and record the immune response in important cases

f) Collection of biological samples for disease screening and genetic study during the first 72 hours of arrival at the quarantine facility

g) Strict entry protocol for staff entering the facility with proper foot bath and wearing applicable PPE.

h) Disinfection procedures are followed strictly

Duration for various groups of animals

a) For most animals: 30 days

b) Psittacine: up to 60 days

c) Primates: up to 90 days if the records from the previous facility are not satisfactory or sufficient. Large animals like giraffes, elephants, rhinos, hippos are quarantined at the animal holding with proper biosecurity measures to avoid stress and repeated handling and transfer (Figure 4,5).

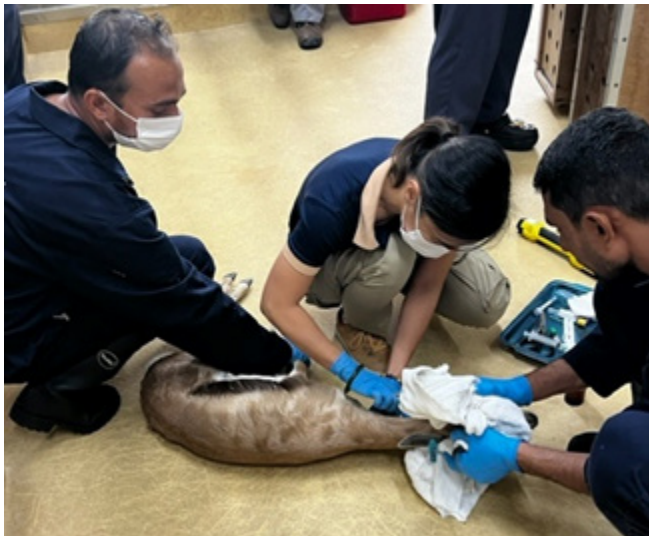

Figure 4 Blood sampling from a Speke's gazelle.

Figure 5 Vaccination of Rock hyrax.

Routine/daily health monitoring

Routine health monitoring of resident animals will make it possible to detect illness earlier, thus increasing the chance for successful treatment and preventing the spread of the disease to other animals. An important aspect of health monitoring is performed by the animal caretakers. They are often the first to detect changes in the animal's behavior such as alertness, response to food or body condition that may indicate illness. If possible, animals should be weighed periodically. Unexplained weight loss, even if the animal appears otherwise normal, should be investigated because it may indicate health problems such as inadequate diet, dental disease, neoplasia, etc. (Figure 6).

Figure 6 Giraffes in Dubai Safari Park during the morning observation.

Routine physical examination

Recommended for all species (note: there may be a rare exception). Generally recommended annually at least every other year, depending on species (note: there may be a few exceptions to this recommendation) Similar examination procedures as for pre-shipment or quarantine. Should also include dentistry, radiology, reproductive assessment, etc.

Neonatal care

Captive breeding programs in zoos are key components in endangered species management. It is important that any captive endangered species breeding program also have a plan in place to provide critical neonatal support care when natural rearing is not possible. Physical examination of the newborn for any congenital deformity, identification of sex and placement of unique identification (micro transponder/leg ring) for future reference. Ungulate species are handled after 72 hours of birth which gives the newborn enough opportunity to establish a bond with the mother and get sufficient colostrum to become stable. Carnivores are handled a bit late; after 45 days not disturbing their maternal bonding until the essential suckling period (Figure 7).

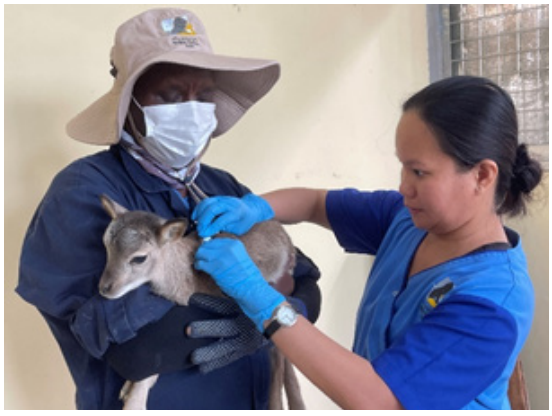

Figure 7 Microchip implantation in a mouflon lamb.

Preventative dentistry

Although the systemic health effects of diet-related oral pathology and the importance of dental health in animals is well documented, only in recent time has dental care of captive wild animals become common. Foremost was the difficulty of restraint and anesthesia, which prevented a thorough examination of the teeth and supporting structures. Thus, most dental diseases went undetected and untreated until swelling or clinical signs (anorexia, dropping food, etc.) became obvious. When dental problems were found, the lack of available dental expertise often led to incomplete treatment or needless tooth extractions. Another reason for poor dental health in captive mammals was the sparse knowledge of proper nutritional and functional diets in the past. Too often, the cheapest and the most readily available foods were used. Fortunately, many zoos have now added nutritionists to their staff (Figure 8).

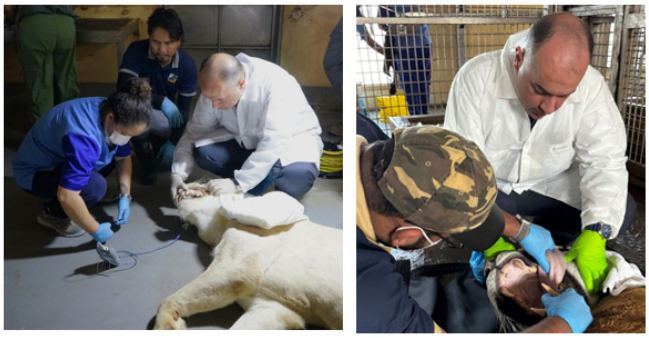

Figure 8 Complete examination including dental check of a young lion and an adult tiger.

Pest Control

Many infectious diseases of captive animals are carried by invertebrate and vertebrate pest species frequently encountered in and around animal facilities. Specialist advice should be sought to reduce or eliminate such pests, which include ticks, insects such as cockroaches, snails, rodents, and birds. This can be especially challenging in enclosures with natural substrate and/or vegetation, and/or ponds and moats, which may require constant attention in this respect. Organisms such as *Shigella* sp., *Salmonella* sp., *Campylobacter* sp., *Chlamydia* spp., *Leptospira* sp., *Yersinia* sp. and nematodes such as *Angiostrongylus sp* and *Capillaria sp*. can all be introduced or spread by pest species. In endemic areas of *Echinococcus spp* dogs and foxes might cause serious problems by contaminating outside enclosures, bedding material, material for behavioral enrichment, and even food.

Therefore, attention is required to prevent the introduction of pest animals as far as possible. It is usually much easier to prevent the ingress of pests into an area through good facility design and construction principles, than retrospectively trying to deal with the situation. However, many zoo buildings are aged, and this creates significant challenges to pest proofing. Regardless, a comprehensive integrated pest management program must be in place, and this should include ongoing monitoring and adaptive management, reacting to the levels of pest activity as required. While an important element of this is the reduction of pest numbers through baiting or other methods of killing, consideration should be given how to reduce numbers through other methods, including reducing the availability of areas harboring pests, food, and water, as well as entry routes into indoor exhibit areas

Vaccinations

Execution of an effective vaccination programme for the Dubai Safari Park inmates to develop a proper immunity and immune response to combat the probable disease occurrence in the park. Vaccination programme for carnivores, nonhuman primates, equids, artiodactyls, and birds are developed with the insight of the source of the animal, prevalence of the disease locally. Vaccination of zoo carnivores is essential because of their susceptibility to various diseases such as feline panleukopenia, feline rhinotracheitis, feline calicivirus, rabies, canine distemper, and canine parvovirus. Previously, only killed virus vaccines were recommended, but recent studies have shown that some modified-live vaccines are safe for use

in select species. Further studies are required, because some modified-live vaccines (especially canine distemper) can result in fatal disease in certain species. A canary pox-vectored recombinant canine distemper vaccine has proved safe for use in those species susceptible to modified-live virus vaccine-induced disease. Appropriateness of rabies vaccination depends on the circumstances of each collection. If indicated in rabies-endemic areas for protection of individual animals, only a killed rabies vaccine should be used. The decision to vaccinate zoo animals for less common diseases for which a vaccine is available should be made on an individual basis. Recombinant and subunit vaccines are being developed for a variety of infectious diseases for domestic animals. Extra-label use of vaccines should be done with caution until safety and efficacy studies have been completed for zoological species.

The vaccination programme for each animal in Dubai Safari Park has been developed considering the prevalence of the disease in and around Dubai Safari Park and previous reports of incidences in the emirates/region with Reference to concerned Authorities in UAE. The following schedule have been formulated for prophylactic immunization of the various categories of animal species in Dubai Safari Park.

Ungulates

Physical examination by manual restrains with nets of species/individuals below 15kg body weight to verify the microchip numbers/ear tags. Individuals with higher body weight need tamers/restrain crush cages for the same. Blow darts are an alternative to physical restraint to avoid handling stress and trauma but an expensive practice. Hoof trimming exercise can be undertaken if necessary, during the restraint (Figure 9).

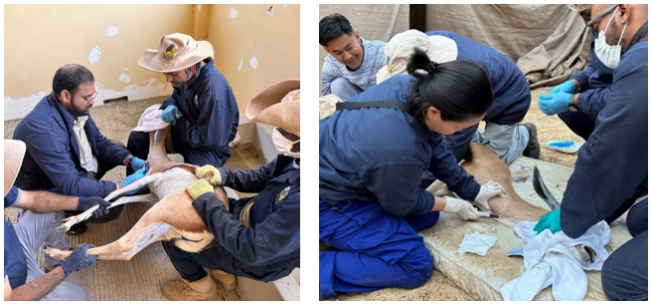

Figure 9 Blood sampling from a springbok for serology and routine blood work.

Fecal examination (direct, flotation and sedimentation) for endoparasites and treatment based on fecal analysis findings. Fecal culture for Johne's disease and *Salmonella* sp.[6] Urinalysis if possible.

Blood examination: Random sampling of blood from 30% of the population for

a) Routine examination (Complete Blood Count)

b) Blood smear examination for blood parasites

c) Serum/plasma Bio-chemistry profile

Serology for

a) Mycobacterium sp. (Rapid/Immunochromatography)

b) Foot and Mouth Disease (Rapid/Immunochromatography)

c) Brucella abortus (Rose Bengal Test/Immunochromatography)

d) Rabies sp. (Rapid/Immunochromatography)

Molecular biology (PCR)

a) Mycobacterium sp./complex. (PCR)

b) Mycobacterium avium subsp. paratuberculosis (PCR)

c) Foot and Mouth Disease (PCR)

d) Brucella spp. (PCR)

e) Bovine Viral Diarrhea (BVD) (PCR)

f) Leptospira sp. (PCR)

g) Bluetongue disease (BT) (PCR)

h) Pasteurella sp. (PCR)

i) Clostridium perfringens (PCR)

j) Peste des petits ruminants (PPR) (PCR)

Vaccination

a) Foot and mouth disease

b) Clostridial and Pasteurella polyvalent.

c) Pest des petits ruminants

d) Bovine pox

e) Rabies

White rhinoceros: The behavioral repertoire of rhinos is quite limited regarding illness. Depression and in appetence are often the only signs of major disease problems. Diseases and injuries of white rhinos in captivity are skin lesions, gastrointestinal torsion and impaction (resulting in severe colic), leiomyomas, pleuritis, pneumonia, Clostridium sp. Infections, fertility problems, internal tumors, pododermatitis and tuberculosis. White rhinos should be trained to ease inspection and treatment. Dental issues are often a problem at very old age, resulting in emaciation and death. Hence examination for dental health be recommended for old rhinos.[7]

The animals are prone to dart /injection injuries; usually get an abscess if injection sites are contaminated with mud. Hence vaccination is limited to the very essential ones only (Figure 10).

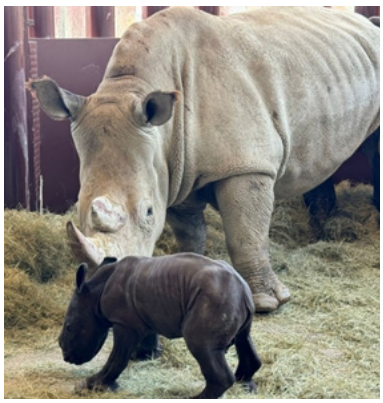

Figure 10 A white rhino neonate with its mother in Dubai Safari Park.

a) Blood can be collected from the ear veins from trained rhinos for routine blood chemistry and serology like the other ungulates.

b) Routine fecal analysis every three months with deworming based on the fecal analysis results.

c) Regular fecal and blood progesterone monitoring of expected and pregnant females.

Vaccines

Clostridial vaccines including tetanus by handheld syringes. Pole syringes are good alternative and darts with long steel needles are the least stressful (Figure 11).

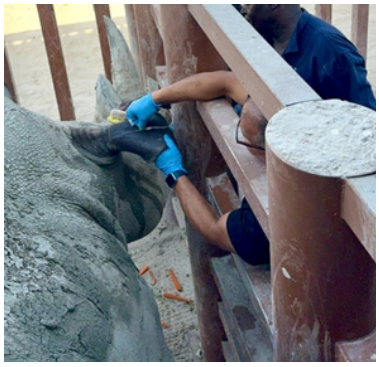

Figure 11 Blood collection from ear vein of White rhino

African elephant

Blood sampling: For standard analysis, blood sampling is recommended twice yearly from the age of one year on to create a database of normal values for each individual. Subtle changes in the blood can be very informative when trying to diagnose disease (e.g. in calves with active Elephant Endotheliotropic Herpesvirus (EEHV) infections). It is advisable that breeding herds are banking plasma and serum at -20°C for EEHV treatment; these blood products are thought to increase the survival rates of treated calves. All elephants must be trained for voluntary blood draw exercise for routine blood examination. Freshly collected venous blood should be subjected to

a) Routine examination (Complete Blood Count)

b) Blood smear examination for blood parasites

c) Serum/plasma Bio-chemistry profile

Serology for

a) Mycobacterium sp. (Rapid/Immunochromatography)

b) Foot and Mouth Disease (Rapid/Immunochromatography)

c) Brucella abortus (Rose Bengal Test/Immunochromatography)

d) Rabies sp. (Rapid/Immunochromatography)

1. Molecular biology (PCR)

a) Mycobacterium sp./complex. (PCR)

b) Mycobacterium avium subsp. paratuberculosis (PCR)

c) Foot and Mouth Disease (PCR)

d) Brucella spp. (PCR)

e) Pasteurella sp. (PCR)

f) Clostridium perfringens (PCR)

Fecal testing

Routine, individual fecal sampling is advisable. Samples should be collected over a three-to-five-day period and analyzed for any bacteria or parasites that could cause disease. The frequency of testing is dependent upon the history of such findings in the group but should occur at least twice a year. Treatment should be initiated dependent on results. Dried maize (not flaked) or edible glitter can be fed to identify an individual elephant's feces. Checking Closed Circuit Television (CCTV) footage where available might also help.

Urine sampling

Urine samples can also be used for checking the presence of blood, glucose, protein, pus cells, pH measurement, hormone analysis (for welfare or reproductive assessment) and other health factors.

Trunk wash

The ability to perform a trunk wash is a requirement. For this procedure, 60 ml of sterile saline is put into a nostril or nostrils, the trunk is raised and lowered to wash the saline up and down, and then the saline is forcibly expelled (by the elephant) into a sample bag placed over the end of the trunk. The saline collected by this method should be subjected to culture for Mycobacterium tuberculosis.

Body weights and/or body condition must be assessed and recorded at least three times a year, through actual weighing or using standardized body measurement tables, photographs, or similar, previously validated techniques. These results must be reviewed after each measurement is taken.

Routine foot care

Foot health is critical for the physical health of captive elephants. Knowledge and skills concerning elephant foot care are mostly developed within elephant keeper teams of zoological institutions, and different husbandry conditions required different approaches, so that there might not be one single way in doing proper foot care. Routine examination and trimming of the overgrown sole/foot pad and nails is practiced preventing crack and formation of abscesses. A proper area/suite with windows for training of the elephant to present the foot for examination and required foot care is essential part of any foot care programme. Soaking and bathing of affected feet with suitable antiseptics for short period of great use. In solar horn and pad lesions, soaking might only be effective if the applied container is adapted to allow circulation of the solution below the foot. If these aspects are considered, soaking may be helpful and have a softening effect on the nails, which may facilitate subsequent trimming. Soaking can never replace a therapeutic pedicure (Figure 12).

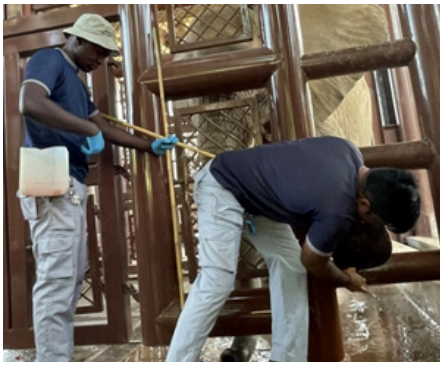

Figure 12 Routine foot examination and care of an African elephant in Dubai Safari Park.

Vaccination

Vaccine programme vary based on the history of disease within the collection and the risks in that geographic area. The veterinary advisors of the elephant Taxon Advisory Group (TAG) have recommended to vaccinate Asian and African elephants against

a) Clostridium

b) Rabies

c) Tetanus

Pygmy hippopotamus

General behavior and demeanor Appetite Respiratory rate and character Eyes, ears, nostrils, mouth and anogenital regions for abnormal discharge or excretions Quantity and quality of feces and urine Locomotion and posture Skin for any lesions, cracks, wounds, abscesses, or evidence of dermatitis. Nails for cracks and soles of feet for abrasions. Oral cavity for any dental pathology, broken teeth, mucosal lesions, malocclusion, or canine tooth overgrowth. Every pygmy hippo should be checked monthly for:

a) Body condition and weight. Adult pygmy hippos weigh between 180 and 250 kg. Animals above these weight ranges are likely to be overweight and diet modification is indicated.

b) Keepers can perform these checks and inform the veterinary staff if concerns arise.

c) Training the animals to allow tactile exams of the skin and feet and to perform an 'open mouth' behavior is advised if logistically possible.

Blood sampling can be challenging in pygmy hippos. The medial saphenous vein may offer a suitable venipuncture site. The cephalic or ventral tail vein may also be used. In anaesthetized animals, the sublingual veins and superficial digital veins are also accessible. Warm water bathing before attempting blood sampling and/or ultrasound can be helpful to identify cutaneous vessels.

Fecalysis

Endoparasites are rarely observed in captive pygmy hippos, fecal samples should be examined (parasitology and microbial culture) minimally once year, and whenever abnormal fecal excretions are seen. Assessment of normal feces can be difficult because defecation can take place in water. Anthelminthic drugs that have been used in hippopotamoids include ivermectin and benzimidazoles (equine paste formulations).

There are currently no recommendations for routine vaccinations. However, based on previous experience and local recommendation Clostridial and Pasteurella vaccinations are recommended in Pygmy hippos. If pygmy hippos are anesthetized for any reason, EDTA and serum samples should be obtained for routine hematology and serum chemistry analysis, and aliquots stored at -20° Celsius. Punch-biopsies of the skin and/or EDTA-samples should be stored for genetic analysis and bio banked at -20°Celsius or preferably -80° Celsius. Trans-rectal ultrasonography can be performed in an anesthetized pygmy hippo to evaluate the kidneys for polycystic kidney disease (Figure 13).

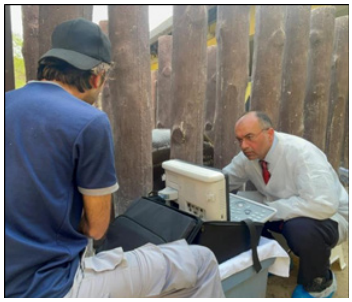

Figure 13 Ultrasound for pregnancy monitoring in a trained Pygmy Hippo in Dubai Safari Park.

Handling and clinical examination

Physical restraint or handling is not recommended because the species can be unpredictably dangerous. For any procedures that require closer contact with the animal, chemical restraint is necessary. A valuable alternative for minor examinations and procedures is medical training in protected contact. Procedures that can be performed using protected contact include oral examination, obtaining rectal body temperature, blood sampling, and trans-abdominal ultrasound, disinfection of skin wounds, walking onto a scale to obtain body weights, injections, and foot care. A walk-through passageway or tunnel helps to position a pygmy hippo sideways adjacent to a training wall or bars where an examiner can access different body parts. Most individuals learn to accept this installation in a few training sessions. Simple construction of a walk-through training tunnel where the animal can be approached after desensitization via the bars on the right (in protected contact).

Note: No confinement or squeezing is necessary. Animals are trained to enter tunnel from both sides. Side view of the training tunnel from the handler's side. Keeper offers food while examiners perform transabdominal ultrasound for pregnancy diagnosis (Figure 14).

Figure 14 A passageway used to train the Pygmy hippos for medical procedures in Dubai Safari Park.

Wild equids

Members of these taxa are known and/or assumed to be susceptible to all domestic equid diseases common to the region.

a) Annual routine physical examination while under anesthesia are suggested which include including dental exam, ecto-parasites, hoof exam and trimming.

b) Blood collection for complete blood count (CBC), chemistry panel and serum banking.

c) Annual vaccinations can be delivered via blow dart, via IM injection under anesthesia for the annual physical or opportunistically when anesthetized for an unrelated reason or via IM injection given by the vet and voluntarily accepted by the equid through operant conditioning

d) Clostridial vaccines including Tetanus

e) Rabies.

f) Fecal analysis for endoparasites and treatment based on the fecal analysis results (Figure 15).

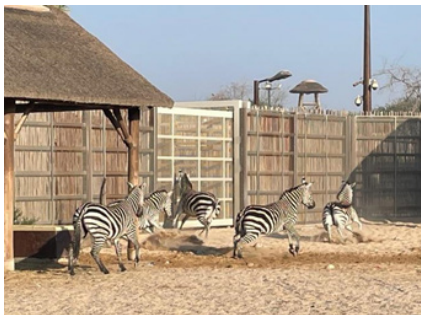

Figure 15 Plains zebras are very flighty during vaccination by darting.

Canids

Smaller canids of the size of a Fennec fox can be easily handled physically using protective gloves and towels, however larger sized canids need immobilization for handling. Complete physical examination under general anesthesia every 3-5 years or opportunistically. Well trained captive canids can volunteer for blood collection for routine examinations to avoid sedation or squeezing for the same (Figure 16–18).

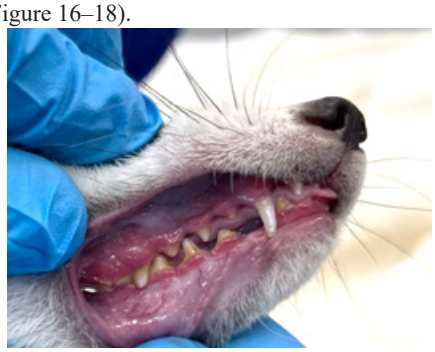

Figure 16 Dental examination of an Arabian wolf.

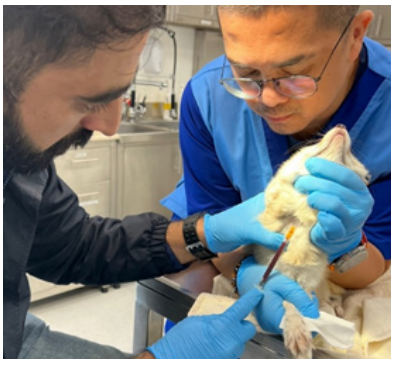

Figure 17 Blood collection from jugular vein of fennec fox.

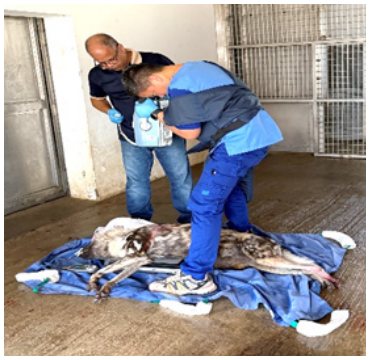

Figure 18 Radiograph of a sedated African wild dog.

A complete physical examination under general anesthesia is recommended to check

a) Dental examination

b) Complete ophthalmic examination

c) Ear examination and cleaning

d) Body weight measurement

e) Body score

f) Palpation (including testes, prostate, and mammary gland)

g) Verification of the identification number (microchip/transponder chips/tattoos should be checked for readability annually – and preferably each time the animal is handled)

Blood examination

a) Complete blood count and blood smear for blood parasites.

b) Serum chemistry for the renal, hepatic health and Thyroid/T4.

c) Serological screening of antibodies to common canine pathogens

i. Toxoplasma gondii Ab (Rapid/Immunochromatography)

ii. Dirofilaria immitis Ag (canine heartworm) (Rapid/Immunochromatography)

iii. Giardia sp. (Rapid/Immunochromatography)

iv. Canine Parvo Virus (Rapid/Immunochromatography)

v. Canine distemper (Rapid/Immunochromatography)

vi. Rabies (Rapid/Immunochromatography)

Molecular biology

a) Toxoplasma gondii (PCR)

b) Rabies (PCR)

c) Parvo Virus (PCR)

d) Canine distemper (PCR)

e) Fecal exam for endoparasites and treatment depending on the results. Rectal swab for enteric pathogen screening.

f) Urinalysis, if possible, to check for urinary crystals and for kidney worm eggs for Capillaria sp. pH and microscopic exam.

g) Radiographs every 3-5 years.

h) Ultra-sonographic evaluation every 2-3 years

Felids

A routine examination schedule should be part of a comprehensive Preventative Medicine Programme for each institution holding felid species. Examinations under anesthesia should be performed at least every 2-3 years, but that frequency will be dependent on the age and history of the individual, the species, and the staffing of the facility. Many components of routine examinations can be done in between full anesthesia (e.g. in years when no full examination is planned or opportunistically) with training and visual examinations, including assessment of body condition, weight, blood draws, and palpation or visualization of specific body parts. However, this does not replace regular examinations under anesthesia for more thorough physical and diagnostic examinations. Blood samples can be drawn from well-trained animals mostly from the tail veins for routine blood examinations (Figure 19).

Figure 19 An adult tigress during daily observation.

Recommended components of routine examinations

Complete physical examination under anesthesia including body weight measure and body condition score with thorough dental and ophthalmic examination.

Bloodwork

a) Complete blood count (CBC) with manual differential and blood parasite examination

b) Complete Serum chemistry panel for renal, hepatic functions and Thyroid/T4

Urinalysis, if possible (catheterization may be practiced collecting urine from the bladder upon sedation)

Fecalysis for endoparasites every three months and treatment based on fecalysis findings (Figure 20,21).

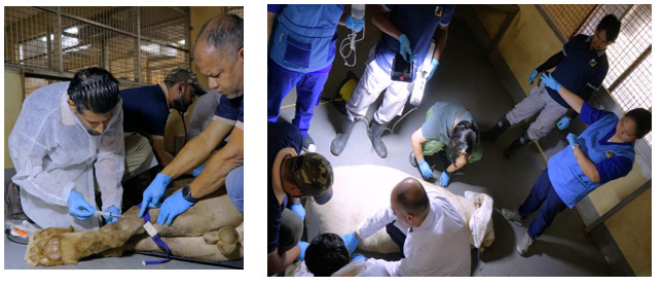

Figure 20 Blood sampling and complete physical examination of adult African lion.

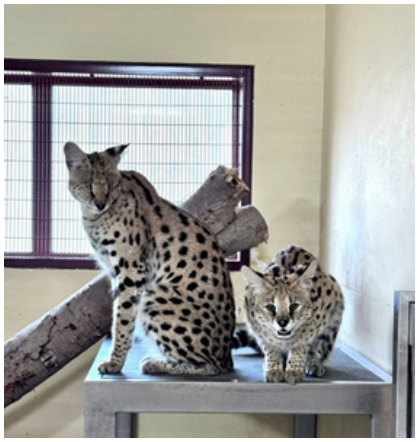

Figure 21 Adult serval cats during daily observation.

Serology

a) Feline Leukemia Virus (FeLV)

b) Feline Immunodeficiency Virus (FIV)

c) Feline Infectious Peritonitis (FIP)

d) Toxoplasma gondii

e) Feline parvo (Panleukopenia)

f) Canine distemper

g) Rabies

h) Dirofilaria immitis antibody as applicable by region.

i) Giardia

1. Molecular biology (PCR)

a) Toxoplasma

b) Feline Infectious Peritonitis (FIP)

c) Feline Enteric Coronavirus (FCoV)

Radiographs every 3-5 years. Ultra-sonographic evaluation every 2-3 years

Vaccinations

a) Feline panleukopenia, calicivirus, herpesvirus (killed, e.g. TruFel™ HC2P, previously Fel-O-Vax® PCT + Calici Vax®, Elanco)

b) Rabies (killed)

c) Canine Distemper Virus (CDV) if risk is deemed high

d) Feline Leukemia Virus FeLV (killed) only if risk is deemed high for certain species

e) SARS CoV-2: Recommend vaccination if community transmission is high

Cheetah

Vaccination programmes for felids are often designed after recommendations for domestic cats.

For felines core vaccines are:

a) Feline parvovirus (panleukopenia virus) (FPV)

b) Feline calicivirus (FCV)

c) Feline herpesvirus (FHV), Cheetahs are at a high risk of contracting this disease, therefore it is recommended to vaccinate cubs at 6 weeks of age

d) Rabies

Primates

If primates have been held captive and in close contact with humans, care must be taken to screen them for all those diseases that are transmissible between human and non-human primates. The risk of zoonotic disease transmission, in both directions, is greatly reduced if all attendant staff always wears facemasks, gloves and gowns when in contact with primates. Primates should be held in strict quarantine for at least 30 days after arrival and before any further relocation. Many institutions insist on 60 days of quarantine and increase this to 90 days for animals of unknown medical histories, those with known exposure

to infectious disease, or for wild-caught animals (Figure 22, 23). The following are recommendations and suggestions for appropriate testing procedures for diseases of primates held in captivity.

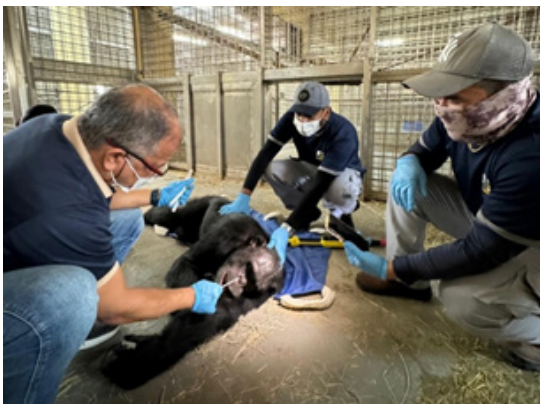

Figure 22 Sampling from a sub adult chimpanzee under sedation.

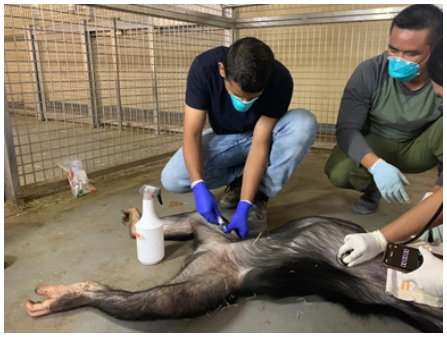

Figure 23 Collection of blood from the femoral vein of a sub adult chimpanzee under sedation.

Faecal examination (direct and flotation) for endoparasites, especially *Entamoeba* sp. which often infect primates, causing diarrhea in animals subjected to stress. Since *Entamoeba* sp. are shed intermittently, several samples should be examined, and treatment should be rendered on the fecalysis findings. Faecal culture for *Salmonella* sp., *Shigella* sp. (*Gorillas (Gorilla* sp.*)* are particularly susceptible), *Campylobacter* sp. and *Yersinia* sp.[8]

Appropriate serology is conducted opportunistically for toxoplasma, retroviruses, parainfluenza, measles, cytomegalovirus, Simian Immunodeficiency Virus (SIV) and Hepatitis A, B, C (HAV, HBV, and HCV).

All Hepatitis virus infections in primates are diagnosed serologically.

Serum/plasma chemistry profile

Urinalysis if possible

Complete Blood Count and PCV

Blood smears should be examined for *Filaria* sp. and *Plasmodium* sp. (malarial parasites). Mycobacterium PCR tests for tuberculosis. Chest radiography opportunistically or every 3-5 years whenever possible to check the lungs. Check for ectoparasites whenever sedated for other medical procedures. Ectoparasites should be eliminated before release by applying pyrethrin-based acaricides and by administering an avermectin. Sarcoptic mange will require two consecutive treatments with an avermectin, followed by a negative skin scraping Hair sampling with 10 body hairs, with hair follicles attached, should be collected for later DNA analysis. These can be stored in dry envelopes and may be valuable when it is desirable to check for genetic origin, to avoid "genetic pollution" of a recipient wild primate population.

Vaccination

Rabies

Primates, like all mammals, are susceptible to infection with rabies virus. Vaccination in rabies-enzootic areas is recommended. A killed, inactivated vaccine, as recommended for human use, can be used but is expensive. Imrab 3 (Merial Ltd) has also been used.

Tetanus

All primates are susceptible to tetanus and should be vaccinated before release. Standard human tetanus toxoid is suitable. A combination human vaccine containing diphtheria, pertussis (whooping cough) and tetanus (DPT) is sometimes used but since non-human primates are not susceptible to diptheria or pertussis the use of this combination product is unnecessary.

Aves

In the aviaries where the bird population is large, individuals restrain is not practical from welfare point of view and considering stress of restraint; random fecal sampling is recommended for fecalysis and associated disease screening. Opportunistic handling or restrained birds should be sampled for blood, buccal and cloacal swabs for serology and other recommended diseases (Figure 24).[6]

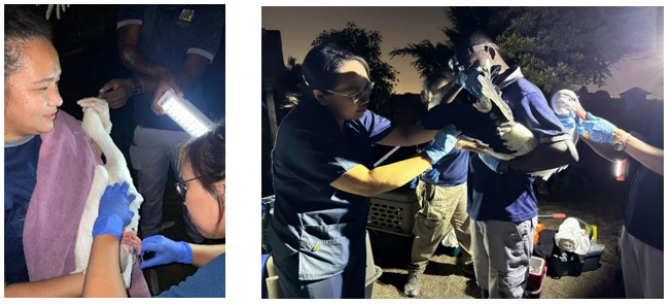

Figure 24 Handing, sampling and vaccination of Greater flamingos in the dark hours in the evening.

The serology screen should be appropriate for the disease profile of the species concerned.

Blood examination:

a) Complete Blood Count and PCV.

b) Serology/ELISA, as appropriate, for aspergillosis, Chlamydia sp., paramyxovirus 1 (PMV-1), PMV-2, PMV-3, Eagle herpes virus, pigeon and raptor viruses, adenovirus, avian pox, avian influenza, mycoplasmosis and, for psittacine, "beak and feather virus" disease, Pacheco's disease and polyoma virus disease. All ELISA tests should be negative in birds for release or entry into captive breeding flocks.

c) Raptors, Otidae (bustards) and Columbidae for oral trichomoniasis.

d) Blood smear examination for Avian malaria, *Babesia* sp. and *Leucocytozoon* sp.

Faecal examination

Direct and flotation method for trichomonads, other motile protozoa and coccidia, gizzard worms of ducks and geese and tapeworms in small passerines. Stain faecal smear (Gram) and examine for *Candida* sp. *and Clostridia* sp., *stain faecal smear* (Ziehl-Neelsen) for acid fast bacteria but remember that Mycobacterium avium may be shed only sporadically and that thus a negative smear is not significant. For the diagnosis of avian tuberculosis, a liver biopsy may be more useful. Examination for *ectoparasites,* especially *Amblyomma* sp. ticks and lice that can be vectors of other diseases. Serological tests for *chlamydiosis (psittacosis*) which is a dangerous zoonosis and if positive, confirm by cloacal swab cultures. If culture is positive, the bird must be treated if of conservation value or culled if not. Faecal cultures for *Salmonella* sp. and *Campylobacter* sp. Choanal and cloacal swabs for virus isolation from all incoming birds. Samples may be pooled from members of a flock. Samples for virus isolation should be routinely collected from all birds, which die in quarantine. All virus isolation tests should be negative in birds destined for release or entry into captive breeding flocks. Ventral air sac endoscopy for aspergillosis in rare and valuable species (Figure 25).[9]

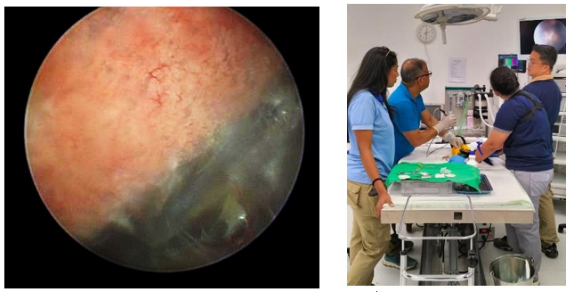

Figure 25 Ventral air sac endoscopy for surgical sexing, Aspergillosis and pulmonary anthracosis diagnosis.

Note: Birds destined for release into a Newcastle disease-free area should not originate from an area where Newcastle disease is present. Newcastle disease has zoonotic implications. Clinical signs reported in humans are mild to severe conjunctivitis, general malaise and sinusitis, which usually resolve after 7-20 days. The wearing of goggles, gloves and a facemask when performing a postmortem examination on a bird is recommended.

Polyoma Virus

This viral disease is a threat to the neonatal New World and some Old World psittacine. The virus may be a commensal infection of Australian cockatoos. It can cause very serious losses in New World species such as macaws. A PCR probe exists, and they are known to be occult and intermittent excreters of the virus. *Psittacine Circovirus* (PBFD) or Psittacine Beak and Feather Disease This virus primarily affects Old World and Australian species. Infection results in immunodeficiency and death. It is believed that the virus may have been introduced into Australia from Africa by aviary-bred birds. A PCR probe exists but may not identify all carriers.

Psittacine Herpesvirus (Pacheco's Disease)

This disease affects both New and Old-World species. It is enzootic in South America and was first described in Brazil. Pacheco's Disease can produce very severe losses in birds stressed by crowded confinement.

Chlamydia, Psittacosis or Ornithosis

This is a common rickettsial disease that can affect all bird species and some other vertebrates, including humans. Carrier status may be difficult to detect but PCR probes and serological tests can help in detection of the status.

Proventricular Dilatation Disease (PDD)

This disease can affect all species of psittacine and many non-psittacine species such as passerines and Ramphastidae. It is believed to be viral and causes irreversible neural damage to birds of all ages. The carrier state cannot yet be detected.

Papillomatosis

This disease is believed to be of viral origin and affects both new and Old-World birds. The disease causes verrucose fleshy growth on the mucosae and can affect general health and reproductive capacity.

For Aves core vaccines are:

a) New castle disease

b) Avian influenza

c) Avian pox

Recommendations

The long-term advantages of having a sound preventive medicine program in a zoo exceed any short-term inconvenience caused by preventive treatment; it improves the animal's welfare, zoo staff/ visitors' safety and lowers the financial risks. It is highly recommended that each facility that houses wild animals in captivity should have a comprehensive preventive medicine programme.

Conclusion

A well-structured preventive medicine programme is the foundation of maintaining good health and welfare of the animals. Dubai Safari Park maintains a high standard of animal welfare and successfully implements a strong preventive medicine plan that includes quarantine protocols, targeted vaccination protocols, routine health screening, proper nutrition, and disease surveillance. As a result, the park has never faced any major disease outbreaks and ensures the long-term well-being of our animal collection.

This program not only enhances the quality of life and lifespan of our resident animals but also protects our animal caretakers and other zoo staff. Additionally, adopting such preventive measures helps us to maintain the highest standards of veterinary care, conservation efforts and visitor experience. The commitment towards the preventive medicine program ultimately ensures a sustainable and thriving zoo environment at Dubai Safari Park.

Acknowledgments

None.

Conflicts of interest

None.

References

1. James W Carpenter. Preventive medicine for zoo animals (Proceedings). 2010.
2. Youn Soong, Efladl Ahmed K, Myung-Jin, et al. Symmetric dimethylarginine is a promising biomarker for the early detection of age-related kidney dysfunction in zoo felids. *Acta Veterinaria-Beograd*. 2022; 72 (3): 408–418.
3. Greg Simkins. Re-introduction of arabian oryx into the dubai desert conservation reserve, dubai, UAE.

4. Borjana Pervan. A grain of hope in the desert. 2011
5. Mustafa MB, Herawati NM, Talukdar A, et al. Medical behavior training for blood collection of Bengal tiger (Panthera tigris tigris) in Dubai safari park. *Int J Avian & Wildlife Biol.* 2024;8(2):85–90.
6. Woodford MH. Quarantine and health screening protocols for wildlife prior to translocation and release into the wild. 2000.
7. L. Versteege. EAZA White rhino EEP Best Practice Guidelines. 2018
8. Hinshaw KC, WB Amand, CL Tinkelman. Preventive Medicine. 1996; 16–24.
9. Junge RE. Preventive medicine recommendations. *American Association of Zoo Veterinarians*. 1993.