# COMMON CHIMPANZEE (*Pan troglodytes*) PREVENTIVE VETERINARY PROGRAM for ZOOS

Kathryn C. Gamble DVM, MS, Dipl ACZM and Kay A. Backues DVM, Dipl ACZM
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An appropriate chimpanzee health care program includes proper animal husbandry and veterinary care based on current professional standards, and addresses the complete physical and behavioral well-being of the animals.  Since chimpanzees have a close taxonomic relationship to humans, they are susceptible to many human diseases.  Close contact between the public and chimpanzees in the zoo setting may lead to inadvertent exposure to disease for either group.  Sub-clinical infectious disease and carrier animals can occur in chimpanzee colonies that can be transmitted not only to naïve conspecifics but also human caregivers.   A successful preventive medicine program therefore addresses the health of both the chimpanzee and the animal care staff.

Veterinary care with a strong preventive medicine program will minimize responsive medicine needs.  Caregivers must monitor Individual health of each chimpanzee to facilitate a healthy environment.  The basic components of a sound program include:  quarantine, review of individual and troop medical histories, daily keeper observations and reports to veterinarians, routine physical examinations, immunization, parasite control, proper nutrition, and monitoring for new medical problems.

Quarantine:  The purpose of quarantine is protection of the existing animals and their personnel from the introduction of infectious agents from the newly arriving animal(s).  The quarantine period (30-60 days) is accomplished by separation of the new animals from the existing troop and screening them for known diseases.  The depth of this screen will vary with the previous history of the individual animal and its collection source.  In situations where minimal prior screening has been accomplished, it is important to consider longer quarantine intervals (60-90 days) and for those animals from private facilities or the wild, this extension is mandatory (in imported animals) and will be substantially increased (90-120 days).

As part of this evaluation, the troop that the quarantine animal will enter must have known status for the infectious agents of concern.  This is managed through routine physical examinations and documented in their medical history.  For the new animal, quarantine begins with a thorough review of the medical records and social history of the individual, its source troop, and collection history.  Prior to departure from the sending institution, the chimpanzee should receive a complete examination (see below) that should also be reviewed by the receiving institution veterinarian and curator before departure.  Within two weeks of arrival to the new facility, the chimpanzee optimally should be immobilized for a repeated physical examination (see below).  When parasites are identified by fecal flotation, appropriate treatment regimens should be prescribed.  Combination of the pre-shipment and quarantine examinations provide the minimum of two physical examinations during this period.  However, longer quarantine intervals will include repeated examinations every three to four weeks.

Personnel and husbandry tools should be dedicated to a quarantine situation as well as physical isolation from the remaining troop.  If this is not possible with staff, keepers should move from collection animals to quarantine with change of clothing between these facilities, preferably with shower between the two facilities which is required if staff must return to the collection animals.  Increased attention to enrichment is necessary when an animal is housed singly during this period.

Daily observation:  This is a critical point to maintaining good chimpanzee health on a daily basis.  Careful inspections of each individual, how it relates to its conspecifics, appetite, eliminations, and detecting signs of injury or disease should be made by keepers – preferably multiple times or by multiple keepers – each day. At these times, medications and supplements can be provided as prescribed by the attending veterinarians. To complete this process, a written record should document these observations and provided to the veterinarians within 12 hours of completion.

Operant conditioning should be planned to include daily management routines and veterinary procedures – such as, weighing, oral inspection, injection presentation, and auscultation.

Quarantine/annual physical examination (Appendix A): Physical examination of all animals in a troop is recommended at 18-24 month interval, preferably in a dedicated zoo veterinary hospital or designated space within the holding facility. This procedure will require full sedation or anesthesia of the animals for their safety and that of their caretakers (see Anesthesia). Once the animal is induced and stabilized, full examination would include both visual assessment and palpation systematically. This will include thoracic auscultation, deep transabdominal palpation, rectal palpation, and use of an appropriate instrument to examine eyes, ear canals, nasal passages, and, for female chimpanzees the vaginal vault.

Dental examination can be facilitated by consultation with a dentist or veterinary dentist. Human dental charts can assist with monitoring long-term problems or routine dental health. Dental cleaning can be opportunistically coordinated with the annual physical examination and supplemented by operant conditioning that includes tooth brushing. Gingival tissues should be closely monitored for development of periodontal disease; low-dose, daily doxycycline has provided effective assistance in resolution of this condition in humans and is documented in great apes. Broken teeth or teeth with exposed root canals should be evaluated for extraction or endodontic treatment (root canal) by a dental specialist. Management of a troop should not include removal or alteration of teeth to facilitate introductions or to minimize wounding.

Blood collection is accomplished typically from the femoral, saphenous, or cephalic veins, for complete blood count (CBC), serum chemistry panel, viral serology (Appendix B), blood typing, and serum banking for all ages, with thyroid assessment, cholesterol, triglycerides, and lipoprotein concentrations, and cardiac markers for adults, especially those over 30 years of age. Normal values are available from the International Species Inventory System databases.

Fecal samples or rectal cultures should be collected for culture of *Shigella*, *Salmonella*, *Campylobacter*, and *Yersinia* routinely, and if collection history is present, *Clostridium* toxins. This culture panel should be assessed in animals with refractile diarrhea or diarrhea with other clinical signs of systemic illness.

Radiographs of the thorax and abdomen should be imaged in two views (lateral and dorsoventral (anteroposterior)) with the limbs extended from the view. Any skeletal areas of concern or prior injury should be imaged. Abdominal ultrasound should be routinely performed with rectal ultrasound or other advanced imaging scheduled when needed diagnostically. Due to increasing identification of cardiac disease in this species, complete cardiac assessment is important and should include an EKG, blood pressure measurement, and echocardiography. This cardiac ultrasound is most successful, especially in older, obese animals, using trans-esophageal echocardiography (TEE). Recording of these dynamic imaging procedures will be helpful for long-term monitoring. In the last two years, a frequent clinical sign of cardiac disease in male chimpanzees is dependent scrotal edema so particular attention to this feature is important during the physical assessment.

Mycobacterial (tuberculosis) testing must be thorough, particularly in troops of unknown history or with known mycobacterial history. It should include minimally an intradermal testing with mOT (mammalian old tuberculin) with a saline or APPD (avian purified protein derivative) in a contralateral location. The usual location for test administration is the palpebrae for ease in reading the test at 24 hr intervals for three days;

however, naturally unhaired, thin skin (such as the areolae) or shaved and minimally thickened skin can be utilized with animals trained to present these body parts. Additionally during the annual examination, a lavage should be collected for mycobacterial culture at an experienced laboratory; this sample can be a gastric, thoracic, or, most ideally, bronchoalveolar in origin. Thoracic radiographs should be closely inspected for characteristic lesions of lymph node enlargement as this bacterial infection is routinely found as a respiratory disease from inhalation for *Mycobacteria tuberculosis* or lymphoid infection in atypical mycobacterosis. Whole, heparinized blood can be submitted for interferon testing (Primagam) for evaluation of serologic evidence of mycobacterial infection.

Anesthesia: Induction of anesthesia is routinely accomplished by intramuscular injection of a sedative(s) following an appropriate (12-24 hour) fasting interval. In a 2006 survey of attending veterinarians in AZA-accredited institutions holding chimpanzees (n=40), 88% responded to queries about induction regimens, supplementation, adjustment of protocols for known cardiac patients, intubation frequency, reversibility of anesthetic protocols, and changes in protocols over the last decade.

Table 1. Typical immobilization agents included telazol (tiletamine-zolazepam), ketamine, or combination of these products with medetomidine. Occasionally, xylazine, benzodiazepenes (diazepam or midazolam), or butorphanol were utilized in the combinations or as premedications. Very rarely carfentanil was included.

| Drug/drug combination | Dose | Frequency utilized* |
|---|---|---|
| Telazol alone | 1.5-3 mg/kg | 15 % |
| | 3-6 mg/kg | 34% |
| Ketamine alone | 2-5 mg/kg | 9% |
| | 8-10 mg/kg | 9% |
| Telazol//ketamine | 1-3 mg/kg// 1-3 mg/kg | 3% |
| Telazol//medetomidine | 2 mg/kg// 0.02-0.030 mg/kg | 9% |
| Ketamine//medetomidine | 2 mg/kg// 0.015-0.025 mg/kg | 9% |
| | 2-5 mg/kg// 0.03-0.04 mg/kg | 18% |
| | 5-7 mg/kg/ /0.025-0.07 mg/kg | 25% |
| Ketamine//midazolam | 4-5 mg/kg// 0.05-0.1 mg/kg | 3% |
| Medetomidine/butorphanol/midazolam | 0.015mg/kg// 0.085mg/kg// 0.06 mg/kg | 3% |
| Medtomidine/butorphanol/ketamine | 0.015 mg/kg// 0.15-0.3 mg/kg// 1.5mg/kg | 3% |

*Of the 35 responding veterinarians, this is the percentage of veterinarians using this regimen. In some instances, veterinarians provided two or more routine induction protocols.

Table 2. Typical supplementation agents included telazol (tiletamine-zolazepam) or ketamine intramuscularly (at higher doses) or intravenously (at lower doses). Inhalant anesthetic agents, primarily isoflurane, were used to effect when this was routinely planned for the procedure. Occasionally, propofol (1-2 mg/kg, i.v., n=1, 3%) or diazepam or midazolam (0.1 mg/kg i.m., n=1, 3%) were utilized to maintain the induction.

| Drug | Dose | Frequency utilized** |
|---|---|---|
| Telazol alone | 1-2 mg/kg | 9% |
| Ketamine alone | 1-2 mg/kg | 50% |
| | 3-4 mg/kg | 13% |

** Of the 35 responding veterinarians, this is the percentage of veterinarians using this regimen.

Maintenance of the anesthetic event will be determined by the extent of the procedure and can be accomplished by supplemental parenteral agents or inhalant methods. However, it is strongly encouraged that in procedures longer than 30 minutes (i.e., most standard physical examinations) chimpanzees be intubated and maintained by inhalant agents such as isoflurane or sevoflurane in oxygen. In the survey, 51% of the 35 veterinarians responding routinely intubate all anesthetized chimpanzees, 18% routinely intubate at least 50% of the time, while 24% do not routinely intubate any of their chimpanzees.

Revision of the induction protocol should be considered for animals with cardiac disease or risk factors for cardiac disease – i.e., obesity, advanced age (30 yr or greater), or undocumented cardiac health in these older adults. In the survey, only 18 veterinarians have managed – or are managing - active cardiac disease chimpanzees. Of these, 6 (35%) did not alter their primary induction method, as they were using ketamine or telazol exclusively at the lowest dose possible to safely induce the animal. Of twelve of the remaining veterinarians, 5 indicated that the primary induction regimen changed to ketamine alone, 2 avoided alpha-2 agonists (i.e., xylazine or medetomidine), 1 utilized lower doses of routine induction agents, and 1 changed to telazol alone. Three of the veterinarians reported discontinuing elective sedations in known cardiac disease patients.

Intra-procedural monitoring of heart rate and rhythm, pulse quality, capillary refill time (CRT), breathing (respiration depth and rate), and body temperature is the minimal assessment necessary during an anesthetic event. Close monitoring should be ongoing regularly throughout the procedure. Protracted procedures are encouraged to add EKG, pulse oximetry, and blood gases as monitoring tools. Although re-positioning will occur due to the procedure needs, lateral recumbency typically provides improved anesthetic maintenance.

During recovery, chimpanzees should be positioned in lateral recumbency to minimize risk of aspiration if regurgitation, vomition, or heavy salivation occurs. It may be helpful to maintain this position with hay or blankets placed along the animal's dorsum with the head slightly elevated but the mouth directed downwards. Medetomidine induction can be reversed intra-procedurally or at the conclusion of the procedure with atipamezole at 5 mg of atipamezole for each 1 mg of medetomidine utilized. All but one institution using medetomidine reversed the sedation in this manner. Institutions using xylazine utilized yohimbine (0.13mg/kg) to reverse the sedation. Where butorphanol or midazolam were utilized, occasionally it was reported that narcan or flumazenil were used for reversal.

Over the last decade, changes were reported in anesthetic protocols in 43% of the responding institutions. These changes largely focused on increased use of medetomidine and reduced use of telazol. Despite this, 19% of the responding veterinarians reported mixed results, rousable inductions, or reduced confidence in medetomidine regimens.

Immunization: Vaccinations should be considered for each animal and troop by collection history, risk of exposure, and current human prophylaxis guidelines. Pediatricians and infectious disease specialists can serve as both a reference and possibly a source of these products. Separate protocols for juveniles and adults should be developed and maintained. Vaccinations that should be considered minimally include measles, polio, and tetanus. Hand-raised infants may require additional vaccinations as compared to mother-reared infants due to increased direct exposure to human caregivers. Chimpanzees with routine exposure to free-ranging mammalian wildlife should receive extra-label rabies prophylaxis.

Whenever possible, killed vaccination products should be utilized rather than modified-live (MLV) products for vaccinating chimpanzees. This choice will minimize adverse vaccination events, particularly those due to re-activation of disease agents. It is particularly important to note that neither efficacy nor safety have been confirmed formally for these vaccination products in chimpanzees, or any great ape species, so are used in an extra-label manner. However, with the extensive administrations that have occurred in AZA institutions to date, no particular species sensitivities have been identified. However, it is recommended to heed warnings that accompany human guidelines, such as not administering rubella vaccinations to pregnant or non-contracepted, reproductively active females.

Even in proven vaccination protocols, routine adverse vaccination events can occur either immediately as anaphylactic shock or delayed hypersensitivity. Anaphylaxis occurs within minutes of the vaccination with extreme life-threatening signs of collapse, cardiovascular arrest, inability to breathe, and death; it is typically reversible with epinephrine administered parenterally. Delayed reactions occur within hours of the vaccination and include hives or rash, facial swelling, or itching. These reactions can be controlled with antihistamines. In the 24-48 hours following a vaccination, particularly in juveniles, other clinical signs can be seen that are not adverse reactions but related to the immune stimulation, including lameness associated with the limb injected, general malaise, anorexia, and lethargy; these signs typically resolve without treatment but may respond favorably to routine NSAID administration.

Endoparasitism: Routine monitoring for endoparasites by fecal flotation should be performed at least twice yearly to monitor seasonal variation. At each evaluation, two samples, separated by several days, should be collected to monitor for intermittent shedding. Evaluations should include sedimentation and direct fecal smears for more complete assessment. During quarantine periods, fecal samples should be evaluated by at least three samples at weekly intervals.

Based on these results and the baseline history of the troop and collection, specific antiparasitic treatment can be prescribed. References for human infections are the preferred information source for treatment regimens. It is important to use effective doses, ensure complete compliance by selection of appropriate vehicles, and repeat the dose at appropriate intervals. Post-treatment monitoring is necessary to determine long-term treatment needs. Over-treatment or ineffective treatment regimens can contribute to persistent diarrhea through disrupted gastrointestinal bacterial flora. Complete elimination of endoparasites is often not the expected goal but rather control of clinical signs and reduction of endoparasitic numbers.

Particular helminths of importance to the common chimpanzee include *Enterobius* sp. (pinworms) and *Strongyloides* sp. that may require repeated, even monthly, anthelminthic control for 12-18 months. Diagnosis of *Enterobius* may be suggested by intense anal itching but may not be apparent on routine fecal flotation. During anesthesia for evaluation, clear adhesive tape can be applied to the anus and perineum to retrieve eggs and make a confirmatory diagnosis. Rotating anthelminthic products (see Therapeutic Agents) can be considered for recalcitrant infections. Protozoal populations of note include *Balantidium coli* and *Troglodytella* species. Although these protozoal infections rarely produce clinical disease in chimpanzees, they may need management if these animals are in close contact with other great ape species.

Routine disinfection of impervious surfaces and replacement of naturalistic substrates is important for control of endoparasites. As this primate species can be prone to coprophagy, daily removal of fecal material and increased environmental enrichment can assist with reduced completion of parasite life cycles.

Nutrition: Although daily human caloric needs can be a guide for this species, NRC guidelines were published recently for non-human primates. A good quality complete food (chow) with mixed produce (vegetables, fruit/starches) will compose the base diet with minimal dairy and protein sources provided. Supply of browse is important whenever possible by seasonal availability. It is important that all plants used as browse be properly identified as non-toxic species and sources that are not chemically treated.

As complete diets should be balanced for vitamin and minerals, routine supplementation is not expected as necessary although non-human primates have an absolute requirement for vitamin C. (See also Pregnancy

Management). However, human supplement products can be used by label direction; selection of products without excess iron is important unless iron-deficiency anemia is specifically under treatment.

In juveniles, documented cases of vitamin D deficiency (metabolic bone disease) have occurred in chimpanzees housed exclusively indoors. Prevention includes routine outdoor access. When this is not possible due to exhibit design or season, appropriate supplementation of calcium and vitamin D is essential.

For adults, obesity is a substantial risk factor to cardiac disease and inconsistent with good long-term health. It is important to include calories obtained from enrichment and operant conditioning sources as part of the balanced diet. Judicious use of sugar free or low sugar products will assist in maintaining appropriate weight and body condition. Regular – several times yearly - weighing is critical to long-term nutritional maintenance and weight loss when indicated.

Social management: Traumatic wounds are not an uncommon result of social imbalance within a troop. This can result from normal hierarchy disputes as juveniles mature or during introductions of new troop members. Behavioral assessments of troops and individuals are important to minimize long-lasting injuries or delays in introductions. Operant conditioning can facilitate resolution of this social altercation but other emergency procedures should be prepared in the event of serious altercation.

When serious traumatic wounds result, anesthesia is often required for direct management including thorough cleaning, debridement, and lavage. Primary closure of the wound should be considered by depth and affect on a particular area with caution to not entrap infectious debris or create an anaerobic environment. Post-operative lavage or topical treatment of open wounds may be possible with operant conditioning and can use diluted antiseptics (such as chlorhexidine or povidone-iodine) or topical agents.

Chemical behavioral modifiers, such as haldol, can be incorporated into introduction plans with the caveats that changed behavior may provoke social instability and sufficient time for pharmacologic effect is important to successful application. Consideration of chemical modification of dominant animals may be more appropriate than that of introduced or lower ranking individuals; however, these considerations are a highly individual basis.

Preganancy management: Chimpanzees are typically maintained within their family group throughout the pregnancy, during parturition, and immediate post-natal bonding period. Diagnosis of pregnancy can be accomplished by collection of urine, usually the first morning voiding, in over-the-counter human pregnancy test kits.

Veterinarians should be prepared to intervene in the case of weak neonates by sedation of the dam. In the event of a neonatal fatality, all attempts should be made to retrieve the body promptly to permit full necropsy to identify congenital problems or maternal-neonatal incompatibility that may assist with future reproduction.

It is recommended that reproductively active females receive oral folic acid supplementation at 400 mcg/day for the month prior to conception to minimize neural tube defects. This vitamin is routinely provided in most adult human vitamin supplementations. Routine iron supplementation during pregnancy is not needed to prevent anemia in either the dam or fetus but may be provided in known cases of iron-deficiency anemia of the dam.

Contraception: To control reproduction, basic anatomy and physiology must be understood for this species so that the optimal approach is selected. In female chimpanzees, the normal (menstrual) cycle is 36 days with a 72 hours menses. Grossly visible blood in the urine is inconsistently observed although hematuria can be detected by reagent strips and may be used to track individual females. Sexually mature female chimpanzees also develop marked swelling of the perianal and perineal tissues due to interstitial fluid accumulation that fluctuates with hormonal influences. This genital swelling (intumesence) increases to peak size and turgidity during the follicular phase of the cycle. Lutenizing hormone (LH) increases causing ovulation to occur during the last 24-28 hours of maximal swelling. The luteal phase, following ovulation, is characterized by reduction of swelling as the estrogen concentrations decline and progesterone concentrations rise.

Perineal intumesensce is a distinct visual marker of receptivity and potential fertility with marked impact on sociosexual behavior. During peak swelling, females demonstrate more assertive behavior. Troop males of all ranks interact preferentially with intumesent females and their offspring. Competition between males, concurrent with agonistic behaviors, will occur with increased frequency in the presence of cycling females. It is has been documented that mother-raised infants benefit in adult social and sexual competence by the presence of cycling females in a troop.

Because of the profound effects on the normal sociosexual behavior of chimpanzees, genital swelling should not be completely eliminated by the contraceptive option elected. In considering contraceptive options, both genders must be evaluated to permit prevention of pregnancy while minimizing impact on troop behavior. It is important to consider reversibility and safety of these options as well as the tendency of weight gain observed with the hormonal methods of contraception.

Female contraception: *Oral contraceptives* ("birth control pills") are the same products utilized for human females with a combination of progesterone and estrogens. It is important to note that the human menstrual cycle is shorter at 28 days but the typical to higher-dose products can be prescribed successfully for chimpanzees at this dose frequency. These medications have action by negative feedback on the hypothalamus with ultimate suppression of the LH surge and follicular stimulating hormone (FSH) activity. The progesterone component has other effects on the reproductive tract (see below) that improves the contraceptive ability of the product. The majority (58%) of the reversible contraceptive bouts reported to the Contraceptive Advisory Group (CAG) for chimpanzees are contracepted by this method. Oral contraceptives are reported with a < 4% failure rate in chimpanzees. In addition to good contraception, these products are rapidly cleared by the body following discontinuation so are rapidly reversible. In some cases, minimal to moderate impact on the cyclic intumesence is seen in females on this method of contraception with various degrees of swelling and breeding behavior possible.

It is critical that the female receive this product daily, consistently at the same time of day, and completely without refusal for optimal pregnancy prevention. Chimpanzees can be experts at secreting pills offered so complete consumption must be assured and the training maintained by utilizing the package placebos. When a pill is missed, a second dose should be administered promptly and if one day is entirely missed, two doses should be offered within 24 hours to maintain efficacy. *A side effect of concurrent antibiotic administration, particularly by the oral route, may be reduced efficacy of oral contraceptives.*

*Parenteral progesterone analogues* (MGA implants, Norplants, intramuscular Depo-provera) share the same contraceptive mechanism of interference with fertilization by thickening cervical mucus, interrupting gamete transport, and disruption of implantation. It is important to note that ovulation and cycling do occur on these products, even with successful contraception. The CAG database maintains that 29% of the female chimpanzees have utilized a solid silastic implant (melengestrol acetate, MGA) with a 4% failure rate while the Norplant (levogestrol) is no longer utilized in human medicine due to repeated failures as the product approaches the end of it s five year cycle. Although these products are good contraceptives and do not require daily medication events, a surgical procedure is required to place some of these products, except the depo-provera injection. Implants must be routinely checked as in place by palpation during training or scanning a transponder microchip placed within implant. Unlike the oral contraceptives, the parenteral progesterones tend to gradually eliminate perineal intumesence with accompanying negative social side effects although the return of visible cycling can be used as a marker of reduced contraceptive efficacy.

With Depo-Provera administration, repeated administration is required every three months. With implants, implant preparation is required before surgical intramuscular placement of the device. A window of two weeks is required to gas sterilize (EtO) and aerate the implant before utilizing it. Following this, the implant is placed but not considered fully effective for four weeks. The surgical site must be fully healed before contraception is assumed. The failure rate of the MGA implant is 25% in chimpanzees.

*Mechanical contraception* (intrauterine devices or IUDs) causes irritation to the endometrium to prevent implantation of an embryo. Anesthesia and invasive procedure is required to place these devices and the retrieval threads must be cut short to prevent voluntary removal. Higher contraception failures are reported with IUD use, including spontaneous expulsion of the devices, particularly from young, nulliparous animals.

*Permanent contraception* can be accomplished by ovariohysterectomy (OHE) and tubal ligation. OHE should be considered in only those females with reproductive tract pathology. The chimpanzee pelvic canal is very deep and splitting the pelvic symphsis may by required to fully access the uterus during an OHE. In situations where uterine fibromas (leiomyomas) are present, complete removal of the ovaries is necessary to prevent recurrence with potential fatal consequences.

<u>Male contraception:</u> These contraceptive efforts have the advantages of minimizing impact on the troops cycling females, including preventing their weight gains. Male contraception is a consideration for multi-male breeding troops to permit selection of paternity.

*Permanent/semi-permanent contraception* can be accomplished through *vasectomy* that severs the vas deferens to prevent sperm passage from the testes to the penile urethra. As this is not castration – which is only recommended in testicular pathology, hormonal profiles remain intact so the male libido and sexual interactions should be unaffected. With appropriate surgical technique, the deliberate reversibility of the technique can be improved while preventing spontaneous recanalization and return to fertility.

Although this procedure requires immobilization and surgery, it is routine in approach. In contrast to the human male, the chimpanzee vasectomy must be approached inguinally, along the spermatic cord rather than along the scrotum. The vas deferens is isolated and transected. When permanent contraception is desired, suture ligation can be placed before transaction that permits removal of substantial (1.5-2cm) portions of the vas or, in newer techniques that may be more successful at preventing recanalization, a light cautery is applied to the mucosa of the cranial vas segment, by placing a thin cautery needle into the lumen, while preserving the muscular tunic. Additionally, for potentially reversible vasectomies, the caudal segment of the vas is not cauterized to allow sperm to escape into the vaginal tunic, creating a sperm granuloma. In humans, this method has prevented excessive pressure from sperm blockage in the epididymis that would otherwise damage the delicate mucosa of this structure and negatively impact sperm production permanently. In human males, fertility has been consistently restored with this method using microsurgical re-anastomosis of the vas deferens at a later date; this reversibility has yet to be confirmed possible in chimpanzees. Sealing the cranial segment of vas rather than suturing prevents recanulization of the vas and return to fertility in humans, whereas ligating each segment has led to necrosis of the vas with recanalization.

*Vas plugs* of silastic material have only been used in a few animals with inconsistent results. Concerns of permanent sterility even following removal or failure to block transfer of viable sperm to the urethra have both been encountered.

<u>Both genders</u> may be contracepted with a new experimental contraceptive category, *gonadotropin releasing hormone (GNRH) analogues* (deslorelin and lupron). These products act by over-stimulating then suppressing FSH and LH from the anterior pituitary gland through negative feedback. It is important to note

that the initial effect of these products is an increased fertility so adequate contraception must be in place while the GNRH analogue reaches maximal effects. Ultimately due to GNRH analogues, contraception occurs with a subsequent decrease in testosterone and sperm production for males that is expected with a concurrent reduction in aggression. This side effect may produce another use of these products in troop aggression management. Decrease in estrogen and progesterone with ovulation suppression is expected in the female. However, GNRH analogues are not widely in use at this time. Success and failure rate has not been determined yet for chimps nor is the impact on normal sociosexual behavior known. Further research is warranted for the use of this contraceptive in chimpanzees of both sexes.

Geriatric management: With advanced age in chimpanzees, veterinarians should tailor diets to provide for changing nutritional needs to maintain good body condition. Age related health issues – such as renal disease or cardiac failure – may require further specific adaptations through supplements or restrictions. Physicians or medical nutritionists are particularly helpful in assessing more complex individual needs. Well-monitored exercise programs are important to maintain good health in the geriatric animal. Daily exhibit use may require furniture adaptation to accommodate arthritic or less agile animals. Altered mentation or agility in geriatric animals may require adaptation to enrichment activities as well.

With the expectation of increasing medical concerns in geriatric animals and the necessity to initiate prompt treatment to minimize long-term deleterious effects, it is important that routine annual physical examinations continue – perhaps even increase in frequency. Veterinarians should be aware and share the increased anesthetic risks with geriatric animals but not permit them to categorically dissuade sound health care programs.

Therapeutic agents: Human reference texts and formularies are excellent sources for dose recommendations due to the consistent size of adult chimpanzees both with humans and each other (i.e., typically 50-90 kg total body weight). This permits the approach - as with humans - of dosage "by animal" rather than by body weight. The exception is pediatric patients where a dose rate (mg/kg) is more appropriately applied.

Veterinarians may legally obtain any human or animal drug that is approved by the FDA. However, none of these products are approved for use in chimpanzees nor have been evaluated formally for safety or efficacy so all applications are an extra-label use.

<u>Antimicrobials:</u> Antibiotic and antifungal therapy should be evaluated individually and based on bacterial culture and sensitivity whenever possible. It is important to utilize these products judiciously and appropriately to minimize antimicrobial resistance. For example, as viral infection is not cured by antibiotic administration, these agents should be administered only for control of confirmed secondary bacterial infections when a respiratory viral infection is present.

<u>Anthelminthics:</u> As with antimicrobials, antiparasitic products should be targeted to the specific parasite. Helminths have been treated by benzimidazoles (such as, fenbendazole or mebendaozole), avermectins (ivermectin), and pyrantel pamoate. Protozoal infections have been addressed by metronidazole and doxycycline.

<u>Analgesics:</u> Pain control is an increasingly common component of complete veterinary care for all non-human primate species. It should be considered for chronic or acute needs. Chronic, or long term, needs would include arthritis management. Balanced analgesia requires pharmaceutic doses be maintained at minimum effective doses to reduce adverse effects. This balance can be achieved through anti-inflammatories (non-steroidal, steroidal), nutraceuticals, and environmental adaptations (comfort, heat source, furniture changes). Acute, or short term, needs such as operative sources, will impact timing and duration of pharmaceutic administration. Balanced use of non-steroidal anti-inflammatories (aspirin,

ibuprofen, acetaminophen) with narcotics (butorphanol, buprenorphine, codeine, tramadol and fentanyl) will assist with optimum pain control.

Necropsy and Euthanasia: With any chimpanzee death, a full necropsy (gross and histhopathology) is expected to advance understanding of the species medical management, baseline anatomy, and for appropriate care of the remaining troop members. Standard guidelines for a great ape necropsy are detailed for those unfamiliar with the procedure. Pathology reports are submitted to the veterinary advisor for evaluation and comparison with other deaths and pathology.

Euthanasia should be considered for progressively deteriorating quality of life, intractable disease without cure, or irreparable trauma. Options for humane euthanasia include barbiturate or sedative overdose as dictated by the AVMA Guidelines for Euthanasia.

Disease transmission control: Zoonotic disease is important for both chimpanzees and their caretakers. It is important to regularly monitor chimpanzee health through a preventive medicine schedule for the safety of the conspecifics and involved humans. Similarly, caretakers and other in-contact staff should participate in institutional health programs, minimally an annual re-evaluation of mycobacteriosis status through skin testing or interview where skin reaction occurs or prior vaccination is known. This should include personnel that work indirectly with non-human primates in handling their biomaterials or veterinary care. Guidelines, developed by AZA's Animal Health Committee and AAZV, for recommendations on non-human primate handling should be reviewed for institutional application; vaccination prophylaxis for staff in accordance with CDC guidelines should be considered at each institution.

Of particular note, humans that are ill should not directly work with non-human primates or prepare their diets whenever possible; when this is not possible, full personal protective equipment (facemask and barrier gloves) should be worn. Respiratory diseases are some of the more common causes of illness in non-human primates. As these are usually viral infections with spontaneous resolution, the focus of treatment should be supportive care of good hydration and rest rather than antimicrobial prophylaxis.

Staff should be encouraged to work with their personal physicians to monitor their own health, remain vaccinated, and fully understand the risks of working with non-human primates. Staff veterinarians can provide an information source to these physicians, particularly in times of increased human risk such as illness or during pregnancy.

In food management, Hazard Analysis Critical Control Points (HACCP) methods should be instituted in the central nutrition area and individual non-human primate kitchens. This includes handling, washing, storage, preparation, and provision of foodstuffs to the animals.

Conclusions:
Veterinary care of chimpanzees is similar to good medical care and preventive health of a human. Routine evaluation of staff should be included in the health assessment of these primates. A team of medical consultants that is familiar to the veterinarian and medical publications can be valued assets to the regular veterinary care of this species. Reports, generated annually by the veterinary advisors, highlight changes in protocols of preventive medicine and disease concerns for this species and should be consulted in addition to this document.

## RECOMMENDED READING

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http://www.medletter.com/ On-line human medical current updates for therapeutic agents

http://www.stlzoo.org/downloads/CAGrecs2005final1.htm#apes Current contraception recommendations

www.cdc.gov Current immunization schedules recommended for (adult and pediatric) humans

www.isis.org Med Ref Ranges 2002\USApages\34941292.HTM   Baseline clinical pathology

http://www.aazv.org/PRIMATESAFETYGUIDELINES.htm  Non-human primate safety handling guidelines

http://www.aazv.org/primates.htm  Annual veterinary advisor updates posted

http://www.aazv.org/secure/ape_primate_necropsy_form.htm  Necropsy form for great apes

Code of Federal Regulations, Title 9,  Volume 1, 3.87-3.110 Animal Welfare Act (non-human primates)

http://www.aazv.org/guidelines.htm  Guidelines for zoo veterinary hospitals

Appendix A:  Recommended annual/quarantine physical examination for chimpanzees

- Physical examination (systemic using tools to extend senses of examiner as needed)
- Dental examination and prophylaxis
- Accurate weight
- Blood collection (all ages – CBC, chemistry panel, blood typing, viral serology, serum banking)
  (adult – older than 15 yr – thyroid panel)
  (geriatric – older than 30 yr – cholesterol, lipid panel, cardiac disease markers)
- Rectal culture (*Salmonella*, *Shigella*, *Campylobacter*, *Yersinia*)
- Mycobacterial testing (intradermal skin test, lavage-gastric, tracheal, bronchial, ± Primagam)
- Imaging (all ages - radiographs (thoracic, preferably abdominal))
  (adult – older than 15 yr – abdominal ultrasound)
  (geriatric – older than 30 yr – echocardiography)
- Immunization

Appendix B:  Recommended viral screening for chimpanzees

- Simian Immunodeficiency Virus (SIV)
- Simian Foamy Virus (SFV)
- Cytomegalovirus (CMV)
- Herpes Simplex Virus 1 and 2 (HSV-1, HSV-2)
- Influenza A and B (Flu A and  Flu B)
- Parainfluenza 1, 2, and 3
- Respiratory Syncitial Virus (RSV)
- Simian Adenovirus (SA-8)
- Measles
- Human Varicella Zoster (HVZ)
- Epstein Barr Virus (EBV)
- (Optional) Hepatitis A and Hepatitis B, Encephalomyocarditis (EMC)