Routine health monitoring should be performed on all rhinoceros on an ongoing basis. Animals should be trained to permit sampling and examination. The following protocol advises that specific baseline laboratory tests be performed for the purpose of evaluating current health status. Additional tests are recommended to increase baseline information on other diseases to determine their significance to rhinoceros health. The final decision for specific procedures should be made by the animal care and veterinary staff based on individual circumstances. For additional information, refer to the AZA Rhinoceros Husbandry Manual and contact the TAG/SSP Rhinoceros Veterinary Advisors.

Minimum Database:

1. **Anamnesis** - review information regarding previous health screens, medical problems, diagnostic test results, and treatments.

2. **Physical exam** by a veterinarian familiar with rhinoceros health problems. This should include a review of all systems (if performed in a restraint device, exam may be limited by training and temperament of the individual, and design of facility). Special attention for certain species include:
   a. Black rhinos – oral exam due to prevalence of dental problems/gingivitis; nasal exam due to epistaxis;
   b. Great Asian one-horned rhinos – foot exam due to prevalence of pododermatitis; ophthalmic exam (keratitis)
   c. Sumatran rhinos – ophthalmic exam due to prevalence of keratitis; dermatologic exam

3. **Body weight** – actual weight should be recorded when possible; body score and/or digital photos can be used when scales are not available.

4. **Blood collection**
   a. Complete blood count (CBC), serum chemistry panel, fibrinogen, serum protein electrophoresis
   b. Bank a minimum of 10-20 ml serum (duplicate sample for SSP serum bank) – all banked samples should be labeled with species, studbook #, age, sex, and date collected.
   c. Blood smears should be carefully screened for the presence of hemoparasites, especially in recently captured or imported animals.
   d. The current Rhino SSP/TAG tissue/sample collection protocol should be consulted for additional samples that may be requested for research, disease screening, etc.

5. **Fecal analyses**
   a. Parasite screen - Fecal samples should be collected semiannually-annually (depending on management system); direct, flotation, and sedimentation should be performed on every sample to detect intestinal parasitism.
   b. Enteric pathogen screen - Aerobic culture of feces for enteric pathogens should include special media for the detection of *Salmonella spp*. Because Salmonella organisms may be shed intermittently, at least 3-5 fecal cultures should be performed (may be done on consecutive days) on an annual basis. PCR is also highly recommended in addition to culture on the same sample.

6. **Vaccinations**
   a. Annual vaccination for leptospirosis in black rhinoceroses, and possibly for greater Asian one-horned rhinoceroses.
b. Vaccination for rabies, tetanus, arboviruses (EEE/WEE/WNV) may be considered if the area is considered endemic or there are increased risk factors involved. There have been isolated cases of rabies and tetanus documented in rhinoceroses.5,7,9

c. Check with SSP veterinary advisor for current recommendations on specific vaccination protocols.

Additional Preventive Health Recommendations:

1. Serological screening for leptospirosis (multiple serovars), and WNV (West Nile Virus). Although these tests are not species-specific and have not been validated for rhinoceroses, they may detect cross-reactive antibodies in exposed animals. The presence of antibodies does not necessarily denote infection/disease. Antibodies to leptospirosis have been detected in vaccinated rhinoceroses and may be used to monitor response and possibly determine frequency of vaccination, although data is insufficient to determine protective titers (M. Miller, pers. comm.). Insufficient data is available at this time to determine the significance of WNV antibodies in rhinoceroses; although it is important to note that an Indian rhinoceros with clinical signs developed a WNV titer during a period of known exposure (P. Calle, pers. comm.). One study in greater Asian one-horned rhinoceroses did not find seroconversion in response to vaccination with a commercial equine WNV vaccine.10

2. Serum/plasma vitamin E levels should be checked on a regular basis to assess adequacy of diet and supplementation protocols. Levels should be checked in any black rhinoceros with signs of illness. See the most current Rhino TAG/SSP preventive health protocol for recommended laboratories. Can submit heparinized plasma to Michigan State University, Animal Health Diagnostic Lab.

3. Reproductive tract examination – whenever feasible, a complete reproductive examination should be conducted to include transrectal ultrasound, semen collection and analysis, and serum or fecal collection for hormone analysis.8 Uterine leiomyomas, cystic ovaries, and irregular cycling have been observed in captive animals.4 Since these conditions can have potentially significant effects on reproduction, a careful evaluation is warranted if the animal is being considered for breeding. Standing laparoscopy enabled visual examination and uterine biopsy of a leiomyoma in a southern white rhinoceros. A number of publications describe the technique for ultrasonography in rhinoceroses and normal reproductive biology. The reader is referred to the Rhino Resource Center for further information (www.rhinoresourcecenter.com).

4. Urinalysis should include both fluid and sediment evaluation of a clean voided sample. Microbial culture should be considered if there is evidence of blood cells or bacteria.

5. Radiographs of feet are strongly recommended if any signs of pododermatitis or nail cracks are observed, especially in greater Asian one-horned rhinoceroses.1 Regular foot trimming and care may require immobilization in certain individuals (i.e., those that have a history of chronic foot problems). See section on pododermatitis in Rhino Husbandry Manual or check with SSP veterinary advisor.

6. Diagnostic tests for tuberculosis – periodic testing for tuberculosis in rhinoceroses should be considered especially if there has been a history in the institution or herd. Antemortem testing includes intradermal tuberculin test, tracheal and/or gastric lavage for mycobacterial culture, and serological tests. Intradermal testing can be performed using PPD bovis (0.1 ml ID) in the eyelid, behind the ear, caudal tailfold, or axillary region. Both false positive and false negative results have been found when pdp skin testing in rhinos.3 Serological tests (ElephantTB STAT-PAK®, MAPIA, DPP (dual pathway platform); Chembio Diagnostic Systems, Inc.) are being investigated for use in rhinos. Retrospective analyses of serum from M. tuberculosis-infected black rhinos showed positive results using the ElephantTB Stat-Pak®.2 Check with SSP veterinary advisors for latest recommendations.

7. Other vaccination regimens will depend on regional requirements and exposure risks (consider vaccination for Clostridial diseases). Contact the SSP veterinary advisor for the most current information.
References Cited

*Black Rhino SSP Veterinary Advisor
Dr. Michele Miller
Palm Beach Zoo
1301 Summit Blvd.
West Palm Beach, FL 33405
(561) 727-9630  FAX: (561) 833-7135
Email: mmiller@palmbeachzoo.org

*Greater Asian One-Horned Rhino SSP Vet. Advisor
Dr. Barb Wolfe
The Wilds
14000 International Road
Cumberland, OH 43732
Phone: 740-638-2109
Email: bwolfe@thewilds.org

*Rhinoceros SSP/TAG Nutritional Advisor
Dr. Ellen Dierenfeld
Phone: 314-453-7776
Email: Ellen.Dierenfeld@novusint.com

For Leptospiral and WNV titers, contact:
Cornell University, College of Vet. Med.
Diagnostic Lab
Upper Tower Rd.
Ithaca, NY 14853
(607) 253-3900

*Sumatran Rhino SSP Veterinary Advisor
Dr. Mark Campbell
Cincinnati Zoo
3400 Vine St.
Cincinnati, OH 45220
Phone:
Email: mark.campbell@cincinnatizoo.org

*Rhinoceros TAG Veterinary Advisor
Dr. Eric Miller
St. Louis Zoological Park
1 Government Dr.
St. Louis, MO 63110-1396
(314) 781-0900 ext 483  FAX:314-768-5454
Email: remiller@stlzoo.org

*White Rhino SSP Veterinary Advisor
Dr. Jeff Zuba
San Diego Wild Animal Park
15550 San Pasqual Valley Rd
Escondido, CA 92027-7017
(706) 291-5404
Email: jzuba@sandiegozoo.org

For vit E analysis, contact:
Michigan State University
Animal Health Diagnostic Lab
4125 Beaumont Rd.
East Lansing, MI 48910
(517) 353-1683