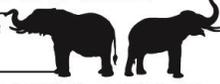


ELEPHANT ENDOTHELIOTROPIC HERPESVIRUS (EEHV) RESEARCH AND NECROPSY PROTOCOL SUPPLEMENT

(Elephas maximus and Loxodonta africana)

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INTRODUCTION

This protocol is a collaborative effort of the Association of Zoos & Aquariums (AZA) Elephant Taxon Advisory Group/Species Survival Plan (TAG/SSP), the International Elephant Foundation (IEF), and the EEHV Advisory Group. Its purpose is to provide a format for the systematic collection of information and samples that will add to knowledge of Elephant Endotheliotropic Herpesvirus (EEHV) and contribute to the diagnosis and treatment of EEHV Hemorrhagic Disease (EEHV HD). All North American institutions caring for elephants will receive a copy of this protocol. More information on the viruses can be found at eehvinfo.org. The password for the “Member Area” can be gotten by emailing EEHVinfo@si.edu. Please include in the email your affiliation and connection to elephants (researcher, elephant manager, veterinarian, etc.).

ELEPHANT ENDOTHELIO TROPIC HERPESVIRUS ALERT

Infectious disease is one of the factors threatening the long-term survival of Asian and African elephants. EEHV Hemorrhagic Disease (EEHV HD) can be a fatal disease of elephants in human care and in the wild and is one of the many conditions which can impact elephant health and survival. Current knowledge indicates EEHVs are endogenous viruses of both African and Asian elephants. Different virus subtypes occur in the two elephant species and are responsible for acute illness and/or fatal disease. Young elephants are most vulnerable to EEHV HD making it a particularly devastating disease. Reproductive failures and early deaths of juvenile elephants in North America and Europe have been attributed to EEHV HD, and EEHV HD has been confirmed as the cause of death in up to 20 wild elephants in Cambodia, India, Thailand, Sumatra, and Myanmar, including both orphaned and free-ranging calves [Reid et al 2006; Zachariah et al, IEF Conservation & Research Symposium conference abstracts Bangkok 2008, Pretoria 2010, Zachariah et al, 2013; Zachariah, pers comm; Oo, Z, pers comm]. It is not known if there have been widespread outbreaks in Asia; however the impact of EEHV may now be exacerbated by increased fragmentation of elephant populations. Little is known regarding basic epidemiology of this virus, such as transmission patterns, incubation period, site, and cell tropism for viral latency.

EEHV is associated with a group of unique herpesviruses (8 species or sub-species - EEHV1A, EEHV1B, EEHV2, EEHV3, EEHV4, EEHV5, EEHV6 and EEHV7), of which all but EEHV7 have caused fatal disease (Ossent 1990, Richman 1999; Richman, 2000; Garner, 2009; Latimer 2011; Denk, 2012). These herpesviruses affect primarily young elephants (<8 years of age) and can have a fatal outcome. The onset of the disease may be very rapid with few prodromal signs and peracute death within hours to 7 days. When present, clinical findings are often vague and can include lethargy, lameness, colic, anemia, thrombocytopenia, edematous swellings of the head and thoracic limbs, oral ulceration and cyanosis of the tongue. Necropsy findings are consistent with vasculitis and include extensive cardiac and serosal hemorrhages and edema, hydropericardium, cyanosis of the tongue, and oral and intestinal ulcers. Histologic features include systemic microhemorrhages and edema with variable numbers, but often few, intranuclear inclusion bodies in vascular (most often capillary) endothelial cells. Hemorrhage and edema may be accompanied by very mild inflammation in the heart, liver, kidney and tongue, and in some cases vascular fibrinoid necrosis. Transmission electron microscopy of the inclusion bodies shows 80-90 nm diameter viral capsids consistent with herpesvirus morphology.

EEHV is the single largest cause of death in Asian elephants born in North America since 1980. There have been more than 40 known clinical cases in North America since 1977 with over 30 deaths (the majority in Asian elephants). EEHV1A is the most common type associated with fatal disease in Asian elephants, and there are significant genetic differences among the over 20 EEHV1As identified. There have also been deaths worldwide from EEHV1B, EEHV2, EEHV3, EEHV4, EEHV5 and EEHV6 [Latimer, 2010; Denk, 2012]. Diagnosis of EEHV is made by detecting herpesvirus DNA in EDTA whole blood using polymerase chain reaction (PCR). In North America, there have been more than 10 cases of clinical illness from EEHV HD in Asian elephants which responded to early detection, supportive therapy, and famciclovir or ganciclovir treatment. Since 2015 in North America, there has been one 5 year old African elephant who survived clinical illness from EEHV3 HD with supportive therapy and anti-viral treatment (Bronson JZWM), and two African elephants (6 and 7 years old) who have died from EEHV3 HD.

Serological tests are being developed to detect antibodies to EEHV in Asian and African elephants. However, diagnostic tests are confounded by the inability as yet to cultivate any of these viruses *in vitro*. At present 10% - 30% of the Asian elephants tested in the US have given consistently positive serological results; these animals are predominantly greater than 30 years old and were wild-born. It is likely that many of the wild-born elephants in the North American population were carrying EEHV1 strains upon importation. The serological status of North American African elephants has yet to be investigated. Based on multiple analyses of EEHV shedding in trunk washes, it is believed that many if not most captive and wild elephants are latently infected by one or more of the EEHVs (Stanton, 2010; Hardman, 2012; Stanton, 2014)

Herpesviruses have been evolving within most mammalian host species for over 300 million years, where they usually establish a stable host-parasite relationship that only rarely leads to serious or fatal disease. Many animals, including humans, carry several species of herpesviruses throughout their lives and never become clinically ill. Once inside a host animal, herpesviruses establish a latent (or hidden) phase after causing mild signs or subclinical infection. The virus then persists in the body, undetected by diagnostic tests or the body's immune system. For transmission to a new host, all herpesviruses need to have a mechanism by which they occasionally reactivate and shed infectious particles from localized skin lesions or in saliva or other body fluids. Different herpesvirus families establish latency in different cell types or organs and have different mechanisms for reactivation. For reasons not completely understood, some primary or reactivated herpesvirus infections lead to massive viremia, where virus particles circulate through the bloodstream, infect multiple organs and cause serious or lethal systemic disease.

Under normal conditions, primary subclinical infections with endogenous herpesviruses should be nearly universal in early infancy in the natural well-adapted host species. While serious disease is not normal in the natural host species for most herpesviruses, serious disease can occur if the host species is immunosuppressed, has concurrent infections with other agents, or in rare situations when a virus comes into contact with and is able to infect an animal that is not the normal host species. Healthy adult African elephants carry EEHV2, EEHV3, EEHV6, and EEHV7 in lymphoid lung nodules, where it can be detected because of localized reactivation in

epithelial cells. Although studies have not been performed to verify this hypothesis, it is possible that many healthy wild-born Asian elephants are subclinically infected as well. There is no treatment for latent herpesviruses in any species; however, anti-viral drugs can suppress viral replication and cell damage during periods of viremia and productive infection. It is believed that early detection of EEHV and immediate intervention with supportive care are critical to successful treatment of an elephant affected by EEHV HD. Antiviral medications may also play an important role in treatment. Timely intervention with the human anti-viral drug famciclovir is credited with contributing to the survival of ten Asian elephant calves with confirmed EEHV HD disease. No animals are known to have survived systemic EEHV HD disease without treatment; however, treatment does not guarantee recovery.

EEHV infections in elephant populations in human care may be a potentially useful predictor for EEHV's impact on the increasingly smaller, isolated wild elephant populations in Asia. Plans have been initiated to develop molecular and serological assays specific for each of the other seven EEHV species based on the available DNA sequences.

EEHV SUMMARY POINTS

- EEHV HD infection can be a fatal disease of African and Asian elephants and has been found in captive and wild Asian elephants.
- EEHV affects mainly young elephants (<8 years of age, peak between 1 and 3 years).
- Clinical findings are often vague and may include lethargy, lameness, colic, anemia, thrombocytopenia, edematous swellings of the head and thoracic limbs, oral ulceration and cyanosis of the tongue. Signs may progress to death within hours or days.
- Necropsy findings may include extensive cardiac and serosal hemorrhages and edema, hydropericardium, cyanosis of the tongue, oral and intestinal ulcers, and lymphoid nodules (3-30 mm) in lungs, skin and vestibule.
- Histologic features are systemic microhemorrhages and edema with endothelial cell intranuclear inclusion bodies
- More than 40 known clinical cases have occurred in North America since 1977 with over 30 deaths (the majority in Asian elephants). EEHV1A is the most common type and there are significant genetic differences among the over 20 EEHV1As identified. There have also been deaths worldwide from EEHV1B, EEHV2, EEHV3, EEHV4 and EEHV5 [Latimer, 2010; Denk, 2012].
- Diagnosis and status of EEHV in clinical cases is made by detecting herpesvirus DNA in EDTA whole blood and sometimes serum, using polymerase chain reaction (PCR).
- Early detection of EEHV and immediate intervention with supportive care and antiviral therapy are critical to the success of treating an elephant affected by EEHV HD.
- Famciclovir and ganciclovir have been used for successful treatment in elephants, although their efficacy is unknown. The success of the treatment also may have been due to concurrent supportive care.
- Recent evidence shows that there are subclinically infected carriers among North American Asian elephants.
- Serological tests are being developed to detect antibodies to EEHV in Asian elephants. At present 10-30% of the Asian elephants tested in the US have given consistently positive serological results; these animals are predominantly greater than 30 years old and were wild-born. The serological status of North American African elephants has yet to be investigated.
- Studies suggest that it is likely that many wild-born elephants in the North American population were carrying EEHV strains upon importation.
- **There is no evidence that virus is shed in semen, or that transmission of EEHV occurs during breeding, natural or artificial insemination, or during transport. Therefore, the AZA Elephant TAG/SSP recommends that institutions continue to exchange elephants and elephant semen as specified in the breeding recommendations.**

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ALL FACILITIES MUST HELP FIND ANSWERS TO EEHV

The knowledge gained from the elephants held in North America is very important for the protection of elephant populations worldwide. There is still much that needs to be done to aid in the prevention and treatment of EEHV HD.

In particular, we need each facility to:

- 1) Review this and the Elephant TAG/SSP Research and Necropsy protocols with keepers and vets annually;**
- 2) Familiarize keepers and vets with EEHV, its signs, and research needs for healthy, sick and recently deceased elephants;**
- 3) Provide samples from each of your living elephants for ongoing research projects;**
- 4) Contact research groups at the first sign of any elephant injury or illness;**
- 5) Refer back to this protocol for standard and ancillary procedures and sample collection;**
- 6) Contact research groups if an elephant is to be euthanized;**
- 7) Contact research groups immediately upon all elephant deaths;**
- 8) Identify a necropsy team for elephants that are moribund, dead or for planned euthanasias and provide the team with a copy of this protocol;**
- 9) Develop an institutional EEHV diagnostic and therapeutic plan, especially for breeding facilities or those with young animals; examples can be found at eehvinfo.org on the Elephant Management and Training page.**
- 10) Keep Elephant TAG/SSP chair and advisors informed of cases/suspects, deaths and planned euthanasias; and**
- 11) Contact the Elephant TAG/SSP chair and advisors if there are any questions or if more information is needed.**

EEHV NECROPSY PROTOCOL

Post-mortem examination of an elephant can be a daunting task, but with proper personnel, planning, and experience, it can be done safely and efficiently. The information gained from an elephant necropsy is hugely valuable to institutions, the AZA, and to elephants both in human care and in the wild. Collection and review of the requested data and samples is our best means of defeating EEHV.

Broader necropsy information and all postmortem research sample requests are contained in a separate document, Elephant TAG/SSP Research and Necropsy Protocol, available online at www.elephanttag.org/Professional/ElephNecropsy_2010.pdf. All elephant vets, pathologists and caretakers should be acquainted with the protocols in both documents (Elephant TAG/SSP Research and Necropsy Protocol and Elephant Endotheliotropic Herpesvirus (EEHV) Research and Necropsy Protocol Supplement) and should have the necessary equipment ready to facilitate sample collection. A team should be designated in advance for data and sample collection to save valuable time. A list of researchers interested in participating in elephant necropsies is included in the Elephant TAG/SSP Research and Necropsy Protocol.

Please consult the Elephant TAG/SSP Research and Necropsy Protocol document for general guidance on how to best plan for and execute an elephant necropsy. The following provides additional specific information and procedures to be considered with respect to EEHV.

Whole blood and serum samples from sick or dead elephants should be obtained for diagnostic testing in any suspected case of herpesvirus infection.

Postmortem examination should include thorough investigation and documentation of any gross lesions suggestive of EEHV HD. The oral, thoracic and peritoneal cavities should be evaluated for mucosal and/or serosal abnormalities such as hemorrhage, edema, cyanosis/congestion and ulceration. Distribution and size of lesions should be noted; written documentation should be augmented by digital imaging if available.

Lung should be visually examined and thoroughly palpated for the presence of EEHV-associated pulmonary lymphoid nodules on surface and “bread-loafed” cut sections. These lesions have been found in a high proportion of African elephants culled in the wild, and the few that have been examined so far proved to contain high levels of EEHV2, EEHV3 and/or EEHV6 (subclinical or latent infection). These lung nodules have also been reported in Asian elephants. Affected lungs may have rare to many, 3-30 mm diameter, white to gray, soft spongy nodules. Nodules may occur in the absence of other pulmonary disease in otherwise healthy elephants. In the absence of visible or palpable lesions, collect 4 representative sections of lung for histopathology (2 sections from each side including one cranioventral and one caudodorsal section).

Skin, particularly from the trunk and face, should be examined for raised nodules with darker fibrous centers. Such EEHV-associated skin lesions have been found occasionally in otherwise healthy juvenile African elephants and in one outbreak of skin lesions in Florida.

Mucosa of the distal female reproductive tract (vulva and vagina) should be evaluated for reddened, raised nodular or depressed ulcerative lesions. Such lesions have been associated with EEHV1 in the genital tract of female African elephants.

Multiple, representative sections of any and all suspect EEHV-associated lesions (i.e. hemorrhage/edematous tissues, pulmonary lymphoid nodules, raised cutaneous lesions, vulvar/vaginal mucosal nodules) should be collected for histopathology and frozen archive.

Please send an electronic copy of the **final necropsy and histopathology report** including all pertinent culture results to Dr. Jaime Landolfi (contact information below).

Jaime Landolfi, DVM, PhD, Dipl. ACVP
Elephant TAG-SSP Pathology Advisor
Email: jaimeland@gmail.com; landolfi@illinois.edu
Work: (312) 585-9043; Cell: (708) 305-0611

Zoological Pathology Program, University of Illinois
c/o Chicago Zoological Society, 3300 Golf Road, Brookfield, IL 60513

ANTEMORTEM RESEARCH REQUESTS AND CONTACT INFORMATION

Postmortem EEHV-related research sample requests are listed and detailed in the **Elephant SSP/TAG Research and Necropsy Protocol** document. Additional antemortem EEHV-related research sample requests exist and are listed below.

1. National Elephant Herpes Lab

Erin Latimer
Smithsonian's National Zoo
Department of Pathology
3001 Connecticut Ave. NW
Washington, D.C. 20008
Work: 202-633-4252
Cell: 703-855-9611
Email: latimere@si.edu

1. Serum – 2 mls; transfer to plastic screw-top tube and store at -80C or non-defrosting freezer until shipped. Ship samples overnight with ice packs or dry ice. **2. Whole blood** – 1-2 mls in EDTA tube, then transfer to plastic screw-cap for storage at -80C freezer until shipped (for EEHV detection). **3. Placenta** – freeze 1 inch³ piece in liquid nitrogen or dry ice, then store at -80C freezer until shipped. Also, serum and whole blood from dam and baby. **4. Suspected herpetic lesions** – wet a cotton swab with small amount of sterile saline, swab lesion and place in sterile 15 ml plastic test tube; store at -80C until shipped. Label with type of tissue, elephant ID, date. **Shipping** – FedEx overnight; email tracking number to latimere@si.edu. EEHV Lab will pay for shipping of samples; contact lab for account information.

2. John Hopkins School of Medicine

Gary Hayward
Johns Hopkins School of Medicine, Viral Oncology Program
3M09, Bunting-Blaustein Cancer Research Building,
1650 Orleans St,
Baltimore, MD 21287 (Fedex)
PH 410-955-8684 Fax 410-955-8685 (work)
PH 410-821-8197 (Home/weekend)
Email: ghayward@jhmi.edu
Contact lab for FedEx information

1. Fresh Unfrozen Blood and Serum from All Live Confirmed EEHV Viremia Positive Animals: Virus Culture and EEHV Whole Genome DNA Sequencing.

(a) Blood and Serum: Fresh whole blood (2ml to 4ml) and serum (20ml to 200ml in butterfly catheter: ie **as much serum as possible please**) transported on ice/refrigerated packs. In late stage untreated viremic cases and non-responders a great deal of virus is released as cell-free virions into the serum. This has not been the case in early stage acute disease or in drug-treated survivors. Cell-free virus is needed for attempts at deep sequencing of intact EEHV genomes. Unfrozen blood samples will be used for PBMC fractionation and virus cell culture attempts in primary elephant vascular endothelial cells. **Preferably please collect and ship a first set of samples obtained before or at the same time that FCV/GCV treatment is initiated.** A second sample at 24 or 48 hours (and subsequent ones if desired) after treatment will allow us to evaluate the effectiveness of the medication in terms of increase or decrease of viral load.

2. Birth of Asian or African Elephant Calf. For Primary Endothelial Cell, Epithelial Cell and Lymphocyte Cell Cultures.

[All samples for culture are shared with Virginia Pearson, Visiting Scientist at Fox Chase Cancer Center. (a) Fresh unfrozen umbilical cord (several 8 to 12 in. segments) in 1x or 2x 500ml wide-mouth bottles provided with sterile PBS plus antibiotics (wash thoroughly with contents of second bottle). Transport on ice/refrigerator packs ASAP with return collect Fedex pre-package that will be provided.

(b) Fresh unfrozen whole cord blood (4-10 ml if possible) in EDTA tubes for PBMC fractionation. Transport on ice/refrigeration packs provided.

3. Fox Chase Cancer Center

Virginia R. Pearson, Visiting Scientist
Rall Laboratory
Fox Chase Cancer Center
333 Cottman Ave,
Philadelphia, PA 19111
mobile 215-816-5734, Lab phone 215-728-3677, FAX 215-728-2412
virginiarpearson@gmail.com

From healthy African and Asian elephants primary cell culture: Birth of Asian or African Elephant Calf. For Primary Endothelial Cell, Epithelial Cell and Lymphocyte Cell Cultures.

(a) **Fresh unfrozen umbilical cord** (several 8 to 12 in. segments) in 1x or 2x 500ml wide-mouth bottles provided with sterile PBS plus antibiotics (wash outside thoroughly with contents of second bottle). Transport on ice/refrigerator packs ASAP with return collect Fedex pre-package that will be provided.

(b) **Fresh unfrozen whole cord blood** (4-10 ml if possible) in EDTA tubes for PBMC fractionation. Transport on ice/refrigeration packs.

(c) **Amniotic sac unfrozen** (fetal, still or live birth) 3x 3sq" pieces and 6" section of umbilical cord connecting to placenta - include blood vessels lying over and 1" sq piece of placenta

d) Saliva from newborn and mother, and remainder of herd

NOTIFY before shipment and as early as possible about pending euthanasia, expected or sudden deaths to receive shipping reagents. WASH all tissues gently with sterile PBS unless otherwise noted, DO NOT WASH inside of blood vessels; SUBMERGE all tissues in fresh sterile PBS containing Pen/Strep/Fungizone; USE 50ml tubes; KEEP on wet ice until packed for shipping. SHIP on wet ice (DO NOT FREEZE TISSUES) overnight for next morning delivery to:

Virginia Pearson
701 West Gravers Lane,
Philadelphia, PA 19118
home 215-247-1287

CONSENT FORM FOR USE OF SAMPLES BY AZA ELEPHANT TAG/SSP

I give consent for the sample submitted to the AZA Elephant TAG/SSP serum/tissue bank to be used for research on any elephant related issues based on recommendations by the veterinary advisor and/or steering committee.

The results could be reviewed and used by the AZA Elephant TAG/SSP Veterinary Advisor in providing health-related recommendations and publications.

I understand that all results and recommendations regarding the individual elephant will be kept confidential.

_____ Yes, I agree to allow the AZA Elephant TAG/SSP to use our sample for designated research and testing results.

_____ No, I do not consent to the use of our sample and test results unless specified.

Signature, title

Date

Printed name

Phone number

Institution

Email address

Address

Comments: _____

FREQUENTLY ASKED QUESTIONS ABOUT EEHV

In the wild, elephants face extreme pressure from human-elephant conflict, habitat loss and poaching. In North America, elephants are important conservation ambassadors for their species and ecosystems. Seeing, hearing, and even smelling these magnificent animals up close is critical to helping visitors make an emotional connection to the natural world of elephants and take action to help protect their future. We need elephants in human care if we are to save them.

There are many questions about this complex group of viruses. We hope these questions and answers help you better understand as well as explain to others these viruses and the diseases they can cause.

What do we know about elephant herpesviruses?

To date, scientists have identified 14 genetically different elephant herpesvirus types, eight of which are known to cause hemorrhagic disease. The viruses found in clinically ill elephants at different zoos and other institutions are genetically distinct, which means that they are not all the same strain spread by the transfers of elephants between and among zoos.

Herpesviruses are widespread in all mammal species, including humans. While species-specific, they share common features. Once inside a host, the virus can go into a latent (hidden) phase after causing only mild symptoms or no signs of disease at all. Scientists do not yet know where in the body EEHV resides in the latent phase.

For unknown reasons, primary or reactivated latent elephant herpesvirus infections can sometimes circulate throughout the bloodstream, causing disease. This is the only time when a herpesvirus can be readily detected in blood samples. As yet, reliable tests are not available to detect a latent (hidden) infection. Most elephants are able to fight the virus and survive when it comes out of latency. Calves appear to be most susceptible to EEHV disease after they have been weaned, at a time when they are not protected by their mother's antibodies.

Does EEHV affect elephants only in zoos?

We know that EEHV is not just a disease of the captive Asian elephant in western countries. More than twenty cases of EEHV have been identified in elephant populations in India, Thailand, Myanmar, Sumatra, and Cambodia – including several wild as well as orphaned Asian elephant calves that have died within the past few years. Moreover, these deaths only represent the cases in which necropsies were conducted in sufficient time to detect it.

Current research indicates that the elephant-specific herpesvirus may have been in elephant populations for tens of millions of years, just as human herpesviruses have been in human populations. Since this is a naturally occurring disease, every elephant – in the wild and in human care – probably is subclinically infected with one or more forms of elephant herpesvirus.

If elephants in both zoo and wild populations probably have one or more herpesvirus, why do some get ill and others don't?

Many animals and humans carry herpesviruses throughout their lives and never become ill. What researchers don't know is what triggers the virus to become active and where exactly in the body the virus hides in its latent phase. We don't know why some animals become ill and others don't. It's important to understand that it's not about *who has* the virus, but *who gets ill* and *when*.

Can elephants transmit EEHV to other elephants?

There is not enough research to confirm how EEHV is transmitted. Viral shedding occurs when the virus comes out of latency and most human herpesviruses are transmitted predominantly in saliva. Until recently EEHV could only be detected when the virus was circulating in the blood by using a blood test, but studies now show that most healthy Asian elephants periodically shed low levels of EEHV1, 4, and 5 (which may or may not be infectious) in secretions from the trunk.

Can the elephant herpesvirus be transmitted through semen?

- There is no evidence of shedding of virus into semen or transmission of EEHV through natural breeding or artificial insemination.
- **There is no evidence to suggest that EEHV is being transmitted between elephants through transport and breeding activities. At present, no two facilities have been found to have disease caused by the same strain of EEHV1; they are all different. Therefore, the AZA Elephant TAG/SSP recommends that institutions continue to exchange elephants and elephant semen for breeding and artificial insemination as specified in the breeding recommendations.**

Is a facility contaminated once an outbreak of EEHV has occurred?

Like all mammals and humans, elephants carry a variety of different herpesviruses throughout their lives. Some cause mild disease and some cause severe disease or death. This is how herpesviruses operate. Claims that certain zoos are contaminated once an animal becomes ill from EEHV are unfounded and based on a lack of understanding of how the viruses live within their hosts. Having a herpesvirus is the norm, not the exception. Like all viruses, herpesviruses cannot live very long outside the body, so a herpesvirus outbreak does not “contaminate” a facility.

Is there a cure for EEHV?

There is no cure for herpesviruses in animals *or* in humans. Based on what we are learning from our ongoing research and from elephant care institutions that have experienced an EEHV outbreak, the treatment protocols continue to improve, and detection and treatment recommendations continue to evolve.

Current treatments suppress EEHV and elephants can potentially recover if treatment starts early. Of the elephants that have been treated, the success rate with anti-viral therapy against EEHV has been about 40 percent. Veterinarians and scientists continue to collaborate to better understand this disease and develop more effective treatment options. To date, anti-viral drugs have been used successfully in treating eight Asian elephants in North America.

Shouldn't zoos discontinue breeding elephants if calves are at risk for EEHV?

Stopping zoos from breeding elephants will severely impede the progress that is being made in studying EEHV and finding a cure. Discontinuation of captive breeding is not the way to solve the disease. When an outbreak of equine herpesvirus infection occurred in 2005 in horses, the industry did not shut down. Instead it funded research that resulted in treatment, prevention and control of that disease. When black-footed ferrets were nearly driven to extinction in the 1980s due to canine distemper virus infection, captive propagation continued, and the U.S. Fish and Wildlife Service, AZA institutions, private

landowners, conservation organizations, and other groups collaborated on a rescue and recovery program. An effective vaccine was developed and the species recovered from the brink of extinction.

But why take the risk of exposing another calf to EEHV?

While we have no guarantees as to the fate of a future elephant calf, we have operated for many years under the conservative assumption that all elephants could have one or more latent (hidden) herpesviruses. The risk is no higher or lower for an elephant born in the wild or at a zoo or sanctuary. We will continue to gather the evolving research and use the latest information to guide our decisions in caring for elephants.

Is further research being done to learn more about EEHV?

Multiple research teams worldwide are dedicated to investigating this set of diseases, to understanding how to protect elephants in human care and in the wild, to solving the mystery of how EEHV is spread, and developing an effective vaccine for the virus.

The collaborative work to better understand EEHV may have important implications for wild elephants in the future. Wildlife biologists may one day need to draw upon the growing body of work and knowledge generated by the international elephant community to contribute to the long-term survival of the species for wild populations and those in human care.

