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IN THIS ISSUE

University of Kentucky

College of Agriculture

Department of Veterinary Science

LLOYD'S

COMMENTARY

There have been increasing reports of the needs of horses in disasters. Examples include Hurricanes Hugo, Andrew and Fran; California and Florida wildfires; floods in Kentucky and Ohio; and droughts in Texas. Many media reports give the impression that large-scale disasters are common, the victims will be helpless, and some national group will rescue the situation.

By contrast, the Federal Emergency Management Agency (FEMA) estimates that every year 2-3 million people in the US are affected by local and personal disasters, causing approximately $52 billion in damages. Also, extensive sociologic and epidemiologic research indicates that the issues that emerge in large-scale disasters are merely an exacerbation of pre-existing deficiencies. From these data it can be concluded that large-scale disasters are the exception rather than the rule, and the first and most effective level of mitigation, preparedness and response is at the local and personal level.

Many horse farms are prone to floods and fires because they are located in low-lying agricultural land, and in the wildland-urban interface. Personal disaster preparedness involves reducing hazards (*e.g.*, no smoking policies, inspection and repair of wiring and heating systems, and biosecurity). Horse owners should also practice evacuations, and teach their horse(s) to trailer. Personal preparedness reduces direct losses, and when horse owners are faced with a disaster, they will be less likely to be torn between needing to help themselves and being able to care for others.

The second level of disaster preparedness is in the workplace. Equine-related businesses that are not capable of continuing to function due to a disaster can lose revenue, clients and employees, and may face liability suits. A disrupted horse industry is detrimental to the economy. Examples of local disasters that can disrupt equine enterprises include utility outages (failure of security systems, heating, cooling, lighting, gas and water supply), computer failures (loss of sales, betting and breeding records), fire (human and animal injuries, liability suits), disease outbreaks (loss of reputation), and crime (restricted access). It is important to remember that these are similar problems that businesses face in large-scale disasters. Therefore, local disaster preparedness is the best preparation for large-scale disasters.

Disaster preparedness at the municipality, county and state (third) level is best developed in collaboration with the appropriate level Emergency Management Agency (EMA). States that have developed Veterinary Emergency Operations Plans with their EMA include Indiana, New Jersey, Ohio and Florida. Kentucky has recently embarked on a similar project.

Less than 10% of small businesses that are severely affected by a disaster ever reopen for business. A rapid return to normal business operation after a disaster is critical to the recovery of a community. In an attempt to reduce the impact of disasters on local businesses, FEMA has launched a new initiative, "Project Impact." Project Impact promotes the collaboration between local businesses, individuals and emergency management to develop and prioritize disaster reduction plans for local communities.

CONTACT
Dr. Sebastian E. Heath, (765) 496-3102
Purdue University School of Veterinary Medicine,
West Lafayette, IN

INTERNATIONAL

Second Quarter 1998

The International Collating Center, Newmarket and other sources provided the following information.

Cases of African Horse Sickness were reported from South Africa. Contagious equine metritis was reported from California (USA) among two Warmblood mares recently imported from Germany diagnosed during the post-arrival quarantine. The various clinical manifestations of equine herpesvirus infection were reported from several countries: the paralytic form from France, Ireland and United Kingdom; abortions from Ireland, United Kingdom and the USA; and respiratory disease outbreaks from France, Switzerland and the United Kingdom. Twenty-one herpesvirus cases were diagnosed in Kentucky by the Diagnostic Laboratory in Lexington, considerably less than the numbers recorded during the two previous foaling seasons.

Influenza virus was isolated from horses in France, racehorses in the United Kingdom and a Standardbred racehorse in Kentucky. Strangles as usual was frequently reported, and an outbreak of *Salmonella typhimurium* was reported on a Thoroughbred farm in South Africa on pasture recently fertilized with chicken manure.

Cases of vesicular stomatitis were reported from premises in the states of Arizona, New Mexico and Texas; Colorado had positive cases in July.

NATIONAL

The Rationale for Greater National Control of EVA

Equine viral arteritis (EVA) continues to be a source of widespread concern and at times, significant controversy among many horse breeders and owners because of the potential risk of virus-related abortion in mares and establishment of the carrier state in stallions. Much of the current awareness and concern over EVA has stemmed from the restrictions that were imposed on the international movement of horses from the USA following the 1984 epidemic in Thoroughbreds in Kentucky.

Studies carried out since 1984 have confirmed the importance of the carrier stallion in the epidemiology of equine arteritis virus (EAV) infection. Many stallions continue to harbor the virus in the reproductive tract for extended periods of time. Since such animals shed EAV constantly in the semen, they are very effective transmitters of the virus and readily infect seronegative mares to which they are bred by natural service or artificial insemination.

There is growing evidence that a significant percentage of the frozen semen currently imported into the USA is contaminated with EAV. The use of semen from certain carrier stallions has occasionally been directly linked to the occurrence of EVA outbreaks, some associated with abortions and deaths in neonatal foals. At the present time, the USA is unique among all other horse breeding countries in having no federal requirements whatsoever relating to the importation of carrier stallions or infective semen. In the majority of instances, horse owners and breeders are breeding their mares with imported semen in total ignorance of its infectivity status for EAV and the potential risks involved.

In view of the significant role of the carrier stallion in the epidemiology of EVA, every effort should be made to minimize frequency of the carrier state through immunization of susceptible stallion populations. Furthermore, vaccination of sexually immature colts between 6 and 9 months of age is recommended as a means of preventing establishment of the carrier state in the event of possible exposure to EAV at a later age. Such a vaccination strategy would, in a matter of a few years, reduce the carrier reservoir of the virus in those breeds in which the virus is currently endemic.

In light of the very real risk of introducing EAV into a susceptible horse population through the use of infective fresh-cooled or frozen semen, appropriate measures should be adopted to prevent possible outbreaks of EVA resulting from insemination of mares that are seronegative and unprotected against infection with the virus.

Current programs for the prevention and control of EVA have been directed primarily at restricting spread of the infection in breeding populations both to minimize the risk of virus-related abortion and

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Editors
Roberta Dwyer
David Powell
Neil Williams

Staff
Deborah Witham
Diane Furry
Linda Millercox

Correspondence should be addressed to the editors,
Department of Veterinary Science
Gluck Equine Research Center
University of Kentucky
Lexington, KY 40546-0099
Telephone (606) 257-4757
Fax (606) 257-8542.

Internet address:
gopher.ca.uky.edu
or
http://www.uky.edu/Agriculture/VetScience/gluck1.htm

prevent establishment of the carrier state in the stallion. Kentucky and New York are the only states in the USA which have formulated specific control programs. However, the programs in both states apply specifically to their respective Thoroughbred breeding populations. In late 1996, the Dutch Warmblood Registry of North America instituted a requirement that all stallions be tested prior to registration to establish their carrier status for EAV and also, that all imported semen be examined to determine its virus infectivity status.

The impact that EVA continues to have on the international movement of horses underscores the need for an effective and practical policy for the prevention and control of the disease at the national level. This will require testing and identification of imported carrier stallions and infective semen, and acceptance of approved guidelines for the control of EVA by the US horse industry.

An appropriate set of guidelines has been developed under the aegis of the American Horse Council which has received the full endorsement of the US Animal Health Association and the American Association of Equine Practitioners. The need to implement a national control program for EVA based on these guidelines is long overdue.

CONTACT
Dr. Peter Timoney or Dr. William McCollum, (606) 257-4757
Maxwell H. Gluck Equine Research Center; or
Dr. Mary Lynne Vickers, (606) 253-0571
Livestock Disease Diagnostic Center

A Portrait of the Pathogenesis of Equine Herpesvirus Abortion

Each year, abortion in mares caused by equine herpesvirus-1 (EHV-1) causes significant foal crop losses despite current control efforts. Development of more effective strategies for prevention of this equine viral disease requires a better understanding of the important pathogenic events that lead to EHV-1 abortion.

For many years, we have not understood much about how or why the virus causes abortion or what immune mechanisms are necessary for its prevention. However, the results of much painstaking research have finally shed light on the abortigenic process. Important recent contributions to this current portrait of the pathogenesis of EHV-1 abortion were made by equine researchers at the Animal Health Trust, Cambridge University, and the Royal Veterinary College in the United Kingdom.

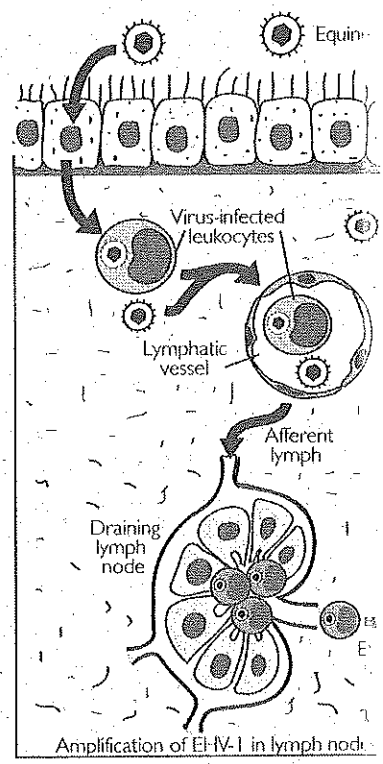
It is, first of all, a sequential and stepwise procession of events **(Figure 1)**. At the starting point, virus shed from an infected contact horse is inhaled and deposited onto the epithelium forming the mucosal lining of the mare's upper respiratory tract. During primary replication at the respiratory mucosal surface, EHV-1 penetrates the epithelial barrier to replicate in deeper tissues of the mare's respiratory tract. This subepithelial invasion is rapid, occurring within 24 hours after initial virus inoculation. The invading herpesvirus is transported, via lymphatic drainage, to regional lymph nodes and undergoes a secondary phase of amplification at these sites, with spillover of infected lymphocytes into the peripheral blood circulation.

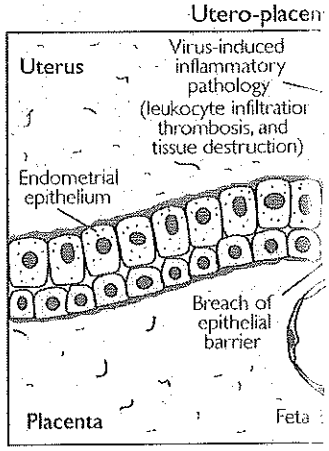
By this stage of EHV-1 infection, most of the viral burden carried by the infected mare is intracellular, contained within the sheltered sites of circulating lymphocytes; *i.e.*, a cell-associated viremia occurs. In the absence of clinically effective immunity, cell-associated EHV-1 viremia is detectable in nearly 90% of exposed pregnant mares and persists for several days. At the peak of viremia, as many as 1 in 10,000 peripheral blood lymphocytes may be infected with EHV-1.

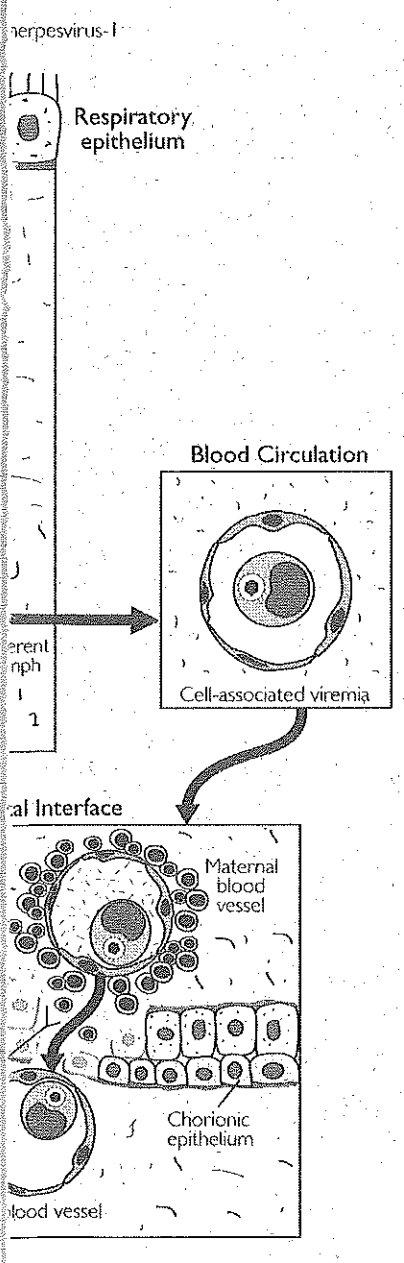
Blood-borne viremic lymphocytes serve the role of spreading viral infection from primary sites of replication in the respiratory tract and draining lymph nodes to the pregnant uterus and fetus. Forty percent of pregnant mares that become viremic with EHV-1 during the last 4 months of gestation abort their fetuses. The extraordinary ability of EHV-1 to disseminate systemically, by transport in infected blood lymphocytes, to reach the uterine vasculature by a pathway resistant to antibody is the hallmark of EHV-1 abortion pathogenesis.

At the pregnant mare's uterus, EHV-1 infected lymphocytes attach firmly to endothelial cells that line the endometrial blood vessels. This adhesion phenomenon permits efficient transfer of EHV-1 infection from viremic lymphocytes to the uterine vascular endothelium. In an effort to terminate the uterine infection, the mare responds to each focus of virus-injured endothelium with an intense inflammatory process. Prominent features of the host re-

Figure 1.
Pathogenesis of EHV-1 Abortion







sponse at the endovascular surface are an influx of inflammatory cells, the formation of intravascular fibrin clots with consequent thrombosis, and severe tissue destruction.

A recent finding of importance was that EHV-1 induced endometrial vessel inflammation (vasculitis) with its associated tissue damage is the mechanism primarily responsible for allowing further, transplacental spread of the virus to the fetus. Two tightly adjoined, interdigitating layers of epithelium (chorionic and endometrial) located at the intersection of the maternal and fetal blood circulations are the main components of the mare's placental "barrier" which normally imposes an effective physical constraint to the passage of viruses into the fetal compartment.

As a result of the immunoinflammatory cellular injury within and around endometrial blood vessels, this epithelial continuity is disrupted. The localized loss of the physical integrity of uteroplacental epithelia at sites of virus-elicited inflammatory pathology is sufficient to allow the unimpeded spread of EHV-1 infection through the placental barrier to reach the fetal circulation. Thus, a second critical epithelial barrier of the mare becomes breached by the herpesvirus pathogen.

The question of why the EHV-1 infected fetus is aborted is less well understood. The consensus is that either uterine pathology or fetal distress from viral infection, or a combination of both, initiates an incompletely understood, physiological cascade that leads to sudden, premature separation of the placenta from the endometrium, with subsequent anoxic death of the fetus and expulsion of the separated fetoplacental unit.

From this updated understanding of the pathogenesis of equine herpesvirus abortion, an important practical ramification has emerged. Two layers of immune protection are necessary to effectively prevent EHV-1 abortion: (1) blocking viral infection of the respiratory mucosal epithelium (mucosal immunity) and (2) curtailment of the generation and systemic spread of viremic lymphocytes (cellular immunity).

CONTACT
Dr. George Allen, (606) 257-3663
Maxwell H. Gluck Equine Research Center

EIA Testing of Wild Free-Roaming Horses

Every year, the majority of new cases of equine infectious anemia (EIA) is found in the same states where EIA has been diagnosed with the highest frequency since testing was initiated in the early 1970s. Thus, an untested reservoir of infection appears to be present and serves as a source for transmission to our mobile and tested population.

In areas of the United States where infection with EIA virus (EIAV) has been diagnosed infrequently, there has been hesitation to embrace wide-scale testing because of the perceived low benefit/cost ratio. The result of not testing is difficult to judge. Given sufficient time, EIAV has the potential to spread within equid populations, but the rate cannot be predicted accurately.

This study documents testing for EIA in an area where testing has traditionally occurred at a low rate annually. Wild free-roaming and domesticated horses populate the more remote rural areas of the Uinta Basin of northeastern Utah. The wild free-roaming bands owned by the people of the United States are under the authority of the Bureau of Land Management (BLM). Private citizens of the United States and of the Ute Nation own domesticated or other free-roaming equids.

As the area has few fences and is rugged sagebrush desert country, the equids are relatively free to commingle on public and private lands. Testing was initiated in response to the gathering of 593 equids on Ute Nation lands in April 1998; about 15% of those sampled were test-positive for EIA. The exact origin of each individual was not recorded, but most test-positive ones were gathered in the White River area (marked in **Figure 2** as the index cases).

The areas considered at-risk and tested were within designated BLM Horse Management Areas (HMAs) or in areas immediately contiguous to those where test-positive horses had been gathered earlier. Horses were located and gathered by helicopter and hazed into traps. Animals were immediately sorted into foals and adults and transported to holding pens at a distant site. Once samples were collected at the holding pens, mares and foals were reunited; stallions were placed in separate enclosures.

An accredited veterinarian collected paired blood samples in sterile evacuated glass tubes using multisample needles to minimize blood contamina-

tion of the sampler and the area. One blood sample was used for immediate horse-side testing in ELISA test formats (CELISA kits from IDEXX; Vira-CHEK EIA kits from Synbiotics; SA-ELISA kits from Centaur), the second was transported to the state laboratory in Salt Lake City for testing in the agar gel immunodiffusion (AGID or Coggins) test. The manufacturers kindly donated ELISA test kits. The rapid ELISA test results were used to effect immediate separation of negative and positive/suspect groups, which were separated by at least 200 yards. Final disposition was made after confirmation of the field data by AGID test results.

The topography of this area of Utah is not conducive to rapid or efficient capture of horses. In most of the units, the land is broken with plateaus and draws that carry water along washes, which appear with the infrequent rains. In areas where more vegetation is present, horses often elude gathering by remaining motionless, camouflaged beneath trees or large brush. Despite these limitations and frequent high velocity spring winds which restrict helicopter flight, an estimated ≥95% of horses were gathered from three HMAs and from the area immediately contiguous to the index area.

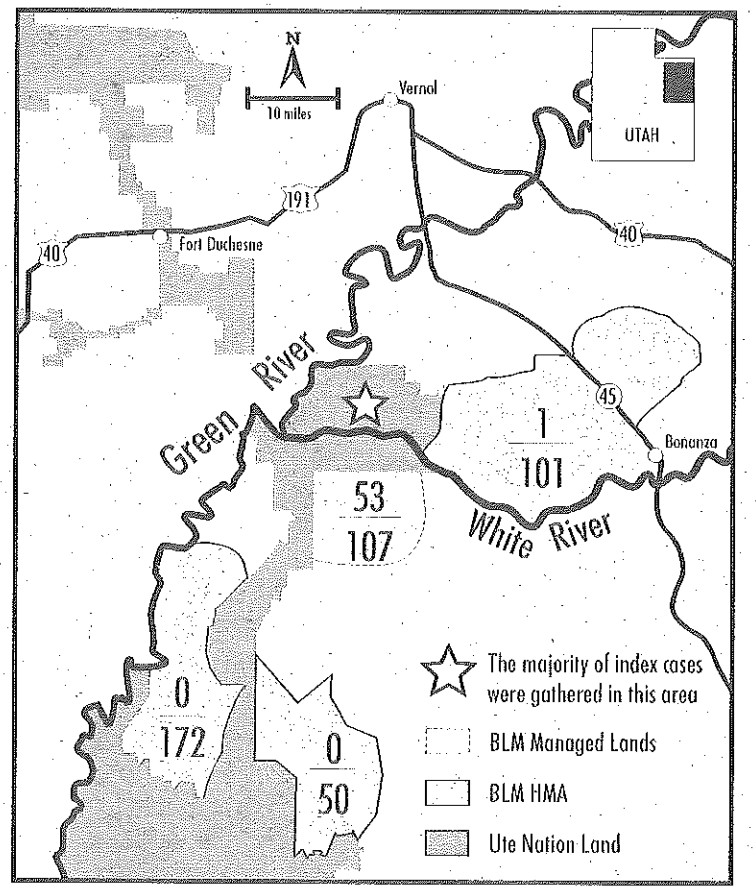
Samples collected from adult horses yielded identical results in field and laboratory assays. Samples with positive ELISA test results were confirmed positive in all three ELISA formats before the horses were segregated, generally within 2 hours of the time of blood collection. The rate of positive reactors within the other sites ranged from 0-49.5%.

The infection was limited to horses in the BLM Managed Lands contiguous to the index cases, with one exception. The other positive horse (a 2-year-old bachelor stallion) found in the BLM HMA, however, had markings and hoof structure/wear that suggested it originated from the population on the Managed Lands. The only results that did not agree in all official test formats were of foals out of test-positive mares. Those samples were confirmed as positive in the immunoblot test, which has proven to detect antibodies against multiple EIAV proteins with higher sensitivity than the current official tests. Repeated testing will be required to determine if these antibodies are passive in origin or are present as the result of infection.

Control of EIA by traditional test/quarantine/removal/retest methods will be difficult in this type of situation and will require a high degree of individual, inter-nation and interagency cooperation to succeed. Results generated in multiple ELISA tests offer additional power to the diagnosis of EIA. They can be adapted to horse-side testing and should be adopted for these types of applications.

CONTACT
Dr. Charles Issel, (606) 257-1710
Maxwell H. Gluck Equine Research Center

Figure 2. EIA Study Locations in Utah
Number of test positive horses / total number tested.



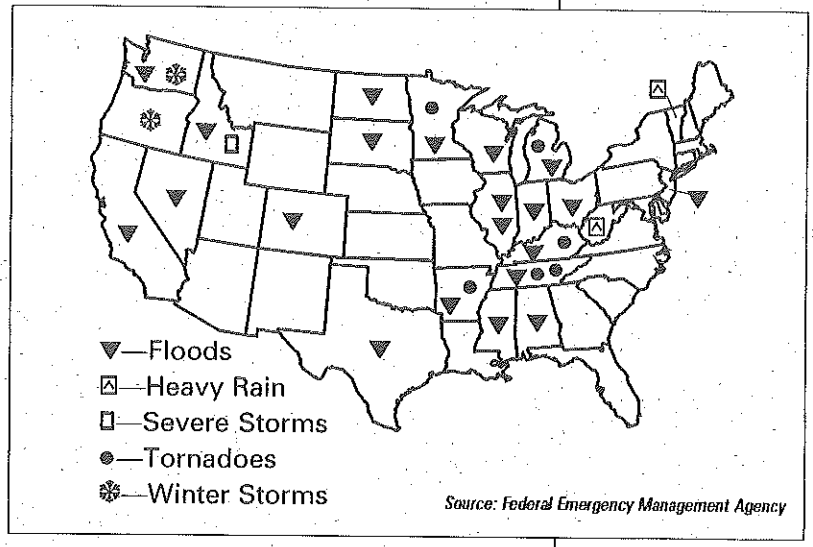
K E N T U C K Y

Kentucky Disaster Planning

In 1997, Kentucky Disaster and Emergency Services (now Kentucky Emergency Management) was called for more than 2400 separate events within the state. The majority of these were related to hazardous material incidents, followed by fires (275), water emergencies (234), search and rescue (89), weather-related events (65) and multiple other categories ranging from bomb threats (6) to one aircraft crash.

As the FEMA map indicates **(Figure 3)**, Kentucky had federally designated disasters caused by floods and tornadoes in 1997, impacting hundreds of people and their animals, including horses. Representatives from local, regional and state organizations have joined forces to design a Kentucky veterinary disaster plan to assist in future emergency situations.

Figure 3. Major Disasters—1997



CONTACT
Dr. Roberta Dwyer, (606) 257-4285
Maxwell H. Gluck Equine Research Center; or
Bob Stephens, (502) 564-8577
Kentucky Emergency Management

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Department of Veterinary Science
Gluck Equine Research Center
University of Kentucky
Lexington, Kentucky 40546-0099

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