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IN THIS ISSUE

University of Kentucky

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LLOYD'S

Commentary

The article on databases in this issue identifies a challenge to all those with an interest in the horse as we come to terms with the escalating avalanche of information technology.

For many individuals, an increasing amount of time is spent online so that information previously restricted to a few is now available to everyone with access to a personal computer. Information can be sought from a variety of Web sites on the Internet, provided by professional and commercial organizations, universities and private individuals.

The databases identified in the article considerably extend the horizons of those seeking information across the whole range of equine disciplines. Despite this option, the traditional avenues, which include scientific journals (particularly those that contain review articles), textbooks, and conferences and their proceedings, remain the preferred source of information for enhancing knowledge. Gradually the emphasis will change as publishers concentrate more on developing electronic content and agree on access arrangements on behalf of professional groups and organizations.

That the practicing equine veterinarian has the opportunity to obtain up-to-date and accurate information was overwhelmingly emphasized in the study by the USDA's National Animal Health Monitoring System (NAHMS) entitled Equine '98. Owners and operators on 84% of facilities surveyed in 1997 rated veterinarians "very important" as sources of information for equine health care decisions.

While access to information is the first priority, the restraint imposed by the time it takes to search through the plethora of databases is an important consideration for those who spend long and arduous hours engaged in other activities. Consequently, sites that are customer-friendly, providing simple and rapid access, are likely to be the most popular.

Once access has been achieved, the next and equally important phase is to evaluate the quality and value of information provided. A recent study of veterinarians in the United Kingdom conducted on behalf of The Royal College of Veterinary Surgeons identified credibility of source, personal experience and discussion with colleagues as the three most important criteria for evaluating information.

While databases provide the technology to enhance the scope of available information, the old-fashioned but time-tested tenets of experience and peer discussion are still necessary to achieve a correct and "common sense" interpretation.

Libraries have greatly benefitted from the revolution in computer technology but they still maintain the traditional role as a repository of historical information. This is exemplified in the article on rabies in this issue when examination of archives in the University library uncovered an essay written in German at the beginning of the last century describing the death of a woman following a bite on her thumb from a rabid horse. Such information helps to overcome the myth that the horse is not recognized as a potential source of rabies to the human population.

The John A. Morris Library at the Gluck Equine Research Center, supported by the considerable resources of the Agricultural Information Center and the University of Kentucky W.T. Young Library, is available to all who seek information on equine topics. As more individuals go online, so information and knowledge to promote the health and well-being of the horse will become increasingly available, even to the remotest corners of the world. ■

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International

Fourth Quarter 1999

The International Collating Centre, Newmarket and other sources reported the following disease outbreaks.

Over 20 cases of Equine Infectious Anemia (EIA) were reported in Pennsylvania following tests initially conducted at a horse auction during September. All but one of the horses were euthanized as required by state regulations. During December, positive cases were also diagnosed in a herd of feral horses in Utah.

Equine influenza was widely reported throughout France among Thoroughbred and non-Thoroughbred animals. In the United Kingdom, several outbreaks were reported during October. Cases of salmonellosis were reported from Queensland, Australia and Ireland. Strangles was also reported from Queensland, Ireland on eight premises, South Africa, Switzerland and the United Kingdom.

Further to the report of West Nile Fever in the northeast of the United States in the January issue of the *Quarterly*, no further equine or human cases have been confirmed. Surveillance of dead wild birds is continuing along the East Coast, as far south as Florida, and will continue for several months. A number of overseas countries, including the European Union, have rescinded their restrictions on the shipment of horses from certain parts of the northeastern states. Further information is available at **http://www.aphis.usda.gov.** ■

Bibliographic Databases on the Web

Bibliographic databases are those which help the researcher find published information on a given topic. They provide details as to author, title, place and date of publication and often an abstract or summary of the article. For many years, information professionals have relied on these databases to help users find relevant publications appropriate to research, practice and study.

Such databases have predominantly been produced by government institutions. In the fields of agricultural and biological research, two standard databases in use have been AGRICOLA and MEDLINE. With the advent of the Internet, what was previously available primarily to people within the field of information services is now being made available to the general public.

AGRICOLA (AGRICultural OnLine Access) is the database produced by the National Agricultural Library (NAL) in Maryland. Located on the web at **www.nal.usda.gov/ag98,** the database is split into two sections. The "Online Public Access Catalog" covers the actual holdings of NAL, while the "Journal Article Citation Index" includes coverage of research articles, conference proceedings, experiment station publications, and trade journals in the general field of agricultural sciences.

It is this index which may best serve the researcher or practitioner for finding the most current information on a given topic in the areas of veterinary medicine or animal sciences. The index currently covers records produced from 1979 to the present. Both sections of the database offer searching by keyword and by browsing. NAL also offers a document delivery service.

MEDLINE is the extensive database on biomedical research compiled by the National Library of Medicine (NLM), also based in Maryland. At first glance, it may seem inappropriate to search a medical research database for information regarding veterinary topics. MEDLINE, however, covers the core veterinary research journals as well as providing indexing to articles of interest that may appear in journals not normally associated with veterinary research.

Published research on osteoarthritis in horses, for instance, may occur in a variety of journal titles not limited to strictly veterinary topics, and therefore can be found in this database but not in AGRICOLA. This database does not, as a rule, cover trade journals or university publications.

MEDLINE is available on the Web at **igm.nlm.nih.gov** (Internet Grateful Med) which provides a graphic user-friendly interface. It is also available through the National Center for Biotechnology Information at **www.ncbi.nlm.nih.gov** by following the link for literature databases and then the link for PubMed.

PubMed offers direct links to journal articles available online as full-text. Many of these links will require the user to have a subscription to the online journal; some are free.

Both versions of the database are primarily the same in coverage, spanning the years 1966 to the present. NLM also offers a document delivery service.

A third database, AGRIS, which like AGRICOLA is focused on the agricultural sciences, is available at **www.fao.org/agris/default32.htm.** AGRIS is produced under the umbrella of the Food and Agriculture Organization of the United Nations.

This is a cooperatively built database, with member

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countries providing data for input into the database. As such, it offers access to research conducted in many developing countries which may not be provided in either AGRICOLA or MEDLINE. Coverage in AGRIS spans the years 1975 to present.

All database sites listed in this article offer the searcher aid in the form of help screens, search tips, and in the case of Internet Grateful Med, an online user's manual. Each database has a unique construction that requires building a unique retrieval inquiry in order to obtain the most accurate results. However, they also offer simple keyword queries that give the user quick access to citations of interest. ■

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Equine Genome Project

As sequencing of the human genome nears completion, one only has to open the newspaper to see how the Human Genome Project has affected and will continue to affect our lives. The applications of the Human Genome Project are immense, involving identification of disease genes, to therapeutics and preventive health care.

The impact of the Human Genome Project is not only highly significant for human health, but also for the health of animals. The technological and genetic information gathered from the Human Genome Project can be and is being applied to animal genomics.

With support from the Dorothy Russell Havemeyer Foundation, scientists from 25 countries met for the first time at Lexington, Kentucky in 1995 to form the International Equine Gene Mapping Workshop (IEGMW). This collaborative effort was undertaken to initiate the development of a horse gene map, a valuable tool for studying inherited traits and diseases in horses and ultimately for developing better diagnostic tools and therapies.

The first phase of the IEGMW was to develop the "backbone" of the map, a basic gene map that could be used to study the inheritance of genetic diseases. This "backbone" map consisted of 161 markers but has now expanded to 300 markers.

Use of this map and other tools has allowed scientists to compare the genome organization of the horse to the human. "Comparative genomics" has enabled researchers to use human gene map information to identify potential disease-causing genes or "candidate genes" in the horse.

Three applications of comparative genomics currently benefiting horses are identification of the genetic mutations causing severe combined immunodeficiency, hyperkalemic periodic paralysis, and overo lethal white foal syndrome. The birth of an affected foal can be devastating, both financially and emotionally, to a breeder. Genetic testing for these conditions is currently available to aid breeders. Genetic testing allows breeders to avoid breeding together carriers of the disease trait, thus eliminating their chances of having an affected foal.

Many other diseases affecting equines are being studied around the world. Scientists are interested in diseases that are likely the result of multiple gene interactions—such developmental bone diseases as wobbles, lordosis or sway-back, and osteochondrosis dessicans.

Other areas of interest are respiratory diseases such as chronic obstructive pulmonary disease and "bleeding" during extreme exertion, muscle diseases like exertional rhabdomyolysis, immune system disorders causing sarcoid tumors and insect bite hypersensitivity, as well as genes influencing fertility and performance.

In order to study these potentially multigenic complex diseases, researchers are moving to the next phase of the workshop, renamed the International Equine Genome Workshop (IEGW). This phase will not only increase the density of markers on the horse gene map using new genetic tools gleaned from the Human Genome Project, but also will study the expression and interaction of genes, or simply put, how genes work in a horse environment.

This next phase will lead to a better understanding of how the diseases mentioned above develop. It may also provide information on how certain toxins induce devastating illnesses like laminitis or how certain drugs affect fertility or performance. Most importantly, it will lead to the development of better diagnostic tools and therapies to treat those diseases.

Horses contribute immensely not only to our economy, but also to our health and well-being as humans. Scientists studying horse genomics share the common goal with horse owners, breeders and veterinarians of improving the quality of life for horses. By continuing with genomics research and working together in the next millennium, we can achieve this goal. ■

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Figure 1
Cases of Rabies in Ho

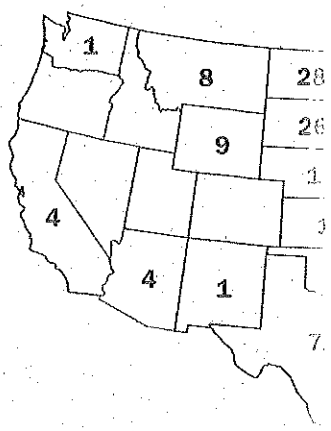


Figure 2
U.S. Animal Rabies Ca

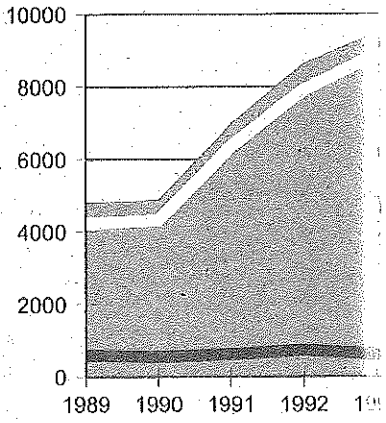
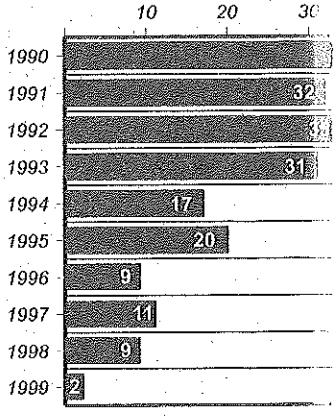


Figure 3
EIA Surveillance Te
total positive cases



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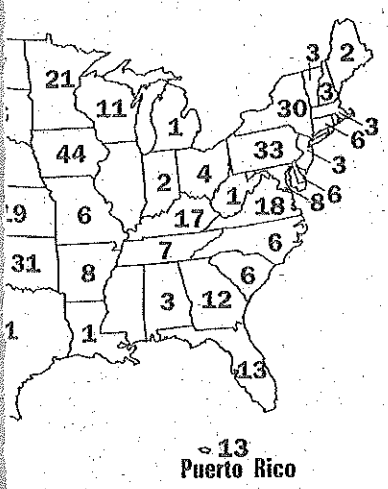
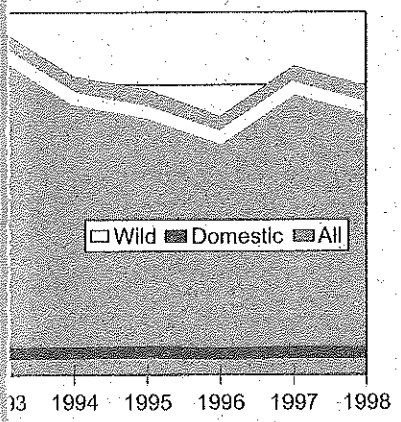


es—1989-1998



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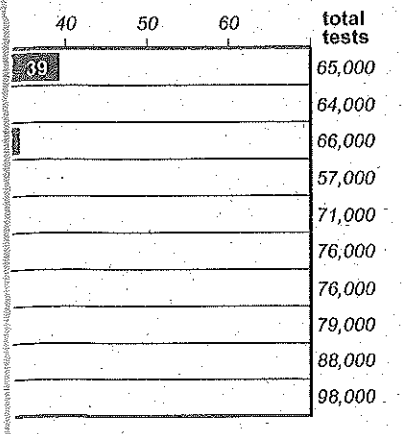

National

Equine Rabies: Old Disease, New Risks

From data collected by the Centers for Disease Control and Prevention (CDC), the total number of rabies cases in the United States during 1998 remained consistent with those in previous years. Of the 7,961 cases in animals, 92% were in wild animals. So why worry about equine rabies?

In 1998, there were 82 cases of rabies in horses, *a 74.5% increase over 1997*, and the highest number of cases reported for any single year since 1981. Positive cases were documented in Texas (12), North Dakota (11), Iowa (7), South Dakota (7), Oklahoma (7), Pennsylvania (5), Kentucky (4), New York (4), Kansas, (3), Minnesota (3), Virginia (3), two cases each in Florida, Missouri, Montana and Puerto Rico, and single cases in Alabama, Arizona, Connecticut, Delaware, New Jersey, North Carolina, South Carolina and Tennessee.

While 82 cases of any equine disease might seem small compared to the approximately 7 million horses in the United States, several factors need to be considered. Rabies is 100% fatal in domestic animals and people. Any animal infected with rabies can infect people, primarily through bite wounds or exposure to nervous tissue. Evidence exists in scientific literature published in Europe at the beginning of the last century that humans can become infected from the bite of a rabid horse.

The disease can be prevented in exposed people (not animals) through an injection of rabies immunoglobulin and five rabies vaccines over four weeks, an expensive undertaking. The 82 rabid horses exposed hundreds of people, resulting in thousands of dollars of post-exposure vaccinations. Public health officials determine the fate of animals that have been definitely exposed to the rabid animal, and some animals, especially unvaccinated domestic species, may be euthanized or put under a long-term quarantine.

What animals potentially expose horses? In 1998 wild animals identified as rabies positive in the United States were raccoon (3,502), skunk (2,272), bats (992), and fox (435). Other wildlife which were rabid include groundhogs, beaver, rabbit, bobcat, deer, coyote, wolf, otter, bison, wapiti, opossum, and mongooses (35 cases, all in Puerto Rico).

Currently an epizootic of raccoon rabies which began in the late 1970s following the translocation of infected raccoons from the Southeast is occurring along the Mid-Atlantic states. Until recently, this rabies variant had been kept from spreading west and north due to the Ohio River and Appalachian Mountains.

The first raccoon-rabies-infected animals occurred in northeastern Ohio in 1997, resulting in an intensive oral rabies vaccination program for wildlife in the immediate area. In July 1999, a case of rabies caused by the raccoon variant was detected in Ontario, Canada across the St. Lawrence River from New York. A trap-vaccinate-release program was implemented in local wildlife to stop the spread of the disease.

If raccoon rabies becomes established in the Ohio River Valley, there are few geographic barriers to prevent its spread across the midwestern United States, where skunk rabies is already established.

A historical look at equine rabies is warranted for perspective on this problem. Total confirmed cases of equine rabies for 10 years (1989-1998) are shown in **Figure 1**, as reported by CDC. Of noteworthy interest is that the largest number of equine cases is not in states with the current epizootic in raccoons. Texas and midwestern states account for the highest numbers of cases, while New York (30), Pennsylvania (33) and Virginia (18) are the only states in the midst of the raccoon rabies epizootic with double-digit cases. **Figure 2** illustrates the number of rabies cases in wild and domestic species.

What accounts for this difference? The assumption is being made that the equine cases are caused by the rabies variant predominant in each area: skunk in the Midwest, raccoon in the mid-Atlantic states, and fox/coyote/skunk in Texas. Although variant testing can be done to determine what wildlife type of rabies caused the disease, this is rarely performed on equine cases, and complete data is not available. However, one horse in Kentucky which was variant tested died from bat rabies and not the predominant skunk variant.

Are horses on the East Coast more rigorously vaccinated than those elsewhere? If horses are exposed to the major rabies variant in their locale, do the habits of raccoons and skunks vary such that skunks inhabit horse barns and pastures more so than raccoons?

Licensed rabies vaccines are available through veterinarians for domestic animal species: horses, cattle, sheep, dogs, cats and ferrets. **Use them** (and be sure to include the barn cats). Do not move wildlife across state lines. Do not build bat houses around homes or barns (20 of 22 human rabies cases died from bat variants during 1990-1998). Be aware that, although an old disease, rabies remains with us in the twenty-first century. ■

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From Blood To Hair

As we begin a new century, DNA testing is about to replace blood typing for almost all horse breed registries. DNA testing has a number of advantages over blood typing. For the standard test of 12 DNA systems most commonly used today, the probability of detecting an incorrect parentage is 99.99%. Efficacy is based upon the variability of the systems tested (reflected in the number of variants at the tested systems and the frequency of the variants).

The higher the variability of the systems tested, the greater the ability to detect an incorrect parentage. DNA systems used for equine parentage testing have greater variation than blood typing systems. This is partly because the DNA systems tested are non-coding DNA. That means that they are not part of genes that actually have a function, thus they are free to accumulate mutations which are the source of variability.

Blood typing is based upon testing proteins, which are gene products. Variation causing mutations are much less common in functional genes and their products because mutations usually result in proteins with diminished function.

Another advantage of DNA is that only one laboratory procedure is required for testing, while several different procedures are required for typing the different blood typing systems. Simplification of testing will help prevent cost increases.

Also, DNA can be obtained from almost any bodily tissue. The easiest tissue for horse owners to collect is pulled hair with the follicle (or root bulb) attached. It is the follicle, not the hair shaft, that has the DNA. Hair samples can be mailed to the laboratory with little chance of spoilage, as can happen with blood.

With these advantages it may seem surprising that many registries did not change to DNA typing sooner. The primary reason is related to DNA testing technology. The methods developed in the early 1990s utilize genetic markers called microsatellites. Microsatellites are highly variable and fairly easy to test using an electrophoresis-based technology.

An alternative technique is to use a marker type known as a single nucleotide polymorphism (SNP). SNPs are not as informative individually as microsatellites, so more must be tested to obtain the same efficacy, but they could be tested using a microchip technology.

The microchip technology offers several advantages to the electrophoresis-based technology, but it is not yet available for horse parentage testing, while microsatellite techniques are well-established. Those registries that have not changed to DNA testing have chosen to accept the existing technology rather than wait an unspecified time for a new technology

Another issue is that DNA testing involves a different set of gene markers than does blood typing. This means that all blood-typed horses involved in a parentage case must be DNA typed, which is a considerable expense for registries that have a major investment in blood typing. In the long term, there should be enough cost saving resulting from DNA testing to offset the cost of re-testing the breeding stock.

The re-testing issue also influences which DNA technology to use. SNP markers are different from microsatellite markers and if there is a decision to change from microsatellites to SNPs for horse parentage testing, the breeding stock will need to be re-tested again. The costs and advantages of an SNPs-based test will determine if this is a viable alternative.

DNA-based parentage testing of horses has arrived. The Jockey Club plans to have the 2001 foal crop DNA typed and most horse breed registries will be using DNA rather than blood typing within the next two years.

Blood typing has served the industry well and there are still aspects of blood typing that may continue to be used (such as testing related to neonatal isoerythrolysis). However, the future of equine parentage verification is in DNA and the integration of genomic science into the horse industry. ■

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EIA Surveillance, 1999

In 1974 the Kentucky Department of Agriculture implemented a program to determine the occurrence of Equine Infectious Anemia (EIA) among Kentucky's equine population. Testing conducted during the late 1970s and into the 1980s annually identified between 120 and 150 animals as affected by EIA.

During the mid-1980s and throughout the 1990s, an

increased amount of attention was placed on stopping the spread of EIA among Kentucky's equine population. Surveillance in 1999 identified two positive animals from 98,000 samples tested. Both were identified through the Market Surveillance Program (see **Figure 3**).

The first animal had been purchased at a sale in Iowa. Upon its return to Kentucky, it was consigned for sale at an approved market in Kentucky. The blood sample drawn at the sale indicated the animal was positive.

The second animal was also discovered after being tested at an approved auction market. Subsequent investigation found this animal had also originated outside of Kentucky, and had reportedly been through markets in Alabama and Tennessee during the weeks preceding its arrival in Kentucky.

The Kentucky Department of Agriculture requires that an official test be conducted by a laboratory approved by the USDA. Sale and exhibition regulations require equine animals changing ownership to have tested negative during the previous six months. Equines which are being used for exhibition (*i.e.*, racing, showing, trail riding, etc.) must test negative during the previous 12 months.

Both the agar gel immunodiffusion (AGID) and the enzyme linked immunosorbent assay (ELISA) are recognized as official tests. When time permits, the use of the AGID test is encouraged. On rare occasions, instances of "false positives" have been reported using the ELISA test.

The ELISA tests are not always recognized by some states and are not recognized for exporting animals from the United States. In the event that an ELISA test is used for the interstate movement of an animal, it is important to contact the state of destination to ensure that the test is recognized. ■

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