

Zoonoses Surveillance and Prevention in International Zoo Animal Trade and Zoological Gardens

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Introduction

Zoonoses are diseases that can be transmitted between animals and humans. They comprise viral bacterial fungal and parasitic diseases. In zoos, the most important source of zoonotic diseases are primates, birds and reptiles. In wildlife, the most important potential carriers of human diseases are rodents and carnivores (MONTALI, 1999).

There are more than 200 communicable diseases known to be common to man and animals (ACHA and SZYFRES, 1987, KRAUSS et al. 1997), less than 10% of which are contained in the lists A and B of the OIE International Animal Health Code (OIE, 1998). The number of zoonoses regulated by national legislations is not much higher and, in many countries, may even be lower. In the case of Switzerland for instance, the animal health legislation regulates a total of 80 infectious or contagious diseases, 26 of which have a zoonotic potential (DOLLINGER et al. 1998a). As a result, zoonoses in zoo animals are often only detected, once an animal is already in the collection, and has either fallen sick and died, or other animals or humans have been infected. This situation is largely due to veterinary administrations addressing primarily diseases of agricultural livestock. When confronted with an import application for zoo animals, import conditions are often established on an *ad hoc* basis which may not necessarily be scientifically sound. To reduce the risk of introducing zoonoses by international trade and of their spreading in zoos, measures have to be taken at several levels.

Measures by the Office International des Epizooties (OIE)

To improve the knowledge about the presence of infectious diseases in wildlife, and to create awareness, an **OIE Working Group on Wildlife Diseases** produces, since 1992, annual reports. In 1996, drafting a recommendation on zoonoses transmissible from non-human primates was initiated, and an *ad hoc* Working Group was formed, largely consisting of members of the European Association of Zoo and Wildlife Veterinarians. In 1998, the draft elaborated by this group was adopted and included in the **OIE International Animal Health Code** (OIE, 1998). Unlike in other chapters of the OIE Code, the recommendation was developed in recognition of the particular and unique nature of the subject animals, non-human primates who are potential carriers of a very large number of – often very dangerous - agents transmissible to man (BRACK, 1998, BRACK et al.

1995). Therefore, primary emphasis was not given to the steps necessary for the control of any specific zoonotic agent, but rather the need to address the zoonotic disease potential of the entire group of animals was stressed. The recommendation focuses on defining the health of non-human primates and on the practice of protective measures against disease transmission. The two basic elements needed for assuring public health and humane animal care are the process of health certification before, and the process of quarantining after international transportation. In analogy to the International Animal Health Code's recommendations on domestic livestock, the responsibility for health certification for non-human primates was placed with the veterinary services of the exporting country. The health certification process should be viewed as producing the best attainable assessment of the animal's health before exportation, but it should never be equated to a guarantee of a disease-free health status. Therefore, the recommendation emphasises the process of quarantining after importation. The periods of time chosen for quarantine represent those which are sufficient for animals incubating diseases, before or during international transportation, to become clinically ill during quarantine and to resolve their infections before release from quarantine. (DOLLINGER et al., 1998b).

For certain diseases, e.g. Herpes B, it must be assumed that target animals are universally infected and infective, and that public health protection should not be placed on eliminating infectious animals, but on protecting persons coming in contact with these animals by appropriate personnel protection practices.

In May 1999, an **annex on quarantine requirements**, again elaborated by a the OIE-EAZWV Working Group was adopted by the OIE International Committee. Quarantine facilities must be premises with a distinct and fully limiting barrier between the inside and the outside for the purpose of holding animals in isolation from other animals and non-essential personnel. They must provide for the complete isolation of the animals being contained, and comprise both a physical structure, and an established and implemented programme for maintaining animals in isolation. The programme includes: established criteria for animal admission, procedures for the isolation or elimination of diseased animals, a description of the animal disease monitoring programme, procedures for the health screening and surveillance of humans entering the facility, facility cleaning arrangements, the disposal of used feed, water, supplies and animal wastes, measures to exclude pests, and dead animals disposition. Entry and exit of animals, animal care staff and other humans must be controlled to minimise environmental exposures to animals and inadvertent exposure to transmissible infectious agents.

As a next step, standards on zoonoses potentially present in zoo animals should be included in the **OIE Manual of Standards for Diagnostic Tests and Vaccines** (OIE, 1996).

Measures by veterinary administrations

Currently both, the spectrum of species and the spectrum of diseases regulated by national veterinary administrations in the context of the imports vary greatly, and so do the measures imposed to prevent the introduction of diseases. Taking

Switzerland as an example, the following **taxa** are subjected to animal health requirements upon importation to prevent the introduction of diseases that are either notifiable or do not occur in Switzerland: Primates, Carnivora, Lagomorpha, Equidae, Artiodactyla, Struthioniformes, Casuariformes, Rheiformes, Anseriformes, Galliformes, Columbiformes and Psittaciformes. There are no animal health regulations for species of other taxa, although some of them are known to be potential carriers of zoonoses, such as the rodents or turtles. The European Union's legislation is similarly sketchy: Council Directive 92/65/EEC, the so-called balai directive, addresses a similar range of species as the Swiss Import, Transit and Export ordinance with a reference to birds in general, and on the other hand the bats having been omitted.

In the case of bats and fruit bats, Swiss importers are informed about the risk of bat lyssa, but no further action is taken. In the other taxa, the **requirements** include: pre-export quarantine in certain cases only, presentation to the Swiss Border Veterinarian of an official animal health certificate issued in the country of export, post-import quarantine or on-farm-isolation, testing, vaccination or prophylactic treatment for specific diseases.

Diseases addressed include *inter alia* tuberculosis, *Salmonella* spp., *Shigella* spp, endoparasites, Hepatitis A and Herpes B in non-human primates, rabies and endoparasites, including *Isoospora*, in carnivores, tularemia in lagomorphs, glanders and vesicular stomatitis in equids, all OIE List A diseases, tuberculosis brucellosis, and certain zoonoses depending of the species, such as leptospirosis, coxiellosis, Aujeszky's disease and endoparasites in even-toed ungulates, and Newcastle disease, psittacosis/ornithosis and salmonellosis in birds.

It would be desirable, if the countries were to **harmonise** the range of species and diseases they regulate in the importation context. However, this is hardly achievable within a foreseeable future. What veterinary administrations could and should do is to draw up their import requirements for zoo animals in compliance with the **OIE International Animal Health Code**. Where no such standards exist, a sound **risk assessment** has to be made, or established quarantine procedures of national zoo organisations should be followed. Certification requirements should not be overemphasised, but proper quarantine should be ensured either by means of state-run quarantine stations, or at the premises of the importing trader or zoo.

The **quarantine** must effectively isolate the animals inside from the outer world, to the extent this is necessary to prevent the escape of pathogen agents. Obviously other criteria have to be used if the risk consists in air-borne diseases, such as foot-and-mouth, than in cases where the only risk are diseases transmitted by direct animal contacts like e.g. contagious equine metritis. To be suitable for the quarantine of high-risk animals, closed, insect and rodent proof, artificially ventilated buildings are required. Larger quarantine buildings should be split into sub-units, which are effectively isolated from each other. The quarantine must be supervised by an official veterinarian who ensures that proper procedures are followed, including: daily monitoring of all animals for signs of illness and clinical examination of suspect animals, proper execution of all tests prescribed by the veterinary administration, post mortem examination of all perished animals, disinfection both in- and outside the quarantine room, changing of clothes and boots, wearing gloves and a breathing mask. The quarantine periods must last at

least as long as prescribed by the veterinary authorities, and any cause of illness or death must have been determined before the group to which the animals belong is released from quarantine. When a group of animals from different sources is newly formed, arrival of the last individual will be determinant for the length of the quarantine and for the execution of the testing scheme. If there is a possibility of the animals being affected by a high-risk disease, all the water, excretions and rests of food must be stored in special tanks within the facility during the whole quarantine period. There should be a possibility to incinerate, if necessary, the contents of these tanks at an incineration plant.

It is obvious that in cases where high-risk diseases can be ruled out, facilitations may be granted, i.e. that rather a on-farm isolation would be carried out than a quarantine in the strict sense.

At **international airports** with regular arrivals of animals from other continents, veterinary administrations should provide facilities for the safe temporary keeping of live animals to prevent the spreading of diseases on the airport area.

Permanent **veterinary supervision** of zoos and traders should be mandatory, and this could best be achieved by subjecting the operation of a zoo or trading operation to **licensing**, as it is e.g. now required under the new zoo directive of the European Community. **Training requirements** for pet traders and zoo keepers should include lessons on animal health and disease prevention. There should be a legal provision obliging traders and zoo staff to **notify suspect cases** of disease or mortality to the zoo veterinarian, who in turn has to notify the official veterinarian responsible for the area. The veterinary administrations should also designate the **laboratories** authorised to perform post mortem examinations and other tests, and should define the standards to be met by such laboratories. When organising **country-wide surveys** in order to get a clearer picture on the presence, prevalence and distribution, or the absence of a disease, veterinary administration should not restrict random sampling to agricultural holdings, but should include zoological parks and game farms. Particularly the latter are important in this context, because they use to be set in agricultural surroundings, and the introduction of e.g. tuberculosis into the game industry of a country may jeopardise the health status of the national cattle herd.

A major contribution to the prevention of zoonotic risks would be a legal provision preventing non-human primates from entering the **pet trade**, because they have by far the most diseases in common with man.

Measures by the zoological gardens

The fact that, in many countries, zoological parks are greatly ignored by the relevant legislation does not mean that they face no zoonoses risks. On the contrary: in the past, bovine tuberculosis was widely distributed in zoos. It had devastating effects particularly on the carnivore and primate collections. As cattle populations became free from tuberculosis, the zoos succeeded too in eliminating this disease. Other zoonoses, such as infestations with intestinal protozoa, toxoplasmosis, campylobacteriosis, leptospirosis, or salmonellosis continue to be a problem. Sometimes a disease appearing only sporadically may lead to an aggravated enzootic situation, and there are numerous cases documented, in which a zoonotic disease spread from the animals to the staff. Since few

Government regulations exist, the zoological parks should adopt additional measures to prevent zoonoses on a voluntary basis.

Zoos should keep **high hygienic standards** for animals, keepers and food. They should consider all animals entering the collection as potential carriers of zoonoses and other infectious or contagious diseases and, recognising that a quarantine procedure at the time of animal receipt is an essential element, if not the critical element for predictable and controlled animal health assessments, should place all incoming animals in veterinary controlled isolation or **quarantine**, until their sanitary status has been checked, but at least for 30 days. Zoos should recognise that the **individual identification** of animals is essential to the success of zoonotic disease control measures and should mark as many animals in their collections as possible. They should also attempt to **exclude** from the zoo **wild animals**, that may be potential carriers of zoonoses. Such efforts help also to prevent losses owing to predation, e.g. by foxes. The most important measures are certainly the close clinical surveillance of the collections and the systematic performance of necropsies in the captive as well as in free roaming wild animals.

The **surveillance of the collections** should include systematic faeces sampling for bacteriological and parasitological testing, implemented according to an annual plan, and serologic or other tests as appropriate. It may seem redundant to say that the samples have to be taken *lege artis*. However, in practice, diseases remain often undetected simply because of inadequate sampling procedures. For instance, to detect several parasitic diseases, including *Hexamitiasis* in reptiles and *Strongyloides* infections in mammals, it is crucial to examine the faecal or cloacal samples as quickly as possible because they can easily be diagnosed within the sample only for a short period of time.

Also essential is a good record keeping allowing to trace back the medical history of each animal group over a longer period of time.

Diseases to be looked at include in the case of

- *Bats*: Lyssa virus
- *Primates*: bacterial examination of the faeces for *Salmonella*, *Shigella* and *Campylobacter*. Parasitological faeces examination for enteric protozoa such as *Entamoeba*, *Balantidium* and *Giardia*, and helminths such as *Strongyloides stercoralis*, tuberculosis testing, and serologic examination for herpes B virus, simian immunodeficiency virus and echinococcosis. Regarding tuberculosis testing, there are, however, often practical problems, e.g. orang utans (*Pongo pygmaeus*) may show reactions to several tuberculins with no exposure to pathogenic mycobacteria or clinical evidence of tuberculosis. The question of how to deal with an orang utan with tuberculin responses in the absence of historical, clinical, radiographic, or cultural evidence of tuberculosis, remains unresolved.
- *Rodents*: Faeces examination for leptospirosis, listeriosis, *Yersinia pseudotuberculosis* and *enterocolitica*, lymphocytic choriomeningitis (mice, hamsters), examination for trichophyton infection.
- *Lagomorphs*: Testing for *Encephalitozoon cuniculi*, examination for trichophyton infection, faeces examination for *Yersinia pseudotuberculosis*.

- *Carnivores*: Faeces examination for *Isospora*, ascarids and *Echinococcus*. Depending of the rabies situation, examination of all wild carnivores shot or trapped in the zoo for rabies.
- *Elephants*: Serological examination for orthopox virus infection, and tuberculosis testing. As in certain primates, the results of the intradermal tuberculinisation are not necessarily conclusive in elephants. This fact and the appearance of *Mycobacterium tuberculosis* in a number of elephants in the United States has resulted in the development of "Guidelines for the Control of Tuberculosis in Elephants" in 1997 by the National Tuberculosis Working Group for Zoo and Wildlife Species. These guidelines were distributed to exhibitors who maintain animal welfare act regulated elephants in the United States by the USDA APHIS. Compliance with this policy requires that all elephants have annual mycobacterial cultures collected and submitted. In the guidelines, the trunk wash is recommended as the most practical method of obtaining a culture sample from an elephant (ISAZA and KETZ, 1999).
- *Even-toed ungulates*: Monitoring for tuberculosis, brucellosis, rickettsiosis, leptospiroses, in *Camelids* also serological examination for orthopox virus infection.
- *Birds*: Faeces examination for salmonellae, monitoring for psittacosis
- *Reptiles*: Faeces examination for bacterial agents (Salmonellosis);

Of course, the health surveillance should not be restricted to zoonoses, but faecal testing for non-zoonotic endoparasites or checking for ectoparasites (ticks) should also be done in the interest of a healthy collection and of animal welfare..

Susceptible animals should be subjected to preventive treatments, or should be vaccinated for relevant zoonoses and other diseases, unless a non-vaccination policy exists. These measures may include rabies, leptospirosis, yersiniosis, *Chlostridium tetani*, *Erysipelothrix rhusiopathiae* and psittacosis/ornithosis

Zoos should, on each possible occasion, collect of blood samples, for direct diagnosis and for establishing **serum banks**.

As a matter of principle, all dead mammals, birds and herps should be **necropsied**, even if the cause of death seems to be obvious (trauma, age, still born). Moreover, the mortality causes of fishes should be monitored, and an appropriate follow-up should be given to the necropsy results. This is not only important for diseases under official registration but also for other infectious diseases. For example, it is very often tolerated that fishes in tropical aquariums have tuberculosis. This type of tuberculosis or mycobacteriosis is caused by other agents than the mycobacteria of homothermes (*Mycobacterium poikilothermorum*). The zoonotic potential for humans seems to be low, but it exists (granulomas, lymphadenitis); keepers working at the aquarium and having direct, unprotected skin contact to the water, are at risk.

There are many instances known where **wild living animals** pose a zoonotic threat to zoos, e.g. where zoos have encountered incidences with rabid foxes, where diseases were introduced by migrating birds or where wild rodents were at the source of diseases affecting the collection and, sometimes, zoo staff. The monitoring and, where necessary, the control of wild and feral animals living in or entering the zoo is, therefore, another important measure to contain zoonoses.

The inclusion of wild animals found dead, trapped or shot on the zoo area in the post mortem surveillance provides important information on possible sources of zoonotic infections and parasitoses.

Zoos should recognise that for some latent infections harboured for the life of the animals, such as herpes B virus in non-human primates, no amount of time in quarantine will make the animals non-infectious, and they should address this problem by **proper handling procedures** after quarantine.

Exposed **staff** should be included in the surveillance and prophylactic measures. These measures have to take into account the specific risks to which a staff member is exposed considering the animal species involved and their health status. Animal keepers working in wooded wildlife parks in Europe or North America should be immunised against tick-borne encephalitis, because Lyme borreliosis is wide spread in ungulates and carnivores of such parks (STÖBEL, 1999). In the case of staff coming into contact with primates during the quarantine period, occupational safety procedures should include immunisations of personnel against high risk diseases such as hepatitis A, hepatitis B, tetanus, rabies, polio and measles, etc.; provisions for disease monitoring including once a year, for tuberculosis, and twice a year faecal examination for parasites and enterobacteriaceae; directives to the effect that the monkeys should never be handled without reason and without sedation, protocols for treating bites, scratches and other injuries. These protocols should comprise emergency procedures posted at the work site, including the washing and disinfection of the wound and the immediate information of the direct superior, and the transfer of the wounded person to a hospital that has been informed of the risks by the zoo will take the appropriate steps. A tetanus booster should be given in all cases. Observance of good personnel hygiene practices, including the wearing of protective clothing, no eating, smoking or drinking in animals areas or other animal use areas may be useful not only for monkey keepers. Quarantine programmes may wish to also incorporate measures aimed at protecting workers from agents endemic in the country of origin of the quarantined animals, i.e. yellow fever.

To improve the surveillance of the collections, all zoos should participate in the establishment of a **serum bank** and co-operate with other institutions at the national and international level.

Measures by the WVA / WAWV and their affiliated organisations.

Further training of zoo and wildlife veterinarians in the field of zoonoses surveillance and prevention is essential to ensure healthy collections and to avoid transmission of disease to the staff. Zoonoses should, therefore, be a prominent feature in **scientific venues**. Actually, this has been the case in recent years with “Emerging Diseases” having been on the agenda of the American Association of Zoo Veterinarians annual meetings, and “Diagnosis of infectious diseases” as well as “Zoonoses – Risks for veterinarians and other zoo staff” having been main issues at the scientific meetings of the European Association of Zoo and Wildlife Veterinarians and the Symposium on Diseases in Zoo and Wild Animals. Regional organisations should co-operate with the OIE Working Group on Wildlife Diseases,

and should follow the example of the European Wildlife Disease Association (EWDA) in producing **regional reports**. As AAZV in North America, they should **co-operate** with the zoo organisations of their region in establishing procedures for minimising the zoonosis risk (MILLER, 1995). EAZWV should continue to co-operate with OIE in improving international **standards**, and should involve other groups from within the WAWV family.

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