ZOONOSES

INTRODUCTION:

There are more helminth parasites of lower animals infecting humans than any other group of animal parasites. Nematodes, cestodes and trematode infections abound in nature and are found in every known species of vertebrate. Most parasites usually exist in harmony in their natural hosts, but when they become zoonotic parasites, they usually cause serious disease in humans.

Zoonoses are "those diseases or infections that are naturally transmitted between animals and man". In a broad sense, all animals are included in the definition, but most studies of zoonoses involve only diseases of vertebrates. The term anthroponoses means human diseases that are transmissible to animals.

The word "zoonoses" (singular zoonosis) originated from the Greek word 'zoon' meaning animal, 'nosos' meaning disease and it was Rudolf Virchow who first used this term in 1855 in his famous 'Handbook of Communicable Disease' to describe the animal diseases secondarily transmissible to man.

The overall concept of zoonoses is complex. It involves man, another vertebrate, often an arthropod, the agent that causes disease, and the environment – all forming a biologic whole. The interaction of these parts involves more than just a sum of the parts. A serious study of zoonoses should thus include the ecology of all organisms involved – parasite, animal, vector and man.

Many zoonoses such as balantidiasis (caused by an intestinal ciliate), fascioliasis hepatica (liver fluke disease) and tongue-worm infection, are found almost exclusively in animals and only rarely in man. Others, such as leishmaniasis (Oriental sore), flea infestation, African sleeping sickness and clonorchiasis (chinese fluke infection), are common in both animals and man. Well over 100 zoonoses are known, and they may be grouped on the basis of the causative organisms: viruses, rickettsiae, bacteria, fungi, protozoa, nematodes, trematodes, cestodes, arthropods.

A zoonoses is defined (WHO, 1979) as a disease or infection naturally transmissible between vertebrate animals and man.

These diseases have been ailing human beings from time the close man-animal association has become essential.

Besides feeding on seeds and fruits of wild trees, the existence of human beings depended on flesh of animals in ancient times. Association of dog with man from antiquity followed by other pet animals is known from the history and scientific findings. Living under one roof, taking flesh and milk in raw form, use of dung for daily household purposes and use of other animal by products for clothing etc. predisposed ancient man to these commonly shared bacterial, viral, fungal and parasitic diseases.

This association of animal with human cannot be ruled out and can never become out dated. Even in present electronic age the animal species are reared for obtaining milk, flesh, transportation, fur and manure. The animals are domesticated for games, detecting of crimes, tracking unsocial elements, experimentation of life saving drugs, trial of human and animal vaccines, guarding livestock and houses and for fancy purpose. The animal products contribute about 8.5% in GDP from milk, meat, fur and other by-products.

About 11 – 12 % of our population solely depends on livestock as Gujar, Backerwals, Chopans, Gaddis, Markabans etc. It is as such an unavoidable association. In urban areas dog rearing is common.

As health and disease are two faces of the same coin, same is true for this association. The unquantifiable benefits from animals are well recognised, but the zoonotic aspect needs also to be studied, discussed and all concerned made aware about their transmission for effective control.

As per WHO about $4/5^{th}$ human ailments have either their location in animals or the animals play a vital role in their transmission (Abusalam, 1974). To quote a few important of them are Rabies, Anthrax, Brucellosis, Salmonellosis infections, Japanese encephalitis, Plague, Q. fever,

Tuberculosis, Taeniasis, Hydatidiasis etc. WHO has claimed that losses of animal product sector in milk production only is about 30 million tons/year sufficient to feed 200 million children.

Zoonoses represent a permanent risk of humans. Not only living animals but also foods can be carriers of zoonotic agents. Zoonotic agent means any bacterium, virus, parasite or biological entity, which is likely to cause zoonoses.

CLASSIFICATION OF ZOONOSES

As per classification adopted by the joint WHO/FAO Expert Group on zoonoses, the zoonoses have been grouped into three categories:

[A] Based in terms of reservoir host:

1. **Anthropozoonoses:** The infections transmitted to man from lower vertebrates are termed as anthropozoonoses. e.g., ascariosis.
2. **Zooanthroponoses:** The infections transmitted to lower vertebrate animals from man referred as zooanthroponoses. The infections are primarily of human origin, e.g. schistosomosis, hymenolepiosis.
3. **Amphixenoses:** The infection maintained between man and lower vertebrate animals, which may be transmitted in either direction, e.g. salmonellosis.

[B] Based upon the type of life cycle:

1. **Direct zoonoses:** The infection transmitted from the infected vertebrate host to a susceptible vertebrate host (e.g. Man) either by direct contact, contact with a fomite or by a mechanical vector. During transmission the agent undergoes no developmental and little or no propagative changes e.g. trichinellosis.
2. **Cyclozoonoses:** The infection requires more than one vertebrate host species in order to complete the life cycle of the agent. No invertebrate hosts are required.

   Type I - Obligatory Cyclozoonoses - Man must be one of the vertebrate hosts in these cycles e.g. *Taenia saginata* and *T. solium* infections.

   Type II - Non-obligatory Cyclozoonoses - Man is sometime involved, but the human involvement is the exception rather than the rule e.g. hydatid disease.
3. **Metazoonoses:** The infection is transmitted biologically by the invertebrate vectors. In the invertebrate, the agent multiplies (Propagative or cyclopropagative transmission), in which case the invertebrate also serves as reservoir of infection or the agent merely develops (developmental transmission). In the metazoonoses there is always an extrinsic incubation period in the invertebrate hosts before transmission to another vertebrate hosts is possible.

   Depending upon the hosts required, at least four subtypes of metazoonoses may be distinguished:

   Subtype I - requiring one vertebrate host and one invertebrate host e.g. yellow fever.

   Subtype II - requiring one vertebrate host and two invertebrate hosts e.g. paragonimosis.

   Subtype III - requiring two vertebrate hosts and one invertebrate host e.g. clonorchiosis.

   Subtype IV - representing transovarian trans mission e.g. tick borne encephalitis.
4. **Saprozoonoses:** Saprozoonoses are those zoonoses which require a non-animal site to serve either as a true reservoir of infection or as a site for an essential phase of development. Considered as nonanimal are organic matter (including food), soil and plants e.g. various forms of larva migrans. (Special cases of zoonoses are given in table).

[C] Based upon etiological agent:

1. **Bacterial zoonoses:** Zoonoses caused by bacterial agents e.g. brucellosis, plague, salmonellosis, anthrax.
2. **Viral zoonoses:** Zoonoses caused by viruses e.g. rabies, influenza, yellow fever.
3. **Rickettsial zoonoses:** Zoonoses caused by rickettsia e.g. Qfever, tick typhus.
4. **Protozoan zoonoses:** Zoonoses caused by protozoans e.g. toxoplasmosis, trypanosomosis, leishmaniosis.
5. **Helminthic zoonoses:** Zoonoses caused by helminthes e.g. hydatidosis, taeniosis, schistosomosis, trichinellosis.
6. **Fungal zoonoses:** Zoonoses caused by fungal agents e.g. histoplasmosis, cryptococcosis.
7. **Ectoparasitic zoonoses:** Zoonoses caused by ectoparasites e.g. scabies, myiasis.

Table 1. Etiological Based Classification of Zoonoses

Agent	Name of Important Zoonoses
Bacterial	Anthrax (Wool Sorter's Disease), Leptospirosis, Brucellosis, Campylobacteriosis, Salmonellosis, Tetanus, Plague, Tularemia, Clostridial Disease, Botulism, Tuberculosis, Listeriosis, Erysipelothrix Infection.
Viral	Rabies, Influenza, Japanese Encephalitis, KFD (Kyasanur Forest Disease), Lassa Fever, Buffalo Pox, Yellow Fever.
Rickettsial	Psittacosis/Ornithosis, Q-Fever, Indian Tick Typhus, Murine Typhus.
Mycotic	Candidiasis, Histoplasmosis, Aspergilosis, Coccidiodomycosis, Cryptococcosis.
Parasitic	Trichinosis, Hydatid, Taeniasis & Cysticercoses, Anasakiasis, Leishmaniasis (Kala Azar), Dipylidiasis, Paragonimiasis, Opisthorchiasis, Schistosomiasis, Filariasis

Table 2. Classification Based On Reservoir and Mode of Transmission

Type	Examples
A) Direct Zoonoses	
1) Direct anthropozoonoses	e.g., Rabies, Trichinosis, Q-Fever, Bovine Tuberculosis
2) Direct zoonthroponoses	e.g., Diphtheria, Human type tuberculosis.
3) Direct Amphixenoses	e.g., Streptococosis, Staphylococosis
B) Meta-Zoonoses	e.g., Paragonimiasis, Sylvatic Yellow Fever, KFD, WEE, EEE, Clonorchiasis, Tick-borne Encephalitis etc.
C) Cyclo-Zoonoses	e.g., Taeniasis *(T.solium* & *T. Saginata),* Hydatidiosis.
D) Sapro-Zoonoses	e.g., Cutaneous larvae migrans, Histoplasmosis. Fascioliasis, etc.

Table 3. ZOONOSES CLASSIFIED ON HOST BASIS

Name of Host	Important Zoonoses
Dog	Pneumocystosis, Leishmaniosis, Trypanosomiasis, Dipyliodiosis, Echinococcosis, Dracunculosis, Filariosis, Strongylodiosis, Rabies, Hydatid Disease, Scabies, Brucellosis
Cat	Rabies, Toxoplasmosis, Trypanosomiasis , Strongylosis, Dipylidiosis, Plague, Tuberculosis
Sheep/Goat	Babesiosis, Toxoplasmosis , Trypanosomosis , Trichinellosis, Hydatidiosis (Indirectly), Tick Borne Encephalitis, Ganjam Disease, Scabies Tuberculosis, Q-Fever, Brucellosis
Cattle/Buffalo	Babesiosis, Sarcocystosis, Trypanosomiasis, Toxoplasmosis, Fascioliasis, Taeniasis, Trichostrongylosis, Hydatidiosis, Tuberculosis, Brucellosis, Q-Fever, Cow Pox
Horse	Babesiosis, Trypanosomiasis, Strongylosis, Dipylidiosis
Pig	Taeniasis, Trichinosis, Brucellosis, Influenza
Swine	Sarcocystosis, Babesiosis, Fasciolopsiosis, Taeniosis, Trichinellosis
Poultry	Salmonellosis, Tuberculosis, Influenza, Newcastle Disease
Wild Animal	Leishmaniasis, Simian malaria, Trypanosomiasis, Babesiosis, Paragonimiasis, Echinococcosis, Rabies, Trichinellosis, Tanapox, KFD (Kyasanur Forest Disease), Yellow Fever,

Table 4. Zoonosis on the Basis of Reservoir

Type	Important Zoonoses
A) Anthropozoonoses	Rabies, WEE, Leptospirosis, Salmonellosis, Brucellosis, Anthrax, Cutaneous Larvae Migrans, Hydatidiosis.
B) Zooanthroponoses	Human Tuberculosis, Diphtheria
C) Amphixenoses	Streptococci & Staphylococci

FACTORS RESPONSIBLE FOR EMERGENCE /REEMERGEN OF ZOONOTIC DISEASES

- Population explosion
- Exploitation of newer Geographical areas.
- Construction of pipe lines, roads, rivers, dams, new colonies, mining and similar ecology damaging activities
- Change in foods and food technology etc.

Some Important occupational zoonoses

Group	Major Occupation/Groups	Examples
Agricultural	Farmer, Veterinarian, Livestock transporter	Haemorrhagic fevers, Japanese encephalitis, Kyasanur Forest disease, rabies, Anthrax, Brucellosis, Gladers, Leptospirosis, Salmonellosis, Tuberculosis
Animal product manufacture	Butcher, slaughterhouse worker, animal food handler of wastes and by-products	Louping ill, Newcastle disease, Rift Valley Fever, Anthrax, Brucellosis, Salmonellosis, Tetanus, Tuberculosis, Psittacosis/Ornithosis, Q- fever
Sylvan and campestral	Wildlife worker, hunter, fisherman, construction worker	Haemorrhagic fevers, Japanese encephalitis, Bruccellosis, Pasteurellosis, Plague, Yersiniosis
Recreational	Employee of wildlife parks, pet dealer, veterinarian	Rabies, campylobacteriosis, Glanders, Leptospirosis, pasteurellosis, tetaus
Laboratory	Scientist, laboratory animal handler, livestock handler	Haemorrhagic fevers, Japanese encephalitis, Rift Valley Fever, Anthrax, Brucellosis, Glanders, Salmonellosis
Epidemiological	Physician, veterinarian, field investigator	Japanese encephalitis, rabies, salmonel
Emergency	Refugee, disaster victim, pilgrim	Rabies, plague, flea-borne typhus

CONCLUSION:

Helminthiasis of animals that are transmitted to man remain a continuing problem throughout the world. Although no population can be considered free from or immune to the scourage caused by these worms, the predominance of infections occur in the lesser developed parts of the world where poor sanitary practices are rampant. Eating habits are also important in the continued existence of the helminthiases. The eating of raw pork, beef, lamb, fish and crabs and the accidental ingestion of arthropods are major sources of these zoonoses. Improvement of sanitation and changes in eating habits would certainly lower the incidence of these diseases, but this is easier said than done. Any one with experience in dealing with people in impoverished areas is well aware of the difficulty of changing the habit of the people. Helminthic zoonotic diseases have existed for generations and unless changes are made, they will continue into the future.

However, there is hope for the future. Even though people are becoming infected, we are now developing the tools to accurately diagnose these parasitoses. There has been a great improvement in serodiagnosis. Specific antigens for the respective parasites are being purified and the ELISA test is in widespread use. Specific monoclonal antobodies are available to detect antigens from helminthic parasites and DNA probes will be available in the not too distant future. DNA analysis will also aid in the specific identification of those parasites in cases where a taxonomic status is questionable. Unfortunately, it will take some time before these tools of the future become available and are cheap enough to be used in endemic areas where they are really needed.

During the past decades, several new species of zoonotic parasites have been found to traumatize man. The question arises as to how may new ones are still there in nature. Great changes are occurring in our environment that jeoparadize our ecology. These changes will cause havoc with our wildlife and will thus also change the helminth fauna in these animals. Will these worms adapt to man who is moving into former animal habitats? Future public health workers, physicians and veterinarians should keep a vigilant eye for the possible emergence of new zoonotic diseases.