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Insect-Borne Zoonotic Diseases Representing Significant Public Health Threats and Ways for Their Avoidance

Muhammad Sarwar*

Agricultural Biotechnology Division, National Institute for Biotechnology & Genetic Engineering (NIBGE), Faisalabad, Punjab, Pakistan

Abstract

The complex ecology of zoonotic infections poses both challenges and opportunities for their surveillance and control. There are numerous zoonotic diseases and infections that can be passed from animals to humans. These diseases cause mild to severe symptoms and are a definite concern for the farmers and their families. Recognizing the potential of zoonotic diseases, this article analyses the state of knowledge on public health importance of key emerging insect vector-borne zoonoses as well as their control matters. There are many disease agents that can cause disease in multiple species of animals including humans. Peoples are exposed to the bacteria, protozoa, fungi, viruses and parasites that cause zoonoses in a number of ways and therefore anyone working with or handling of animal's needs might be infected. Shipping traffic results in the transport of larvae of several important mosquito species, such as *Aedes aegypti* (a vector of dengue, yellow fever, chikungunya virus and others), *Culex pipiens* (a vector of West Nile virus) and *Culex quinquefasciatus* (a vector of West Nile virus and filariasis). Some pathogens (*Plasmodium vivax*) are introduced to new continents and became established and caused chronic infections in peoples. Other pathogens that have only short periods of infectiousness in peoples, including yellow fever virus and dengue virus, could also reach to distant regions in which vectors are present and might reproduce. Fortunately, the occurrence of zoonotic disease can be minimized and contact with zoonotic infection agents is preventable by taking a number of precautions including practicing good personal hygiene; providing prompt and effective first aid treatment to cuts and scratches; using personal protective equipment e.g., overalls, gloves, boots, goggles and aprons; cleaning and disinfecting work spaces and equipment; vaccinating pets and livestock; worming pets; controlling rodents; and isolating and treating sick animals. Some mosquito control programs should conduct surveillance for diseases harboured by birds, including crows, other wild animals, sentinel chicken flocks, and for these diseases in mosquitoes. Integrated vector control approach is the present trend for zoonotic diseases control defined as utilization of all appropriate technological and management techniques to bring out an effective degree of vector suppression in a cost effective manner and also to avoid the overuse of one of the methods.

Keywords

Emerging Infectious Disease, Arbovirus, Public Health, Vector-Borne Disease, Zoonosis

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1. Introduction

Zoonosis or Zoonoses are any diseases caused by infectious agents that are transmitted from animals to humans. A disease that is transmitted to humans or other animals by an insect or other arthropod is called a vector-borne disease. Insect vectors of human disease are typically mosquitoes or fleas. It is important to realize that zoonoses may be contracted from both ill and apparently healthy animals. Transmission of zoonotic pathogens occurs through biological vector which

* Corresponding author
E-mail address: drmsarwar64@gmail.com

allows for multiplication e.g., mosquitoes that transmit West Nile virus. Mechanical vector is insect that carries pathogen on body surface or mouthparts or even within the gut but which does not allow for multiplication of the pathogen e.g., house flies. Some species of mosquitoes and fleas are able to transmit viruses, rickettsia, bacteria, parasites and fungi to humans. Sources of zoonoses include cattle, sheep, horses, pigs, dogs, cats, chickens, native birds, kangaroos, wild animals, rodents, rabbits, sheep, goats, reptiles (including turtles and tortoises) and bats (Gubler, 2009; Kulkarni et al., 2015; Sarwar, 2016).

Bacteria and viruses that are deadly to one type of creature can evolve quickly to infect another individual. While the swine flu outbreak is the latest example, a host of infectious and deadly diseases have hopped from animals to humans and from humans to animals. The cross-species infection can originate on farms or markets, where conditions foster mixing of pathogens, giving them opportunities to swap genes and gear up to kill previously foreign hosts. Or the transfer can occur from such seemingly benign activities as letting of a performance monkey on some street corner climb on human's head. Microbes of two varieties can even gather in human's gut, do some viral dancing and evolve to morph into a deadly, contagious host. Diseases passed from animals to humans called zoonoses are more than three dozen that can catch directly through touch and more than four dozen which result from bites (Glaser et al., 2000; James 2001; Sarwar and Sarwar, 2016).

2. Agents of Zoonotic Diseases

Agents of the infectious agents that cause zoonotic diseases include mainly bacterial agents and viral agents as stated following:-

2.1. Bacterial Agents

Bacterial agents are the etiologic means of cutaneous anthrax, murine typhus, plague, tularaemia and sleeping sickness.

2.1.1. Cutaneous Anthrax

Anthrax is a bacterial disease caused by *Bacillus anthracis*, which forms spores that survive for years in the environment. Cattle, sheep and goats are at the highest risk of developing anthrax, but other farm animals, as well as wildlife and humans, can contract the disease. Most animals are infected by oral ingestion of soil contaminated with anthrax spores. Peoples develop anthrax when the organism enters a wound in the skin, is inhaled in contaminated dust, or is eaten in undercooked meat from infected animals. Biting flies can transmit the bacterium, which results in redness and swelling at the bite site. The most common clinical sign in animals is sudden death, and blood may be seen oozing from the mouth, nose and anus of animals that have been died of anthrax. During an outbreak of sheep anthrax, the owner of a flock located about 3 km away from the affected farm developed skin lesions attributable to cutaneous anthrax. The DNA extracted from the human scabs confirmed the diagnosis and 15-loci multiple locus variable number tandem repeat analysis following single-nucleotide repeat analysis yielded the same genotype as that found in the dead sheep. The breeder, who has not contact with infected or dead animals, reported having been stung by gadflies. A vaccine for livestock is available in areas where anthrax is a common livestock disease. Animals suspected of dying from anthrax should be examined by a veterinarian immediately. Animals that have died of anthrax should be burned or buried deeply and covered with lime. The area should be thoroughly decontaminated with lime, as anthrax spores can survive in the soil for decades. Anthrax is prevented by avoiding of contact with animals that are suspected to have anthrax and areas that may contain bodies of animals that died from anthrax. Microorganisms could also be located on the outside surface of a vector (such as a fly) and spread through physical contact with food, a common touch surface, or a susceptible individual (Chin, 2000; Fasanella et al., 2013).

2.1.2. Murine Typhus Fever, Endemic Typhus or Flea-Borne Typhus

The murine typhus fever, endemic typhus or flea-borne typhus occurs worldwide, most commonly among peoples in contact with rats or areas where rats live. Disease also occurs among peoples who live near or have contact with other small mammals such as opossums. Endemic typhus fever is transmitted mostly by bite or faeces of rat flea (*Xenopsylla cheopis*). Rodents and fleas are perfect examples that can host or act as reservoirs of disease. Mainly the known infectious bacteria *Rickettsia typhi* or microorganism called *Rickettsia felis* or *Rickettsia prowazekii*, is shared between rodents and humans. Endemic typhus fever is not directly spread from person-to-person and rat fleas become infected when they feed on the blood of a rat with endemic typhus fever. Infected rat fleas pass infected faeces while taking a blood meal from a person. Peoples are disease-ridden when infected rat flea faeces come into contact with bite of an infected flea or small cuts on the skin. Disease may also be spread in the same way by cat fleas infected with endemic typhus fever caused by *R. felis*. Cat fleas probably become infected when they feed on the blood of opossums with endemic typhus fever. It is possible that endemic typhus fever may spread by breathing in dried infected rat flea or cat flea faeces. Symptoms of murine typhus include headache, chills

and fever with low case fatality rate, while common symptoms of endemic typhus fever include low-grade fever, mild headache, tiredness, joint pain and muscle aches. About half of peoples who are infected, develop a flat red rash that lasts only a short period of time. The diagnosis of endemic typhus fever is based on signs and symptoms of illness, as well as laboratory blood tests. A complete blood count (CBC) may show a low white blood cell count, anaemia and low platelets. Other blood tests for typhus may show high levels of typhus antibodies, low levels of albumin, low sodium level and mildly high liver enzymes. Endemic typhus fever is treated with antibiotics and there is currently no commercially available vaccine for endemic fever. Healthcare providers choose the antibiotic based on the patient's symptoms and the results of laboratory tests (Pitout and Church, 2004; Raoult, 2011; Blanton et al., 2014).

2.1.3. Plague

Black plague is actually part of a larger zoonotic disease simply called the plague; it is a bacterial disease of rodents that can spread to humans and other animals by infected fleas. There are three major forms of the disease, bubonic plague is an infection of the lymph nodes (black plague), pneumonic plague is an infection of the lungs, and septicaemia plague is an infection of the blood. The organism *Yersinia pestis* causes plague and rodents such as rats, spread the disease to humans. Peoples can get the plague when a flea that carries the plague bacteria from an infected rodent bites them. In rare cases, the disease may be get when handling an infected animal. Some other ways to get plague are by the bites of infected fleas, direct contact with the tissues or body fluids of a plague-infected animal, inhaling infectious airborne droplets from persons or animals, especially cats, with plague pneumonia, and laboratory exposure to plague bacteria. Bubonic plague is spread by flea bite (especially *Xenopsylla cheopis*) and pneumonic plague is spread from person to person (respiratory route). The signs and symptoms of the plague are, that bubonic plague symptoms appear suddenly, usually after 2-5 days of exposure to the bacteria. Symptoms include high fever; smooth, painful lymph gland swelling called a buboes, commonly found in the groin, but may occur in the armpits or neck; pain may occur in the area before the swelling; chills; general ill feeling (malaise); muscle pain; severe headache and seizures. Pneumonic plague symptoms appear suddenly, typically 2-3 days after exposure, and they include severe cough, frothy, bloody sputum and difficulty in breathing. Septicaemia plague may cause death even before the symptoms occur and symptoms can include abdominal pain, blood clotting problems, diarrhoea, fever, low blood pressure, nausea, organ failure and vomiting (Frean et al., 1996; Enria and Pinheiro, 2000).

The treatment for the plague is to diagnose it in time and plague is treatable with antibiotics. Treatment of suspected plague cases should start as soon as possible after the laboratory examinations of the specimen. Streptomycin is usually the antibiotic administered, but several other antibiotics are also effective. Plague can be prevented by do not feeding any rodent or rabbit species in the wild. When camping or hiking, do not hang around in rodent-infested areas. Do not catch, play with or attempt to hand feed wild rodents. Avoid contact with all sick and dead rodents and rabbits. Look for the presence of blowflies or dead animal smell as evidence of animal die-offs. While hiking, treat pants, socks, shoe tops, arms and legs with insect repellents. Insecticide powders or shampoos should be used on cats and dogs every few days while in plague areas. Cats sometimes exhibit swelling and sores around the mouth, head and neck when infected. Seek professional veterinarian care for such animals and do not handle suspiciously sick pets without gloves and face protection. Remember the incubation period of 2-6 days and consult a physician if sudden unexplained illness occurs within that period after activities in the outdoors (Ayyadurai et al., 2008).

2.1.4. Tularaemia

Tularaemia is a bacterial disease associated with both animals and humans. Many wild and domestic animals can be infected. The rabbit is most often involved in disease outbreaks, which hints at its alternate name, rabbit fever. Tularaemia is caused by the bacterium *Francisella tularensis*. The primary vectors are deer flies and ticks although it can also spread through other arthropods. The most known reservoir hosts include rabbits, prairie dogs, hares and muskrats. Peoples can get this disease mostly by being involved in outdoor activities. Some of the most common ways are bites from infected ticks, direct contact through the skin or mucous membranes with blood or tissue while handling infected animals (rabbit hunting), contact with fluids from infected deer flies or ticks, handling or eating insufficiently cooked rabbit meat, drinking contaminated water, inhaling dust from contaminated soil or handling contaminated pets or wild animals, and tularaemia is not spread from human to human. The signs and symptoms of tularaemia vary, depending on the route of introduction, cases of infection after handling an animal carcass (slow-growing ulcer at the site where the bacteria entered the skin usually on the hand, swollen lymph nodes), cases when the bacterium is inhaled (pneumonia-like symptoms, severe cough, frothy and bloody sputum, difficulty in breathing), and cases when the bacterium is ingested (sore throat, abdominal pain, diarrhoea and vomiting). Usual cases for tularaemia are treated with Streptomycin, Gentamicin, Tetracycline, Chloramphenicol, or Fluoroquinolones. Tularaemia can be prevented trough

avoiding drinking, bathing, swimming or working in untreated water where infection may be common among wild animals; using impermeable gloves when skinning or handling animals, especially rabbits; and cooking the meat of wild rabbits and rodents thoroughly. Few helpful hints to avoid being bitten by deer flies and ticks are checking of clothing often for ticks, wearing light-coloured long-sleeved shirts and long pants so the tiny ticks are easier to see, tucking long pants into socks and boots, and wearing a head covering or hat for added protection. For those who may not tolerate wearing all of these clothes in hot and humid weather, should apply insect repellent containing DEET. Be sure to wash treated skin after coming indoors. Walk in the centre of trails so that weeds do not brush against a person. Weeds serve good nesting locations for flies and ticks. Check oneself, children and other family members every two to three hours for ticks. Most ticks seldom attach quickly and rarely transmit tick-borne disease until they have been attached for four or more hours. If anyone lets the pets outdoors, check them often for ticks as infected ticks also can transmit some tick-borne diseases to them and check with veterinarian about preventive measures against tick-borne diseases. Make sure the property around home is unattractive to ticks, keep grass mowed and keep weeds cut (Sjostedt, 2007; Hepburn and Simpson, 2008).

2.1.5. Zoonotic Sleeping Sickness or Human African Trypanosomiasis

Unlike the other diseases described, whose distribution is worldwide, sleeping sickness or human African trypanosomiasis, is limited to the continent of Africa where its insect vector the tsetse fly, is found. There are two forms of sleeping sickness, the chronic gambiense form is found in Central and West Africa and although an animal can be found infected, the disease is maintained by transmission between the insect vector and humans. However, the animal reservoir is important in the acute rhodesiense form found in Eastern and Southern Africa. The causal agent, *Trypanosoma brucei rhodesiense*, infects humans, wild animals and domestic livestock, which maintain infection between epidemics, and coexists in animals with a complex of pathogenic trypanosomes (*T. congolense*, *T. vivax* and *T. brucei*) that present a major problem for livestock keepers. If untreated, the disease is always fatal in humans and devastating epidemics have occurred over the last century. Treatment is normally expensive and in the later stages of the disease treatment itself involves some 5% mortality. Control is via the vectors or the disease on human and livestock reservoirs. For rhodesiense, the key to preventing the disease in peoples is now thought to be by treating the cattle reservoir, using drugs which are effective not only against the trypanosomes pathogenic to humans, but also those which cause substantial losses to livestock production backed up by appropriate vector control measures (Lundkvist et al., 2004; Brun et al., 2010).

2.2. Viral Agents

The viral agents are responsible for much of the public health burden of Dengue Fever, West Nile Virus, Yellow Fever, Mayaro Fever, Eastern Equine Encephalitis Virus, Western Equine Encephalitis Virus, California Serogroup Viruses and Cache Valley Virus.

2.2.1. Dengue Fever

Dengue fever is a viral disease spread by the bite of infected mosquitoes. Its more sever and often fatal form is called dengue haemorrhagic fever. Dengue and dengue haemorrhagic fever are caused by any of the dengue family of viruses, Flaviviridae. Infection with one virus does not protect a person against infection with another. Dengue is spread by the bite of an Aedes mosquito containing the dengue virus. The mosquito transmits the disease by biting to an infected person and then biting someone else. In its incarnation, monkeys also serve as maintenance hosts and tree-hole breeding mosquitoes transmit it. According to medical news, dengue fever is the most common insect-borne virus infection, causing more than 50 million infections, cases of dengue haemorrhagic fever and deaths per year. Early symptoms of dengue fever include high fever, rash, severe headache, pain behind the eyes and muscle and joint pain. More sever signs include nausea, vomiting, loss of an appetite, dengue haemorrhagic fever symptoms, and bleeding from the nose, mouth and gums. There is no specific treatment for dengue and persons with dengue fever should rest and drink plenty of fluids. They should be kept away from mosquitoes for the protection of others. Dengue haemorrhagic fever is treated by replacing lost fluids and blood transfusions to control bleeding may be required for severe haemorrhagic symptoms. There is no commercially available vaccine for the dengue virus. Avoid mosquito bites by the use of mosquito repellents on skin and clothing. When outdoors during times the mosquitoes are biting, wear long-sleeved shirts and long pants tucked into socks. Avoid heavily populated residential areas, as this increases the chance of transmission from person to person. When indoors, stay in air-conditioned or screened areas. Use bed nets if sleeping areas are not screened or air-conditioned. Eliminate mosquito breeding sites in areas where dengue might occur by eliminating mosquito breeding sites around homes, discard items that can collect rain or run-off water, especially old tires, and regularly change the water in outdoor bird baths, pet and animal water containers (Sarwar, 2014 a; 2014 b; 2014 c; 2015 a).

2.2.2. West Nile Fever

West Nile is a virus of the family Flaviviridae that spreads by the bite of infected mosquitoes. Peoples get West Nile disease from the bite of the *Culex pipiens* complex mosquito that is infected with West Nile virus. A mosquito becomes infected by biting a bird that carries the virus. West Nile virus is not spread by person-to-person contact or directly from birds to peoples. Most peoples who are infected experience mild signs such as fever and headache. More sever signs include (usually elderly individuals) West Nile encephalitis (inflammation of the brain). There is no specific therapy for West Nile disease and in more severe cases, intensive supportive therapy (hospitalization, intravenous (IV) fluids, airway management, respiratory support (such as ventilators) are used. Prevention of secondary infections (pneumonia, urinary tract etc.,) is also optional. The best way to prevent West Nile disease or any other mosquito-borne illness is to reduce the number of mosquitoes around the home and neighbourhood, and to take personal precautions to avoid mosquito bites. Some suggestions are avoiding of being outdoors when mosquitoes are most active, especially between dusk and dawn. When outdoors, wear shoes and socks, long pants and a long-sleeved shirt, and apply insect repellent or oil of lemon eucalyptus according to label instructions. Consult a physician before using repellents on infants. Make sure that doors and windows have tight-fitting screens and repair or replace screens that have tears or other openings. Try to keep doors and windows shut, especially at night. Eliminate all sources of standing water that can support mosquito breeding, including water in bird baths, ponds, flowerpots, wading pools, old tires and any other receptacles. In communities where there are organized mosquito control programs, contact municipal government to report areas of stagnant water in roadside ditches, flooded yards and similar locations that may produce mosquitoes. Of the zoonotic mosquito-borne viruses this is the best known transmitted from birds to humans via the bite of an infected mosquito, also transmissible through blood transfusion, and tissue and organ transplantation. Mosquitoes of the genus Culex are the most common vectors, most human infections cause no illness, while about 20% suffer from fever, and less than 1% experience severe neurological disease including meningitis and encephalitis (Fearon, 2011; Sejvar, 2014).

2.2.3. Yellow Fever

Yellow fever is a tropical disease and peoples get fever from the bite of a mosquito that is infected with the Flaviviridae family of viruses, more specifically the yellow fever virus. The main source of yellow fever is infected mosquitoes mainly the *A. aegypti,* but non-human primates (monkeys) can also be infected with the yellow fever virus, which allows for the virus to remain present in the absence of human hosts. Many yellow fever infections are mild, but the disease can cause severe life-threatening illness. Symptoms of severe infection are high fever and chills, headache, muscle aches, vomiting and backache. After a brief recovery period, the infection can lead to shock and bleeding, and kidney and liver failure. Liver failure causes jaundice (yellowing of the skin and the whites of the eyes), which gives to yellow fever its name (Chastel, 2003; Soghaier et al., 2013).

There is no specific treatment for yellow fever and persons with yellow fever should rest and drink plenty of fluids. They should be kept away from mosquitoes for the protection of others. Individuals with a healthy lifestyle and a good immune system usually get better after a long recovery period. Yellow fever can also be prevented by vaccination. Travelers should also take precautions against mosquito bites when in areas with yellow fever transmission. Travelers should get vaccinated for yellow fever before visiting areas where yellow fever is found. International regulations require proof of yellow fever vaccination for travel to and from certain countries. Peoples who get vaccinated should be given an international certificate of vaccination. Mosquitoes that spread yellow fever usually bite during the day and travellers should take steps to reduce contact with mosquitoes when outdoors and inside. When outside wear long-sleeved clothing and long pants, and for extra protection, treat clothing with the insecticide permethrin and use insect repellent on exposed skin. The most effective repellents contain 20% to 35% N, N-diethylmethyltoluamide and follow application instructions carefully when using these products. When inside stay in well-screened areas as much as possible, spray living and sleeping areas with insecticide, use a bed net when sleeping in a room that is not screened or air conditioned, and for extra protection, treat the bed net with the insecticide permethrin (Barrett and Higgs, 2007).

2.2.4. Mayaro Fever

Mayaro virus disease is a mosquito borne zoonotic pathogen endemic to certain humid forests. Infection with Mayaro virus causes an acute, self-limited dengue-like illness of 3-5 days duration. The causative virus belongs to the family Togaviridae and genus Alphavirus. It is closely related to other alphaviruses that produce a dengue-like illness accompanied by long-lasting arthralgia. The infection is characterized by fever, headache, myalgia, rash, prominent pain in the large joints and association with rheumatic disease, but these signs and symptoms are unspecific to distinguish from other arbovirus. The infection can be confirmed by laboratory testing such us virus isolation, RT-PCR and serology. The virus isolation in cell culture is

effective during viremia. The RT-PCR helps to identify virus, serology tests detect antibodies like IgM and the most common assay is IgM-capture enzyme-linked immunosorbent assays (ELISA). This test usually requires a consecutive retest to confirm increasing titters, while the IgG detection is applied for epidemiology studies. Research has suggested that macrophage migration inhibitory factor plays a critical role in determining the clinical severity of alphavirus-induced musculoskeletal disease and may provide a target for development of antiviral pharmaceuticals for Mayaro virus and other arthrogenic alphaviruses, such as Ross River virus, chikungunya, Sindbis virus, and O'nyong'nyong virus (Hayes et al., 1999; Hassing et al., 2010).

2.2.5. Western Equine Encephalitis Virus

Western equine encephalitis virus belongs to the genus Alphavirus in the family Togaviridae. Togaviridae also encompasses Eastern equine encephalitis and Venezuelan equine encephalitis. Western equine encephalitis virus is of historic importance with epidemics recorded wherein the health consequences of human infection with these mosquito borne viruses range from mild febrile illness to severe neurological disease; the latter may result in long-term neurological sequelae or death. As with is West Nile virus, the endemic mosquito-borne viruses differ in their geographical distribution, which is influenced by the distributions of their main mosquito vector species, animal reservoir hosts, and of environmental conditions suitable for transmission. Western equine encephalitis is spread primarily by the vector mosquito *Culex tarsalis*. Other mosquitoes (e.g., Aedes species) and occasionally, small, wild mammals also have been known to spread this virus (Artsob, 2000; Zacks and Paessler, 2010).

2.2.6. California Serogroup Viruses

Recently, enhanced testing for California serogroup, virus-associated disease has resulted in the identification of new neuroinvasive and non-neuroinvasive cases associated with these bunyaviruses. Widespread exposure to these viruses in wildlife populations has been demonstrated e.g., seroprevalence data suggest that deer have been infected, but there have been rare reports of human infection. Studies have found up to 10% seroprevalence of California serogroup viruses in residents of local communities. Importantly, such studies demonstrate that infection of humans with California serogroup may be occurring, and suggest that viruses may be contributing to an under recognized burden of disease during the mosquito season (Makowski et al., 2009; Drebot et al., 2010).

2.2.7. Eastern Equine Encephalitis Virus

Eastern equine encephalitis virus is found along the gulf and coasts, as well as with human cases reported. But, no autochthonous human cases of Eastern equine encephalitis virus have been reported in few places to date, although the mosquito vector *Culiseta melanura*, has been reported and the virus has caused periodic outbreaks in horses and exotic domestic bird populations e.g., pheasants and emus (Iranpour et al., 2009; Kramer et al., 2012).

2.2.8. Cache Valley Virus

Cache valley virus has been documented to cause congenital defects in livestock, but cases of virus-associated neurological disease in humans have been reported. Cache valley virus, in common with California serogroup virus in most jurisdictions, has been detected in mosquitoes. Cache valley virus infections in livestock have been noted and are associated with lamb (Dimitrova et al., 2011; Nguyen et al., 2013).

California serogroup and Cache valley viruses are arboviruses (mosquito-borne pathogens) belonging to the genus Orthobunyavirus (Family Bunyaviridae). Although the majority of exposures to these viruses result in asymptomatic or mild infections, both California serogroup and Cache valley viruses can cause febrile and neurological diseases similar in nature to those associated with infections by West Nile virus. California serogroup and Cache valley viruses are widely distributed and circulate in a number of vertebrate hosts and mosquito vectors, including several species of Aedes and other non-Culex mosquitoes. The Jamestown canyon and snowshoe hare viruses are the most common kind of California serogroup viruses, and these potential pathogens may be contributing to a higher burden of illness than previously recognized and should be considered as part of the differential diagnosis for febrile and neuroinvasive disease during the mosquito season (Drebot, 2015).

Emergence of vector-borne zoonotic diseases in new regions is caused primarily by pathogens movement due to trade and travel, whereas local emergence is driven by a combination of environmental changes that affect vectors and wildlife hosts and social changes (poverty and conflict) that affect human exposure to vectors. Pathogens introduced into novel regions often cause explosive epidemics followed by declining incidence, whereas pathogens that emerge locally because of land-use or social changes usually show consistent increases. Vector-borne diseases are highly sensitive to climate, but the past and future effects of climate change on vector-borne disease will probably be less than will those of changes in land use and social factors. Land use and increasing human populations exert selective pressure on vector-borne pathogens to be able to infect and be transmitted by peoples

and vectors associated with human development. Control of vector-borne zoonotic diseases needs combined efforts by clinicians and public health officials to treat patients and promote behaviour likely to minimize risk of infection, and by disease ecologists, urban planners, and medical entomologists to advise on development, restoration of ecological communities, and vector control to reverse the ecological drivers of transmission (Jay et al., 2005; Romero and Newland, 2006).

3. Protecting of Peoples from Zoonotic Diseases

For protecting peoples from zoonotic diseases, human, animal and vector contacts investigation and a search for the source of the infection should be initiated. Prevent access from mosquitoes to patient for at least 5 days after the onset of disease symptoms (screening the sickroom, spraying quarters with residual insecticide, and using insecticide-treated bed-nets). Disinfect the homes of patients promptly with an effective insecticide, and also disinfect the homes of all contacts as well as homes in the general vicinity promptly with an effective insecticide. Family, neighbours and all other contacts who have not been immunized should be vaccinated promptly. Investigation on of source infection, inquire about all contacts and all places including travel history and forested areas visited by cases, and observe other peoples visiting that area. Search places such as the home, place of residence and visiting premises of the case/ patient within several days for mosquitoes capable of transmitting the disease. Apply effective insecticide and investigate unexplained illness/ deaths that may suggest illness (Sarwar, 2015 b; 2015 c; 2015 d).

Peoples must take the precautions and familiar to minimize their risk of infection from the incidence about zoonoses. Infectious diseases, many of which are zoonotic (transmitted from animals to people), remain a major cause of illness and death throughout the world. New infectious pathogens and disease are being detected, and some diseases seemingly under control have re-emerged in recent years. Accounting for more percent of infectious diseases and emerging diseases, zoonotic diseases pose a public health threat with the potential to cause large-scale outbreaks. The zoonotic disease program protects the public by reducing risks to zoonotic diseases and responding to public health emergencies involving zoonoses. To accomplish this, it needs to work in partnership with federal, state and local agencies, and local health departments in particular. In collaboration with these partners, the program focuses on activities to monitor incidences of zoonotic disease in wild and domestic animals and in the environment, educate and train public health professionals on prevention and control, prepare and respond to outbreaks and zoonotic-related emergencies, create public awareness through the media and development of educational materials, and strengthen regulation and policies for prevention of zoonoses (Weaver and Reisen, 2010; Kilpatrick and Randolp, 2012).

The zoonotic disease program should collaborate closely with numerous local, state and federal partners in efforts to provide state-wide surveillance for West Nile virus. Local involvement, particularly by local health departments and mosquito control, is crucial to effectively monitor viruses and ensure a timely response in communities at increased risk. The subsequent program activities can help to support local partners in addressing viruses, identify and test mosquito populations, provide online reporting of dead bird sightings, test suspected dead birds, coordinate environmental surveillance data where information is shared among partners, create public educational materials for use by the media and partners, and provide online information on current viruses activity and prevention messages (Weiss, 2001; Schlundt et al., 2004; Sarwar et al., 2017).

4. Conclusion

Vector borne diseases are illnesses that are transmitted to humans by an animal (the vector). Classically, the term vector is restricted to arthropods like mosquitoes, however, it is often used to refer to any animal that can transmit a pathogen to a human host. Most vector borne diseases are also zoonotic diseases that are originating in animals, although some, like yellow fever and malaria, are transmitted from human to human. Recent concerns have focused on West Nile Virus and now avian influenza. While most strains of avian influenza are not pathogenic to human, today's news is filled with reports of the spread of H5N1 avian influenza in poultry, and its ability to infect humans. While zoonotic and vector borne diseases occur at a relatively low rate, but chronic conditions can also be linked to animals, for instance, reports found sufficient evidence to suggest a causal relationship between exposure to house dust mite allergen and development of asthma in susceptible children. It has been also found some evidence to link asthma's development with exposure to cockroach allergen in preschool-aged children. In addition to the priority of emerging diseases, there is a need for enhanced surveillance to detect other emerging diseases and those with potential for introduction through international travel and trade. To decrease the risk of infection, education about these viruses or pathogens and the importance of personal preventive measures are warranted.

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