World Journal of Zoology 3 (2): 71-76, 2008
ISSN 1817-3098

Emerging and Re-Emerging Zoonoses

[1]E. Zowghi, [1]M. Bayat, [2]A. Kousha and [3]M. Nissiani

[1]Department of Medical and Veterinary Mycology,
Science and Research Branch, Islamic Azad University - Iran
[2]Islamic Azad University Ghaemshahr Branch, Iran
[3]Islamic Azad University Tehran Shomal Branch, Iran

Abstract: After world war II it was widely believed that human-kind was winning the battle with the microbial world due to the advent of safe and antimicrobial compounds against diseases, such as tuberculosis, typhoid and so on, vaccine against polio, diphteria and pertusis, vast improvements in public sanitation and water/food quality and effective chemical pesticides to control insect vectors of disease. Many elements can contribute to the emergence of a new zoonotic disease, including microbial / parasitical / virologic determinants, such as mutation, natural selection and evolutionary progression; individual host determinants, such as acquired immunity and physiologic factors; host population determinants, such as host behavioral characteristics and societal, commercial and iatrogenic factors; and environmental determinants, such as ecologic and climatologie influences. In general, there is no way to predict when or where the next important new zoonotic pathogen will emerge or what its ultimate importance might be. A pathogen might emerge as the cause of a geographically limited curiosity, intermittent disease outbreaks, or a new epidemic. No one could have predicted the emergence or zoonotic nature of the BSE prion in cattle in the U. K. in 1986, the emergence or zoonotic potential of Sin Nombre Virus as the cause of hantavirus pulmonary syndrome in the southwest U. S. A. in 1993 and certainly not the species-jumping emergence of HIV as the cause of AIDS in 1981.

Key words: Mocrobial · Emerging · Zoonotic patogen

INTRODUCTION

In 1969, the United States Surgeon General William H. Stewart even declared to the congress that: "it is time to close the book on infectious diseases, declare the war against pestilence won"[1].

However, word wide infectious and parasitic diseases still cause untold suffering and exact an enormous physical, economic and social toll on human existence, causing 33% of deaths world-wide, with more than half of the victims under the age 5 years. But the figure is much higher in developing countries. Foe example, in Africa it is estimated that 68% of all deaths are the result of infectious diseases. The actual burden of infectious disease deaths and illness may even be higher as an increasing body of evidence indicates that infectious agents may play a significant role in the etiolog of a wide range of chronic disease conditions, including cardiovascular disease, chronic pulmonary disease, arthritis and cancer.

In 1992, "new, reemerging or drug-resistant infectious whose incidence in humans has increased within the past two decades or whose incidence threatens to increase in the near future" were defined as "Emerging Infections". Previously, zoonoses were defined as "The diseases and infections which are naturally transmitted between vertebrate animals and man" (WHO, 1959). After that, who noted "zoonotic diseases caused either by totally new or partially new agents, or by microorganisms previously known, but now occurring in places or in species where the disease was previously unknown" as Emerging and re-emerging zoonoses (meslin, WHO. 1992).

While a significant of the burden of human illness due to infectious agent is the result of well-known infectious agent with human reservoirs, the majority of infectious agent known to afflict human are zoonotic. Zoonoses are diseases of animals that can also infect humans. Taylor et al catalogued 1709 species of infectious agents reported to cause disease in humans, including

Correspondig Author: M. Bayat, Department of Medical and Veterinary Mycology, Science and Research Branch, Islamic Azad University - Iran

viruses, prions, baeteria, rickettsia, fungi, protoza and helminthes in the year 2000. Of these, 832 (49%) are considered zoonotic and 156 (9%) are considered "emerging" disease, 73% (114) of which are zoonotic.

One year later he and his eolleagues reclassified the human infectious agents and noted 1415 sepecies of the agents, of those, 868 (61%) are considered zoonotic and 175 (12%) are considered "Emergent" diseases, 75% (132) of which are zoonotic.Thus, while a majority of infectious agents affectiong humans are zoonotic, an even greater majority of emerging agents are zoonotie. Animals not only serve as a significant reservoir for agents infectious to humans, but also serve as a wellspring of new infectious agents introduced into the human population.

In general, an emerging disease is either new to science or is an existing disease with incidence increasing in a given place or population, such as West Nile Virus (WNV) in north ameria (an agent which gains the ability to infect new hosts), the highly pathogenie $H_5 N_1$ avian influenza (which has caused hundreds of human cases in several countries since 1997 and 2004), or agents which evolve into new strains, such as the various antibiotic resistant strains of staphylococcus aureus1.In the past four decades, emergen disease episods have increased in many countries of the world. High profile examples of emerging diseases include the human immunodeficiency virus (HIV), Ebola virus, severe acute respiratory syndrome (SARS) virus, the highly pathogenic $H_5 N_1$ avian influena virus, bovine spongiform encephalopathy (BSE-mad cow disease), antibiotic resistant staphylococcus aureus and antibiotic rersistant mycobacterium tuberculosis. A preponderance of these agents are either directly zoonotic or, like HIV, have zoonotic origins. While the number of people affected by some of these agents in small, others inflict significant medical, social and economic burdens. The list of important emergent diseases is impressive indeed and, given what we know about disease ecology, it will only continue to grow. Nearly all of these emergent disease episodes have involved zoonotic infectious agents, that is, they have involved the transmission of the etiologic agent to humans from an ongoing reservoir life cycle in animals or arthropods, without the permanent establishment of a new life cycle in humans. Fewer episodes have involved species-jumping by the etiologic agent; that is, they derive from and ancient reservoir life cycle in animals but have subsequently established an new life cycle in humans that no longer involves an animals reservoir.

Some Major Bacterial Etiologic Agents of New Zoonoses Identified since 1976 Are:

1976	*Capnocytophaga canimorsus*
1977	*Campylobacter* Spp.
1982	*E. coli* O157: H7
1982	*Borrelia burgdorferi* (Lyme disease)
1983	*Helicobacter pylori* and other Spp.
1986	*Ehrlichia chaffeensis* (human monocytic Ehrlichiosis-HME)
1992	*Bartonella henselae* (cat serateh disease-CSD)
1994	*Rickettsia felis* (murine typhus like)
1994	*E. equil A. phagocytophila* (HGE-human Granulocytotropic Ehrlichiosis)

Also, Some Major Viral Etiologic Agents of New Zoonoses Identified since 1990 Are:

1991	Guanarito virus (Venezuelan hemor. fever)
1993	Sin nombre virus (Hantavirus pulm. syndr.)
1994	Sabia virus (Brazilian hemor. fever)
1994	Hendra virus (Equine morbilivirus)
1996	Anstralian bat lyssavirus (Rhabdovirus)
1997	Menangle virus (Paramyxo virus)
1997	Influenza virus $H_5 N_1$ (Hongkong)
1998	Nipah virus (Paramyxo virus)
1999	Influenza virus $H_9 N_2$ (Hongkong)
2002	SARS virus (Corona virus) (Severe Acute Respiratory Syndrome)

Disease Emergence: Many elements can contribute to the emergence of a new zoonotic disease, including microbial/ parasitical/virologic determinants, such as mutation, natural selection and evolutionary progression; individual host determinants, such as acquired immunity and physiologic factors; host population determinants, such as host behavioral characteristics and societal, commercial and iatrogenic factors; and environmental determinants, such as ecologic and climatologie influences[6].

The Institute of Medicine (IOM), in its 2003 publication Microbial Threats to Health: Emergence, Detection and Response, proposes a "Convergence model" of infectious disease emergence, which consists of four broad domains of factors that influence pathogen/ host interactions and the resulting emergence of new diseases.

These Four Are:

- Genetic and Biologic factor,
- Physical and Environmental factors,

- Ecologic factors and,
- Social, Political and Economic factors. Within these 4 broad domains, the IOM identifies 13 more specific factors, that belong to one or more of these domains.

These Specific Factors Consist Of:

- Microbial Adaptation and Chang,
- Human Susceptibility to Infection,
- Climate and weather,
- Physical Events,
- Changing Ecosystems,
- Economic Development and Land use,
- Human Demographics and behavior,
- Technology and Industry,
- Internatiol Travel and Commerce.
- Breakdown of Public Health Measures,
- Poverty and Social inequitly,
- War and Famine and
- Lack of Political will.

In addition, the factor of intent to harm by Bioterrorism (such as, the 2001 anthrax terrorist attacks in the United State) should be added.

Emergence of new zoonotic pathogens seems to be accelerating for several reasons, including global human and livestock animal populations have continued to grow, bringing increasingly larger numbers of people and animals into close contact; transportation has advanced, making it possible to circumnavigate the globe in less than the incubation period of most infectious agents; ecologic and environmental changes brought about by human activity are massive; and bioterroristic activities, supported by rogue governments as well as organized amateurs, are increasing and in most instances the infectious agents of choice seem to be zoonotic [6].

In general, there is no way to predict when or where the next important new zoonotic pathogen will emerge or what its ultimate importance might be. A pathogen might emerge as the cause of a geographically limited curiosity, intermittent disease outbreaks, or a new epidemic. No one could have predicted the emergence or zoonotic nature of the BSE prion in cattle in the U. K. in 1986, the emergence or zoonotic potential of Sin Nombre Virus as the cause of hantavirus pulmonary syndrome in the southwest U. S. A. in 1993 and certainly not the species-jumping emergence of HIV as the cause of AIDS in 1981. Consequently, investigation at the first sing of emergence of a new zoonotic disease is particulary important, although the investigation usually resembles a field - and laboratory – based research project rather than a typical case – control – based outbreak investigation. This reality must drive strategic planning for dealing with new zoonotic diseases.

The factors and mechanicsms discussed above have likely affected the emergence, distribution and prevalence of zoonotic diseases in the world. In relation to factors including environmental and distributions to the balance of natural habitats, human demographice and behavior, international travel and commerce, complications of modern medicine, microbial adaptation and change and the breakdown of publie health measures, zoonotic diseases emerge. Some emerging diseases are associated with environmental changes that occure with economic or agricultural development or changes in land use patterns. Certainly, the development and growth of cities fueled by an influx of migrants can foster the establishment of a new infection in a population. Once established in a crowded urban area, a disease can easily take root and can be extremely difficult to eradicate. Other human activities that disturb natural ecosystems, including road – building, logging and irrigation projects, can also bring humans into new areas while displacing microbes that must then seek out new hosts. Changes in local climate, such as drier, wetter, or warmer periods, can extend the range of mosquitos and other disease vectors.

On other hand, in areas where populations are rapidly rxpanding beyond the capacity of the local water / food supplies, waterborn / food born infections can be expected to create serious outbreaks of disease. Bacteria, viruses and parasites can all thrive in untreated or inadequately treated water system by contaminated feces. In 1993, U. S. experienced one of the largest outbreaks of wsaterborne disease ever reported. An extimated 403,000 people in the Milwaukee. Wisconsin, area were stricken with zoonotic cryptosporidiosis, a parasitic infection that causes severe diarrhea and is found inereasingly in unfiltered raw watter. Of the 44,000 people who sought medical attention in the city, more than 4,000 had to be hospitalized. City public health officials surmise that heavy rains, snowmelt and runoff from nearby farms may have overloaded the city's water treatment plants. Cryptosporidia are resistant to chlorine and must be removed from water supplies by mechanical filtration. Also, food-related illnesses and death in the world are increasing. In the U. S., it is estimated that annually food borne diseases cause approximately more than 76 million illnesses, 325,000 hospitalizations and 5000 deaths (CDC, 1999). Some of the factors that contribute to the epidemiology of food borne diseases are: diet, commercial food service, new methods of food production, new or reemerging infectious agents, ethnic preferences and "high-risk" populations, especially increase of immuno-compromised individuals (up-to 20%). Also, factors associated with the "Globalization" of food-borne diseases include, water, animal feeds and manures, workers, transportation, rodents, other wildlife, insects and food processing[11]. Some of these diseases will be discussed in briefly below.

Hantavirus – Hanta virus, one of the newest diseases, causes different symptoms (such as hemorrhagic fever, adbdominal pain, or respiratory infection) depending on the strain of the virus. It appears in areas where litter and trash abound and rats and mice nest[12]. More than 100,000 cases have been reported in China. The disease is also found elsewhere in Asia and in Scandinavia, the Balkan region, much of Europe and recently in the United States[12].

The recent hantavirus outbreak in the Southwestern United States has been linked to a change in ecologieal conditions. The strain that hit New Mexico in 1999 causing a frequently lethal respiratory infection was transmitted by inhalation of airborne droplets of rodent urine and feces. Between 1999 and 1993, an unusually wet and mild winter led to increased adult rat and mouse survival and, in turn, an inereased rodent population in the spring. As competition forced the rodents beyond their normal habitat in search of food, human contact with infected animals (and, hence, with the virus) also increased [13].

For the United States as a whole, as of June 1995, the CDC had confirmed 110 cases in 23 states, 50.9 pereant of these were fatal. Now that tests that can diagnose hantavirus infection are available, it is clear that infection is more wide spread than was initially expected and that the virus has probably been around for a long time [14]. In 1997, more than 164 cases in U. S. and more than 400 in Americas with mortality rate 45% had been confirmed.

Rift Valley Fever (RVF) – Some infectious diseases have been linked-to the ecological changes brought about by dam construction; dams change the water flow and can cause water to puddle and serve as breeding sites for mosquitos. In Senegal, the construction and activation of Diama Dam are believed to have led to the introduction of RVF, a disease never before seen in the region. Surprisingly, one third of inhabitants were found to have antibodies to the virus. Still, near the village of Keur Mecene upstream from the dam, 1987 epidemic caused 244 human deaths and more than 1,200 illnessesm, as well as spontaneous abortion in sheep and cattle [14].

Dengue – Dengue virus, which is now the most important and fastest growing insect – borne viral infection in the world, is tran smitted primarily by the Aedes aegypti mosquito. The mosquito vector that transmits dengue multiplies in any small pool of stagnant water, especially in discarded tires or other detritus that result from life in overcrowded urban areas. The disease, also known as "break – bon fever", produces severe headaches and disabling pain in muscles and joints. A far more serious form of the disease, hemorrhagic dengue fever or dengue shock syndrome, has a 40 to 50 percent fatality rate if it is left untreated [15].

In 1993, some 23.000 deaths from dengue and 250,000 cases of dengue were officially reported to WHO, a substantial increase over previous years. During the 1960s, dengue typically averaged about 30,000 cases per year, from 1985 through 1989, nearly 1 million cases were reported. However, even these numbers are likely to be underestimates, for every confirmed case of dengue, officials suspect that there are four additional cases that have either not been reported or have been misdiagnosed. In poor urban areas in the tropics, where mosquito-control programs are sparse of nonexistent, dengue is becoming an enormous problem. In Southeast Asia, dengue hemorrhagic fever (and dengue shock syndrome) is one of the leading causes of hospitalization and death among children. In many parts of the Latin America, dengue has reached epidemic proportions, even though the disease was belived to have been nearly eradicated in the 1960s. In addition, hemorrhagic dengue fever is increasing in incidence. Brazil has been hardest hit, with 88,039 confirmed cases of dengue and 105 cases of hemorrhagic dengue fever in the first 9 months of 1995, the year's unusually long wet season and high number of hurricanes are believed to be contributing to the severity of the epidemic, providing fertile breeding grounds for the Aedes aegypti mosquito[14].

Ebola virus – If the public needed a reminder that a deadly, infectious disease could emerge at any moment, they got one in the spring of 1995. Reports began trickling out of the city of Kikwit, zair, that the local hospital was being swamped with cases of hemorrhagie fever. Both WHO in Geneva and the CDC in Atlanta sent teams of expets to evaluate the outbreak, but even as the teams were arriving in Kikwit, blood samples that had been sent to the CDC confirmed that the illness was caused by the Ebola virus[16].

Although extremely deadly, the Ebola virus is not easily transmitted. Close contact with blood or other body fluids appears to be necessary. The CDC and WHO teams trained local health workers in proper infection control procedures, including the use of masks and gloves and the need to sterilized needles and surgical instruments.

Local Red Cross warned people not to perform a traditional burial ritual, which would expose them to infected body fluids. After several nervous weeks, WHO officials appeared confident that the epidemie was under control, although nearly 250 people died in the outbreak [17]. Health officials were especially relieved that the epidemic did not spread to Kinshasa, the capital city of 4 million less than 250 kilometers away.

But it certainly could have. The Ebola virus outbreak appears to have begun in the winter of 1994 – 1995, but it was not recognized until several months later. The illness has an incubation period of up to 3 weeks, although it may often be 1 week or less. During this time, the patient has no sympotoms. It is easy enough to imagine a truck driver or riverboat captain becoming infected and bringing the disease into the capital before showing any symptoms and then swiftly spreading the disease to others. If the disease had not been recognized promptly when the patients began showing symptoms and were therefore most infectious, the capital could easily have had a public health disaster on its hands. And the disease could even conceivably have spread to other parts of the world via air travel.

The illness caused by the Ebola virus in just one of a number of new diseases such as Hantavirus that has emerged in recent years or that has "reemerged" in a new location or a more dangerous form. This phenomenon has sparked alarm among health officials worldwide. Although new diseases like that caused by the Ebola virus capture headline, the death toll from the latest outbreak fortunately remained in the hundreds.

West Nile Virus (WNV) – The West Nile Virus arrived in Texas, U. S. A, in 2002, first in the mosquito vector and avian reservoir populations, then spilled over into equine and human populations. Temperature, rainfall, human behavior and living conditions, immunologic naively within the animal and human populations, land sue and other factors play a role in the ongoing distribution, prevalence and incidence of this disease. For example, clogged pain gutters, storm drains and other water-collectiong items associated with urban and suburban environments create extensive breeding habitats for Culex quinquefaciatus, the predominant mosquito vector species of WNV in the eastern and southern portions of Texas. Irrigation canalas in the El Paso area and the Texas Panhandle provide increased breeding habitat for Culex tarsalis, the predominant vector of WNV in those areas. Socio economic, cultural and behavioral factors, among others, also affect the incidence of WNV infection [2,18,19].

Equine morbillivirus (EMV) – In 1994, horses on a property in Queensland developed acute pespiratory distress with hemorrhagic manifestation – 14 of 21 infected horses died. A horse trainer and a stable – hand becam ill after nursing a sick horse – the trainer died. The disease was found to be caused by a previously unknown morbilivirus. Remarkably, in 1996 fruit bats (flying foxes) were found to be the natural host of the virus[6, 20].

Venezuelan Equine Encephalitis (VEE) – In 1971, as the virus of VEE crossed from Mexico into Texas, agricultural disease control authorities were prepared to start shooting and burying horses in a massive slaughter campaign. Scientist from CDC and the Middle America Research Unit (at the time a Unit of National Institutes of Health) provided the virologic and epidemiologic base to override the sanitary rifle strategy of agricultural authorities and the U. S. Army provided its then new TC83 vaccine. But, again in 1995, VEE epidemis had progressed from Venezuela and Colombia and jumped over the north[6].

Monkeypox virus In 2003, a Texas animal dealer imported a large shipment of wild – caught animals, primarily rodents, from Ghana in west Africa. An unknown number of these animals were infected with Monkeypox Virus, an ortopoxvirus closely related to Smallopox. A second animal dealer purchased some of these animals, transporting them to Iowa in an enclosed van with wild – caught prairie dogs. The prairie dogs became infected with monkeypox and were the sold or bartered to the public throughout several states, leading to 72 probable and confirmed cases of monkeypox in humans. This outbreak illustrates the risk of disease translocation associated with the international trade in animals and animal products[2, 6].

BSE Prion – Bovine Spongiform Encephalopathy (BSE) was first diagnosed in the united kingdom in 1986, as of 1997, more than 170,000 cattle had been reported as infected, but modern statistical methods have indicated that about one million cattle had been infected, roughly half of which entered the human food chain in the U. K. In 1995, the BSE agent "prion" was reported to be the cause of a new human zoonotic disease, new-variant Creutzfeldt – Jakob disease[6].

CONCLUSION

In addition to examples mentioned above, many emerging and reemerging infections are zoonoses that have emerged because *Homo sapiens* and its domestic animals are coming into contact with infectious agents that they haven't had contact with before or those we haven't seen for a long time. In all cases, one of the most important points is the need for greater epidemiologic resources and better trained professional for dealing with human and animal diseases or with the zoonotic interface between the two. This training component requires consideration of all steps along the discovery to control continuum. Finally, in 1934, Hans Zinsser, an eminent professor of bacteriology at Havrard University wrote in his book "Rats, Lice and History": "Infectious disease is one of the few genuine adventures left in the world. The dragons are all dead and the lance grows rusty in the chimney corner. About the only sporting proposition that remains unimpaired by the relentless domestication of a once free living human species is the war against those ferocious little follow creatures, which lurk in the dark corners and stalk us in the bodies of rats, mice and all kinds of domestic animals, which fly and crawl with the insects and waylay us in our food and drink and even in our love". Which is still true?

REFERENCES

1. Nelson, R., 2003. Antibiotic development pipline runs dry. lanceset, 362: 1726-1727.
2. Fonken, E., 2008. Mechanisms of disease emergence. The Epilink Vol. 65 / No. 3 / April 14,2008.
3. Microbial threats to health, 1992. Institute of Medieine Press U. S. A. 1992.
4. Taylor, L.H. and M.E.J. Woolhouse, 2000. Int. Conf. Emerg. Infect. Diseases. Attlanta, GA, USA, July 16-19, 2000.
5. Taylor. L.H., S.M. Katham and M.E. Woolhouse, 2001. Risk factors for human disease emergence. Philos. Trans. R. Soc. Lond. Biol. Sci., 356: 983-9.
6. Murphy, F.A., 1998. Emerging Zoonoses. Emerging infectious disease, 4(3): 429-435. Updated 2008.
7. Microbial Threats to Health, 2003. Emergence, Detection and Response, Institute of Medicine of the National Academies of Sciences, National Academies Press, 2003.
8. Stephen, S.M., 1990. Regulating viral traffic. Issues in Science and Technology, 7(1): 84.
9. Wilson, M.E., 1995. Anticipating new diseases. Current issues in public Health, 1: 90-94.
10. CDC and prevention 1994. Addressing Emerging Infectious Disease Threats. Morbidity and Mortality report. 43(5): 1994.
11. Chomel, B.B., 2002. Control and Prevention of Emerging Zoonoses. Agena for Action: Veterinary Medicine's Role in Biodefense and Public Health (AAVMC). Washington, DC. Nov. 1-3.
12. Leduc, J.W. *et al*. 1993. Hantaan (Korean Hemor. Fever) and related rodent Zoonoses, in: Emerging viruses. Stephen S.morse ed. (Oxford University Press), New York, 1993, pp: 149-158.
13. Stephen S. Morse, 1995. Factors in the Emergence of Infectious diseases. J.E.I. D. Vol. 1 No. 1. (Jan, 1995), pp: 7-15.
14. World Resources, 1996-97 1997. The urban environment. World resources institute, U. N. E. P, U. N.D.P and world Bank. 8: 1-8
15. Tod Robberson 1995. Dengue Fever epidemic spreads despite Latin America efforts. Washington post (Oct. 20, 1995) P. A 22.
16. CDC 1995. Update of Ebola viral hemorrhagic fever, Zair, 1995, morbidity and Mortality weekly report, 44(20): 339.
17. WHO, 1995. Weekly Epidemiological Record. 70, 4, Ebola Hemorrhagic Fever, pp: 241.
18. Armstrong, G.l., L.A. Conn and R.W. Pinner, 1999. Trends in infectious disease mortality in the United States during the 20th century. JAMA, 281(1): 61.
19. Reed, K.D. and J.K. Neece, 2003. Birds, migration and Emerging Zoonoses: WNV, Lyme disease, Influenza A and Enteropathogens. Clinical Medicine & Research, 1(1): 5-12.
20. Meneghi, D.D., 2006. Zoonoses, Environment and Wildlife. Ann. Ist. Super. SANITA, 42(4): 405-409.
21. Zinsser, Hans, 1934. Rats, Lice and History. Transaction publishers, Rev. Ed. Edition, 2007.