

Zoonotic Diseases Threatening Human Reproductive Health, a Review

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Abstract: Zoonotic diseases pose a considerable risk to humans. They impact the global public health and are from the biggest obstacle for developing nations. Over the past three decades, there has been an increase in the prevalence of new infectious diseases in humans. From the most recent infectious diseases that affect humans are those with animal origins. COVID-19 (SARS-CoV-2) is one of the much recent worldwide zoonotics. The reproductive health is negatively impacted by developing infectious zoonotic illnesses, making it particularly vulnerable to unfavorable reproductive consequences. Coronavirus disease 2019 (COVID-19) is a serious illness that affects both humans and animals. Previous and current studies suggested that COVID-19 may have an effect on both men's and women's reproductive systems. One health strategy is crucial for preventing and controlling zoonoses.

Key words: Zoonotic Diseases • Reproductive Health • COVID-19 (SARS-Cov-2) • One Health

INTRODUCTION

Zoonotic diseases or zoonoses are the naturally transmissible diseases or infections from animal to humans (Anthropozoonoses) or from human to animals (Zooanthroponoses) according to the World Health Organization [1, 2]. In another meaning, diseases shared between animals and people. However, the majority of zoonotic diseases are transmitted and spread from animals to human, but according to some reports, human also can spread disease to animals [3-6].

Zoonotic diseases pose serious risk to human and represent a great, major public health problem worldwide and it represent the largest challenge for developing countries since they are spread by humans, animals and the environment [7]. Asia Pacific strategy for emerging diseases [8] had reported more than 60% of zoonotic infections that affect humans including bacteria, viruses, fungus, protozoa, parasites and others. Incidence of emerging infectious diseases in humans has increased over the past three decades; 70% are zoonotic in nature and the majority are caused by viruses and drug-resistant infections [9-12].

Recently, the newly emerging human infectious diseases are of animal origin [13]. Moreover, animals are not hosting only pathogens, but they enhance and amplify their effects, which increased the risk for human, putting humans at danger [14].

Zoonotic diseases are classified according to the etiological agent into bacteria, viruses, parasites, fungi, rickettsia, chlamydia, mycoplasma and protozoa. As well as, some zoonotic diseases are caused by acellular non-viral pathogenic agents. The majority of zoonotic diseases are caused by bacteria [15]. Regarding viruses, both DNA and RNA viruses known to cause Zoonoses however, RNA viruses are more frequently connected to zoonoses than DNA [16].

The major zoonotic diseases are listed below [17].

Viral Zoonotic Diseases: New castle disease, Avian influenza, Herpes Simplex (Type 1), Measles, Severe acute respiratory syndrome (SARS), COVID-19, Rift Valley fever, West Nile fever, Ebola virus disease (Ebola Hemorrhagic Fever), Dengue fever, Rabies virus, Hantavirus infection (Hantavirus Pulmonary Syndrome),

Zika fever, Monkey pox, Viral hepatitis, Nipah virus, Marburg viral hemorrhagic fever, Chikungunya fever, Foot-and-Mouth Disease and AIDS

Bacterial Zoonotic Diseases: Anthrax, Tuberculosis, Brucellosis, Leptospirosis, Actinomycosis, Vibriosis, Salmonellosis, Ehrlichiosis, Pasteurellosis, Arcobacter infections, Clostridioides difficile Infection, Enterohemorrhagic Escherichia coli infections, Helicobacter infection, Corynebacterium ulcerans, Corynebacterium Pseudotuberculosis, Campylobacter enteritis, Campylobacter fetus, Lyme disease, Bubonic plague, Glanders, Leprosy, Tularemia and Bordetellosis.

Parasitic Zoonoses: Malaria, Trichinellosis, Visceral larva migrans, Cutaneous larval migrans, Hydatidosis, Cryptococcosis, Cryptosporidiosis, Fascioliasis, Tinea/ringworm infection, Aspergillosis, Blastomycosis, Coccidioidomycosis, Cryptococcosis, Sporotrichosis, Malassezia infection, Histoplasmosis

Rickettsial Zoonoses:

- Q-Fever, Epidemic typhus, Rocky mountain spotted fever, Queensland tick typhus and Scrub typhus
- Chlamydial zoonoses
- Enzootic abortion, Psittacosis and Chlamydiosis
- Protozoal zoonoses
- Toxoplasmosis, Trypanosomiasis, Leishmaniasis, Toxocarosis, African sleeping sickness, Giardiasis, Balantidiasis and Chagas disease
- Disease caused by acellular non-viral pathogenic agents
- BSE (Bovine spongiform encephalopathy), or mad cow disease, is another name for the condition that affects cattle, recognized as Creutzfeldt-Jakob disease in humans (CJD)

Zoonoses and Human Reproductive Health: The emerging infectious zoonotic diseases have negative impact on the reproductive health making it acutely susceptible to adverse reproductive outcomes [18, 19]. One of the main causes of infertility in both female and male, is microbial infection from diverse sources. Numerous microbial pathogens have been implicated as the root cause of various reproductive dysfunctions which resulted in infertility or a delayed fertility. About 15% of cases of male infertility are caused by genital tract infections,

which affect spermatogenesis at various stages; as well as semen quality [20]. In addition, urogenital tract infections triggered inflammatory reactions in the male reproductive system leading to orchitis, epididymitis, prostatitis and urethritis, with leukocyte infiltration forming a physical barrier breakdown in the testicles resulting in testicular dysfunction [20-22]. Moreover, the infectious pathogens can direct harm the reproductive organs and trigger the immune response and the release of inflammatory cytokines, resulting in oxidative stress and subsequent oxidative damage, causing reproductive dysfunction that impair male reproduction [23]. Zika virus, Crimean–Congo Hemorrhagic Fever, Ebola Virus, Monkeypox Virus, Lassa virus, COVID-19 and Influenza viruses are from the zoonotic viral diseases that affect the male reproduction, [24].

Women are exposed animal-borne diseases became under greater risks [25]. However generally, due to anatomical and hormonal factors, women exhibit diseases and infections differently than men [26-28]. Pregnant woman or trying to conceive are more susceptible and have greater risk to some zoonotic diseases due to immunosuppression and the impact of the disease [29]. Therefore, the unusual immunologic state of pregnancy as it relates to fetal and maternal risk must be given special attention by doctors who must also be aware of the atypical symptoms of emerging infectious risks [30].

It's important to take into account how pregnant women react differently to infectious diseases [31]. Pregnancy-related immunologic alterations may result in increasing the susceptibility to specific intracellular infections, such as viruses, intracellular bacteria and parasites. Pregnant women may be more susceptible to infectious diseases and more severely impacted by infections due to changes in immunity and physiology, for instance, increase susceptibility to toxoplasmosis and listeriosis, Hansen disease increased the sickness severity, fatality rates and risks of influenza and varicella [29].

West Nile Fever (WNV), dengue hemorrhagic fever (DHF), yellow fever, RVF, hantaviruses, Crimean-Congo hemorrhagic fever, Ebola fever, Marburg hemorrhagic fevers, Lassa fever, Argentine fever, Bolivian fever, Venezuelan hemorrhagic fevers, Avian influenza viruses, Severe acute respiratory syndrome coronavirus (SARS) and small pox threatened pregnant women health. Q fever (*C burnetii*), syphilis Spirochetes

(*Treponema pallidum*), Lyme disease (*Borrelia burgdorferi*), Tick-borne relapsing fever (TBRF; *Borrelia*), leptospirosis, Chagas' disease, tularemia, plague and anthrax influenced pregnancy in women[30].

COVID-19 Impact on Reproductive Health: COVID-19 (coronavirus disease 2019) is significant diseases in both humans and animals. It caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). It has initiated the spread from animal to humans by the end of 2019 in Wuhan city of China [32]. On March 11, 2020, World Health Organization (WHO) classified COVID-19 as a global pandemic coronavirus outbreak [33]. Previous and current investigations revealed that COVID-19 might have an impact on the reproductive systems of both men and women [34]. (SARS-CoV-2) is an enveloped, containing positive sense single stranded RNA genome that encodes for four major structural proteins which are Spike (S), envelope (E), membrane (M) and nucleocapsid (N) proteins as well as 15 non-structural proteins (nsps) and 8 accessory proteins [32, 35-38]. The spike protein binds to the angiotensin-converting enzyme 2 (ACE2) receptor on host cells which mediated the viral entry into the cells [39].

Males have been found to be more susceptible to SARSCoV-2 infection than women and this is may be due to the expression of ACE-2, which is significantly higher in testis than ovarian tissue [40].

In males, leydig cells and Sertoli cells control the sperm production and the accessory genital glands (prostate, seminal vesicles and bulbourethral glands) contribute seminal fluid and expressed high levels of ACE2. The possibility that COVID-19 could infect the male reproductive organs resulting in direct damage in testes, impaired spermatogenesis and decreased sperm quality causing a risk to male fertility [41-46].

In women, SARS-CoV-2 infection may impact oocytes, ovarian tissue and the endometrium epithelial cells with expressing medium to high levels of ACE 2 receptor [47-49]. The follicular membrane and granular cells of the ovary could be attacked by COVID-19, therefore impair oocyte quality and growth, decrease the function of the ovarian reserve and result in infertility or miscarriage. COVID-19 may damage the endometrial epithelial cells and impair early embryo implantation [34] with throwing risks onborn babies due to intrauterine viral transmission [38, 50]. Not only the oocytes and embryos are susceptible to SARS-CoV-2 infection but

also embryonic cells expressed ACE2 receptors [51]. This finding aids in bringing specific focus to embryo transfers and "In vitro" (IVF) procedures [52].

One Health and Control of Zoonoses: There is a necessity to take into account the links between the health of people, animals and the environment in disease prevention and control methods is highlighted by the recurrent outbreaks of zoonotic infectious diseases that are emerging and re-emerging [53].

The One Health Commission described the One health as "the combined effort of different disciplines to obtain optimal health for people, animals and our environment" [54]. In order to combat the disease using a One Health approach, it became clear that interdisciplinary in-country and regional capability was needed among biologists, veterinarians, ornithologists, doctors and government ministries[7, 14]. The idea of "one health" attempts to unite the human, animals and the environmental health together. The one health approach plays a significant role in the prevention and control of zoonoses [55].

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