Veterinary Interventions and Public Health Implications: Zoonotic Disease Perspective

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Abstract

Livestock veterinarians play a crucial role in addressing the threat of zoonotic illnesses, diseases transmitted from animals to humans. This comprehensive review underscores the importance of early detection through robust monitoring programs and modern technologies like genome sequencing, emphasizing the interconnectedness between animals and humans. Veterinary diagnostics play a pivotal role in swiftly identifying and characterizing zoonotic pathogens. Preventive measures, such as vaccination techniques and sanitation, are implemented by veterinarians to curb disease transmission. Employing the One Health approach, recognizing the interdependence of human, animal, and ecological well-being, the review highlights the indispensable role of animal care in global efforts against pathogenic hazards. It advocates for sustained research, multidisciplinary collaboration, and a commitment to veterinary systems. The paper delves into the aetiology of significant zoonotic diseases within this context, exploring the complex interaction of factors influencing their patterns, geographic distribution, and incidence over time. In the face of a changing global landscape, the emergence of new and re-emerging infectious threats underscores the need for a profound understanding of their origins and behaviors, incorporating an agricultural perspective.

Keywords: Veterinary Interventions, Public Health, Zoonotic Disease.

Introduction

Infectious diseases can arise and spread because of people, animals, and the environment (Thompson & Kutz, 2019). A great deal of viral illnesses that afflict humans are spread by livestock. According to the Asia Pacific Strategy for emerging diseases 2010, zoonotic pathogens have been accountable for over seventy per cent of newly found infections in people (Rahman et al., 2020). Foods derived from animals were directly linked to the newly discovered human ailments in recent decades. The name "zoonoses" originates from the Greek words "zoon" (animal)

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and "nosos" (disease). The WHO defines *zoonosis* as any Disease inherently transferable from vertebrates to people and humans to animals (WHO, 2020). Approximately 61% of all human infections are endemic naturally (Taylor et al., 2001). Zoonoses are a significant threat to community safety and pose a direct sickness issue that can lead to death. The 13 most frequent infectious diseases have had the most significant effect on destitute agricultural workers in nations with low or intermediate incomes, causing a total of 2.4 billion episodes of disease and an estimated 2.7 million fatalities in humans per year, as well as their harmful influence on the well-being of people. Many illnesses affect animal behaviour and impair cow output (Grace et al., 2012).

The financial effects of infectious disease control are quickly receiving interest in light of current and potential issues. Wildlife sources of traditional and new zoonoses (e.g., bovine tuberculosis) remain in several nations, significantly slowing livestock control efforts (Smith et al., 2006). The rapidly growing need for milk and meat in the urban centres of nations with restricted resources is driving a growing number of farms that raise livestock, particularly in these counties' periurban zones. However, due to a lack of effective zoonotic surveillance and food safety, the danger of zoonotic is rising, especially in the expanding urban areas of resource-limited nations (Bonfoh et al., 2003).

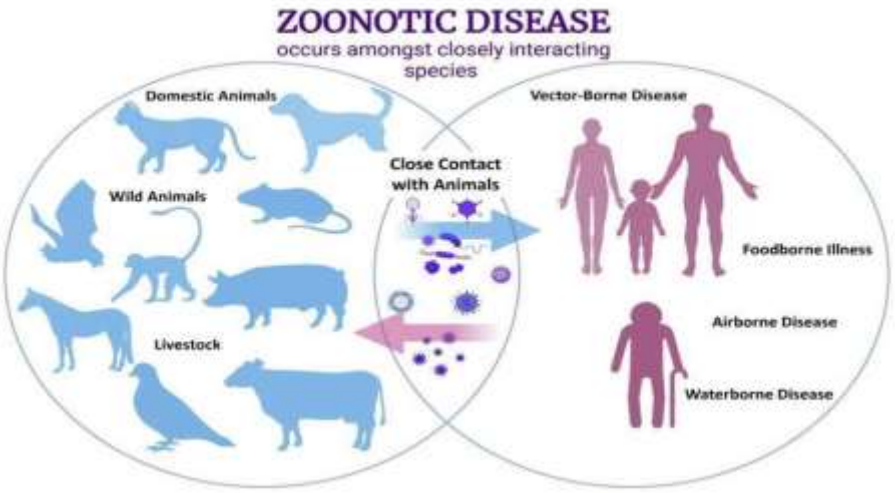
The development of antibiotic resistance, environmental degradation, and the emergence of long-term illnesses have all threatened the well-being of people and animals (Destoumieux-Garzón, et al., 2018). To efficiently regulate and prevent infections at the human-animal user interface, it is vital to comprehend and use the notion of One Health. With the emergence and dissemination of epizootics, zoonoses, and epidemics, the notion of One Health is expanding, while global epidemic hazards have become an increasingly urgent concern (Dhama et al., 2013). Antimicrobial medicines have been widely used in treating humans and animals for over fifty years and have demonstrated significant health advantages (Mwangi et al., 2016). Nevertheless, antibacterial misuse and overuse create selective evolutionary forces that strengthen the possibility of surviving antibiotic-resistant bacteria, putting persons at risk of infection. Resistance to bacteria renders antimicrobial medicines useless, creating a severe public health issue. The past decade has seen a rise in fascination with botanical medicine due to a drop in antibiotic research and rising worries concerning the spread of resistant bacteria to antibiotics (Shin & Park, 2017).

Nevertheless, the processes that operate on the majority of phototherapeutic compounds remain unknown. However, their synergistic impact on bacteria is typically thought to be due to lipophilic chemicals damaging the bacterial membrane or DNA synthesis suppression, reducing cell division. The demand for alternatives to inefficient conventional antibiotics led to the development of phytotherapy as a significant novel notion for health science. The advancement of innovative and effective methods for extraction has resulted in a revived and increasing curiosity in plant-based bioactive chemicals (Chandar et al., 2017). Among the phototherapeutic medicines is oleanolic acid, which is employed as a natural auxiliary for amino acids because it enhances the permeability of membranes (Shin & Park, 2015). Most plant-derived substances have lower antibiotic action than commonly generated molecules by bacteria and fungi. This review aims to provide information regarding zoonotic origin and insight into the wide range of anti-bacterial secondary compounds (i.e., phytochemicals) found in plants that can treat zoonoses.

Classification of Zoonoses

The microbes responsible for zoonotic illnesses are diverse. Zoonoses are classified into illnesses: zoonoses (such as anthrax infection and salmonellosis), viral zoonoses (such as rabies, obtained AIDS, and Ebola), and parasitic zoonoses.

Figure 1: Zoonotic disease



Zoonoses of Domestic Animals

Domesticated creatures play a significant role in transferring several illnesses to people, and in numerous circumstances, they act as pathogenic boosters originating in wild creatures (Morand et al. 2014). Long ago, it was hypothesized that domesticated pets and human beings positively influence pathogen biodiversity. Around 60% of the human viral illnesses are caused by terrestrial animals. Personal contact, ingesting or inhaling via conjunctiva, or biting are all plausible modes of transmission for zoonotic bacteria, viruses, parasites, or fungi (Klous et al., 2016). Domesticated creatures serve as reservoirs for viruses that cause household zoonoses and may transmit infections to humans (Samad, 2011). Disease-causing organisms can be spread by direct touch or foods derived from animals. Examples of zoonotic illnesses that might be passed on to humans from domestic animals include the diseases anthrax, rabies, and tuberculosis (Ghasemzadeh & Namazi, 2015). Brucellosis is one of the most frequent bacteria zoonotic illnesses, accounting for about 500,000 human cases worldwide each year, this illness is a neglected zoonosis (WHO, 2015). Brucella melitensis, Brucella abortus, Brucella suis, and Brucella sp. Canis are zoonotic amongst all 12 species in the family Brucella. The most prevalent mode of brucellosis transference in humans is due to the intake of unprocessed milk or dairy products. However, people-to-people contact is rare. Spreading via aerosol inhaling and exposure to fluids has also been documented. Every year, around 30,000-70,000 people die around the world. Whereas dogs are the primary carriers of the rabies virus, other feral creatures such as cats and jackals contribute to the infection's transmission. As a result of the stray dog problem, humans in impoverished countries are infected with rabies through biting (Tang et al., 2005).

Pets, Domestic Animals, and Birds Zoonoses

Around 14-62% of people who own animals allow their beloved pets into their sleeping areas, which may contribute to the spread of zoonoses. Domestic and pet creatures have grown in popularity over the last few decades. However, they are essential carriers of microorganisms that cause illness. Because of the chance of transmission of illnesses, the growing appeal of animals and animal companions has endangered the wellness of humans. Exotic pets are kept alongside ordinary animals in numerous homes nowadays. As a result, a large number of people are in danger of contracting a new zoonotic illness via pets, pet companions, and exotic birds and animals. The sickness is transmitted from cat to cat diagonally. However, people are infrequently infected through vector arthropods. Furthermore, the most common transmission routes for human mechanisms involve cat lapping of bites and scrapes that cause injury. The sickness's duration of incubation ranges from 3 to 14 days. Numerous lesions may occur, including redness and swelling, and swelling with elevated, circular regions, and pus can accumulate at the location of the disease. Furthermore, lymphatic vessels nearest the bitten or scraped area and those on the neck are generally enlarged (Klotz et al., 2011). To keep pets safe from zoonotic infections, good cleanliness habits and routine immunization and medical checkups are required.

Zoonoses in Fish and the Aquatic Environment

Many bacteria with zoonotic potential have been found in fish. The majority of fish-associated infectious illnesses are bacteria. Fish that are immune to these illnesses can often cause significant illness. These bacterial diseases caused by opportunism in fish are rare. Fish can obtain these infectious agents from their aquatic surroundings, where they are naturally present.

Furthermore, agricultural operations, human and animal excreta, domestic rubbish, and wild animals can all pollute aquatic ecosystems. These zoonotic illnesses can be passed on to humans via the unsanitary administration of aquatic organisms and the goods they produce. Raw or inadequately prepared aquatic goods may also expose individuals to foodborne illnesses. Aeromonas hydrophila, Brucella spp., Shigella spp., and Streptococcus iniae are major zoonotic illnesses isolated and transmitted through fish. Nocardiaasteroides, Nocardiaseriolae, Nocardiasalmonicida, and Nocardiacrassostreae, are all connected with fish and aquatic settings. Humans, ruminants and marine mammals have all been infected with Nocardia sp. Amongst the several, Nocardia spp is strongly linked to infections that affect humans. Immunocompromised patients are more sensitive to nocardiosis in general. Skin infections, pneumonia, and ulcers are common symptoms of the condition. It is crucial to note that evidence on genetic or epidemiological links between pilated and human nocardiosis is limited (Gauthier, 2015).

Zoonoses and Foodborne Pathogens

Food is a vital means for transmitting infections, referred to as pathogens transmitted through food, which typically cause diarrheal illnesses. Zoonotic infections cause many foodborne diseases. Foodborne infections can cause severe illnesses and fatalities in young and teenagers. Mortality, which affects thousands of individuals, is frequently connected to diarrheal disorders resulting from contaminants in food and contaminated water. Managing and butchering creatures without proper safeguards, as well as swallowing overcooked animal-based food, are risk factors for foodborne zoonoses. Salmonella sp. and Escherichia coli are examples of common foodborne zoonotic infections. Salmonella sp. is responsible for more than 90% of bacteria-related foodborne infections. All domesticated animals, especially poultry, can be an incubator for germs that cause food poisoning (Ievy et al., 2020). STEC is also known as E. coli and produces verodoxin

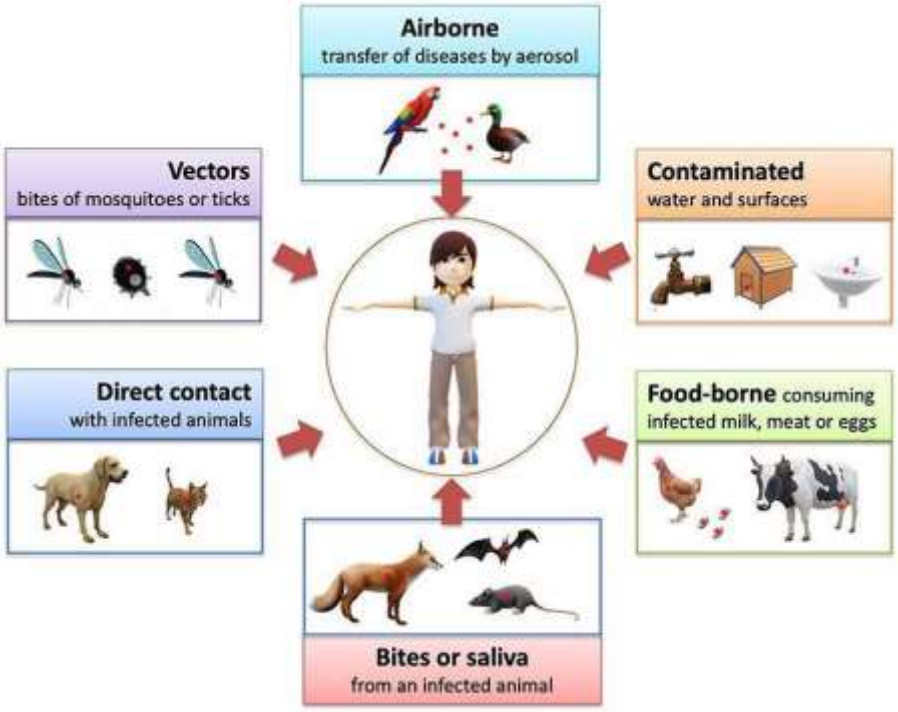
(verocytotoxin). They can be transferred to humans by personal contact with food that has been contaminated. In the 1980s and 1990s, the Escherichia coli O157:H7 serotype of STEC was identified as an essential contributor to foodborne zoonotic disease. STEC toxins can cause significant sickness in humans, including digestive symptoms, collapse of the kidneys, and bloody diarrhea.

Transfer of Zoonoses

Insects that can be eaten are under-utilized food sources with a high nutritional profile. They are growing more common as consumer appetite for metabolized, appetizing and nutritious food items increases (Hanboonsong et al., 2013). Beetles, caterpillars, true bugs, and termites are among the insects devoured by humans. Around two billion people worldwide consume some of these insects as food, primarily in Asia and Africa. Many tasty insects harm humans' health by creating allergies and other diseases. Delicious creatures such as insects, such as caterpillars, can cause allergic responses in children, including drooling, trouble breathing and swallowing, pain, and generalized urticaria.

Furthermore, eating mopane caterpillars and silkworm pupa has been linked to allergic reactions in people. Isospora species., Giardia lamblia and Sarcocystis species. It could all be found in edible insects such as beetles and cockroaches (Graczyk et al., 2005).

Figure 2: Sources of disease



Impact of Zoonoses

Zoonoses have a wide range of effects on the well-being of humans and animals. Though it is difficult to measure the effect caused by zoonoses, it can be measured using indicators such as illness frequency, frequency, death from any cause, and revenue losses. Rabies, anthrax, cysticercosis, echinococcosis, and zoonotic sleeping sickness are extremely significant zoonotic

illnesses. Rabies in Africa and Asia are examples of overlooked zoonoses, as are echinococcosis and taeniasis (Taenia solium) in Asian, African, and Latin American countries, leishmaniasis in Asian and African countries, and cysticercosis and foodborne trematodiasis in African countries. African and Asian countries are impoverished. In other cases, affected persons might be separated from others in society, making them more vulnerable to acquiring psychological problems. *Microbial immunity* is an international medical problem that may cause devastation to the medical management of bacteria-related zoonoses. Individuals experiencing infections triggered by resistant bacteria require specialized care and costly medications and are often a strain on the medical-care system, particularly in emerging nations. Animal mortality from zoonotic infections can generate huge revenue loss in any country's livestock sector. Even if no living things are killed, animal well-being and mental and physical health can be suffered. This can result in substantial losses of products derived from animals, such as meat and eggs.

Zoonoses Control: Veterinary Interventions

Zoonoses pose a severe medical risk to the worldwide population. Approximately 58-61% of illnesses in humans are transmissible, as much as seventy-five per cent being zoonotic (spread by animals). *Zoonosis* is a multi-sectorial disease encompassing the interactions of people, creatures, and their surroundings. A methodology is necessary to establish successful oversight measures (Aenishaenslin, 2013).

Surveillance is critical for preventing and controlling zoonotic illnesses. It may be employed to find early-onset infected persons and creatures, dams, carriers, and chronic locations, particularly "hotspots." It aids in the improvement of preventative measures for coming and resurfacing illnesses. A thoroughly prepared lab, proper diagnostic facilities, competent people, and sufficient resources are all required for efficient and functioning surveillance. The subsequent four methods of inspections can be used to control zoonoses:

- Disease surveillance for finding and recognizing pathogens
- Serological monitoring includes tracking immune system reactions to identify an outbreak of infections in the bloodstreams of humans or animals.
- Symptom monitoring to detect illness propensity via data analysis by signs. That kind of analysis-based observation is incapable of recognizing the existence of diseases.
- Assessment of risk to determine the factors that lead to transmission of diseases. Its oversight method cannot identify the medical characteristics and incidences of many diseases.

The treatment of those afflicted, vaccination of well-being people and animals, restriction of transportation of animals, livestock control, and testing as well as culling (anthrax, glanders, and rift valley fever) are all broad disease control principles that can be used to control zoonoses. Infected materials must be decontaminated to lessen the chances of contracting new diseases. Secure destruction of terminated fetuses, for example, can help to lower the incidence of brucellosis. Personal hygiene administration, as well as the use of personal safety gear such as face masks, gloves, lab coats, helmets, and goggles, are required. Thorough decontamination of contaminated objects and locations is required when applicable to help reduce the dissemination of brucellosis, salmonellosis, and TB.

The study titled "comprehensive treatment of overlooked zoonoses for the avoidance and management of overlooked zoonotic ailments in African countries" highlights a unified medical-based approach endorsed by professionals and educators from 21 European and African nations (Pal et al., 2014). Recognizing that all disease management measures require substantial financial

assistance, often lacking in developing nations, the study emphasizes the imperative for developed countries and foreign donors to support underdeveloped nations in controlling zoonoses.

Conclusion

Ensuring access to a plentiful supply of nutritious foods is crucial to mitigate foodborne zoonoses. The paper suggests two primary strategies: risk estimation and food threat management. Risk assessment involves collecting and analyzing data and making recommendations based on relevance, while risk management requires the implementation of regulations and objectives for reducing risk. The safety of meat, milk, and eggs derived from animals hinges on the health of the animals, necessitating proper antemortem and observational inspection of livestock. The study underscores the significance of maintaining sanitary conditions throughout the food production process, with particular emphasis on the personal hygiene of food-processing staff. Additional initiatives for zoonoses control encompass establishing legislation and rules governing confinement and detention, developing effective infection reporting networks, land biosecurity, mass vaccination, surveillance, selective slaughtering, general awareness campaigns, and healthcare education.

The paper emphasizes the importance of livestock health in ensuring safe food production in agriculture. Integrating media, including computerized databases, social networks, mobile devices, and other communication channels, is a valuable tool for raising awareness among people about zoonotic diseases and their control measures. This multidimensional approach, combining agriculture and public health strategies, is a comprehensive framework for addressing and managing overlooked zoonotic ailments in African countries.

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