

## The role of veterinary research in human health promotion in South Asia

Vishnu Prasad Santhosh Pillai,\* Sneha Aji Reji

College of Veterinary and Animal Sciences Pookode, Wayanad, Kerala, India, 673576

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\* Corresponding author:

V.P.S. Pillai

Email: [vishnuprasads693@gmail.com](mailto:vishnuprasads693@gmail.com)

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### Abstract

Veterinary science research has a leading role in promoting human health, in a One Health approach. In this review the public health challenges in the South Asian region were analyzed and the role of the veterinary sector in addressing them were highlighted. Livestock and livestock products research is integral to achieving food security and beating malnutrition. The veterinary public health domain encompassing zoonoses research, food safety, environmental health, and antimicrobial resistance research, is worthy of attention as it integrates animal and human health. Biomedical research is an exciting field that utilizes veterinary expertise to understand human diseases. Food security and safety, antimicrobial resistance, environmental pollution and climate change, and insufficient funds were described as major challenges faced by South Asian countries. Impressive prospects of veterinary science research to address these challenges were highlighted. Increasing awareness, better allocation of funds and One Health approach were enumerated as some recommendations to overcome the challenges. From a One Health perspective, veterinary science research has a notable role in addressing major public health issues in South Asian countries. Increased surveillance and optimized research could promote better public health and support economic growth in the South Asian region.

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## 1. Introduction

Human, animal, and environmental health were perceived to be distinct entities, until several unprecedented events like emerging zoonoses and antimicrobial resistance started to prevail. A unified approach towards global health has become an imperative to address such challenges, marking the genesis of the concept of One Health (Shomaker et al. 2013). One Health can be defined as an approach to mitigate the emerging threats that arise at the interphase of human, animal, and environment (WHO 2022). The impact of climate change on human and animal health has been a major concern that demands coordinated efforts from both sectors, especially in the backdrop of emerging and re-emerging zoonoses (Zinsstag et al. 2018). Recent outbreaks of Monkey pox, Marburg, and COVID-19 pandemic have been an alarm to the public, that emerging and re-emerging infections could have profound impacts on the global health (Bunge et al. 2022; Zhao et al. 2022; Haider et al. 2020). Increasing incidences of infections caused by antimicrobial resistant pathogens in humans have led to understanding antimicrobial resistance (AMR) as a serious threat to public health (CDC 2019).

South Asian countries include India, Bangladesh,

Afghanistan, Pakistan, Nepal, Bhutan, Maldives, and Sri Lanka; and all of them being developing countries (World Bank 2023). Emerging public health risks can debilitate the growing economies in these regions. AMR is a major issue faced by public health sector in South Asian Countries (Taneja and Sharma 2019; Bilal et al. 2021; Calhoun et al. 2008; Dahal and Chaudhary 2018; Ahmed et al. 2019). Several outbreaks of zoonoses in these countries have also grabbed attention (Kumar et al. 2015; Yasmeen et al. 2022; Chowdhury et al. 2021; Gautam et al. 2021; Sunil Chandra 2007; Gamage et al. 2014). Therefore an outlook on public health challenges faced by the countries in this region was found to be essential.

Veterinary science, owing to the diversity it embraces, is regarded as a significant research area with potential impacts on not just animals, but also on humans (NRC 2005). As animal health is also within the umbrella of One Health, the need for focused research to understand the shared risks among humans and animals is relevant. Our attempt is to describe the importance of veterinary science research on improving human health with special focus on South Asian region, comprehending the contributions of different components of veterinary science ranging from food animal production to

biomedical research and highlight the potential impacts it would have on humans, enunciating the One Health concept.

## 2. Role of veterinary research on human health promotion

### 2.1 Ensuring food security

According to the World Bank, the total population of South Asia is around 191,93,48,000 (World Bank 2022). This increasing population demands a hike in food supplies from both animals and plants. Foods of animal origin are highly favored owing to its taste and nutritional quality (Howe 1950). This highlights the need of research and development in terms of enhancing quality as well as quantity of these food animals and their products. Veterinary research plays a vital role in the promoting food security. Veterinary research encompasses different aspects of animal husbandry from general management to proper healthcare of farm animals. Safety concerns are also relevant due to possibilities of contamination by several pathogens like *Escherichia coli*, *Staphylococcus aureus*, *Brucella* spp., etc. (UN FAO n.d.). Therefore, in the pursuit to improve quantity of food produced, microbiological safety of foods should also be addressed.

### 2.2 Public Health Approach

Increased consumption of animal products and exacerbated human-animal interactions have been instrumental in the development of a discipline called Veterinary Public Health (VPH). VPH is a multidisciplinary approach that uses applications of Veterinary Science for the health and welfare of humans (WHO 2002). Food safety becomes a major challenge to food security. Foodborne diseases caused by different pathogens and toxins have deleterious effects on the health of humans. Therefore, research on food-borne zoonotic pathogens has gotten great relevance. There are several pathogens associated with food-borne illnesses. *Escherichia coli*, *Campylobacter* spp., *Salmonella* spp., *Staphylococcus aureus*, *Listeria* spp., Norovirus, Hepatitis A virus are to name a few (WHO 2022). There have been increased incidences of food-borne diseases in South Asian countries like India (Vemula et al. 2012). VPH encompasses research on ensuring safety at different stages of food production.

Zoonoses research is another principal domain of VPH. Almost 61% of infectious diseases in humans are known to be zoonotic (Taylor et al. 2001). This fact brings out the importance of this domain in the One Health approach. Several factors have influenced the emergence of highly virulent pathogens in recent times. Intensive livestock farming has exposed the risk of zoonotic pathogens (Kimman et al. 2013). The health of farm workers and their families has become an important issue. Climate change has evoked possibilities of spillover events that have led zoonotic pathogens to enter the human population from wildlife ecosystems (Rupasinghe et al. 2022). Increased anthropic activities in the forests and

exploitation of its resources have made humans more exposed to the risks of emerging and re-emerging infectious agents (Tazerji et al. 2022). Veterinary research encompassing wildlife disease surveillance and reporting has a significant role in monitoring diseases in wildlife and predicting the likelihood of spillovers into the human population.

Antimicrobial resistance (AMR) is a growing public health concern that has been referred to as a silent pandemic. Indiscriminate use of antibiotics has led to bacteria acquiring resistance against commonly used antibiotics (Zinner 2007). In a backdrop where novel antimicrobials are meager, treating infections has become a hurdle to the medical practice (Mahoney et al. 2021). Veterinary science has a leading role in combating AMR as inappropriate use of antimicrobials in veterinary practice is also responsible for this grim consequence. Veterinary researchers are also on the track to develop new antimicrobial agents that reduce selection pressure on pathogens and thereby bringing down the chances of acquiring AMR. Efforts to explore the antimicrobial properties of natural extracts are also gaining attention (Khalil et al. 2022). There have been studies on the potential of plant extracts to control animal diseases of zoonotic importance (Lopes et al. 2020). Aligning outputs from veterinary and human medical research towards tackling AMR would be a significant progress in the One Health approach.

### 2.3 Biomedical Research

Veterinary science also comprises domains like comparative biomedicine. In comparative biomedical research, animal models are used to study human diseases to understand the pathology as well as to explore possible therapeutic interventions (Macy and Horvath 2017). Animal models for highly infectious diseases like COVID-19 have been thoroughly studied post the COVID-19 pandemic. Animals like cats are shown to be suitable for COVID-19 research (Rudd et al. 2021). Many other species have also been studied for this purpose (Shou et al. 2021). Such studies have a remarkable impact on understanding human diseases and vaccine production, as far as One Health is concerned (Entrican and Francis 2022). This is another very prominent role that veterinary research has in improving human health.

## 3. Challenges arising

Recent times have witnessed several challenges that encounter the healthy co-existence of humans and animals. In the purview of the role of veterinary science research on human health, some challenges worth addressing are malnutrition, environmental pollution, emerging zoonotic diseases, antimicrobial resistance, and lack of funds and facilities.

### 3.1 Food security and safety

Perera (2014) outlaid the scenario of livestock production in South Asia, highlighting the variations in production systems subject to several factors like climate, land, and livestock

species. Livestock constitutes nearly 29% of the agricultural gross domestic product of countries in this region (Samanta et al. 2019). Production-centered approaches to enhance livestock production and the quality of products derived from it are highly sought after. Reports show that children and women in South Asian countries are facing a serious malnutrition crisis (UNICEF n.d.). The circumstances in Afghanistan are quite grim due to the war and political instability prevailing there (Prasad 2008). War-torn People of Afghanistan, especially children and mothers are facing severe malnutrition (Rahmat et al. 2022). Food-borne infections would render this scenario worse. Ensuring food safety concomitant with food security remains a major challenge, that seeks efforts from different domains including Veterinary science.

### 3.2 Prevalence of zoonotic diseases

Zoonoses like Rabies, Nipah, Japanese Encephalitis, Avian influenza, Kyasanur Forest Disease, Leptospirosis, and Salmonellosis were previously reported in some parts of India (Kumar et al. 2015). Rabies, Encephalitis, Lyme disease, Brucellosis, Q-fever, Leishmaniasis, Avian Influenza, and Anthrax have been reported in Pakistan (Yasmeen et al. 2022). Highly Pathogenic Avian Influenza, Rabies, Leptospirosis, Nipah, Anthrax, Zoonotic Tuberculosis, and Toxoplasmosis were reported in Bangladesh (Chowdhury et al. 2021). While in Nepal, Brucellosis, Leptospirosis, Hydatidosis, Toxoplasmosis, Taeniasis, and Avian Influenza were the prominent zoonoses reported (Gautam et al. 2021). Rabies, Japanese Encephalitis, Chikungunya, and Leptospirosis are some major zoonoses reported in Sri Lanka (Sunil Chandra 2007; Gamage et al. 2014). Maldives is reported to lack Government level efforts to implement surveillance and risk reduction strategies pertaining to zoonotic diseases. Meagre data is available about the prevailing zoonoses in Maldives (GHSI 2021). Rabies and Leptospirosis are prevailing in Bhutan (Rinchen et al. 2019; Dreyfus et al. 2021). Rabies, Brucellosis, and Crimea Congo Hemorrhagic Fever are prevailing zoonoses in Afghanistan (DCA 2020). In war-worn Afghanistan, interventions to control the emergence and spread of zoonotic diseases is a need of the hour. South Asian countries have reported several incidences of Avian Influenza outbreaks in the past years. Increased interaction of humans with poultry and scanty awareness about the risk of zoonoses have intensified the risk of outbreaks (Chowdhury et al. 2019).

### 3.3 Antimicrobial resistance

Antimicrobial resistance has emerged as one of the biggest threats to global health, as many highly infectious bacteria have evolved resistant to commonly used antibiotics, rendering the treatments ineffective (CDC 2019). Addressing this challenge is of huge importance as far as veterinary sector is concerned (Lathers 2001). The veterinary sector is having an equal role in exploring the potential of novel antimicrobial agents that reduce the selection pressure on pathogens, which

could bring down the chance of attaining resistance (Shen et al. 2018). *E. coli*, *Klebsiella pneumoniae*, *Acinetobacter baumannii*, *Staphylococcus aureus*, and *Enterococcus faecium* are some important bacteria reported to have high resistance rates in India (Taneja and Sharma 2019). *Acinetobacter spp.*, *Salmonella spp.*, *E. coli*, *Shigella spp.*, and *Pseudomonas spp.*, were the most reported multidrug resistant bacteria in Pakistan (Bilal et al. 2021). Similar species were reported in Nepal as well (Manandhar et al. 2020). *Citrobacter spp.*, *Enterobacter spp.*, *Proteus spp.*, *Enterococcus spp.*, and *Pseudomonas aeruginosa*, were found to exhibit high degree of resistance in Bangladesh (Nobel et al. 2022). AMR is a very important public health challenge in Sri Lanka (Ariyawansa et al. 2023). Methicillin-resistant *Staphylococcus aureus*, Extended Spectrum Beta-lactamase producing *E. coli*, and *Klebsiella spp.*, were reported in Sri Lanka (Munasinghe et al. 2021). It is important to note that most of these bacteria comes under “Critical”, “High”, and “Medium ” priority pathogens pertaining to AMR as classified by WHO (WHO 2017). Careless use of antibiotics in farm animals and the occurrence of antibiotic residues in animal products like meat and milk can further aggravate the situation. This highlights the shared impact of AMR on animals and humans. There have been several studies that reported the prevalence of antibiotic residues in animal products for human consumption in South Asian countries (Zehra et al. 2019; Sadiq et al. 2020; Ema et al. 2022; Shrestha et al. 2021). Farm effluents are also a potential public health threat as it lodges antibiotic-resistant bacteria that come from animal excreta, reflecting the impact of AMR on environmental health (Sobur et al. 2019). It is important to refrain practitioners from prescribing antibiotics wrongly and making people aware of the possible consequences of indiscriminate use of antimicrobials (Scott and Menzies 2011). The development of new antibiotics offer hope but the clinical application requires a more prudent approach (Hutchings et al. 2019).

### 3.4 Environmental pollution and climate change

Livestock farms release effluents containing excreta, urine, and other waste materials. These effluents, if not treated properly could harbor harmful pathogens and contaminate soil and water bodies (Sobur et al. 2019). In the backdrop of AMR, treatment failure occurs in many situations as some pathogens have evolved to gain a high degree of resistance against antibiotics. Apart from this problem, another matter of concern is the livestock methane emissions that have serious implications in the context of global warming and climate change (Johnson and Johnson 1995). Researchers are carrying out studies to understand the methane emissions from livestock and are trying to explore the mitigation strategies that range from management aspects to nutritional interventions (Kumari et al. 2020; Palangi and Lackner 2022).

### 3.5 Lack of enough funding for research and extension activities



Veterinary universities, research institutes, and animal husbandry departments in South Asian countries are performing differently, subjected to the funds that they receive for research and extension activities. Lack of funds and unavailability of land have hindered the creation of new veterinary colleges (The Tribune 2015). Insufficient funds bring down the quality of education and the research output from those institutes. This also reflects in the lack of extension activities that veterinary research institutes and authorities are supposed to do. It is necessary that the public should be aware of the issues like zoonoses, AMR, livestock health management, etc. (Wu et al. 2023). Interaction between experts and the public is requisite to enhance the knowledge and awareness of people in matters regarding zoonotic infection management, antibiotic usage, hygiene, and farm waste management. This can be brought about by veterinarians and veterinary public health experts if adequate funds and facilities are provided. From the research point of view, lack of funds and laboratory facilities are factors that sometimes decrease the quality and impact of research. Improper vaccination in farm animals and pets has exacerbated the prevalence of zoonotic diseases and their transmission to humans (Carpenter et al. 2022). Vaccination drives undertaken by veterinary colleges and animal husbandry departments to prevent animal diseases, especially of zoonotic nature is also important in this regard.

#### 4. Recommendations to overcome challenges

South Asian countries demand great attention in terms of human and animal health, which needs to be addressed through research and policy interventions. The challenges we highlighted above are presumably the most dreadful issues the global health scenario encounters. Pertaining to such challenges, it would be worthwhile to discuss some of the possible recommendations.

##### 4.1 Increasing awareness among health workers and the public

The health and well-being of the public largely depend on the knowledge and practices of the people (Sandhu and Singh 2014). This brings out the role of veterinary colleges and animal husbandry departments in launching public awareness and extension activities, which are inherent with a great potential to infuse basic understanding about major challenges and their role in overcoming them. By making people aware of the issues like AMR, which usually goes unnoticed, unnecessary use of antimicrobials can be brought down to a great extent (Mathew et al. 2019). The effectiveness of this can be enhanced if practicing veterinarians and veterinary students are also given the right directions and awareness on matters regarding AMR and the possible interventions to mitigate this issue (Odetokun et al. 2019; Sharma et al. 2022; Wangmo et al. 2021). Similarly, people need to be educated about food hygiene practices, especially in handling of foods of animal origin (Thio and Wijaya 2010). Farmers are required to be

aware of the consequences of practices like unnecessary antibiotic use and risks of zoonotic disease outbreaks like rabies (Rinchen et al. 2019; Sharma et al. 2022). They should also be given right directives on the treatment of farm effluents which has a tremendous impact on public health (Sobur et al. 2019).

##### 4.2 Allocation of funding and improving facilities for research

As we have discussed in the challenges section, lack of adequate funds and facilities hinder research activities in veterinary sector, especially in developing countries. More funds and support for research and extension activities of veterinary colleges will enhance the quality and impact of its research that aims at ensuring better health of animals as well as humans (NRC 2005; Rana and Kumar 2017). It can also escalate the quality of education in these institutions, which aids in building future generations of experts who can efficiently tackle the issues that deal with human and animal health. Distant education programs in veterinary science are having potential to provide affordable and more accessible education (Murray and Sicho 2007). Veterinary research institutes and animal husbandry departments should encourage field-level surveys and studies to understand the level of awareness among public and bring about effective approaches to educate common people.

##### 4.3 One Health approach

One Health is recognized as a multidisciplinary approach that aims at bringing human, animal, and environmental health together, for a sustainable living on the planet (WHO 2022). This concept although finds roots several decades ago, has gained momentum in the recent times as the disturbances in human–animal interactions has increased tremendously, having pernicious effects on health and welfare of both groups (Mackenzie and Jeggo 2019). This concept is helpful to materialize strategies for adapting to climate change (Zinsstag et al. 2018). Adopting strategies backed by One Health concept could be effective to contain emerging public health risks affecting humans, animals, and environment. Efforts from the Government side to carryout efficient surveillance program of diseases and multidrug resistant pathogens among humans and animals followed by further strategies to control disease spread are imperatives in a One Health point of view.

#### 5. Conclusions

This review portrays the role of veterinary science research on improving human health, laying special emphasis on the public health scenario in South Asian countries. We analyzed several health challenges faced by these countries and have outlined some recommendations to overcome those challenges in a One health perspective. Zoonotic diseases like Rabies and Avian Influenza were prevalent in most of the countries in the area. Multidrug resistant infections and antibiotic resistant bacteria in foods were also reported to a great extent. A lack of

Government support for disease surveillance and prevention, meagre official reports, and insufficient funds were found to be the limiting factors. Veterinary sector involving research institutes, colleges, and animal husbandry departments have significant role in addressing many public health challenges. One health approach could play a notable role in mitigating the public health issues and support economic growth in the South Asia region.

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