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Research Paper

Impact in Animal Health of Climate Change from AMR, Rabies: One Health Approach Nepal

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Abstract

One Health is an approach to designing and implementing programmes, policies, legislation and research in which multiple sectors communicate and work together to achieve better public health outcomes related to different zoonoses either AMR or Rabies. (WHO. In Nepal, the One Health concept acknowledges the interdependence of environmental, animal, and human health and strives to address health issues in a comprehensive manner. The diversified topography of Nepal, which includes the Terai plains and the Himalayas, offers special opportunities as well as problems for putting the One Health framework into practice. Nepal's One Health programme covers a number of areas, such as agriculture, the environment, wildlife conservation, human and animal health, and agriculture. Integration of the agriculture and livestock farming sectors is essential for disease control, food security, and economic development because of the nation's substantial reliance on these industries. The health of people and animals is significantly impacted by the repercussions of rabies transmission. If the rabies virus exposure in people is not treated right away, it can cause a deadly neurological condition. Rabies can cause localized outbreaks that endanger entire populations, in addition to the suffering that befalls individual animals. The effect can upset biodiversity and ecological balance by cascading through ecosystems rather than being confined to a single species. Campaigns to stop the spread of rabies in animals and population control are important components of public health initiatives aimed at preventing human cases of rabies, as they safeguard animal populations as well. Nepal faces burden of zoonotic diseases of epidemic; endemic and pandemic potentials are major public health concern. 60 different zoonotic diseases have been identified in Nepal as emerging and re-emerging diseases. There is strong connection and effect of climate change, global warming. Nowadays, the interrelation of human, environment and animals is also concern about antimicrobial resistance. One Health approach is an important approach for effective prevent and control of zoonotic diseases. The spread of the highly pathogenic avian influenza virus H5N1 among animals is unprecedented having been found on all continents — except Oceania — with the United Nations calling it “a global zoonotic animal pandemic.”

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H5N1 is known to be able to infect over 350 species of birds and close to 60 species of mammals with migratory waterfowl — including ducks, swans, geese and gulls — being especially susceptible to various avian-borne influenza viruses. H5N1 infected waterfowl are normally asymptomatic carriers, however, these birds can infect other species (including mammals) along their migratory routes. This global transference allows disease to spread, and for virus genetics and virulence to continually adapt.

Alarmingly, evidence indicates that climate change seems to be impacting the emergence of zoonotic viruses like H5N1. As global climate conditions change, avian migratory patterns and routes are also changing. Higher temperatures and extreme weather has resulted in large-scale population shifts in a range of temperate species. These changes have led to diseases emerging in areas — and in genetic configurations — entirely unique and unprecedented.H5N1 is a clear indication that disease monitoring and response efforts are an essential part of any climate change adaptation and mitigation strategy.

Despite recent improvements, there are still over 100 laboratory-confirmed rabies deaths in Nepal each year due to low public awareness, ongoing difficulties with canine vaccination, and insufficient availability or cost of life-saving biologics for people exposed to the virus.

National Public Health Laboratory and Central Veterinary Laboratory in Nepal performs a crucial role as a reference laboratory in diagnosis of rabies in advanced level. These laboratories carry out an extensive range of tests and analysis that provide priceless insights into the nation's illness patterns and animal health. The results for fiscal year 2078/79 highlight the ongoing incidence of prevalent illnesses in animal health populations, such as AMR, Rabies but they also highlight new issues, like the highly pathogenic avian influenza H5N1 clade 2.3.2.1a. The laboratory's data, which comes from more than 3900 specimens of various domestic and wild species that have undergone extensive post-mortem, faecal, larval culture, molecular, and serological testing, is crucial for research, surveillance, diagnosis, and the development of focused policy responses for both endemic and emerging illnesses. The laboratory plays a major role in advancing the national and regional understanding of veterinary care in Nepal by not only meeting proficiency test standards but also fulfilling worldwide reporting obligations related to animal disease control. The abstract highlights how vital it is to maintain infrastructure and labour investments in pathology in order to protect animal welfare, maintain livestock economics, and maintain human health at the intersection of veterinary and public health.

Study background

In Nepal, the One Health concept acknowledges the interdependence of environmental, animal, and human health and strives to address health issues in a comprehensive manner. The diversified topography of Nepal, which includes the Terai plains and the Himalayas, offers special opportunities as well as problems for putting the One Health framework into practice. Nepal's One Health programme covers a number of areas, such as agriculture, the environment, wildlife conservation, human and animal health, and agriculture. Integration of the agriculture and livestock farming sectors is essential for disease control, food security, and economic development because of the nation's substantial reliance on these industries. Furthermore, Nepal's high biodiversity emphasizes how crucial it is to maintain ecosystem health in order to stop the spread of zoonotic diseases. The decentralized governance system in Nepal makes it possible for local communities, NGOs, academic institutions, and government agencies to work together. These collaborations can help with capacity building, information exchange, and coordinated responses to health hazards. Nepal has a long history of using indigenous healing methods and herbal remedies, which can be used in conjunction with contemporary medical techniques. One Health programmes that incorporate traditional knowledge have the potential to improve community involvement and promote culturally appropriate interventions (Acharya, K. P *et al.*, 2019) [1].

AMR from one health in Nepal

Nepal is not an isolated country when it comes to the serious threat that antimicrobial resistance (AMR) poses to public health worldwide. Recognizing the interdependence of environmental, animal, and human health in causing antimicrobial resistance and putting comprehensive policies in place to address this complicated problem are key components of Nepal's One Health approach to antimicrobial resistance (AMR). Nepal is not an isolated country when it comes to the serious threat that antimicrobial resistance (AMR) poses to public health worldwide. Recognizing the interdependence of environmental, animal, and human health in causing antimicrobial resistance and putting comprehensive policies in place to address this complicated problem are key components of Nepal's One Health approach to antimicrobial resistance (AMR). All things considered; Nepal must embrace a One Health strategy to successfully address antibiotic resistance in order to counter this danger to world health. Nepal can create long-term solutions to maintain the efficacy of antibiotics and safeguard public health for upcoming generations by combining efforts across the human, animal, and environmental health sectors (Young CC., 2019)

Global Strategies to Combat AMR

The effectiveness of antibiotics and other antimicrobial medications is threatened by antimicrobial resistance (AMR), a serious global health concern that jeopardizes our capacity to successfully treat infectious infections. Mudenda *et al.*, (2023) [4] stress how crucial it is for international AMR prevention measures to include a One Health viewpoint. This strategy emphasizes the need of sector-wide collaboration in order to address AMR holistically and acknowledges the interdependence of human, animal, and environmental health. Improving antimicrobial stewardship in medical treatment is a crucial component of international efforts to tackle antibiotic resistance. In order to minimize the emergence of resistance in human infections and limit the inappropriate prescription of antibiotics, this entails encouraging the appropriate use of antimicrobials through education, guidelines, and surveillance programmes. Furthermore, strengthening healthcare's infection prevention and control protocols environments can lessen the burden of infections linked to healthcare and stop the emergence of resistant germs. In the field of animal health, minimizing the formation and dissemination of bacteria resistant to antibiotics requires the implementation of responsible antimicrobial use practices in livestock production. Mudenda *et al.,* (2023) [4] emphasize the significance of developing veterinarian oversight of antimicrobial use, encouraging substitutes for antimicrobial growth boosters, and bolstering surveillance of antimicrobial resistance in animal populations. Additionally, encouraging biosecurity protocols and excellent animal husbandry techniques can aid in halting the spread of infections that are resistant to human and animal consumption.

The role of food chain AMR one health approach

In order to reduce related hazards, Sagar *et al.,* (2023) [5] emphasize the critical role that the food chain plays in the spread of antimicrobial resistance (AMR) and support a One Health strategy. The food chain's interdependence between the health of humans, animals, and the environment creates channels for the spread of antibiotic residues and resistant microorganisms. Reducing the dangers associated with AMR requires the implementation of comprehensive measures that incorporate surveillance, regulation, and education throughout the food production continuum. A One Health approach can help reduce the transmission of AMR via the food chain and protect public health by addressing antibiotic use in agriculture, promoting food safety measures, and improving collaboration among stakeholders.

Low resources setting to address AMR

Biswas *et al.*, (2022) [6] provided insight into how One Health techniques might be modified for use in low-resource environments in order to address the urgent problem of antimicrobial resistance (AMR). These areas frequently deal with particular difficulties such poor access to clean water and sanitation, a lack of proper healthcare infrastructure, and limited financial resources. Notwithstanding these challenges, the application of One Health tactics presents encouraging paths for successfully addressing AMR. Promoting interdisciplinary collaboration among medical professionals, veterinarians, environmental scientists, policymakers, and community stakeholders is a crucial component of One Health adaptation in low-resource settings. These partnerships and resource-leveraging can allow for the sharing of knowledge, skills, and resources that are required for comprehensive efforts in AMR surveillance, prevention, and control underline the significance of capacity-building programmes and community involvement in low-resource environments. At the grassroots level, promoting responsible antimicrobial use practices, raising knowledge of AMR hazards, and fostering empowerment of local populations through education, training, and participatory techniques can all contribute to behavior change. All things considered, the application of One Health methodologies in low-resource environments provides a comprehensive framework for tackling AMR by acknowledging the interdependence of environmental, animal, and human health. In resource-constrained environments, stakeholders can collaborate to preserve antimicrobial effectiveness and protect public health by customizing interventions to the unique requirements and obstacles of these contexts.

Potential Causes to spread AMR

A thorough analysis of the possible factors contributing to the spread of antimicrobial resistance (AMR) and countermeasures is provided by Endle *et al.,* (2023) from the standpoint of one health. The overuse and misuse of antibiotics in veterinary care, human healthcare, and agriculture, together with insufficient infection prevention and control measures, are identified by the authors as major factors contributing to the spread of antimicrobial resistance (AMR). International travel, inadequate sanitation, and limited access to clean water are other factors that fuel the spread of resistant infections around the world. The authors support a One Health strategy that prioritizes cooperation between the environmental, animal, and human health sectors in order to solve these issues. Preventive actions that are advised include putting in place antimicrobial stewardship programmes, encouraging responsible use of antibiotics in both clinical and agricultural contexts, and improving surveillance systems. Furthermore, bolstering immunization campaigns, investing in the discovery and development of novel antimicrobial agents, and enhancing sanitation infrastructure are emphasized as critical tactics in the fight against AMR. Policymakers, medical professionals, and other stakeholders can create integrated interventions to slow the emergence of antibiotic resistance and maintain the efficacy of antimicrobial medications for upcoming generations by embracing a comprehensive One Health concept.

Karnali Pradesh Nepal

The Federal Animal Health Structure, which includes labs, is essential to ensuring the health and welfare of the livestock in Karnali Pradesh, Nepal. This organization plays a crucial role in illness surveillance, diagnosis, and the use of preventative measures as part of the federal animal health system in Nepal. Karnali Pradesh's veterinary laboratories of country are set up to carry out necessary examinations and evaluations, assisting in the early identification of illnesses on AMR problem: presence of bacteria species in animal species, resistance and sensitivity of drug used in animal health for treatment and preventive measures that might impact the state's cattle herd. These facilities sustain the lives of the surrounding populations, which are mostly involved in agriculture and animal husbandry, by guaranteeing the health and production of the animals. Furthermore, the Federal Animal Health Structure in Karnali Pradesh actively supports national initiatives to improve food security, encourage sustainable farming methods, and lessen the economic effects of animal illnesses on the agricultural economy of the area.

Aim of the study

The health of people and animals is significantly impacted by the repercussions of rabies transmission and AMR Resistance. If the rabies virus exposure in people is not treated right away, it can cause a deadly neurological condition. Dogs are the major reservoir for the virus, which is mostly spread through animal bites. Rabies is nearly always lethal once clinical symptoms appear which emphasizes the need for preventive measures. When given soon after a possible exposure, post-exposure prophylaxis (PEP) can effectively delay the onset of symptoms. Nonetheless, PEP accessibility and availability particularly in locations with low resources continue to be critical determinants of how human rabies cases turn out. In terms of animal health, both domestic animals and wildlife are seriously threatened by rabies. Animals with the virus may act aggressively, salivate excessively, or become paralyzed, which helps the infection spread. Rabies can cause localized outbreaks that endanger entire populations, in addition to the suffering that befalls individual animals. • In Nepal in 2019, there were 6 400 deaths attributable to AMR and 23 200 deaths associated with AMR. Nepal has the 52nd highest age-standardized mortality rate per 100 000 population associated with AMR across 204 countries (IHME). • A survey of animal and human health sector stakeholders showed that 79% of the respondents purchased antibiotics directly over the counter (Frontiers in Medicine). • According to research, over 70% of veterinary drug sales were obtained from paraprofessionals or retail outlets lacking proper storage facilities and veterinary training (PubMed). The effect can upset biodiversity and ecological balance by cascading through ecosystems rather than being confined to a single species. The fact that rabies is a zoonotic disease highlights the connection between animal and human health. Campaigns to stop the spread of rabies in animals and population control are important components of public health initiatives aimed at preventing human cases of rabies, as they safeguard animal populations as well.

Problem Statement

The health of humans and animals is significantly impacted by the repercussions of rabies transmission and Antimicrobial Resistance. When it comes to human health, rabies exposure which frequently results from animal bites can cause a deadly neurological condition. Post-exposure prophylaxis (PEP) must be administered as soon as possible to prevent the onset of symptoms; nevertheless, there are still issues with accessibility and affordability, especially in places with little resources. The substantial death rate associated with clinical rabies emphasizes how critical prompt intervention is. Regarding animal health, rabies is a major risk to wildlife and domestic animals alike. Animals that are infected may become paralyzed, behave aggressively, or salivate excessively, all of which can help the virus spread quickly among populations. Rabies outbreaks can cause more than just individual misery; they can also disturb entire ecosystems, harming biodiversity and ecological. Recognizing the zoonotic nature of rabies, strategies to control transmission in animals not only safeguard animal populations but also play a critical role in preventing human rabies cases through vaccination campaigns and effective population management.

Significance of the study

Despite recent improvements, there are still over 100 laboratory-confirmed rabies deaths in Nepal each year due to low public awareness, ongoing difficulties with canine vaccination, and insufficient availability or cost of life-saving biologics for people exposed to the virus. Research has shown that over half of the districts had human rabies mortality, with children and disadvantaged rural people being the main victims. Further research with a focus on Nepal can improve rabies prevention and control policies by identifying at-risk areas and populations, enhancing animal vaccination tactics to achieve 70% coverage, assessing the effects of programmers on virus transmission, enhancing the methods used by healthcare providers to administer post-exposure prophylaxis, and more accurately estimating mortality rates. In order to eventually achieve rabies-free status for the benefit of Nepali healthcare and veterinary services, livestock industries, ecosystems, and public health, this can produce evidence that guides resource prioritization and operational modifications.

LITERATURE REVIEW

Fahrion, A. S., *et al.*, 2017 Frontiers in Public Health article titled "The Road to Dog Rabies Control and Elimination What Keeps Us from Moving Faster?" The goal of the book is to discuss the obstacles and difficulties impeding worldwide efforts to manage and eradicate dog rabies. The study aims to investigate the impediments to the prompt adoption of efficient control measures and to identify significant obstacles in the path of accomplishing the goal of eliminating dog rabies. The research technique presumably consists of field studies, interviews with stakeholders in rabies control programmers, and a thorough examination of the body of existing literature. The study's conclusions include expected to provide light on the difficulties and complexities involved in preventing and curing rabies in canine populations and provide insightful suggestions for advancing this vital public health initiative.

Nel (2013) [8] sought to examine global factors affecting rabies control. The author gathered information from published research on the history, epidemiology, diagnosis, and preventative measures of canine rabies, which causes over 99% of rabies infections in humans worldwide. The review process included a qualitative synthesis of previous report findings and surveillance data from several continents that showed the prevalence of rabies and evaluated the effectiveness of current biologics for both humans and animals. Key findings revealed that rabies prevention in developing countries is still hindered by a number of issues, including limited vaccine accessibility, gaps in knowledge about appropriate post-exposure prophylactic use, inadequate animal vaccination coverage levels below the threshold of >70% required to stop virus transmission, lax dog population control policies, obstacles to surveillance and diagnosis, and a lack of intersect oral cooperation. The author came to the conclusion that tackling these problems in concert can hasten regional and global progress towards rabies eradication.

Okonko *et al.*, (2010) [9,10] examined the elements that contribute to rabies' continued global persistence in spite of existing preventative measures. Their goals were to raise awareness of this underappreciated illness and draw attention to obstacles that rabies elimination in endemic nations faces. The data on rabies epidemiology, diagnoses, control methods, and outcomes were collected by the authors from earlier papers. A number of socio cultural, medical access, and policy factors were found to be enabling ongoing cycles of rabies transmission in reservoir populations while restricting the delivery of life-saving biologics. These factors included widespread myths that delay seeking medical attention after exposures, the high cost of vaccines for most at-risk communities, a lack of knowledge among medical professionals regarding appropriate prophylactic protocols, a lack of funding for control programmers and serve sectors related to wildlife. The authors arrive to the conclusion that resolving these shortcomings through a "One Health" approach and being prepared to respond to new viral threats can help end the historical neglect that has allowed rabies deaths in humans and animals to continue into the twenty-first century.

Ogun *et al.*, (2010) [10] used a quantitative analysis of control initiatives in Africa to determine the viability of rabies eradication globally. In order to determine the viability of rabies elimination, their technique gathered previously published data as well as expert consultations on rabies epidemiology, prevention tactics, control programmer expenses, and impacts. Key studies showed that true viral eradication would be unlikely due to animal reservoir and reintroduction hazards, but elimination should be biologically feasible within two decades with significant political will and investments in vaccination and surveillance.

Despite effective biological therapies, Haselbeck *et al.*, (2021) [11] examined the policy and preventive landscape obstacles impeding rabies control throughout Africa. Using a mixed-methods approach, the authors combined studies of the literature on control programmes with qualitative key informant interviews conducted with professionals from the public health and veterinary sectors in 32 African countries. Their findings brought to light challenges related to uneven and inadequately funded control measures, restricted capabilities for public health responses, gaps in monitoring data, uncontrolled dog populations, and inadequate intersect oral cooperation for risk reduction.

Tenzin *et al.*, (2020) [12] used animal brain tissues from Bhutan to assess the diagnosis accuracy of a quick rabies immune chromatographic test in comparison to the gold standard of fluorescent antibodies. In order to screen for rabies, the investigators prospectively used both assays to a panel of 98 field specimens provided in 2019. Test findings for the rapid kit vs fluorescent antibody detection showed high sensitivity and specificity surpassing 90%, demonstrating its usefulness as a speedy, accurate, and low-cost method for animal rabies surveillance in low-resource situations.

The CDC and state health agencies across the country undertake rabies surveillance every year, and Ma *et al.*, (2020, 2021) released the results. In order to characterise epidemiological patterns, both researches collected and examined passively reported data on animal rabies cases that were verified in labs in 2018 and 2019. Important discoveries showed that, although isolated outbreaks continue to occur, domestic animal cases have gradually decreased over the past few decades along with wildlife, which serves as the primary reservoir. These findings emphasize the necessity of ongoing surveillance and raising public health awareness.

Feng *et al.*, (2020) [15] used national surveillance data from 2004 to 2018 to investigate long-term trends in China's rabies pandemic. They used a process that involved compiling genetic sequencing data and analyzing reportable case figures. Findings showed that although China has made incredible strides in rabies control, final eradication was hindered by infections in dogs and other animals that are moving from rural areas in the west to provinces in the east, demonstrating how spatial dynamics affect the persistence of viruses.

The US domestic animal reservoirs for rabies virus variant distributions were studied by McQuiston *et al.*, (2001) [16]. Defining threats to public health and setting management priorities were among their goals. The bulk of veterinary rabies infections are caused by unique regional wild animal strains that the scientists identified after compiling and sequencing rabies virus samples from dogs and cats submitted nationwide in 1999. This emphasized the necessity of coordinated disease surveillance for domestic animals, wildlife, and people.

Evidence in favor of intersect oral "One Health" approaches for the best possible control and prevention of rabies was evaluated by Acharya *et al.*, (2020) [17]. Their approach involved a qualitative synthesis of previous international cases of integrated interventions from the veterinary, medicinal, and environmental domains. Benefits including improved vaccination administration, integrated human-animal surveillance, and consistent public messaging for responsible pet ownership and awareness were emphasized by the findings. Therefore, interdisciplinary cooperation can enhance rabies prevention beyond specialized initiatives.

Kimitsuki *et al.*, (2020) [18] used animal brain samples to assess the diagnostic accuracy of quick rabies immune chromatographic test strips, with standard fluorescent antibody detection serving as the gold standard. Utilizing both procedures on 257 preserved specimens in Cambodia; they discovered a strong association between visual band-based and conventional laboratory findings. endorsing these quick tests as simple, affordable rabies surveillance methods.

The molecular characterization of rabies virus variants found in domestic animals in the United States was studied by Pieracci *et al.*, (2020) [19]. Tracing the transmission channels linked to human exposures was one of their goals. In order to identify circulating strains, the scientists underscored the urgency of promptly analyzing specimens and documented geographic trends based on phylo genetic and sequencing analysis of rabies positive samples submitted during intensified monitoring efforts from 2006 to 2016.

In order to assess the risk of rabies exposure, Benavides *et al.*, (2020) [20] looked into animal bite injuries in Brazil. They identified at-risk groups, such as those bitten by dogs and bats, by profiling nearly 5000 bite victims who sought medical attention in 2018 and compared the circumstances and offending species to the likelihood of rabies transmission using national surveillance data. Integrating bite patient data with rabies diagnoses can improve advice on prevention.

By (G. Yale *et al.*, 2022) [21]. The authors of the paper that was published in Viruses in 2022 set out to assess the oral rabies vaccination programmer for dogs and its implementation in India. The study aimed to investigate the efficacy of oral rabies vaccination regimens for dogs and evaluate their appropriateness within the framework of rabies control initiatives in India. One possible methodology used in the review was a thorough examination of field research, data from oral rabies vaccine campaigns in India, and existing literature. It is expected that the study's conclusions would provide important guidance for improving rabies control efforts in India by shedding light on the viability and difficulties of introducing oral rabies vaccination programmers for dogs in that nation.

By (Restrepo *et al.*, 2022) [22]. This 2022 study, which was published in Zoonoses and Public Health, examined the usage of antibiotics in patients who had been bitten by rabies-transmitting animals. Assessing the frequency and appropriateness of antibiotic usage in people who have been attacked by animals that could potentially spread rabies was probably one of the goals. Retrospective examination of medical records, patient interviews, and data gathering on antibiotic prescriptions following animal assaults could have all been part of the research. It is anticipated that the study's conclusions will clarify the trends in antibiotic usage in these situations, advancing knowledge of present protocols and possible avenues for post-exposure prophylactic advancement.

Freuling, C. M., and Müller, T. (2020) [23]. The writers' 2020 submission to Springer eBooks concentrated on rabies vaccinations for wildlife. Reviewing the body of information regarding rabies vaccination protocols for wildlife populations was probably one of the main goals. A thorough literature analysis that summarized important results about the difficulties and effectiveness of rabies vaccination programmers for wildlife may have been part of the technique. In the larger framework of rabies control initiatives, the results should shed light on the viability and possible effects of vaccinating wildlife.

(C. Mbilo *et al.*, 2021) [24]. This study, which was published in Acta Tropica in 2021, examined dog rabies prevention in West and Central Africa. One of the goals was probably to assess how dog rabies control measures were going in the designated area. A thorough study of the literature, data gathering on currently in place control programmers, and maybe field studies evaluating the effects of different interventions were all possible components of the methodology. It is hoped that the results would provide important insights for future projects and advance knowledge of the difficulties and achievements in dog rabies control in West and Central Africa.

AMR Challenges

The Director of Veterinary Services (DVS) and the Ministry of Health (MoH) in Kenya worked together to create Information, Education, and Communication (IEC) materials for four different audiences: the general public, veterinary professionals, farmers, and human medical professionals. All audience groups received posters with instructional messages attached, along with two pamphlets with Frequently Asked Questions (FAQs) intended for veterinary and human medicine experts. For these five target markets, a total of seven IEC versions were made, with the material initially available solely in English. Time and money restrictions played a role in the choice to develop the materials only in English. Interestingly, in the event that the materials were translated into Kiswahili, the second official language of Kenya, the expenses and time requirements involved would double. Audience segmentation, which was informed by the various information demands of each target group, helped determine the quantity and kind of IECs. This division was made possible by a pre-test that was first carried out on posters meant for the broad audience. The work at hand is further complicated by the difficulty of insufficient country-specific information on antimicrobial resistance (AMR). Antimicrobial resistance (AMR) awareness campaigns, in contrast, are not the same as health communication initiatives for diseases like polio, TB, HIV/AIDS, or malaria since the target groups for those interventions were more homogeneous, enabling a single message to be shared across national boundaries. As opposed to these illnesses, which have more consistent awareness requirements, AMR occurs in a variety of settings, such as clinical medicine, agriculture, and animal husbandry. Because AMR is multidimensional, different difficulties must be addressed in different circumstances. Thus, when taking cues from current or previous health communication strategies for diseases with less diverse audiences, antimicrobial resistance (AMR) campaigns need to be aware of the different contexts in which they are operating and adjust their messaging accordingly to effectively reach the various stakeholders involved in global human and animal healthcare. Due to the complexity of AMR, communication strategies must be flexible and nuanced, taking into account the particular difficulties presented by various practices [16].

AMR in foodborne pathogens in India is markedly high. The WHO Advisory Group on Integrated Surveillance of Antimicrobial Resistance (WHO-AGISAR) assessed the prevalence and resistance profiles of four foodborne pathogens in humans and animals in northern India. While the prevalence of pathogens causing diarrhea in humans ranged between 4.84 percent for enterotoxigenic *Escherichia coli*, 4.32 percent for enteropathogenic *E. coli* (EPEC), and 2 percent for *Campylobacter* spp., the prevalence in stool samples collected from food animals was notably higher for EPEC (32.11%) and *Campylobacter* spp. (24.72%). [One Health]

A few communication ideas that might be used to comprehend AMR

Everett Rogers developed the theory of diffusion of innovations in 1962, which explains how a concept or product acquires traction and gradually permeates a social system [18]. This hypothesis, which is widely applied in behavior change communications, aids in audience segmentation to increase the rate at which inventions or innovations are adopted [18]. When it comes to antimicrobials, which are regarded as innovations, their dissemination has gone through phases like awareness, curiosity, appraisal, and testing before reaching a worldwide level of adoption. The public's perception of antimicrobials' efficacy and the socioeconomic standing of their users have both played a significant role in their successful dissemination.

According to modernization theory, societies tend to undergo convergence and similarity, facilitating the widespread adoption of innovations among the masses [18]. This occurs at the pinnacle of the transformative impact brought about by the innovation. Traditional societies, characterized by entrenched socio-cultural settings, are generally resistant to change [19, 20, 21, 22], and the process of change is inherently gradual. Modernization theory categorizes the transformation process into stages: traditional, pre-condition for take-off, the take-off, drive to maturity, and high or mass consumption of change (product or service) [18]. In the maturity stage, masses extensively adopt the innovation and develop diverse ways of utilizing it. At this point, challenges arise from varied risky behaviors stemming from differences in use, necessitating the identification and prescription of change strategies. Currently, we find ourselves in the stage of mass consumption of antimicrobials, where there is widespread and almost universal adoption and use of these agents. The considerable level of change required to reverse certain antimicrobial usage habits that contribute to antimicrobial resistance (AMR) presents a significant challenge. Simultaneously, new alternatives, such as the use of bacteriophages [23], can be positioned as innovations capable of addressing AMR using the principles of the diffusion of innovations theory. We are currently in the phase of antibacterial mass consumption, in which the usage and adoption of these medicines is nearly ubiquitous. A major obstacle is the enormous amount of change needed to overcome some antibiotic usage patterns that fuel antimicrobial resistance (AMR). Using the ideas of the diffusion of innovations theory, new options, such the employment of bacteriophages [23], may be simultaneously positioned as innovations capable of solving AMR.

The burden of antimicrobial resistance (AMR) in Nepal AMR represents a global challenge • 4.95 million people who died in 2019 suffered from drug-resistant infections. • AMR directly caused 1.27 million of those deaths. • 1 in 5 of those deaths occurred among children under 5 years old.

AMR burden in Nepal • In Nepal in 2019, there were 6,400 deaths attributable to AMR and 23,200 deaths associated with AMR. • Nepal has the 52nd highest age-standardized mortality rate per 100,000 population associated with AMR across 204 countries. According to a 2021 study of the Nepal Health Research Council (NHRC), only 32 percent of the doctors and health workers have access to laboratories for antibiotic susceptibility testing. Among them, only 49 percent recommend antibiotic susceptibility testing before prescribing antibiotics. This means that only 16 percent of doctors recommend antibiotics after susceptibility testing.

“There is a significant reason for influencing rational prescriptions of antibiotics,” the report stated.

The study also shows that more than one-third—37.8 percent—of prescribed medicines were antibiotics, which is higher than the World Health Organisation’s standards.

Global Antimicrobial Resistance

By (Mattar *et al.*, 2020) present a thorough description of the global centre for antimicrobial resistance (AMR) research and development, as well as an examination of the state of the field at the moment. The authors stress the significance of research and development projects while shedding light on the ongoing efforts and difficulties associated with AMR. The study aims to investigate the worldwide framework surrounding antimicrobial resistance (AMR), comprehend the function of the research and development hub, and evaluate the present status of antimicrobial resistance research. The approach used includes a careful analysis and synthesis of the body of knowledge about AMR, including policy papers and statistics. The success of existing therapies is one set of dependent variables, while the numerous factors driving antimicrobial resistance (AMR), such as healthcare and socioeconomic situations, are the other set of independent variable’s frameworks for policies and behaviors. The publication's conclusion highlights the critical role that research and development play in addressing this important public health issue and emphasizes the urgent need for coordinated worldwide efforts to overcome antibiotic resistance [31].

METHOD AND RESULTS

Virology unit

The diagnosis of viral illnesses is the responsibility of this unit. Majority of samples are provided by the postmortem unit of CVL, Veterinary Laboratories throughout various provinces, NADIL, Central Veterinary Referral Hospital (CRVH), and Veterinary Hospital and Livestock Services Expert Centre (VHLSEC). During disease epidemic investigations, samples are also provided by private clinicians, farmers, CVL staff, and quarantine check posts. Competitive ELISA, Fluorescent Antibody Test, Plate Agglutination Test, and Rapid Antigen Detection Test facilities are available at the unit. The first diagnosis of avian influenza, Newcastle disease, infectious bursal disease, infectious bronchitis, PPR, ASF, and rabies is mostly made with a rapid antigen detection test. The samples are transferred to the Molecular Section for a more thorough confirmation diagnosis of avian influenza. Similarly, Fluorescent Antibody Test (FAT) is used for confirmatory diagnosis of rabies.

Rapid Diagnostic Test (RDT)

Using the fast test kit method, 1,394 samples were examined for disease detection in Nepal during the fiscal year 2078/79. Using the Rapid test kits, 263 samples, out of 1,394 samples that were examined showed positive for the illness. In fiscal year 2078/79, out of all the samples analyzed using rapid test kits, about 19% were determined to be positive cases of the disease.

Table 1

Month	Samples	Rapid test						Total
		AIV	NDV	IBDV	IBV	PPR	Rabies	
Shrawan	Total	40	33	18	15	8	9	123
	Positive	0	9	8	0	3	3	23
Bhadra	Total	32	27	17	11	2	4	93
	Positive	0	4	6	1	0	2	13
Ashoj	Total	32	27	17	11	2	4	93
	Positive	2	1	10	2	1	1	17
Kartik	Total	43	5	15	13	1	1	78
	Positive	3	2	8	2	0	0	15
Mangsir	Total	38	15	25	19	5	1	103
	Positive	0	0	9	1	4	0	14
Poush	Total	38	15	25	19	4	1	102
	Positive	3	2	5	2	0	6	18
Magh	Total	30	13	16	15	5	12	91
Month	**Samples**	**Rapid test**						**Total**
		AIV	**NDV**	**IBDV**	**IBV**	**PPR**	**Rabies**	
	Positive	5	1	6	2	0	1	15
Falgun	Total	79	27	20	12	5	7	150
	Positive	24	0	6	4	0	6	40
Chaitra	Total	92	16	19	16	1	7	151
	Positive	22	0	8	2	0	3	35
Baishakh	Total	76	15	21	8	2	7	129
	Positive	11	2	12	1	0	3	29
Jesth	Total	87	19	22	14	3	7	152
	Positive	15	1	13	1	0	3	33
Ashar	Total	82	15	25	5	0	2	129
	Positive	0	1	5	1	2	2	11
Total	**Total**	**669**	**227**	**240**	**158**	**38**	**62**	**1394**
	Positive	**85**	**23**	**96**	**19**	**10**	**30**	**263**

Rabies diagnosis

72 samples from cases that were clinically suspected of having rabies were analyzed in Nepal's fiscal year 2078–2079 to confirm the illness. Forty of the 72 suspected rabies samples that were analyzed tested positive for the disease, representing roughly 55% of the suspected cases. This shows that, more than half (55%) of the suspected cases of rabies were found to have contracted the disease through testing. Canine species accounted for the majority of the samples collected for analysis. The 40 positive rabies cases that year are broken down month by month here: In conclusion, 55% of submitted suspected rabies samples for fiscal year 2078/79 tested positive for the rabies virus, with the majority of specimens coming from dog's creatures. The distribution of the 40 confirmed rabies cases over the course of the year is further shown by the month-wise statistics.

Table 2

Species		Dog	Buffalo	Cat	Human	Goat	Cattle	Horse	Total
Shrawan	Total	0	1	0	0	0	0	0	1
	Positive	0	1	0	0	0	0	0	1
Bhadra	Total	1	1	0	0	0	0	0	2
	Positive	1	0	0	0	0	0	0	1
Ashoj	Total	0	1	2	0	0	0	0	3
	Positive	0	1	0	0	0	0	0	1
Kartik	Total	1	0	0	0	0	0	0	1
	Positive	0	0	0	0	0	0	0	0
Mangsir	Total	3	0	0	0	1	2	0	6

	Positive	3	0	0	0	0	1	0	4
Poush	Total	13	1	0	0	0	0	0	14
	Positive	6	0	0	0	0	0	0	6
Magh	Total	10	3	0	0	1	1	0	15
	Positive	6	3	0	0	0	1	0	10
Falgun	Total	4	0	0	0	0	1	2	7
	Positive	4	0	0	0	0	1	1	6
Chaitra	Total	5	0	1	0	1	0	0	7
Species		**Dog**	**Buffalo**	**Cat**	**Human**	**Goat**	**Cattle**	**Horse**	**Total**
	Positive	3	0	0	0	0	0	0	3
Baishakh	Total	6	1	0	0	0	0	0	7
	Positive	3	0	0	0	0	0	0	3
Jesth	Total	5	0	1	0	0	0	0	6
	Positive	2	0	0	0	0	0	0	2
Ashar	Total	3	0	0	0	0	0	0	3
	Positive	3	0	0	0	0	0	0	3
Total	**Total**	**51**	**8**	**4**	**0**	**3**	**4**	**2**	**72**
	Positive	**31**	**5**	**0**	**0**	**0**	**3**	**1**	**40**

Table 3: District wise

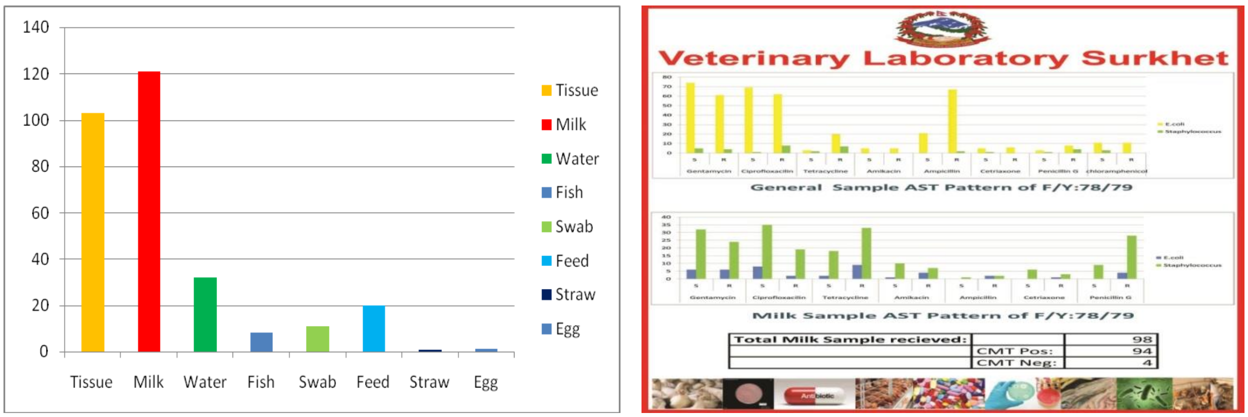
District	Total	Positive
Bhaktapur	3	0
Chitwan	8	5
Dhanusha	1	0
Kathmandu	35	18
Kavrepalanchowk	8	7
Lalitpur	14	8
Makawanpur	1	0
Nuwakot	1	1
Sindhupalchowk	1	1
Total	**72**	**40**

Thorough Instruction and Joint Ventures in Bacteriology

The Veterinary lab surkhet lab has implemented a thorough training programme covering a wide range of bacteriology topics, such as the identification and isolation of bacteria, bio safety and bio security protocols, bio repository administration, and external quality assurance (EQA). Apart from holding virtual meetings with CVL and having conversations about country grants, the team has meticulously recorded procedures concerning bio repository, bio safety, sample processing, and quality control. They have created distinct record sheet forms for effective lab operations in addition to a standardized database that may be compiled across four veterinary labs. The group regularly discusses topics such sample transportation techniques, surveillance programme methodologies, and bio safety. In addition, efforts are focused on streamlining and modernizing the laboratory's capacity to isolate Campylobacter, write prescriptions, and accurately record apparatus, medium, ATCC strains, and antibiotic discs for calibration. Working together with the Regional Grant FF Team, the laboratory monitors and collaborates with the Antimicrobial Resistance (AMR) Technical Working Group (TWG) and National Technical Working Committee (NTWC), and organizes review meetings with the Human Health and Animal Health sectors. The lab was chosen to be an Animal Health AMR Laboratory Fellow in 2020, and they will follow a set of guidelines. Since March 30, 2020, there have been weekly virtual study sessions with mentors from Melbourne University in Australia. The team participated in a virtual WOH congress in 2020 and gave an abstract on Campylobacter while providing a progressing report on AMR during the Fleming Fund Webinar in October of that same year. The goal of the Bacteriology/Mycology Unit is to support the data collection objectives of the Global Antimicrobial Resistance Surveillance System (GLASS) by improving knowledge of cutting-edge culture technology for specific organisms, such as those that produce Extended Spectrum Beta-Lactamase (ESBL) and those of zoonotic significance. Training in laboratory quality management systems is one of the unit's objectives in order to guarantee accurate and trustworthy findings. Furthermore, the unit is dedicated to gathering data on Antimicrobial Resistance (AMR) from chicken farms in the future, which will provide important insights into the dynamics of resistance in this industry. The unit's primary tasks include the enrichment, culture, and subculture of various animal and water samples in addition to carrying out crucial microbiological tests including Oxidase, Catalase, Gramme staining, biochemical testing, and drug sensitivity testing. Additionally, the department actively maintains a bio repository and keeps strict quality control procedures in place, using ATCC strains among other things, in order to maintain the highest standards in mycological and bacteriological research. The unit's dedication to furthering research, establishing quality practices, and resolving important concerns related to antimicrobial resistance is demonstrated by these varied aims.

Out of the 279 samples tested in Veterinary Laboratory (VL) in the fiscal year 78/79, 208 samples proved positive in total. Out of 276 milk samples, 390 showed positive findings on the California Mastitis Test (CMT), whereas 114 showed negative results. E. Coli was the most common isolate in VL patients, followed by Salmonella spp., Streptococcus, and Staphylococcus spp. Notably, 36 milk samples and 11 tissue samples had Multi-Drug Resistant (MDR) E. Coli. Based on sensitivity analysis, the laboratory isolates tested for gentamicin, amikacin, and levofloxacin showed sensitivity rates of 47%, 61%, and 52%, respectively. Staphylococcus aurous was found in 80% of the milk samples that were obtained during active monitoring of milk samples from healthy animals. There was a noticeable increase in the resistance pattern for Amoxicillin, Tetracycline, and Ciprofloxacin highlight how critical it is to keep an eye on and deal with antibiotic resistance in veterinary laboratory procedures.

Figure 11



Pathology section

In veterinary medicine, the pathology division is essential to the thorough assessment and diagnosis of a range of health-related problems. Including separate departments including the postmortem unit, histology, parasitological, and clinical hematology and biochemistry unit, it is an essential centre for comprehending and managing animal health issues. Veterinary Laboratories (VLs), the National Animal Disease Investigation and Laboratory (NADIL), Central Research Veterinary Hospitals (CRVH), Veterinary Hospitals at Local Levels, and Veterinary Health and Livestock Services Extension Centers (VHLSEC) are just a few of the sources from which the wide variety of samples

submitted to the pathology section originate. Furthermore, individual farmers, livestock and poultry farms, and veterinarians all bring samples directly to the table. This cooperative method guarantees a thorough and precise assessment of specimens, enabling prompt and accurate diagnosis that supports the general health and welfare of the animal population. The pathology sector plays a crucial role in developing veterinary medicine and enhancing animal health, as evidenced by its varied capabilities and collaboration with various stakeholders.

Postmortem unit

Necropsy examination is the first and most important stage in veterinary diagnostics when it comes to identifying the reason behind an animal's morbidity. This painstaking post-mortem analysis entails a careful examination of the dead animals, revealing possible illnesses and providing important data that aids in the whole diagnostic procedure. Veterinarians at the Central Veterinary Laboratory (CVL) use a variety of tools, including as clinical findings, epidemiological surveillance data, and the animal's history, to improve the accuracy of these tests. These particulars are crucial in directing the inquiry in the direction of an accurate diagnosis. A noteworthy influx of 1363 animal producers sought the advice of CVL in the fiscal year 2078/79, highlighting the importance of necropsy examinations in the field. 1243 of these farmers were involved in the poultry industry. Farming, with the remaining 120 devoted to various types of animal husbandry. This significant figure highlights the agricultural community's confidence in CVL and highlights the laboratory's vital role in disease diagnosis and surveillance for the livestock industry. Confirmation of diagnoses by a range of accessible tests is another example of CVL's dedication to animal health and welfare, as well as protecting farmers' interests in their pursuit of profitable and sustainable livestock operations.

Poultry postmortem

1243 farmers in all brought chickens for the postmortem analysis broilers (48.02%) were the most common type of poultry among the various varieties, followed by commercial layer and native poultry. Other species were also brought in for PM investigation, including crows, game birds, kuroiler, giriraj, pheasant, breeders, duck, and quail in addition to turkeys and pigeons.

Table 4: Month-wise types of poultry species brought for PM at CVL

Poultry Type	Sharawan	Bhadra	Ashoj	Kartik	Mangsir	Posh	Magh	Falgun	Chaitra	Baishakh	Jesth	Ashar	Total
Broiler	32	34	30	49	57	47	45	58	70	43	64	68	597
Layer	27	4	16	15	9	6	9	16	20	10	16	35	183
Local	16	11	4	21	3	4	7	7	11	13	18	14	129
Kuroiler/Giriraj	25	7	7	12	6	21	9	13	9	7	11	19	146
Turkey	3	0	0	1	0	0	0	1	1	0	1	0	7
Pheasant	8	10	13	16	2	2	2	8		6	1	13	81
Breeder	4	6	1	6	5	4	2	4	5	11	3	0	51
Duck	0	2	0	7	1	3	2	6	1	0	1	1	24
Pigeon	0	3	0	1	0	0	0	2	0	0		1	7
Quail	5	2	2	1	0	0	0	0	0	0	1	1	12
Game birds	0	0	0	1	0	1	0	1	0	0	0	0	3
Crow	0	0	0	0	1	0	0	2	0	0	0	0	3
Total	120	79	73	130	84	88	76	118	117	90	116	152	1243

Poultry diseases diagnosis

A thorough investigation during the PM (post-mortem) examination at the Central Veterinary Laboratory (CVL) for the fiscal year 2078–2079 disclosed a range of infectious and non-infectious disorders impacting bird populations. Remarkably, the most common disease diagnosis was found to be colibacillosis, confirming its ongoing presence. Within the avian community, this Escherichia coli-caused bacterial illness continues to present serious issues. But this year's most notable finding was a noticeable increase in neo plastic disease cases, especially Marek's disease and the Avian Leucosis Complex, which significantly affected pheasant populations. The highly contagious herpes virus that causes Marek's disease and the retrovirus-related Avian Leucosis complex both showed a startling increase in occurrence. These timorous diseases can have significant effects on the health of birds, resulting in elevated rates of morbidity and death. Identifying and comprehending the frequency of these illnesses is essential for creating management and prophylactic plans for bird populations. The results highlight the need for ongoing monitoring, investigation, and preventative actions to address both established and new avian health issues, protecting the health of both domestic and avian wild bird population's death. Identifying and comprehending the frequency of these illnesses is essential for creating management and prophylactic plans for bird populations. The results highlight the need for ongoing monitoring, investigation, and preventative actions to address both established and new avian health issues, protecting the health of both domestic and avian wild bird populations.

Table 5

Type	Disease	Sharawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baishakh	Jesth	Ashar	Total
Bacterial	Colibacillosis	14	19	13	26	19	16	18	26	21	14	28	16	230
	CRD	8	5	3	8	3	4	5	6	8	6	19	12	87
	CCRD	2	2	5	1	3	8	3	2	3	6	1	0	36
Type	**Disease**	**Sharawan**	**Bhadra**	**Ashoj**	**Kartik**	**Mangsir**	**Poush**	**Magh**	**Falgun**	**Chaitra**	**Baishakh**	**Jesth**	**Ashar**	**Total**
	Salmonellosis	7	7	5	10	5	6	4	6	6	1	0	9	66
	Fowl cholera	1	1	0	0	2	0	0	0	1	0	1	0	6
	Infectious Coryza	1	0	1	0	0	0	0	0	0	0	1	1	4
Viral	IBD	7	3	7	10	6	4	5	5	10	10	11	17	95
	ND	10	3	1	5	1	1	1	1	1	2	0	2	28
	AI	0	0	4	2	0	3	5	31	22	11	15	32	125
	IB	1	1	2	2	0	1	1	0	2	1	3	0	14
	MD	4	3	1	6	5	1	0	0	0	0	0	0	20
	ALC	3	1	0	10	0	1	2	2	1	0	0	0	20
	Fowl Pox	1	0	0	0	0	1	0	0	0	0	0	0	2
Mycotoxin	Mycotoxicosis	20	14	11	22	12	9	8	16	10	12	12	23	169
Metabolic	Gout	2	0	0	0	2	3	2	5	2	0	1	0	17
	Ascites	3	2	3	3	12	11	9	8	7	3	2	1	64
Parasitic	Coccidiosis	7	3	2	3	1	5	2	2	4	3	6	4	42
	Histomoniasis	2	2	2	0	0	0	0	0	0	0	0	1	7
	Round worm	1	1	3	3	1	2	1	1	0	1	0	0	14
	Tapeworm	0	0	0	1	0	0	1	0	0	0	0	0	2
Others	Others*	26	12	10	18	12	12	9	7	19	20	16	34	195
Total		120	79	73	130	84	88	76	118	117	90	116	152	1243

Table 6: Poultry type wise diseases of avian species diagnosed by PM in CVL

Type	Name	Broiler	Layer	Local	Kuroiler/ Giriraj	Turkey	Pheasant	Breeder	Duck	Pigeon	Quail	Game birds	Crow	Total
Bacterial	Colibacillosis	171	16	12	17	0	3	8	2	0	0	1	0	230
	CRD	55	3	8	15	2	1	3	0	0	0	0	0	87
	CCRD	27	2	3	2	0	0	2	0	0	0	0	0	36
	Salmonellosis	11	27	5	4	0	9	3	6	0	1	0	0	66
	Fowl cholera	2	1	1	0	0	0	0	2	0	0	0	0	6
	Infectious Coryza	0	0	0	4	0	0	0	0	0	0	0	0	4
Viral	IBD	67	9	5	10	0	0	4	0	0	0	0	0	95
	ND	4	5	9	5	0	0	1	0	3	0	1	0	28
	AI	19	48	22	16	3	6	3	5	0	1	0	2	125
	IB	8	0	3	0	0	1	1	1	0	0	0	0	14
	MD	0	3	5	7	1	2	0	0	1	0	1	0	20
	ALC	0	2	2	4	0	11	1	0	0	0	0	0	20
	Fowl Pox	0	0	1	1	0	0	0	0	0	0	0	0	2
Mycotoxin	Mycotoxicosis	50	35	20	16	0	23	17	3	1	4	0	0	169
Metabolic	Gout	9	2	0	4	0	0	1	0	0	1	0	0	17
	Ascites	60	2	0	0	0	0	1	1	0	0	0	0	64
Parasitic	Coccidiosis	14	3	7	12	0	2	3	0	0	0	0	1	42
	Histomoniasis	0	2	1	3	1	0	0	0	0	0	0	0	7
Type	Name	Broiler	Layer	Local	Kuroiler/ Giriraj	Turkey	Pheasant	Breeder	Duck	Pigeon	Quail	Game birds	Crow	Total
	Round worm	1	0	3	7	0	1	0	0	2	0	0	0	14
	Tapeworm	0	0	1	1	0	0	0	0	0	0	0	0	2
Others	Others	99	23	21	18	0	22	3	4	0	5	0	0	195
Total		597	183	129	146	7	81	51	24	7	12	3	3	1243

Postmortem of animals

This year, the Central Veterinary Laboratory (CVL) examined 120 animals after death, offering important information on the health and welfare of different animal species. The wide range of animals that are brought in for inspection is representative of the laboratory's ability to handle a wide range of veterinary issues. The table below provides a detailed breakdown of the animal species that were examined by post-mortem analysis. In addition to helping identify particular illnesses, this thorough inspection procedure advances our knowledge of general health patterns in many animal groups. For academics, policymakers, and veterinary practitioners, the information obtained from these exams is an invaluable tool that helps with targeted health interventions and decision-making for a variety of species. The CVL's devotion to ensuring the health and welfare of varied animal populations is shown in its extensive post-mortem inspections.

Table 7: Month wise animal species brought for PM in CVL (FY 2078-79)

Animal	Sharawan	Bhadra	Ashoj	Kartik	Mangsir	Poush	Magh	Falgun	Chaitra	Baishakh	Jesth	Ashar	Total
Goat	2	7	5	3	4	3	5	6	1	2	7	2	47
Pig	0	0	1	2	0	3	4	4	2	12	2	3	33
Dog	2	1	0	1	4	9	3	1	4	4	4	2	35
Cat	0	0	2	0	0	0	0	0	1	0	0	0	3
Rabbit	0	0	0	0	1	0	0	0	0	0	0	0	1
Sheep	0	0	0	0	0	0	0	0	0	1	0	0	1
Total	4	8	8	6	9	15	12	11	8	19	13	7	120

Animal disease diagnosis

The thorough data presentation on animal diseases highlights the various health issues that differing species encounter, requiring a focused and comprehensive approach to veterinary care, disease surveillance, and preventative measures.

Table 8: Animal type wise disease diagnosed by PM in CVL (2078-79)

Disease	ET	Pneumonia	Rabies	HS	Anthrax	Helminthiasis	Poisoning	PPR	PRRS	CSF	ASF	Fasciolosis	Ascites	Others	Total
Goat	14	12	0	2	1	5	3	1	0	0	0	1	0	8	47
Pig	0	4	0	1	1	0	0	0	1	5	12	0	1	8	33
Disease	**ET**	**Pneumonia**	**Rabies**	**HS**	**Anthrax**	**Helminthiasis**	**Poisoning**	**PPR**	**PRRS**	**CSF**	**ASF**	**Fasciolosis**	**Ascites**	**Others**	**Total**
Dog	0	0	21		0	0	0	0	0	0	0	0	0	14	35
Cat	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3
Rabbit	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Sheep	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Total	15	16	21	3	2	5	3	1	1	5	12	1	1	34	120

Fecal examination

As a routine examination or diagnosis of parasites, direct smear method, sedimentation method and the floatation methods are used. During FY 2078-79 a total 514 fecal samples were tested, out of which 254 samples (49.42%) were found to be positive for at least one parasitic egg.

Table 9: Number of positive samples for at least one parasitic egg

Animal	Total sample	Positive	Positive Percentage
Goat	216	129	59.72
Sheep	56	35	62.50
Poultry	10	7	70.00
Pig	5	4	80.00
Cattle	56	46	82.14
Buffalo	16	1	6.25
Yak	155	32	20.65
Total	514	254	49.42

Table 10: Parasites identified

Parasite	Goat	Sheep	Poultry	Pig	Cattle	Buffalo	Yak	Total
Fasciola	0	0	0	0	2	0	3	5
Paramphistomes	2	0	0	0	13	1	0	16
Ascaris	0	0	1	0	0	0	2	3
Trichuris	7	10	0	4	23	0	0	44
Strongyle	54	22	0	0	2	0	26	104
Capillaria	1	0	0	0	1	0	2	4
Moniezia	6	2	0	0	0	0	0	8
Coccidia	47	5	6	0	11	0	4	73
Strongyloides	44	19	0	0	11	1	0	75
Oesophagostomum	0	4	0	0	0	0	0	4
Total	161	62	7	4	63	2	37	336

Table 11: Parasites identified in the government farm

Office	Animal	Total sample	Positive	Positive Percentage
Chitlang Goat Farm, Makawanpur	Goat	5	4	80.00
Goat Research Station, Tanahun	Goat	34	24	70.59
Goat Genetic Resource Centre, Kailali	Goat	46	31	67.39
Cattle Genetic Resource Centre, Dolakha	Cattle	44	32	72.73
Sheep Genetic Resoruce Centre, Nuwakot	Sheep	54	33	61.11
Langtang Yak (Research sample for Thesis)	Yak	155	32	20.65
Total		338	156	46.15

Table 12: Parasitic species identified in government farm

Office	Animal	*Fasciola*	*Paramphistomes*	*Ascaris*	*Trichuris*	*Strongylidae*	*Capillaria*	*Moniezia*	*Coccidia*	*Strongylidae*	*Oesophagostomum*	Total
Chitlang Goat Farm, Makawanpur	**Goat**					**2**	**1**		**1**			**4**
Goat Research Station, Tanahun	**Goat**					**9**		**1**	**17**	**11**		**38**
Goat Genetic Resource Centre, Kailali	**Goat**				**3**	**10**		**3**	**26**			**42**
Cattle Genetic Resource Centre, Dolakha	**Cattle**		**9**		**15**		**1**		**11**	**5**	**4**	**45**
Sheep Genetic Resource Centre, Nuwakot	**Sheep**				**10**	**19**		**2**	**5**	**17**		**53**
Langtang Yak (Research samplef for Thesis)	**Yak**	**3**		**2**		**26**		**2**	**4**			**37**
Total		**3**	**9**	**2**	**28**	**66**	**2**	**8**	**64**	**33**	**4**	**219**

Larva culture

Table 13: Larva culture of parasite from government livestock farms

Sr. N	Office	Species	Sample	No. of sample	Positive sample	Larvae identified (No./kg)				
						Trichostrongylus	*Ostertagia*	*Haemonchus*	*Oesophagostomum*	*Nematodirus battus*
1	**Goat Genetic Resource Centre, Kailali**	Oat	Oat	1	1	**298**	**80**	**182**		
		Napier	Napier	1	0					
		Goat	Fecal	6	6	**127**	**163**	**209**		**193**
2	**Sheep Genetic Resource**	Oat	Oat	1	0					**312**
		Ground grass	Grass	1	1	**206**				
Office Centre Nuwakot		**Species**	**Sample**	**No. of sample**	**Positive sample**	**Larvae identified (No./kg)**				
						Trichostrongylus	***Ostertagia***	***Haemonchus***	***Oesophagostomum***	***Nematodirus battus***
		Sheep	Fecal	15	15	**315**				
3	**Cattle Genetic Resource Centre, Dolakha**	Grass	Grass	2	2		**80**			**61**
		Cow	Fecal	8	0					
4	**Bagaicha Farm House Resort, Nawalparasi**	Grass	Grass	2	2		**170**		**190**	
		Goat	Fecal	6	6	**307**	**267**		**303**	
5	**National Animal Breeding Office, Banke**	Grass	Grass	4	0					
		Goat	Feces	10	0					
		Buffalo	Feces	1	0					
		Ox	Feces	1	0					
6	**National Goat Research Station, Tanahun**	Grass	Grass	4	0					
		Goat	Feces	20	11	**175**				
Total				83	44					

Molecular biology unit

Molecular biology unit was established in Central Veterinary Laboratory (CVL) in 2003 A.D. Earlier this laboratory started to diagnose avian influenza by using RT-PCR technique. Later, from 2010, CVL started real time PCR for diagnosis of avian diseases like Avian Influenza (AI), Newcastle disease (ND), and Infectious Bursal Disease (IBD). CVL also started multiplex for respiratory disease of small ruminant (PPR, MCCP, Capripox, Pasteurella) and swine diseases (African swine fever virus, Classical swine fever virus, Salmonella and Erysipelas*)* and other diseases like Porcine Reproductive and Respiratory Syndrome (PRRS-NA and PRRS-EU), since 2016. Later on the technologies expand for diagnosis of other zoonotic and economic importance diseases like Glanders, Lumpy skin Diseases (LSD) and Enterotoxaemia. Molecular unit also participate in proficiency testing (PT) for AI, PPR and Swine diseases since 2016. In the Fiscal year 2078/79, a total of 473 swab samples of avian species suspected for avian influenza were received from thirty districts. Those samples were tested by using Real Time Reverse Transcriptase Polymerase Chain Reaction (rRT PCR). Out of those samples, 44.19% samples were found to be positive for subtype H9N2. During this period, HPAI outbreak was also occurred in eighteen districts like Kathmandu, Lalitpur, Bhaktapur, Kaski, Chitwan, Makwanpur etc. and 194 samples were found to be positive for HPAI (H5N1). Some of the samples were sent to OIE Reference laboratory, Australia. According to WOAH Report, (HPAI) H5N1 associated with the current 2.3.2.1a clade.

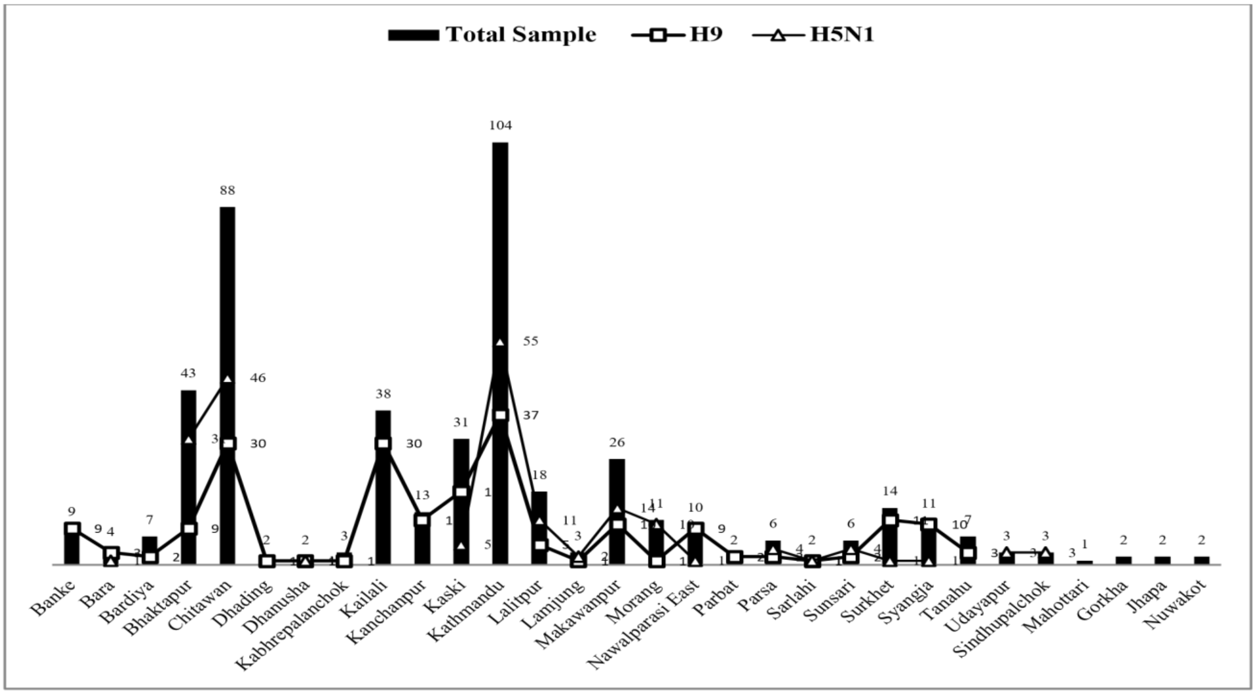


Figure 3: District wise H9 and H5 outbreak of AI.

CVL also received different types of bio-surveillance sample (TS/CS/ES/NS) for avian influenza from fourteen districts. A total of 879 samples were tested by using PCR method. 16.84% samples from Banke, Kavre, Sunsari, Kathmandu, Bhaktapur, Jhapa, Makawanpur and Chitwan were positive for Subtype H9.

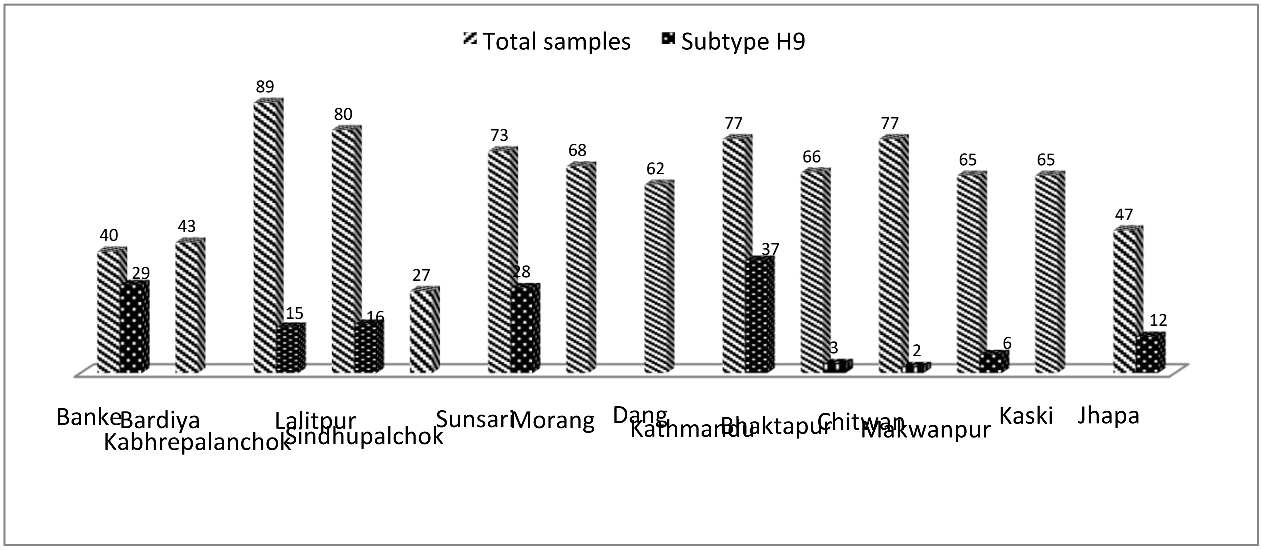


Figure 2: District wise biosurveillance of H9 of AI as diagnosed by PCR

Likewise, CVL received a total of 252 samples of avian species suspected for Newcastle Disease (ND) from 24 districts. Out of those samples, 23.41% samples were found to be positive for ND

Serology unit

Serology section of CVL performs different serological tests for the diagnosis, monitoring and surveillance of animal diseases mainly associated with viral and bacterial infection. Most of the samples are submitted to this unit by Veterinary Laboratories, National Avian Disease Investigation Laboratory, District Offices, Quarantine Check-posts, private practitioner, farmers and staff of CVL during disease outbreak investigations, routine diagnosis well as sero-monitoring. This section possesses capacity and facility of Competitive Enzyme Linked Immunosorbent Assay (ELISA), Immuno-capture ELISA, Indirect ELISA, Tube agglutination Test, Agar-Gel Immunodiffusion (AGID) test, Plate agglutination test and rapid tests. Serology unit also participate in proficiency testing (PT) especially for PPR diagnosis by ELISA method and Brucellosis by PAT since 2016.

Progress report of Serological investigation of various diseases in animals and birds during 2078/79 is as follows.

PPR outbreak

A total of 12 serum samples of goats were received from different outbreaks areas of three districts at different seasons. These samples were tested by ELISA method and 75 % samples were found positive for PPR.

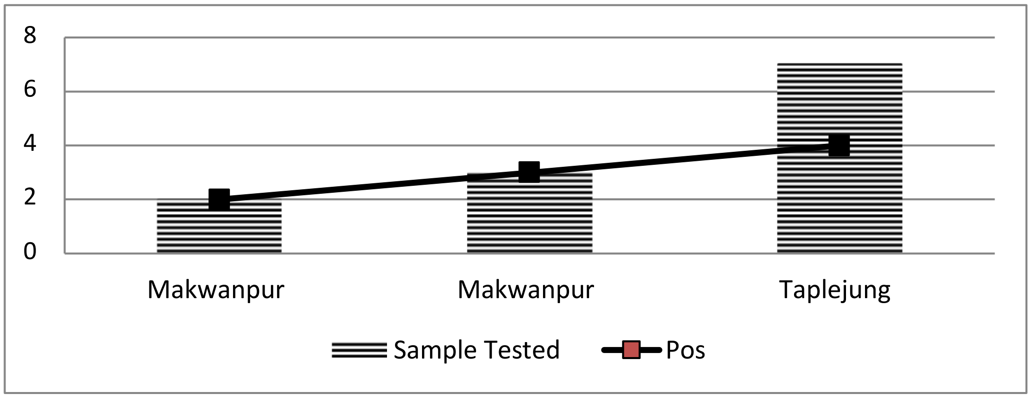


Fig 3: According to WOAH Report, F-gene sequences of the Nepal isolates (virus) belonging to genotype VII.

CONCLUSION

The diverse pathology branch of the Central Veterinary Laboratory performs a wide range of tests and analyses that offer vital insights into the health of animals and disease patterns in Nepal. The continuing prevalence of common diseases like colibacillosis in chicken populations, together with the advent of novel disease concerns like highly pathogenic avian influenza H5N1 clade 2.3.2.1a, are highlighted by key findings from fiscal year 2078/79. Over 3900 specimens from a variety of domestic and wild species have undergone extensive post-mortem, faecal, larval culture, molecular, and serological testing. This data supports research, surveillance, diagnosis, and focused policy responses for endemic and emerging illnesses. The laboratory is a key centre for animal disease control in Nepal, as demonstrated by proficiency test results and global reporting obligations, and it advances national and regional understanding of veterinary care. It is crucial to maintain ongoing investments in the pathology infrastructure and workforce in order to protect animal welfare, livestock economies, and related human health. It is crucial to maintain ongoing investments in the pathology infrastructure and workforce in order to protect animal welfare, livestock economies, and related human.

FUTURE DIRECTIONS

The transmission of rabies and its consequences for public health have been extensively studied, but a notable research gap exists in understanding the dynamics of bridging the species barrier. While much is known about the transmission of rabies within specific animal populations, there is a need for more comprehensive investigations into how the virus successfully crosses from one species to another, particularly from wildlife to domestic animals or humans. The mechanisms and factors that facilitate or hinder cross-species transmission remain insufficiently explored. Filling this research gap is crucial for developing targeted interventions and preventive measures that can mitigate the risk of rabies spillover events, ultimately enhancing public health outcomes.

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