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An update on prevention and control of livestock diseases in India

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Abstract
Millions of farmers keep livestock for the purpose of milk production, and every year a wide variety of diseases, some of which can be fatal, cause illness in these animals. Even cattle and buffalo that have a significant threat of disease transmission. They are among the most susceptible people to the introduction of zoonotic diseases into the human population. Milk is in danger of running out in the not too distant future since both consumer demand and the dairy business are both on the rise. Dairy products are progressively used in more and more foods. Farmers take a financial hit each year as a result of illnesses that affect milking dairy animals; the scale of these losses can approach millions of dollars at the national level. At both the state and the national level, there needs to be a diseases control policy in order to put a stop to the losses. In addition to this, the tight interaction that exists between humans and the animals that they have domesticated presents the highest risk of the spread of a range of infectious diseases. The state animal department and the government of India need to conduct an active review of the situation across the state because the number of households that have milk animals has increased. They should also give the process of establishing new rules and putting them into practice the utmost significance, both with the purpose of strengthening the regulation of diseases that are prevalent among the population and with the purpose of reducing the risk of zoonotic transmission. The purpose of this review is to identify and put into effect those measures that will contribute significantly to the eradication of the cattle illnesses that are most prevalent. In this review, we provide a summary of the most prevalent livestock diseases, probable zoonotic diseases, and developing diseases, as well as present and potential regulations that ought to be put into place.

Keywords: Livestock disease, prevention, control, scheduled diseases

Introduction
The detection and eradication of infectious illnesses in livestock have long been recognized as two of the most important steps in achieving sustainable livestock production. Diseases continue to be a significant obstacle in the way of the expansion and further development of the cattle industry across the world. The continual appearance of new ailments as well as the reappearance of diseases that had previously disappeared has further compounded the situation. Animal diseases not only represent a danger to the health and welfare of animals but also have an effect on the health of humans and their ability to make a living. In the cattle industry throughout the course of the past several years, there has been an increased emphasis placed on disease prevention and management. This has been brought about by a number of circumstances, such as the growing demand for animal products, the globalization of commerce, and the appearance of new diseases as well as re-emerging diseases. In response, governments and international organizations have established a variety of methods and programs targeted at avoiding and controlling diseases that can be transmitted to cattle. The deployment of biosecurity measures is one of the most successful ways for avoiding and controlling livestock illnesses. The term "biosecurity" refers to a collection of precautions used to protect a farm, herd, or flock from the introduction and further spread of illness. Both physical and management techniques are included in biosecurity measures, with the goal of

reducing the likelihood of disease transmission from animals to humans and from humans to the environment. The appropriate use of personal protective equipment, correct cleaning methods, and quarantine protocols are examples of some of the more typical biosecurity measures that are implemented in cattle production. The use of vaccinations is another key technique for avoiding and managing diseases that can affect cattle. Vaccines are used to decrease the likelihood of an animal contracting an infection or disease by preparing its immune system to recognize and fight against specific microorganisms. Vaccines have the potential to protect against a wide variety of diseases, including those that are caused by bacteria, viruses, and parasites. One can get vaccinated either on an individual basis or as part of a larger group through mass vaccination efforts. However, the efficacy of vaccination is dependent on a number of circumstances, including as the type of vaccine that is administered, when vaccinations are administered, and the animals' existing immune systems

Some of the diseases that are frequently reported from India and from different regions all around the country. In India, leptospirosis is a disease that occurs naturally, and recent years have witnessed a significant rise in the number of cases reported in the states of Maharashtra, Tamil Nadu, West Bengal, Karnataka, Gujarat and Kerala (Desai *et al*., 2020c) [6]. It has been suggested by Makwana *et al*. (2022) [16] that an infection with HS could lead to a decline in health and even mortality if it is combined and coinfected with other viral infections such as PPR. It has been found that rotavirus is responsible for the majority of occurrences of diarrhea in neonates. Group A rotaviruses are among the gastrointestinal infections that can affect humans and animals (Tumlam *et al*., 2019; Makwana *et al*., 2020a; Makwana *et al*., 2020b) [33, 14, 15]. Important steps include controlling the collection of epidemiological data and locating the origin of uncommon rotavirus strains (Makwana *et al*., 2020a; Makwana *et al*., 2020b) [14-15]. There are at least three unique strains of the bovine coronavirus, which is responsible for a variety of illnesses including respiratory infections, newborn diarrhea, and winter dysentery. On the other hand, the winter dysentery and neonatal calf strains of the disease are capable of infecting humans as well as cattle. Coronaviruses have the potential to cause villous atrophy in young cattle by infecting the small intestine, causing damage to the villous epithelial cells, and spreading to other cells. They are also capable of penetrating the epithelium of the large intestine. Coronaviruses can infect the large intestine; hence, signs of colitis such as straining may be related to an infection with these viruses. Coronavirus can infect asymptomatic individuals in the same way that rotavirus can, and then transfer to calves through those individuals' feces. The rotavirus is the one that affects more people than the other. When an outbreak has been confirmed, the calves that have been clinically afflicted are the primary carriers of the virus. According to Desai *et al*. (2020a) [3], Desai *et al*. (2020b) [4], Desai *et al*. 2021 [5], Joshi *et al*. (2022a) [10], and Joshi *et al*. (2022b) [11], animal coronavirus can be swiftly identified by using the quick, low-cost, and practical rapid lateral flow assay test. Two of the most significant problems associated with bovine sickness are the development of antibiotic resistance and the presence of antibiotic residue in cow's milk (Patel *et al*., 2019 and Patel *et al*., 2020) [21, 20]. The development of antimicrobial resistance is the most important problem that farmers are currently facing. This phenomenon has been observed in E. coli that was isolated from newborn piglets as well as in parasite and anthelmintic medications (Bhinsara *et al*., 2018; Muglikar *et al*., 2019; Tumlam *et al*., 2022b) [2, 18, 33]. *Corynebacterium pseudotuberculosis* is an economically significant illness of small ruminants, as stated by Sharma *et al*. (2019) [28]. This is despite the fact that other species, such as cattle, buffalo, camels, and pigs, have also been documented to be afflicted by these bacteria, which ultimately results in losses to farmers. Patel *et al.* (2018) [19] conducted a study on the identification of Bovine Herpesvirus-1 infection in bovine clinical samples using the Direct Fluorescent Antibody Test. This test was used to determine whether or not the samples contained the virus. EHV-4 is a respiratory infection of domestic horses and has been connected with epidemics of respiratory illness, according to Vala *et al.* (2020) [35]. In contrast, Mavadiya *et al.* (2021) [17] did a sero-epidemiological investigation on equine piroplasmosis in horses at south Gujarat and discovered that 62.71% of horses had presence of antibodies by cELISA. BPV1 is the virus that is most commonly related with the cutaneous kind of cow warts in Maharashtra, as stated by Tumlam *et al*. (2022a) [32]. Only one health policy is capable of preventing the spread of zoonotic diseases like influenza, preventing diseases that are transmitted from wild animals to humans, and preventing diseases that are transmitted from humans to wild animals. These are the new challenges that farmers face in terms of disease outbreaks (Desai *et al*., 2018a; Desai *et al*., 2018b) [7-8]. There is only one option to stop the spread of these diseases, and that is to implement a comprehensive vaccination policy over the entire country. Adjuvants have the potential to boost the effectiveness of vaccines, and utilizing a variety of adjuvants may prove beneficial in producing a vaccination that is both effective and durable (Makwana *et al*., 2018; Karunakaran *et al*., 2023) [13, 12]. Another disease that affects small ruminants is called PPR, and it is extremely contagious. Cattle and pigs are susceptible to infection with this disease, but they do not contribute to the epidemiology of the disease because they are unable to excrete the virus. However, the potential diseases that affect livestock are what cause economic loss for farmers (Sakhare *et al*., 2019) [27]. Several newly emerging illnesses, such as monkeypox and the Sudan Ebola Virus, offer a danger of zoonotic transmission and are therefore a threat to animal populations (Rana *et al*., 2022; Patel *et al*., 2023a; Patel *et al*., 2023b) [24, 22, 23]. In addition to this, some well-known diseases that were previously assumed to be under control are still thriving. The global economy has already been devastated by major outbreaks, including FMD in Europe (Thrusfield, 2005), classical Swine Fever in the Caribbean and Europe from 1996-2002 (Vargas *et al*., 2004) [36], RP in Africa in the 1980s (Vargas *et al*., 2014) [37], PPR in India and Bangladesh (Rweyemamu *et al*., 2006) [26], CBPP in Eastern and Southern parts of Africa in the late 1990s (Thiaucourt *et al*., 2003) [30]; RVF in Arabian Peninsula (Roeder and Obi, 1999) [25]. After 1998, India was thought to be free of glanders for the next eight years, but in 2006, the illness made a comeback (Balkhy and Memish, 2003; Taylor *et al*., 2001; WHO, 2010) [1, 29, 38]. Animals, which act as reservoirs, appear to be the primary vectors of transmission in virtually all of the recently discovered diseases (Jones *et al*., 2008) [9]. As a result, in order to forestall the spread of more diseases, the government needs to take action in response to the outbreaks and adopt regulations for regulation.

Another approach to preventing and controlling livestock diseases is the use of antimicrobials. Antimicrobials are chemical compounds that destroy microorganisms, such as

bacteria, viruses, and fungus, or impede their ability to reproduce and spread. The livestock sector makes extensive use of them as a means to both cure and prevent illnesses. Yet, the abuse and overuse of antimicrobials have contributed to the development of antimicrobial resistance (AMR), which is currently one of the most pressing issues facing public health worldwide. To address this, governments and international organizations have developed guidelines and policies aimed at promoting responsible use of antimicrobials in livestock production. Surveillance and early detection of diseases are also critical in preventing and controlling livestock diseases. Surveillance involves monitoring the health status of animals and the environment to identify potential disease outbreaks. It involves regular testing and monitoring of animals, as well as the collection and analysis of data on disease incidence and prevalence. Early detection helps to contain the spread of diseases and prevent them from becoming widespread. Livestock producers also play a significant role in preventing and controlling diseases. Producers can adopt good husbandry practices, including proper nutrition, hygiene, and housing, to reduce the risk of disease transmission. They can also work closely with veterinarians and animal health professionals to develop disease control programs and implement biosecurity measures. Furthermore, producers can participate in disease control and eradication programs to ensure their herds or flocks are free from specific diseases.

Inter-sectoral coordination (ISC) for prevention and control of zoonotic diseases

Inter-sectoral coordination, also known as ISC, is very necessary for the diagnosis, containment, and elimination of zoonotic diseases. Zoonotic diseases are those that can be passed from animals to humans and are the cause of a considerable amount of sickness and mortality in people all over the world. To find out that more than seventy-five percent of newly emerging and re-emerging diseases are zoonotic is a fascinating piece of information. An inter-sectoral–coordinated approach that involves all relevant sectors (medical, veterinary, and wildlife departments) with 'One Health Vision' is the need of the hour for effective surveillance, prevention, and control of existing zoonotic diseases and newly evolving zoonotic threats in human beings. This is the only way to ensure that zoonotic diseases do not spread from animals to humans. It is only through this method that we can successfully monitor and prevent In light of this, the Department of Health and Family Welfare, Ministry of Health and Family Welfare, Government of India, launched a scheme in 2012 called "Strengthening of Inter-sectoral Coordination for Prevention and Control of Zoonotic Diseases" during the 12th five-year plan (2012-2017) to strengthen inter-sectoral coordination between the sectors for the prevention and control of zoonotic diseases of public health importance. This was done during the 12th five-year plan. At the moment, operations for the Program are being carried out under the aegis of the Capacity Along with establishing inter-sectoral coordination, facilitating communication between various stakeholders, increasing the capacity of laboratories, and increasing the capacity of laboratories, one of the goals of the Programme is to build awareness and for effective prevention and control of zoonotic diseases.

Integrated Disease Surveillance Programme (IDSP)

The National Center for Disease Control (NCDC), which is a part of the Ministry of Health and Family Welfare of the Government of India, established the IDSP in order to enable laboratory-based surveillance of diseases that are prone to epidemics in the country. The Ministry of Health and Family Welfare of the Government of India oversees both of these ministries. The Integrated Disease Surveillance and Prevention program has a number of primary purposes, the most important of which are the monitoring of disease trends, the identification of disease outbreaks, and the provision of an urgent reaction to contain disease outbreaks (IDSP). The IDSP works in conjunction with the Center, the State, and the district surveillance units to facilitate collaboration on three distinct fronts simultaneously. Both the district surveillance units (DSU) and the state surveillance units (SSU) will be stationed in the respective state capitals. The district surveillance units (DSU) will be located in the districts that correspond to each district. The NCDC, which is located in Delhi, is home to the Central surveillance unit. The Integrated Disease Surveillance Program (IDSP) provides surveillance for a variety of diseases, including leptospirosis, anthrax, and JE, amongst others. It was determined that it was necessary to include a veterinarian in the surveillance units due to the necessity of utilizing the expertise of the veterinary sector in the prevention and control of zoonotic illnesses as well as to improve the level of inter-sectoral cooperation. In addition, it was determined that it was necessary to include a veterinarian in the surveillance units due to the necessity of including a veterinarian in the surveillance units. As a direct consequence of this fact, a number of states have made the decision to include veterinarians among the members of the rapid response teams that are looking into zoonotic diseases. The IDSP is working to provide timely diagnosis of diseases that have the potential to become epidemics by establishing a network of laboratories at the district and state levels. These laboratories are located throughout the country. On the other hand, the diagnosis of zoonotic diseases is also undertaken by a variety of ICAR institutes, such as IVRI, NIHSAD, NIVEDI, and NRCE. This is in addition to other universities and institutions that focus specifically on veterinary medicine. For instance, the NIVEDI in Bangalore serves as the south regional coordinator for the International Society for the Control of Zoonotic Diseases (ISC) in charge of the prevention and control of zoonotic illnesses. The NCDC in Delhi is in charge of running this program. In addition, the NIVEDI is accountable for the delivery of diagnostic services, the development of laboratory capacity, and the cultivation of human resources with regard to human leptospirosis to IDSP units in the state of Karnataka as well as in neighboring states. In addition, the Joint Task Force of ICMR and ICAR project on zoonoses is a promising move toward institutionalizing the integration of research and development with the One Health strategy. This is an important step. In addition, the NCDC and IVRI collaborate on the development of joint orientation training courses for veterinary and medical officials. This highlights the necessity of integrating disease surveillance, data sharing, human resources, and laboratory capacity between public health and veterinary sectors for the effective

prevention and control of zoonotic diseases, which will ultimately lead to the achievement of the larger goal of one health known as one health.

Regional collaboration in transboundary animal disease surveillance

Transboundary animal diseases, more commonly referred to as TADs, present a substantial threat to humans as well as the cattle they keep. These illnesses have the potential to cause extensive destruction, putting the food security of the country as well as the region at danger, and consequently having a major negative influence on the economies of the country as well as the region. The economic loss may be direct if it manifests itself in the affected population in the form of mortality and sickness, or it may be indirect if the appropriate preventative activities are done. Both the decrease in trade and the likelihood of zoonotic transmission represent a serious risk to the nation as both have the potential to spread infectious diseases. In order to improve its ability to diagnose tropical airborne diseases (TADs), India collaborated with international organizations such as the South Asian Association for Regional Cooperation (SAARC), the Association of Southeast Asian Nations (ASEAN), and the Centers for Disease Control and Prevention of the United States of America to build its laboratory capacity and develop its human resource pool. This was done with the intention of bolstering India's regional cooperation with the countries that are located in its immediate vicinity (CDC). Animal health institutes such as ICAR-NIVEDI were among those that contributed to the delivery of a number of training programs as part of the regional cooperation.

Way of preventions

In the year 201, a report entitled "Controlling Diseases at their Animal Source by Early Detection and Rapid Response to Outbreaks of Emerging or Re-emerging Animal Diseases" was published by the OiE (world organization for animal health). In this report, the authors described various methods that can be used to prevent diseases and protect animals. Improving the leadership of the Veterinary Services department. Effective Surveillance: There must be active (planned) or passive (event-based) surveillance that is both effective and efficient "the systematic continuous gathering, compilation and analysis of information and the timely distribution of information to those who need it for action," as defined by the OIE, is what surveillance is. (Code de Santé des Animaux Terrestres de l'OIE). Early Diagnosis and Treatment of Diseases The ability to detect and identify an invasion, emergence, or re-emergence of a disease or infection in a certain country, zone, or compartment in a timely manner is one of the primary benefits of using an early detection system. Obtaining Representative Samples It is necessary for the veterinary authorities to establish a reaction mechanism that allows for the collecting of samples and the laboratory examination of those samples in order to have a timely and effective identification of any newly emerging disease. Diagnosis As soon as veterinary officials become aware of an outbreak, it is their responsibility to inform the local, national, and even international communities about the disease in question. We are able to prevent some of the most terrible diseases with the use of vaccines, and adjuvants have been shown to reduce the immunogen dose required by vaccines, extend their longevity, and make them more effective. The adjuvant is the most significant part of the vaccine, and it is typically mixed in with the immunogen while the vaccine is being prepared (Makwana *et al*., 2018) [13]. Resistance to a variety of anthelmintic drugs is common in cattle populations, and the benzimidazole group of anthelmintic drugs is the most common and widely utilized medication in nematode management strategies (Bhinsara *et al*., 2018) [2]. A single initiative by a health association, significant joint research, and a vaccination strategy are the means by which an epidemic calamity can be controlled (Desai *et al*., 2018a, Desai *et al*., 2018b) [7-8]. Patel *et al*. (2020) [20] studied the dietary exposure and risk assessment of antibiotics residues in marketed bovine raw milk. As a result, there is a need to develop a policy for excellent diet in both bovine and horse populations. The development of resistance to antimicrobial drugs is one of the rising risks, and Escherichia coli is one of the primary agents responsible for diarrhea in neonatal pigs all over the world. Their study was designed to investigate the prevalence of *E. coli* bearing virulence genes and antibiotic resistance in piglet diarrhea in and around Shirwal, which is located in District Satara (Tumlam *et al*., 2022b) [34]. By implementing the One Health strategy for the management of wildlife illnesses, as outlined by Desai *et al.* (2018b), it is possible to keep bovine diseases from spreading through wild populations of wildlife. Livestock, health and disease control program is the name of the ongoing policies that the government of India implements to protect the safety of animals. The primary focus of these policies is on the prevention and control of diseases. These policies include Establishment and Strengthening of Veterinary Hospital and Dispensaries (ESVHD), Assistance to States for the Control of Animal Diseases (ASCAD), Peste des Petits Ruminants Control Programme (PPR-CP), Professional Efficiency Development (PED), Classical Swine fever Programme (CSF-CP) Foot and Mouth Disease Control Program (FMD-CP), the National Project on Rinderpest Eradication (NPRE), the National Animal Disease Reporting System (NADRS), and National Control Programme of Brucellosis (NCPB).

Scheduled animal diseases

Table 1 is a list of diseases that must be reported in accordance with the provisions of sections 2(o) and 38 of the Act for the Prevention and Control of Infectious and Contagious Diseases in Animals (2009). The Indian government must get information regarding the occurrence of certain diseases. This rule is one of the greatest that the government of India has come up with to stop, regulate, and prevent the spread of diseases.

Table 1: Reportable scheduled diseases

A. Multiple species diseases			
1.	Aujeszky's disease	2.	Anthrax
3.	Brucellosis	4.	Blue tongue
5.	*Echinococcosis hydatidosis*	6.	Crimean Congo Haemorrhagic fever
7.	Leptospirosis	8.	Japanese encephalitis
9.	Heart water	10.	Foot and mouth disease
11.	New world screw worm (*Cochliomyia hominiorax*)	12.	Old world screw worm (*Chrysomya bezziana*)
13.	Q fever	14.	Paratuberculosis
15.	Rift valley fever	16.	Rabies
17.	Trichinellosis	18.	Rinderpest
19.	Vesicular stomatitis	20.	Tularemia
21.	West Nile fever		
B. Cattle Diseases			
1.	Bovine babesiosis	2.	Bovine anaplasmosis
3.	Bovine spongiform encephalopathy	4.	Bovine genital campylobacteriosis
5.	Bovine viral diarrhoea	6.	Bovine tuberculosis
7.	Enzootic bovine leucosis	8.	Contagious bovine pleuropneumonia
9.	Infectious bovine rhinotracheitis/ infectious pustular vulvovaginitis	10.	Haemorrhagic septicaemia
11.	Malignant catarrhal fever	12.	Lumpy skin disease
13.	Trichomonosis	14.	Theileriosis
15.	Trypanosomosis		
C. Sheep and Goat Diseases			
1.	Contagious agalactia	2.	Caprine arthritis/ encephalitis
3.	Enzootic abortion of ewes (Ovine chlamydiosis)	4.	Contagious caprine plueopneumnia
5.	Maedi-Visna	6.	Nairobi sheep disease
7.	Peste des petis ruminants (PPR)	8.	Ovine epididymitis (*Brucella ovis*)
9.	Scrapie	10.	Salmonellosis (*S. abortusovis*)
11.	Sheep pox and goat pox		
D. Equine Diseases			
1.	Equine encephalomyelitis (Eastern)	2.	Dourine
3.	Contagious equine metritis	4.	African Horse Sickness
5.	Equine piroplasmosis	6.	Equine influenza
7.	Equine infectious anaemia	8.	Equine encephalomyelitis (Western)
9.	Venezuelan equine encephalomyelitis	10.	Equine rhinopneumonitis
11.	Surra (*Trypanosoma evansi*)	12.	Glanders
13.	Equine viral arteritis		
E. Swine Diseases			
1.	Classical swine fever	2.	Porcine cysticercosis
3.	Transmissible gastroenteritis	4.	Swine vesicular disease
5.	African swine fever	6.	Porcine reproductive and respiratory syndrome (PRRS)
7.	Nipah viral encephalitis		
F. Avian Diseases			
1.	Fowl cholera	2.	Fowl typhoid
3.	Avian infectious bronchitis	4.	Duck virus hepatitis
5.	Avian mycoplasmosis (*M.synoviae*)	6.	Avain mycoplasmosis (*M. gallisepticum*)
7.	Highly pathogenic avian influenza and low pathogenic avian influenza in poultry	8.	Infectious bursal disease (Gumboro disease)
9.	Pullorum disease	10.	Avian infectious laryngotracheitis
11.	Marek's disease	12.	Turkey rhinotracheitis
13.	Avian chlamydiosis	14.	Newcastle disease
G. Other Diseases			
1.	Leishmaniosis	2.	Camel Pox

Conclusions

In conclusion, prevention and control of livestock diseases remain a critical issue in ensuring sustainable livestock production. A combination of approaches, including biosecurity, vaccination, responsible antimicrobial use, surveillance, and good husbandry practices, is necessary to prevent and control diseases effectively. Governments, livestock producers, veterinarians, and other stakeholders must work together to develop and implement comprehensive disease control programs to safeguard animal and human health, improve animal welfare, and promote sustainable agricultural production.

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