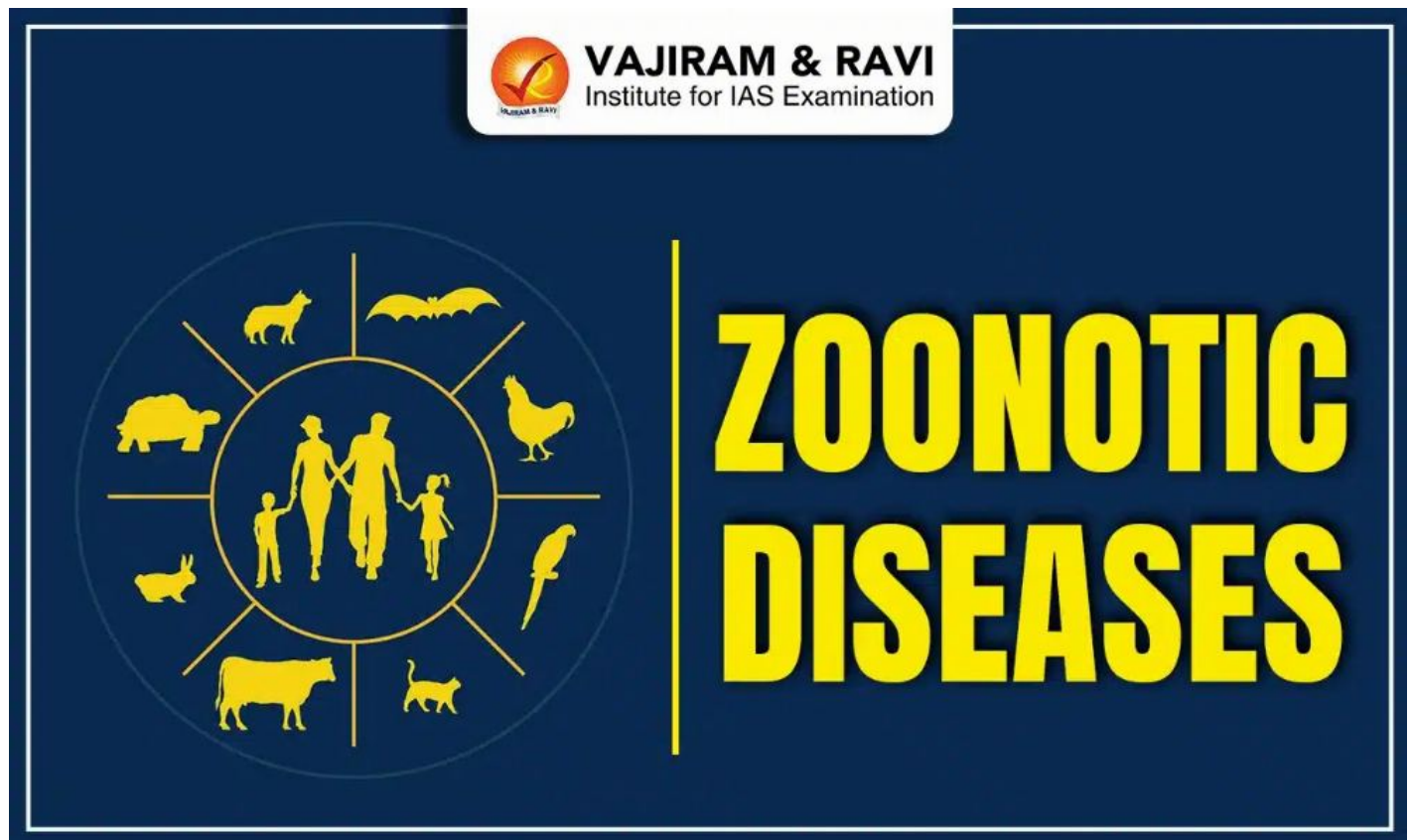


Zoonotic Diseases, Causes, Examples, Classification, Modes

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Zoonotic diseases are infections that spread between animals and humans. These diseases pose a major challenge to public health, agriculture, and the global economy. According to the **World Health Organization** (WHO), around 60% of known infectious diseases and 75% of emerging infectious diseases are zoonotic. They spread through direct contact, contaminated food, vectors, or the environment.

Zoonotic Diseases

Zoonotic diseases, also known as zoonoses, are illnesses caused by pathogens such as bacteria, viruses, parasites, or fungi that can be transmitted naturally from animals to humans. They may spread through animal bites, contact with body fluids, or consumption of contaminated food. Common examples include rabies, avian influenza, anthrax, and **COVID-19**.

Zoonoses

The term **“Zoonotic Disease”/ “Zoonoses”** is derived from the Greek words *“zoon”* (animal) and *“nosos”* (disease). The study of zoonotic diseases highlights the interconnectedness of animal, human, and environmental health, forming the basis of the One Health approach. Understanding and managing zoonotic diseases are essential to preventing global outbreaks and ensuring sustainable health systems.

Zoonotic Diseases History

Historically, zoonotic diseases emerged with animal domestication and agriculture (circa 10,000 BCE). Early hunter-gatherer communities had limited contact with animals, restricting outbreaks. However, as humans began farming and keeping livestock, new diseases like tuberculosis, influenza, and measles evolved from animal strains (WHO, 2020).

The first major medical breakthrough against zoonosis was Edward Jenner’s smallpox vaccine (1796), derived from cowpox virus (while it is a subject of historical debate). This laid the foundation for modern immunization and eventually eradicated smallpox globally by 1980.

Zoonotic Diseases Modes of Transmission

Zoonotic diseases are infections transmitted between animals and humans under natural conditions. Common Modes of Transmission:

- Direct transmission: Through animal bites, saliva, or air (e.g., Rabies, Influenza).
- Indirect transmission: Via contaminated food, water, or surfaces.
- Vector-borne transmission: Spread through mosquitoes, fleas, or ticks.
- Intermediate host transmission: Pathogen passes through a secondary host before reaching humans (e.g., Nipah virus in pigs).
- Host genetics also plays a role; viruses that require fewer mutations to adapt to humans pose higher risks (University of California, Davis Study, 2021).

Zoonotic Disease Causes

The rise in zoonotic outbreaks in the 21st century is linked to both environmental and socio-economic causes:

- Deforestation and Land Use Change: Human encroachment into wildlife habitats increases contact with reservoir species.
- **Climate Change**: Alters habitats of vectors like mosquitoes and bats, expanding disease zones.
- Industrial Farming: Intensive livestock production facilitates viral recombination (e.g., swine flu 2009).
- Wildlife Trade and Bushmeat: Wet markets and wild meat consumption expose humans to novel pathogens.
- **Urbanization** and Population Growth: Bring animals and humans into close, unsanitary contact.
- Global Travel and Trade: Enable rapid international spread of emerging zoonoses.
- A UNEP-ILRI 2020 report identified climate change, unsustainable agriculture, and wildlife exploitation as the three leading drivers of new zoonotic pandemics under seven drivers of disease emergence.

Zoonotic Diseases Classification

Zoonotic diseases can be classified based on the type of pathogen that causes them, mode of transmission, etc as given below. Understanding these categories helps in designing effective prevention and control measures. Bacteria cause the highest share (42%) of zoonotic diseases globally

Zoonotic Diseases Classification				
Basis of Classification	Type / Category	Examples	Animal Hosts / Reservoirs	Transmission Route / Key Features
Etiological (by pathogen type)	Bacterial	Anthrax, Brucellosis, Leptospirosis, Plague, Tuberculosis	Cattle, goats, pigs, rodents	Direct contact, inhalation, ingestion
	Viral	Rabies, Avian Influenza, Ebola, HIV, SARS	Dogs, bats, monkeys, birds	Bite, aerosol, body fluids
	Parasitic	Toxoplasmosis, Giardiasis, Trichinosis, Malaria	Cats, pigs, ruminants	Foodborne, vector-borne
	Fungal (Mycotic)	Ringworm, Aspergillosis, Histoplasmosis	Dogs, cattle, birds	Skin contact, inhalation
	Rickettsial	Q-Fever, Scrub Typhus	Cattle, rodents	Tick-borne, aerosol
	Chlamydial	Psittacosis, Chlamydiosis	Parrots, goats, cats	Airborne, direct contact
	Mycoplasma	Mycoplasma pneumonia	Livestock	Airborne droplets
	Protozoal	Leishmaniasis, Trypanosomiasis, Giardiasis	Dogs, cattle, bats	Vector-borne
	Prion-related	Mad Cow Disease, CJD	Cattle, sheep	Ingestion, neurological

Direction of Transmission	Anthropozoonoses	Rabies, Brucellosis	Animals → Humans	Animal to human infection
	Zooanthroponoses	Tuberculosis in monkeys	Humans → Animals	Reverse zoonosis
	Amphixenoses	Staphylococcal infections	Both	Bidirectional
	Euzoonoses	Taenia solium	Humans act as the obligatory host	Parasitic cycle
Quantitative Distribution (by Origin)	Bacteria (42%), Parasites (29%), Viruses (22%), Fungi (5%), Prions (2%)	-	-	Indicates relative global burden
Transmission-Based	Direct Zoonoses	Rabies, Anthrax, Avian Influenza	Dogs, cattle, birds	Direct contact, bite, aerosol
	Vector-Borne (Metazoonoses)	Dengue, Chikungunya, Lyme Disease	Mosquitoes, ticks	Vector transmission
	Food/Water-Borne	Salmonellosis, Cryptosporidiosis	Livestock, poultry	Contaminated food or water
Ecological / Environmental	Synanthropic	Urban Rabies, Ringworm	Pets, livestock	Domestic or urban cycle
	Exoanthropic	Wildlife Rabies, Arboviroses	Wild animals	Natural or sylvatic cycle
Reservoir-Based	Sapronoses	Histoplasmosis, Aspergillosis	Soil, organic matter	Pathogens replicate in non-living matter

	Saprozoonoses	Fungal or bacterial infections	Soil + animal hosts	Environmental + animal stages
	Cyclozoonoses	Taenia solium	Pigs, humans	Two vertebrate hosts
	Metazoonoses	Arbovirus infections	Vertebrate + invertebrate	Needs vector host
Reverse Zoonoses (Zooanthroponoses)	Human-to-Animal Transmission	Tuberculosis, Influenza A, Staphylococcus infections	Cattle, elephants, pets	Reverse transmission from humans
Emerging / Integrated Classification	Cross-Domain (One Health)	COVID-19, Ebola, Nipah Virus	Wildlife, bats, pigs	Integrated human – animal – environment cycle

Zoonotic Diseases in India

India has recorded several significant zoonotic diseases that impact both human and animal health. Each disease has a specific causative agent, mode of transmission, and region of occurrence.

Zoonotic Diseases in India			
Disease	Causative Agent	Transmission	Affected Regions / States
Rabies	Rabies virus	Dog bites	Nationwide (urban and rural)
Avian Influenza (Bird Flu)	H5N1, H5N8 virus	Contact with infected poultry	Kerala, Haryana, Maharashtra
Nipah Virus	Henipavirus	Fruit bats, contaminated fruits	Kerala
Kyasanur Forest Disease (KFD)	Flavivirus	Tick bites	Karnataka, Goa, Maharashtra

Leptospirosis	Leptospira bacteria	Water contaminated by animal urine	Gujarat, Tamil Nadu
Brucellosis	Brucella bacteria	Contact with livestock or unpasteurized milk	Rajasthan, Uttar Pradesh
Anthrax	Bacillus anthracis	Handling infected animals	Odisha, Jharkhand
Japanese Encephalitis	Flavivirus	Mosquito bites	Assam, Uttar Pradesh, Bihar

Government Policies for Zoonotic Diseases

The Indian government has implemented multiple programs and policies to prevent and control zoonotic diseases under the One Health approach, which integrates human, animal, and environmental health efforts.

Government Policies for Zoonotic Diseases		
Policy / Programme	Objective	Impact
Integrated Disease Surveillance Programme (IDSP)	Early detection and monitoring of zoonotic diseases	Improved outbreak reporting and rapid response systems
One Health Mission (2021)	Coordinate surveillance between human and animal health sectors	Promotes joint research and information sharing
National Rabies Control Programme	Eradicate rabies through vaccination and awareness	Significant reduction in rabies cases in pilot states
National Animal Disease Control Programme (NADCP)	Control Foot and Mouth Disease and Brucellosis	₹13,000 crore initiative for livestock vaccination
National Centre for Disease Control (NCDC)	Coordinate inter-sectoral zoonotic disease management	Strengthened diagnostic and surveillance capacities
ICMR-NIVEDI Collaboration	Joint research and database sharing on zoonotic pathogens	Improved data accuracy and interdepartmental coordination

National Action Plan on AMR (2017)	Combat antimicrobial resistance due to animal antibiotic misuse	Encourages rational use of antibiotics in livestock
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Role of Wildlife Trade in Zoonotic Diseases

Illegal wildlife trade increases spillover risk by bringing multiple species into confined markets. The origin of COVID-19 is linked to wildlife trade in wet markets (WHO-China Joint Mission Report, 2021). Similar connections exist for Ebola, SARS, and HIV, where bushmeat consumption led to cross-species transmission.

The CDC warns that bushmeat practices, especially in Africa and Southeast Asia, expose communities to zoonotic pathogens. Preservation methods like drying or smoking are insufficient to destroy viruses, heightening infection risk

Zoonotic Disease Challenges

Despite institutional support and growing awareness, controlling zoonotic diseases in India faces several challenges related to infrastructure, coordination, and public behavior.

Key Challenges:

1. Limited Surveillance: Fragmented systems between animal and human health sectors.
2. Underreporting: Rural areas often fail to record outbreaks promptly.
3. Lack of Awareness: People ignore hygiene and vaccination practices for pets and livestock.
4. Climate Change: Expands the range of disease-carrying vectors.
5. Antimicrobial Resistance (AMR): Overuse of antibiotics in animals contributes to resistant pathogens.
6. Inadequate Veterinary Infrastructure: Lack of trained veterinarians and diagnostic labs in remote areas.

Way Forward:

1. One Health Integration: Strengthen collaboration between ICMR, NCDC, and DAHD for joint response systems.
2. Surveillance Expansion: Extend IDSP coverage to all districts with real-time digital reporting.
3. Public Awareness: Launch national campaigns on hygiene, vaccination, and pet care.
4. Strengthening Laboratories: Upgrade human testing facilities under the Integrated Public Health Labs Scheme (2021).
5. Vaccine Development: Invest in indigenous vaccines for rabies, Nipah, and brucellosis.
6. Data Sharing and Training: Create shared national databases and train field workers in zoonotic disease management.
7. Climate Adaptation: Integrate disease control with environmental and wildlife conservation policies.

Zoonotic Diseases Impact

Zoonotic diseases have far-reaching consequences on global health, economy, and food security. The World Bank (2021) estimates global economic losses from zoonotic outbreaks at over USD 100 billion annually, with developing

countries like India being most affected due to poor veterinary infrastructure and dense population.

In India, repeated outbreaks have led to human deaths, loss of livestock, and increased health expenditure. A cross-sectional analysis of India's Integrated Disease Surveillance Program (IDSP) data from 2018-2023, conducted by the Indian Council of Medical Research (ICMR), reported that 8.3% of the total recorded infectious disease outbreaks were zoonotic. They also affect trade due to bans on animal exports and poultry products during outbreaks.

The COVID-19 pandemic, of probable zoonotic origin, further highlighted the global need for integrated disease surveillance and cross-sector collaboration.

Zoonotic Diseases Recent Outbreak

The case study of the recent Zoonotic Diseases outbreak has been provided below:

- **COVID-19 Pandemic (2019-Present):** Caused by SARS-CoV-2, likely originating from wildlife reservoirs. It resulted in over 15 million deaths globally (WHO, 2022). WHO declared an end to the Public Health Emergency of International Concern (PHEIC), on May 5, 2023. However, the virus has continued to circulate, with varying levels of impact.
- **Nipah Virus in Kerala (2023):** Linked to fruit bats; prompt surveillance and containment by the ICMR and NCDC prevented wider spread. The outbreak was officially confirmed in Kozhikode, Kerala, in September 2023.
- **Avian Influenza (2021):** Detected in poultry across several Indian states including Kerala, Haryana, Madhya Pradesh, and Maharashtra; controlled through biosecurity and culling measures. The risk to humans was considered low, though India did report a fatal human case of H5N1 avian influenza in July 2021.
- **Ebola Outbreaks (Africa, 2014-2016):** Transmitted through contact with infected wildlife; WHO declared it a Public Health Emergency of International Concern (PHEIC). It was the largest and most complex Ebola outbreak ever, with more than 28,600 cases and 11,325 deaths.

Also Read: **Bacteria**

Zoonotic Diseases UPSC

The Press Information Bureau and NCDC have released key data highlighting the extent and management of zoonotic diseases in India:

- **Rabies:** India accounts for 36% of global rabies deaths (WHO).
- **Leptospirosis:** Reported in over 14 states, affecting coastal and flood-prone areas.
- **Nipah Virus:** Recorded outbreaks in Kerala (2018, 2019, 2023) with mortality rates over 70% (88.8% in 2018)
- **Avian Influenza:** Outbreaks recorded in 10 states (PIB, 2025), affecting poultry trade.
- **Brucellosis:** Estimated to cause ₹9,212 crore annual loss to the livestock sector.

Kyasanur Forest Disease (KFD): The cases are reported yearly from Western Ghats regions. In 2016 outbreak of Maharashtra, confirmed 130 cases in one district alone

Source: <https://vajiramandravi.com/current-affairs/zoonotic-diseases/>

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