

# Rodents and Zoonotic Diseases: Environmental Drivers and Prevention Measures

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## Abstract

*Among the most ubiquitous animal species, rats spread several human diseases. Found in cities, rural areas, and everywhere in between, rats have adapted remarkably well to living alongside people. Unfortunately, this close contact makes it easier for them to carry and pass on harmful germs. Their biology, fast breeding, and ability to host various bacteria, viruses, and parasites often without getting sick themselves make them especially effective at spreading disease. This article explores the many factors that allow rats to act as dangerous disease carriers. Some of the most serious illnesses linked to rats include hantavirus pulmonary syndrome, a severe lung infection; leptospirosis, which can lead to organ damage; plague, a disease infamous for its deadly outbreaks in history; and Lassa fever, a viral illness common in parts of West Africa. These diseases vary in how they spread and affect people, but all pose serious risks to human health. In recent years, rising urbanization, shifting climates, and environmental damage have made encounters between rats and humans more frequent. These changes have increased the chance of diseases jumping from animals to people. To tackle this growing threat, it's important to focus on prevention controlling rat populations, keeping communities clean, and educating people about how to protect themselves. Understanding rodent disease transmission is essential for designing effective therapies and lowering rodent-associated illness burdens on humans.*

**Keywords:** Public health, disease transmission, epidemiology, rodent control, zoonotic diseases

## INTRODUCING RODENTS

“Rodents” refers to any mammalian rodent, including mice, rats, squirrels, guinea pigs, porcupines, and others. Rodents have one set of continuously developing upper and lower jaw incisors that must be cropped by chewing. Rodents are the largest mammalian order and make about 25% of mammals. They inhabit many ecosystems and move terrestrially and arboreally.

As reservoirs and hosts, rats can spread diseases to humans and domestic animals. About 100 diseases globally are zoonotic, meaning they can be spread between animals and people. Some fifty types of infections are caused by rodents. Local and widespread outbreaks occur in the Old and New Worlds, occasionally through imported pests. Because they eat electricity and telephone wires, rats ruin stored agricultural mass, like food and cash crops, fruit trees, building insulation, Spanish Galleons, electronics and bank and company infrastructure. They can create flooding by clogging drains and seepage works

and harm woods and gardens by eating trees and plants. For these reasons, national and state-managed rodent control programs are expensive and extensive [1].

Iran has 80 rodent species, 24 of which are pests that can infect humans and animals. Mostly engaged are Muridae, Cricetidae, and Gerromorpha. Other families are rarely involved. The most prevalent rodent control method is poisoning, but biological control agents, repellents, and traps are also utilized [2].

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## RODENTS AND HABITATS

There are about 2000 species of rodents, including rats, mice, squirrels, hamsters, porcupines, and beavers. They have two constantly growing chisel-shaped incisor teeth in both the upper and lower jaws and are found on all continents except Antarctica and many marine islands. Most successful in biodiversity, biogeography, and population, they are the most numerous mammalian group. There are many biological and ecological variances in rodent shape, size, weight, and temperament. Rodents can be arboreal, wading in the water, or predatory, dwelling in burrows. Some species eat just plants, while others are omnivorous, consuming insects, small animals, and other mammals. Rodents feed numerous predators and regulate many bug populations in natural communities [3].

Rodents graze on field personnel, stored foods, and food manufacture, and they may consume and contaminate food and feed, causing significant economic losses. Approximately 20% of the world's food is consumed or ruined by them. Especially for human diseases, rats spread infections. Some rodent diseases are viral, such as lymphocytic choriomeningitis, tularaemia, and hemorrhagic fever; others are bacterial, such as *Yersinia pestis* (plague), *Leptospira*, *Salmonella*, Hantannova virus, and *Rickettsia*; and others are parasitic.

Rodents are reservoir hosts for at least 60 zoonotic illnesses and vital to their transmission. Salmonellosis, plague, leptospirosis, leishmaniasis, toxoplasmosis, murine typhus, hantaviral infections, lymphocytic choriomeningitis, arenaviral infections, rat-bite fever, and tularaemia are rodent-related public health issues. Only 41 of the 230 rodent species in Africa are related to infectious diseases, indicating a gap in the knowledge of rodent communities and host-pathogen relationships between rodents and zoonotic pathogens. From the high Arctic to the tropics, rodents are the biggest order of living mammals and are found almost everywhere. numerous species have accompanied humans on their global spread because they are well-adapted to numerous habitats [4].

## OVERVIEW OF RODENT DISEASES

Successful and diversified mammals include rodents. They are vital to humans despite their diminutive size. Their medicinal, economic, agronomic, and epidemiological relevance is immense. Worldwide, rats generate huge financial losses. They damage buildings, crops, and stored goods. They spread human, domestic animal, and cattle diseases, making them expensive. Special infectious disorders called "rodent-related diseases" can be transmitted by rats. Infectious disorders transferred to people by rats are caused by viruses, bacteria, or parasites.

Iran reviewed rodent-borne illnesses. The dam, bushy-tailed, black, Mongolian, and dusky-footed rats are important rodent pests in Iran due to their extensive distribution, high population density, and diverse habitats. Some studies have examined rodent distribution and health hazards in urban, rural, forest, and mountainous environments. In rural, residential, and semi-residential regions, rodent-related disease distribution has not been studied. This study aims to raise awareness of neglected rodent-borne diseases in Iran, which can pose a public health danger. Rodents cause major health and economic problems. They help spread infections. Urbanising zoonoses in poor nations are caused by rats. Rodent-related diseases are rare in developed countries, but stockbreeding may be a source. Cutaneous leishmaniasis (CL), prevalent in Iran, infects 400 million people worldwide.

## OVERVIEW OF ZOONOTIC DISEASES

Zoonotic illnesses infect high-income nations' domestic populations. They may potentially be new diseases to the area. The transmission of newly identified zoonoses can occur through movement of infected domestic animals, reservoir species, or their eco-products (host range expansion through incomplete host exoticism), adaptive mutations in previously restricted pathogens or vectors (characteristic shift), or change in pre-existing zoonoses' transmission, infectivity, or virulence mechanisms. Zoo/Reservoir species prevent the spread of a zoonotic infection, while maintained hosting or prey species carry the pathogen and possibly expose sexual or predatory species. Snub-nosed monkeys in Yunnan were halted, but after an indigenous breeding facility multiplied exotic monkeys,

most were introduced legally or illegally. Increased public contacts with exotic monkeys exacerbated living space problems. A new lineage of a human and monkey enterovirus was closely related to a cytolytic picornavirus isolated from a New World Monkey species and can have evolved separately in both hosts after their speciation in Pangea. Human illness epidemics can result from zoonotic viruses spreading during non-human primate PET. Exotic animals with potentially harmful infections should be co-screened using cross-species sequencing and remote sensing. An integrated social configuration governing the non-human primate population is needed to reduce population growth and ambiguous nuisance behaviors. Zoonoses can pose their first public health challenge after infecting a human, but active surveillance through forward-looking geographical risk assessment methods and cross-species communications is crucial to addressing this serious threat to public health and biodiversity [5].

### **DISEASE TRANSMISSION VIA RODENTS**

The order Rodentia includes mammals. They're continuously growing, paired incisors are indistinguishable in both jaws and can devour fruit, vegetables, grains, seeds, roots, and stems. Rodents make for 40% of microbial diversity and 45% of mammalian species. They can be primary or secondary hosts of viruses, bacteria, fungus, protozoa, or metazoa and transmit zoonoses to humans. Over 105 viruses (21 families), 54 bacteria, and 25 parasites (four protozoan genera and 21 metazoan genera) were found in mouse hosts on all continents in a global review.

Since cities were founded, rats have been associated with humans since they are global. In addition to their cultural and economic impact on their habitat, they introduced harmful zoonotic agents, particularly through persistent contact with infected excreta, posing a severe health risk. *Yersinia pestis* and the 1918 Spanish flu virus, which infected rats and humans, illustrate these two pathogen-host connections. More than a dozen rodent species live in human settlements worldwide. Some native species like schizozo-arthropoid lives to avoid people and their illnesses, whereas synanthropic species adapt to human existence.

### **COMMON RODENT DISEASES**

Rats and mice globally carry around 35 diseases by contaminating human food with urine or faeces or by spreading infections through fleas or mites. At least seven of these diseases can kill people. The sickness is mostly related with rats; however, mice can spread more disease agents. Plague is the most virulent in humans, soddening the skin and causing necrosis and appendage loss owing to haemorrhage. The bite site is infected with huge numbers of organisms and their byproducts, producing subsequent septicaemia and death. One disease has many threads, at least some of which are transmitted to humans. Leptospirosis, salmonellosis, and lymphocytic choriomeningitis are major illnesses.

Several kinds of rats and mice are repositories for disease-causing organisms called ectoparasites. In rural places, a rodent-borne disease with several arboviruses is frequent. Lymphocytic choriomeningitis, a virus associated with *Mus musculus*, a long-haired mouse in suburbs due to tall grass, is likely spread by males in the home. Other diseases may be minor but can occur with rodent proliferations. Given primary care for immunocompromised patients, Cryptosporidia, like giardia, can be considered due to their faecal contamination [6].

Absentee illnesses raise horticulture, cotton and grain storage costs. The burrowing insect with wings *Loncherocobius trochilinus* destroys Mason bulbs in many ways. Borers – rodents, rabbits, and marsupials in Halls Australia – are responsive. These mostly affect voles and jerboas in waterways. *Rattus norvegicus* affects stored food in dwellings, whereas Ctenomyidae mice or burrow walls exclude marsupials. Above concrete floor frames and crushed limestone rock profiles, Honey mice find underground houses. Housing rat shoots in aspen-gated chard prevents entrance.

### **Hantavirus Respiratory Syndrome**

Hantavirus pulmonary syndrome (HPS) is a severe respiratory condition caused by any New World hantavirus, a family of 5- to 10-kb, negative-sense, single-stranded RNA viruses. Biohazardous agent's

category 3 (B3) infectious pathogens, like these extremely pathogenic viruses, can kill 50% of people. Initially diagnosed in May 1993 among healthy people in the Four Corner region of the southwestern US, HPS has since spread to over 25 states. Over 400 HPS cases have been reported in the Americas, and all but two occurred in the U.S. Other than rodent surveillance, no preventive measures or vaccines exist for these zoonotic diseases [7].

Many zoonotic viruses require rodent hosts. Many of the rodent genera and species linked to these diseases are southern US natives. Like HPS-associated viruses, they inhabit similar environments. The region lacks the only two U.S. rodent reservoirs of zoonotic viruses. Thus, a thorough rodent survey in these U.S. National Parks is needed. Preliminary research identified animals that may fill favorable ecological niches for one or more HPS-associated viruses and have previously interacted with zoonotic viral reservoirs elsewhere. Unsourced species were also considered. Rodents from Santa Fe urban interface animal control disputes were collected in addition to field surveys.

Lethally tested rodents have hantaviruses serologically and genetically comparable to the highly deadly Sin Nombre virus. 6.2% (76/1,223) of the examined rats were seropositive, and teneral females were found at 100–120 mm snout-to-anal lengths. As the main reservoir, *Peromyscus maniculatus* was serologically (38/135; 28.2%) and genetically (1 isolate) found. Both sexes of *P. boylii* showed infection (3/91; 3.3%). *P. truei*, *P. crinitus*, *Neotoma albigula*, and *Onychomys torridus* were serologically found but not genetically positive or 80% end-point diluted.

### **Leptospirosis**

Leptospirosis is one of the most common zoonotic illnesses worldwide. This disease is caused by the spirochete *Leptospira*, which is found worldwide and especially in tropical locations. Leptospire were stored in rats, which shed up to 107 in a single pee and for months or years. Infected animals excrete large amounts of leptospira in their urine, which can survive in humid circumstances for weeks to months. Soil and water contamination allows zoonotic transmission. Even though rats are sensitive to various *Leptospira* serovars and strains, rare species like *L. kirschneri*, *L. borgpetersenii* can infect rodents. Malaysian urban rodents include rats, mice, and rabbits. Hamsters are also pets. Most Malaysian research focusses on rats; hence this study focused on *Rattus*. As the first seroprevalence of pathogenic *Leptospira* in wild-caught rats in Malaysia, this finding is relevant for public health. This study showed that human illnesses and reservoirs are epidemiologically linked. The results showed that urban rats maintain pathogenic *Leptospira* in urban contexts and can transmit it to humans. This study found pathogenic *Leptospira* in Malaysian urban rats at low levels. These two serogroups predominate in urban Asia, Africa, and America, according to previous studies. Thus, Malaysian leptospirosis epidemiology should be reviewed. This study found pathogenic *Leptospira* species in 5.7% of urban rats from 19 isolates from 10 cities. Vi en has a low leptospirosis rate in urban rats compared to other countries. This study found 45.5% and 18.5% of rats positive for *Leptospira* by MAT and PCR. Due to sampling strategy differences and warmer weather in Malaysia, leptospire detection rates differed between these countries [8].

### **Choriomeningitis Lymphocyte**

LCMV can be contracted spontaneously in people by inhaling, urinating, or droppings from house mice (*Mus musculus*), the virus's reservoir. It causes intrauterine infections after transplacental transfer. A prenatal diagnosis of congenital LCMV infection and radiological abnormalities are described. LCMV, a 300–400 nm enclosed single-stranded RNA virus with a biconvex envelope, was initially discovered in 1933 from a deceased woman in St. Louis during the encephalitis epidemic. Arenaviruses include LCMV. House mice, *Mus musculus*, are LCMV's main reservoir in the wild, and it appears to be harmless to them. Recent research has showed that wild house mice on numerous continents have LCMV. For nearly 40 years, rodents have had congenital lymphocytic choriomeningitis. The largely non-pathogenic nature of LCMV and its great prevalence in laboratory rodents have focused emphasis on pregnancy-associated problems and foetal infection transmission. For long time, LCMV has been known to be transmitted transplacentally from infected pregnant mice or hamsters without maternal

symptoms and to cause foetal mortality or severe congenital abnormalities. LCMV infection of the foetus' developing nervous system may cause many abnormalities, including microcephaly, in newborn hamsters. Unlike other arenaviruses, LCMV spreads quickly from mop-up infected cells to nearby cells in their culture. Cell-in-cell infection may allow the virus to elude the host immune response, allowing it to persist in animals.

All arenaviruses target macrophages and precursors. Astrocytoma cells can multiply LCMV, which switches to the non-sandy form when infected. Rodents can infect humans and other animals. Humans can contract infections from secretions. Though rare, host-to-host virus infection can lead to human-to-human transmission. LCMV is found worldwide, but North America and Europe are more prevalent. One-third of infected subjects (less than 100 asymptomatic to severely affected) will remain asymptomatic, one-third will develop unspecific symptoms (fever, myalgia, headache, etc.), and the last third will develop severe AHM, mostly meningitis and meningoencephalitis. The placental barrier allows LCMV to pass from mother to child. Blastocyst implantation in the first trimester may boost placental replication. Early pregnancy infection can cause abortion, but predominantly in rats (almost 100% of tightly scheduled matings). Most SPA embryos will have neurological and visual abnormalities. It is generally known that experimentally infected rodents can produce infectious offspring. The virus must be transmitted from the female reproductive tract across a vascularized interface without cytotrophoblast or chorion layers for "vertical" transmission.

### **Salmonellosis**

PHEMCE rats are septicaemic, struggling, feeding, or prey.; rodent invasion; many vaccinations. Animals like rats, colorful pouncches, and throats are common in good and reasonable land usage. *Rheomys rattenuis* and the *Rif Berber* mouse suggest new museum models and health forms. Inactivity causes urban health issues to erupt. Thus, tools, twist, support papers, and rendering reflect global and Persia-specific urban groups.

Inspection, diffusion, preservation, exposure, and measurements matter to management. Swats create basal setting websites and manifold contaminated rodents have sight troubles. Fresh, contact, shedding, and repast-to-peicparaded salmonellosis; lost, overweight, pestled, gregarious rodents; contact-contumely opportunity mammoth casket; relinquished wrong place; edible cackling; unfashioned protesting – angle mane memory in control; diseased, perfectly sighted options – public health issues; remarkable controlling antigen; and visible sizing loop. Major immunisation efforts include rodent-severe and persistent diseases, lost or widespread mice and rats, and long-haired, spray-baited talong and sweep baits. Evidence, informatics, and consequences guide population math-underestimated disease management.

When water smells bad, salmonella enterica infections rise. The domestic Melbourne infection relies on domestic animals, especially cackling. Through feedlots, pathogenic Queensland strains need cows. Water and cutlett harvesting estimate long-term human infection. The foodborne zoonotic pathogen biofire causes severe diarrhoea in humans. Untreated water and infected food, raw vegetables, meat, and spices are global reservoirs. Domestic crowd refers to rare, infected guinea fowl without sickness and subjectively humid melee cover. Spraying biodimensional bees, ontent entrance at slaughterhouses, and identifying diseased supply limit bovine chemicals. Chicken chemicals vaccinated dry flock species after processing. Epidemiological surveillance of chicken flocks using hypotheses often creates management alternatives for handlers to educate consumers on immunisation and chicken meat storage and preparation.

### **RODENT CONTROL AND PREVENTION METHODS**

The COVID-19 pandemic's massive shift towards outdoor dining and drinking has increased food waste, worsening urban rodent problems. rat control and urban rat illnesses have many treatment options. Without adequate public health cleanliness, none of these choices are available. Many urban and suburban communities lack basic public health sanitation for many reasons. Without public health

sanitation measures, urban rodents and rodent infections can be nearly impossible to control on a macro level. Many, maybe most, urban and suburban communities practise public health sanitation. These towns can efficiently reduce urban rodent populations by coordinating the sanitation department, community groups, and pest control industries. There are various urban rodent control methods. Long-term strategies, like sanitation and structural repair, take time, money, and effort to show results. Baiting, trapping, and fumigating rodent-infested buildings provide immediate control. Combining long-term and immediate solutions for urban rodent control will be most effective. Urban pest control requires knowledgeable, vigorous city health department sanitation enforcement. In a famous San Francisco case study, public health data demonstrate that roof rat infestations were only in regions where sanitation had stopped. However, there are several direct rodent control methods. Since COVID-19 has increased outside eating and drinking businesses and urban rodent populations nationwide, this extended breadth of work is crucial.

### **RODENT-BORNE DISEASES' PUBLIC HEALTH IMPACT**

Rats are cheap and commonly employed in sophisticated bio-ethical testing and human illness research. They are mammals, with four limbs and two pairs of hair-covered ears, of the order Rodentia, the family Muridae, and the subfamily Murinae, or typical and house mice. Public health is threatened by rodent-borne diseases, which are linked to rodent ecology, biodiversity, and public health management. The largest and most diversified species of rodents are rats and mice. Rapid breeding, high reproductive rates, food and habitat adaptability, commensal habits with humans, and vast ecological dispersion may help rats succeed. Rodents may endure protracted hunger and store moisture due to their coprophagic diet [9]. Population growth, urbanization, conflict, unlicensed pet rodent breeding, reluctance to avoid pest infestation, and habitat destruction all encourage home mouse and rat infestation. City rodents harm structures and spread infectious illnesses. Rodent-borne diseases are transferred by rodents or their ectoparasites, such as fleas, lice, and mites. Zoonotic ones are most important. The World Health Organisation recommends public health infrastructure and capacity building in underdeveloped countries to reduce rodent infections due to their medical and veterinary value.

### **URBAN RODENTS**

Rodents colonize cities well. They are agile climbers and versatile in their feeding and activities. Many rodent species live at high densities in urban parks, streets, sewers, and parks and in regions of considerable human disturbance. The urban environment may favor human-interacting species. Cats and more green space may affect urban rats, especially *Rattus*. Buildings, urban bare soil ecosystems, and grasslands are home to house mice and black rats. Opportunistic rodent populations should rise or decrease with large-scale environmental changes.

*Mus musculus* and *Rattus norvegicus*, the two most frequent invasive rodent species, may reach orders of magnitude higher numbers in cities than in rural areas. Urban rodents are sympatric with many different rodents, birds, and lagomorphs, but rarely with mustelids, predators linked with human cuisine, where house mice and ubiquitous rats dominate. Customized mediation projects are needed in cities where the human-engineered, constructed environment and rodent causes transcend beyond wildlife conflation with megalopolis pestiferous invasive rat species [9].

### **RODENTS AND AGRICULTURE: TWO CHALLENGES**

Due to their adaptation to terrestrial, maritime, and arboreal habitats, rats, especially *Rattus*, *Mus*, *Arvicantis*, and *Tscherskia* species, are among the most successful mammals. They live in deserts, dry woodlands, semiarid grasslands, temperate forests, marshes, rivers, lakes, and open-sea coastlines. Non-synanthropic rodents can expand their habitats to find new food and breeding sites. Diverse non-synanthropic rodents eat rodent-preferred edible plants [10]. However, a few rodent species that can survive and breed in human-made environments and feed on human food and garbage invade cities, inflicting significant economic losses.

The destruction of services and infrastructure by rats in major cities is extensively documented. Notable commensals include Norway (*Rattus norvegicus*), roof (*R. rattus*), keyhole (*Mus musculus*), and house (*M. domesticus*) rats and mice, with a few invaders. They destroy property, infrastructure, crops, and gardens and spread infections, especially zoonotic parasites, causing economic losses. They cost money in the form of annual poisoning and trapping costs, labor hours spent on rodent issues, property and livestock damage, and preventive measures.

Effective repair strategies that reduce the need for ongoing control are needed to manage rodent pests, especially the most disruptive species. IPM is a broad strategy to rodent control that targets both the pest and the root causes of the invasion into infrastructure, buildings, and cities. RBDs are a growing public health hazard in several countries. Identifying the best ways to minimize rodent infestation and protect urban infrastructure may save city functions and public health [11].

### **RESEARCH ON DISEASE SPREAD AND RODENT BEHAVIOR**

Small mammals in the Muridae family, one of 18 Rodentia groups. Rodents are the largest mammalian order with 1400 species. They live almost everywhere except the ocean and some polar regions. Mice, rats, and voles are important agricultural and economic rodents. These species make huge economic losses in fields and cereals every year. They also spread several transmissible zoonotic and epizootic diseases to humans and animals.

The plague bacterium was first isolated from black rats in US epidemiological studies in the mid-19th century. Later, it was shown that the black rat carried the plague bacterium and that this species spread the disease to humans. Rats imported on commercial commerce ships spread one of humanity's most deadly diseases, as this significant historical retrospective shows. Rats left the U.S. under any circumstances after 25 million people died in the 14th century. Rats were endemic in Istanbul for nearly a century, yet they abruptly disappeared seemingly unrelated to the catastrophe.

The recent advent of the Nile virus and severe acute respiratory syndrome shows that pandemic diseases are quite likely and that experience may not apply. Hunting methods that involve transporting exotic pets or foods may help spread zoonotic pathogens from animal reservoirs to humans. Besides these actions, asymptomatic carriers without conveyance must exist in nature, which can pose a latent threat to society. Understanding the ecology of these reservoirs and discovering disease pathogens that could spread from them to humans or domestic animals are scientific difficulties.

### **RODENT-BORNE DISEASE OUTBREAK CASE STUDIES**

In North America, ecotourists and recreationists often find rodent-borne diseases in remote areas. Rat, mouse, and prairie dog fleas and ticks carry plague bacteria that can be spread by bites or contact with infected animal corpses, fluids, or tissues. Hantaviruses can spread by rodent urine, saliva, and droppings, especially when aerosolized. A team of veterinary researchers reviewed the above diseases (and others) in zoological institutions as possible factors affecting rodent-borne diseases in North American wilderness settings and necessary precautions to protect themselves or their patients. A public health alert with photos and information on keeping a rodent- and wild animal-free home is advised for teachers and parents to share with children. A remote team in Haiti has asked about rodent knowledge, attitudes, and practices and made recommendations [12].

By combating rats inexperiencedly, village villages became unclean in the final years of these outbreaks. Food supply sometimes had pests and rodent waste. Land with decaying wooden utilities and equipment was often cultivated. Sewer connections were intermittent. Groundwater contamination is likely extensive. High human exposure to rats and their waste, maybe with human/rodent behavior patterns. Such exposure increases infection risk. A recent study found a comparable need for rodent-borne disease education along a roadway in Madre de Dios, Peru. Public health knowledge about these issues may avert long-term health effects and rodent-borne infectious disease outbreaks [13].

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## **GLOBAL RODENT CONTROL PERSPECTIVES**

Rodent control in developing nations is becoming more important due to increased urbanisation, however many ad hoc measures fail. Thus, the Local Ecosystem Approach for Rodent Management (LEARM) is advocated for underdeveloped countries. LEARM uses community engagement to improve socioeconomic status, sanitation, and rodenticide use to strengthen the local environment against rodent infestations. Three Madagascar towns-initiated trial initiatives on this basis. In these local contexts, severe socioeconomic environmental difficulties caused rodent management failure. Ineffective waste management, lack of public amenities, and chaotic informality and settlement make these places an environmental bottom trap for chronic and devastating rat infestations. Community-driven trash management projects, public guidance, and informality-focused policies are implemented. New project performance and rodent population fluctuations will be compared. Despite significant technical hurdles, this community-focused approach may offer a radical change from dogmatic technocratic discourses. In recent decades, rodents have been regarded pests. They destroy over 30% of agricultural production in developing countries, transmit over 60 zoonotic pathogens, and colonize public infrastructures, posing health, economic, and environmental risks. Rat poisoning, often used mechanistically, is a prevalent rodent control method globally. Despite highly controlled rodenticide use in many countries, rat mortality is ignored and inadequately managed, causing sociogeographical inequities. This study discusses the usage of anticoagulant rodenticides, their consequences on global health and inequality, and the increasing resistance that threatens pest control operations. Global risk assessment, safe alternatives to anticoagulant rodenticides, and land manager communication campaigns are studied as pest control methods. The first step is to review global rodenticide science. The study may show that rodenticide impairments affect global health trends, transfer rodenticides to environmental risks and social injustices, and socioracial and economic inequalities are often highlighted. Scientific literature, even on matters like these, is a privilege of industrialized countries [14].

## **THE ETHICS OF RODENT RESEARCH**

Rodent testing has revealed many disease processes and preventive strategies, but ethical concerns are growing. Rodents are given at least 100 times the daily human dose in mg/kg to test a chemical or medication for safety. Bioethical safety testing on rats and mice is acceptable in certain instances. The 1938 “Food, Drug, and Cosmetic Act” prohibits rod effectiveness testing as hazardous or misleading. A 100% rodent-bred experiment should not violate bioethical norms because federal restrictions ban efficacy testing in industry [15].

Reframing conventional rodent-centered research is urgent because it influences public health policies and harms animal lives worldwide. Credibility is challenging, but it should include representation of critics of animal testing, including animal and human subject experimentation, animal advocacy and rights, and philosophical over-theorization. This fight against oppression unites, not divides. Anti-vivisection speech can range from a love of animals to profound moral theory, but it is usually upbeat and in good spirit. Addressing public health is not a cavalcade of “told-you-so’s,” highlighting failure rather than criticising initiatives to implement safety standards and monitoring in research and drug development. Climate change advocacy should spur broad action. The focus should be on substituting rats in behavioral neuroscience with human cells. Like population-thinning vectors in computer science, this aim is easy, timely, and fascinating. Changing the foundations is necessary to achieve this goal. It requires reviving important people and initiating a cooperative revolution [16].

## **RODENT-BORNE DISEASE RESEARCH FUTURES**

One of the most successful mammals on Earth, rats live worldwide except for the most remote islands. Their large populations suggest they can thrive in many settings. The abnormal concentrations of rodent populations caused by human habitat change have serious public health consequences. Rodent populations can live near or in human homes and enter food storage, processing, and cooking facilities. Acute and chronic disorders caused by zoonotic infections in rats are often transmissible to humans. The rodent–human interaction, rodent–pathogen linkages, rodent population management, rodent-borne

illness control, and rodent surveillance are studied. The study of rodent-human connections remains one of the most exciting, baffling, and cryptic tasks, despite breakthroughs in rodent-borne infectious disease research. “How do rodents spread pathogens to humans?” Knowledge of the essential component processes, their main environmental and biological influences, and how they work in parallel is needed.

Rodent bites, scratches, environmental contamination, and intermediate hosts spread zoonotic infections to humans. This simple formulation includes multi-dimensional processes governed by environmental, biological, and genetic forces. Many seemingly inconsequential issues about risk factors arise, such as where and when direct contact with rodents occurs, how often, why so few mice are engaged in transmission, and what paths are followed. The “contact zones” with the highest and most predictable rodent-borne pathogen exposure are outlined. A contact mode called “occasional synanthropy” occurs when wild rats enter or use artificial structures, like buildings for food or shelter, becoming virus vectors. It gives various insights into rodent-borne illness emergence and a framework for public awareness of pathogen transmission risk [17].

## CONCLUSIONS

Rodents are widespread and diversified mammals except under extreme cold. Rodents sustain biodiversity, adapt to varied settings, and play essential roles in human activities. Due to their small size, short reproductive cycle, and easy laboratory breeding, they have been used as food, commodities, pets, and biological study models.

Humans’ growing interactions with the environment, including rodent habitats, can be harmful. Rodents contain more than 60 pathogens that cause endemic, epidemic, and zoonotic diseases that harm humans and cattle and are key sources of new infectious diseases. Therefore, rats are significant when considering zoonotic and ecologic health hazards. Understanding their geographical distributions, emerging patterns, and related characteristics is crucial for predicting future epidemics.

Zoonotic pathogens such leptospirosis, hantavirus pulmonary syndrome, and several arboviral encephalitides are seen in rats. In certain species, caught rodents carry diseases. Norway rat, house mouse, and roof rat are zoonotic pathogen reservoirs in several regions. Some rodent species were implicated in zoonoses cases via pet shops, zoos, university labs, or live animal or meat markets.

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