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An Analysis of Zoonoses and Environmental Drivers of Zoonoses at Gwalior Chambal area in North India (M.P)

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Abstract - Today, zoonotic illnesses are increasingly common in practically every region of the globe. Numerous studies conducted around the nation have shown that the majority of victims in these locations are the economically underprivileged people, who often lack access to essential services. The current research examined the various zoonotic illnesses and the environmental variables contributing to their transmission in the Gwalior-Chambal area. The region's residents have experienced significant morbidity and death as a result of these illnesses. These illnesses are transmitted due to a variety of reasons.

Keywords - Zoonoses, Environmental drivers, Gwalior-Chambal

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INTRODUCTION

Cattle, wildlife, and domestic animals provide food, income, and companionship for people; as a result, animal and human health are intricately intertwined. Many different diseases may be transmitted to humans from animals. Transmission of viruses from animals Diseases spread from animals to humans are called zoonoses (Hubbert et al., 1975; Coleman, 2002; WHO, 2007). There is always a risk associated with the most common diseases, which are: Crossing geographical barriers, diseases affect people everywhere. It was Ichhpujani and coworkers who first (2000) Humans, nonhuman animals, and domesticated animals have all suffered from zoonotic illnesses throughout history, with livestock owners and workers especially at risk. The economic impact of zoonotic diseases is undeniably larger. Countries with robust economies are set against those with a weaker economy. Infectious diseases are a major contributor to the human health burden in countries with slow economic development. The effects of these diseases are relatively minor in economically developed countries but much more severe in poor countries. It's important to consider the impact of only 4 percent of the total burden on human health, sickness, and death. Foodborne zoonotic infections are often seen as a harbinger of this new occurrence and are not to be dismissed as a minor problem. Every year, ILRI, ILRI, ILRI, ILRI, ILRI causes around a billion deaths and millions of illnesses (2012). Particularly, animals are the most common carriers of these zoonoses. According to Wheelis (2002), zoonotic agents are continually engaged in the global transmission of diseases that originate in animals, and both wild and domestic animals act as reservoirs for these agents. Direct transfer (such as a bite from a rabid animal) and indirect transfer (such as eating raw blood, milk, or meat from diseased animals) are both possible modes of transmission for zoonotic diseases (WHO, 2004). (2007). In the United Kingdom, food is often considered to be the main vector for the spread of zoonotic diseases. Direct forms of transmission include, for example, rabies virus transmission from a rabid dog through saliva, while indirect modes of transmission primarily include, for example, Salmonella Spp. in contaminated food and water. Vector-borne diseases such as Rift Valley fever are well-documented. According to Paramasivan et al., zoos in India have seen the spread of zoonotic diseases such as anthrax, tuberculosis, rabies, and others (2003). Complicating factors contribute to the emergence of zoonotic illnesses. In order for a disease to spread and adapt to a new niche, a number of extrinsic events, or drivers, must take place. Primary drivers include those at the local, national, regional, and global environmental, political, economic, and social levels. When all of these factors come together in one place, concentrated in large numbers, the risk of a zoonotic disease outbreak is high. In this chapter, the Committee investigates many risk and protective variables for developing and relapsing upon an illness. In spite of its incompleteness, it serves to illustrate the richness and complexity of their interconnections.

MATERIAL AND METHODS

- **Study area**

The present study was conducted in the Gwalior-Chambal region of North Madhya Pradesh during the academic years of 2018–19 and 2019–20 in research regions comprising the districts of Gwalior, Morena, and Bhind.

- **Site selection**

27 villages overall, located in 17 blocks across three districts, were determined to be part of the intense research area (Gwalior-Chambal region). The various communities for the research were chosen using multistage random sampling procedures. According to the random number approach, the majority of the communities chosen for the current research were agro-pastoral oriented (Table 3.1). 10% were included in the original sample process while taking various considerations into account. Based on random sample, 10% of the communities in each district were chosen. Finally, just 5% of them met the criterion and were kept. As a result, it was deemed to be too time-consuming and the sample technique was changed to include two families from each of two ten cell units, obtained a broad geographic coverage. The sample size was computed to determine the total number of animals to be tested from each chosen home based on the prior reports of zoonosis.

- **Study of diseases**

Three widely used textbooks, namely PAHO (27), Goldsmid (29), and MVM, will be used to identify zoonotic infections (30)

- **Study of the outbreak of bird flu**

Surveys were done to monitor both healthy and diseased birds during the bird flu epidemic at the Gandhi Zoological Park in Gwalior. To learn more about the potential causes of the epidemic and the casualties, group meetings with specialists and the in-charge zoo veterinarian officer were held on a regular basis. Both afflicted (dead) and living birds were photographed using a Nikon digital camera. Using a portable Garmin® Global Positioning Systems (GPS) 60, the position was noted.

- **Analysis of water quality at the time of bird flu outbreak**

At the time of the outbreak, the water that was provided to the caged animals at the Gandhi Zoological Park was examined. pH, electrical conductivity, total dissolved solids, calcium, magnesium, alkalinity, bicarbonates, total hardness, chlorides, sodium, dissolved oxygen, copper, iron, and sulphate are the factors used to measure the quality of water. Following APHA's standard procedures from 2012, total coliform and standard plate count were analysed.

- **Primary Data collection**

The respondents were chosen from a range of occupations, age groups, and sexes. Questionnaires were utilised to compile information on trends among a large number of respondents. The family head, who represents the home and normally has a good understanding of the herd or flock, took part in the interview. A total of 887 families from 27 villages in the research region were polled throughout the two years 2018–19 and 2019–20. Between 30 and 40 minutes were spent on each interview. Using a portable Garmin® Global Positioning Systems (QPS) 60, the locations of each settlement were recorded. The study's goals were to monitor infection dynamics and ascertain how an illness might impact animals. The most impacted four or five families from the cross-sectional survey were selected.

- **Target Population**

All ages and genders of people were taken into account. By comparing the data to the medical records, every attempt was made to include every instance that was impacted by the data.

- **Studied variables**

Age, gender, employment, place of residence (rural or urban), attitude, the frequency of and knowledge of the route of transmission, and the year patterns of medical treatment provided to the sufferer are preferred variables.

- **Physio-chemical analysis of water sample**

Samples were maintained in accordance with the APHA recommendations, and numerous aspects of water quality were estimated (APHA 2012). The physio-chemical analysis of the samples was finished at ITM University in Gwalior.

- **Secondary Data collection**

Secondary data was acquired from different hospitals (human and veterinary), chief medical offices, and district veterinary offices with the necessary approval from the CMO in question.

- **Monitoring of weather parameters**

Temperature, humidity, and precipitation data from the metrological weather station thathipur in Gwalior were gathered during a two-year period.

- **Instruments**

The study made use of a GPS (Garmin 60), a digital camera (Nikon, 10 optical zoom, and 8 mega pixel), and other research tools.

- **Statistical Analysis**

The statistical analysis for this inquiry was performed using the spss 22.0 software package. Categorical data were represented by numbers and percentages, while numerical measures were wherever applicable represented by mean, standard deviation, maximum and lowest values, and correlation. The correlation between two age groups is shown using the Decans test. The significance level was set at p0.05.

RESULTS

- **Study of Zoonosis**

A cross-sectional study was carried out in the Gwalior-Chambal area to identify and evaluate existing, developing infections and zoonotic illnesses as well as their incidence in livestock, wildlife, and domestic animals. The present research also looked at zoonotic disease awareness, views, knowledge, and attitude as well as the transfer of illness from animals to humans. In all, 27 villages were selected using the random sample approach to quantify different factors, and throughout the research period, in addition to the 11 zoonotic illnesses detected in the Gwalior-Chambal area, five more prevalent diseases were found among livestock and domestic animals.

The rabies virus, a member of the genus Lyssavirus and the family Rhabdoviridae, causes rabies, one of the most prevalent viral zoonotic diseases encountered in the Gwalior-Chambal region. While the rhabdoviridae family, which causes rabies, is usually found in domestic and wild animals, it may also infect people via bites, scratches, and saliva. Dogs are the main reservoir and vector for canine rabies. The bacterium burkholderia melle, which causes the bacterial zoonotic disease glander disease, is mostly found in beasts of burden (horses). Affected animals' body fluids or direct contact with them are the two most common ways to transmit disease. Malaria is a protozoan vector-borne zoonotic disease that is brought on by the parasite plasmodium, which is a member of the genus Plasmodium and family Plasmodiidae. Monkeys and other wild animals may potentially get the parasite in addition to the Anopheles mosquito, the disease's main vector. The plague is a bacterial zoonotic disease that is spread by flea bites and is caused by the Yersinia bacterium present in rodents, notably the black rat, which serves as reservoirs for the disease. Rodents, birds, and animals are the main hosts of the chikungunya virus. Through the bite of an aedes mosquito, the chikungunya virus is spread. The chikungunya virus, an alphavirus from the genus, is the source of the viral zoonotic disease known as chikungunya. The majority of TB cases are caused by domestic animals, and human transmission of bovine tuberculosis from diseased animals to people happens via contaminated surfaces and droplets. The genus Mycobacterium and species Mycobacterium bovis are responsible for the bacterial zoonotic illness known as bovine TB, which affects cattle. The aedes mosquito, which also acts as a vector for the spread of the disease, is the carrier of the flavivirus that causes dengue. The reservoirs for the flavivirus include primates and other wild animals. Canine parvovirus infections, such as parvo, are mostly acquired from dogs. Dogs may get the viral zoonotic illness canine parvovirus via skin or mucous membrane contact with infected animals. Swine flu is a viral zoonotic disease that is transmitted by inhaling infected droplets. It is caused by the swine influenza virus, a member of the orthomyxoviridae family that is mostly found in pigs. Bird flu is an infectious viral zoonotic disease that most often transfers from birds to humans by droplet inhalation. The bacterial zoonotic disease brucellosis is caused by a brucella abortus. Cows and buffaloes are the main carriers of brucellosis, which is spread by skin or mucous membrane contact with diseased animals, their blood, tissue, and other body fluids.

It is common to find the aphthovirus that causes foot and mouth disease in cows and buffaloes. By coming into contact with the saliva, faeces, or respiratory secretions of an infected person, it is passed from one person to another. Hemorrhagic septicemia in cattle is brought on by the bacteria Pasteurella multicoda. It spreads by direct contact with the faeces of diseased animals. Black quarter, which is brought on by clastridium bacteria, most often affects cattle. Three-day fever in cattle, sometimes referred to as ephemeral fever, is brought on by the bovine ephemeral virus. In cattle, a bacteria called staphylococcus causes mastitis (Table 1, 2)

Table 1: List of Zoonotic diseases reported in Gwalior-Chambal Region (Animal to Human)

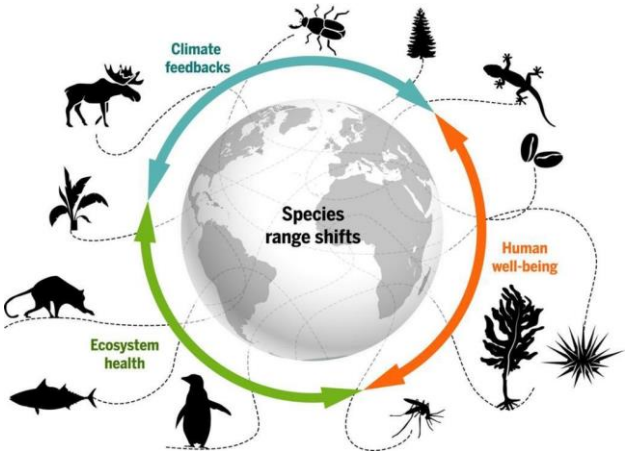
Diseases Name	Carrier	Type of agents	Causative agent	Victims
Rabies	-	Virus	Rhabdoviridae	Humans
Glander diseases (Gorha)	-	Bacteria	Bacterium burkholderiamellei	Horse/Donkey
Malaria	Anopheles Mosquito	Protozoa	Plasmodium Parasite	Humans
Plague	Fleas	Bacteria	Bacterium Yersinia	Rodents
Chikungunya	Aedes Mosquito	Virus	Alphavirus	Humans
Tuberculosis in bovine	-	Bacteria	bacteriumbovis	Buffalo
Dengue	Aedes Mosquito	gue fevervirus	Flavivirus	Humans
Parvo	-	Virus	Canine Parvovirus	Dogs
Swine flu	-	Virus	Influenza Virus	Humans
Bird flu	-	Virus	Influenza Virus	Birds
Brucellosis	-	Bacteria	Brucella abortus	Cow
Foot and Mouth diseases	-	Virus	Aphthovirus	Cattles
Haemorrhagic Septicaemia	-	Bacteria	Pasteurella multicoda	Cattle
Black Quarter	-	Bacteria	Clastridium	Cow
ever (Three daysfever)	-	Virus	ephemeral virus	Cattle
Mastitis	-	Bacteria	Staphylococcus	Cattle

Table 2: Source of Zoonotic infection reported in study area

Zoonotic diseases	Source of Infection	Mode of transmission
Rabies	Dogs (Canin rabies)	Animal bite, contact with infected saliva or Tissue
Glander diseases (Gorha)	Horse/ Donkey/Mules	Inhalation of aerosol droplets
Malaria	Monkey, wild animals	Mosquito bite
Plague	Rodents (black rat)	Fleas bite
Chikungunya	Animals, birds, rodents	Mosquito bite
Tuberculosis in bovine	Domestic animals	Inhalation of aerosol droplets, contaminated equipment, bites
Dengue	Monkey, wild animals	Mosquito bite
Parvo	Dogs	Inhalation of droplets, Skin or mucous membrane contact with infected animals
Swine flu	Pigs	Inhalation of droplets,
Bird flu	Birds	Inhalation of droplets,
Brucellosis	Cow/ buffalo	Skin or mucous membrane contact with infected animals, their blood, tissue, andother body fluids
Foot and Mouth diseases	Cow/Buffalo	Skin or unwashed hands, infected saliva, stool, respiratory secretion
Haemorrhagic Septicaemia	Cow/buffalos	Inhalation of causative agents
Black Quarter	Cattle/ sheep/Goat	Through contaminated soil
Ephemeral Fever (Three days fever)	Cattle	Inhalation of causative agents
Mastitis	Cattle	Through contaminated hands, milking Machine

- **The relationship between climate change, environment and vector born zoonotic diseases**

A rising and unstable climate have a substantial impact on the worldwide development (extension of host ranges and geographic regions), revival, and redistribution of vector-borne zoonotic and water-borne illnesses. The relationship between climate change and environment is that a changing climate affects ecosystems in which vectors and pathogen hosts thrive, that it can result in the loss of original habitats, forcing animal hosts and vectors to relocate as a result of this alarming environmental situation, that it will cause microorganisms to shift and move into new geographical zones, and that it will also have an impact on human behaviour. Figure 4.1 shows the connection between environmental factors, human health, and climate change. Every living thing has a preferred range for the optimal climatic circumstances, such as temperature, precipitation, and humidity, including vectors, diseases, and hosts. A changing environment could also make it possible for additional epidemics to happen at improbable times and locations. The regional and seasonal distributions of infectious illnesses are often determined by climatic factors, and weather has an impact on these distributions.



Source: Gretta T. Pecl et al. Science 2017;355:eaai 9214.

Figuure 1: Link between climate change, environment and human well-being.

According to current study, certain vector-borne human infectious diseases including Malaria, Dengue, and Chikungunya have spread to a larger region. Most of these illnesses have expanded to areas where mosquito vectors may thrive in an ideal habitat.

Climate of Gwalior-Chambal region

The Gwalior-Chambal region has a humid subtropical climate, according to Koppens' classification, with hot summers from late March to early July, a moist monsoon season from late June to early October, and a cool, dry winter from early November to late February. There, temperatures ranged from 4 C to 45 C, respectively. The summer months in Gwalior start in late March, peak in June with an average temperature of 40.7 °C, and conclude with the onset of monsoon season. Every year, the city receives 970 mm (39 inches) of rain, the majority of which falls during the monsoon season, which runs from late June to early October and is wettest in august with about 310 mm (12 inches) of rain. The winter season in Gwalior starts in late October and is usually quite January is the coldest month, with average lows in the 5-8 C range and occasional cold spells that drop the temperature to around 0 C.

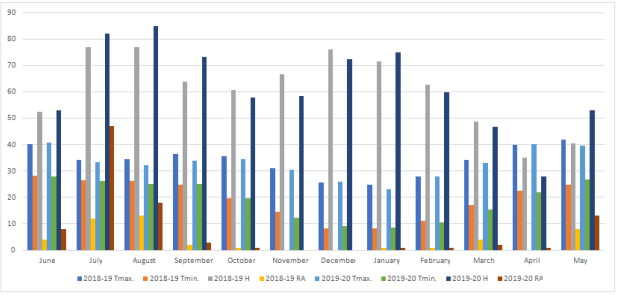


Figure 2: Max, Min. temperature, humidity and rainfall of Gwalior 2018-20

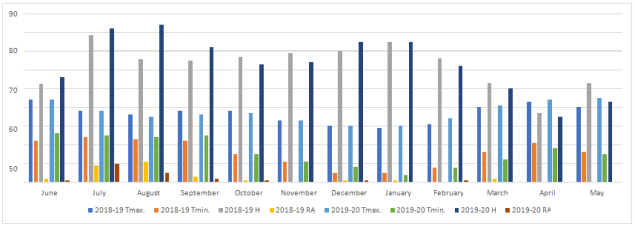


Figure 3: Max, Min. temperature, humidity and rainfall of Morena 2018-20

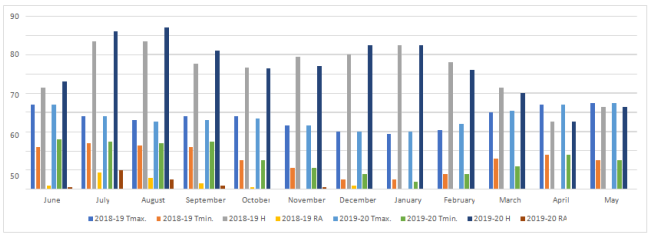


Figure 4: Max, Min. temperature, humidity and rainfall of Bhind 2018-20

- **Prevalence of zoonotic diseases among human population**

Human and animal health are intertwined; although people rely on animals for food, socioeconomic advancement, and companionship, animals can spread a wide range of diseases to people, especially those who have close contact with livestock. Human and livestock lives are significantly lost as a result of zoonotic and human health diseases like tuberculosis, anthrax, rabies, and brucellosis. In order to evaluate the prevalence, knowledge, and awareness of various zoonotic diseases in the Gwalior-Chambal region of North Madhya Pradesh, participatory rural appraisal and a cross-sectional study were conducted between 2015–16 and 2016–17. The participatory rural appraisal study was carried out in Agro pastoral and small dairy households in the study area by using focus group discussion technique, and the cross-sectional study was carried out by using randomised household questioning. Twenty-seven villages in total, located in the districts of Gwalior, Morena, and Bhind, were chosen from the study area in the Gwalior-Chambal region. Twelve villages were chosen from the Chambal region's Gwalior district, while eight villages were chosen from the Morena district and similarly seven villages were chosen from the Bhind district. The profile of the chosen villages, along with information about their altitude, population of men and women, and literacy rate, can be found in Table 4.21. The villages' elevations typically range from 103 to 500 meters. Village populations ranged from 182 (Khera) to 2964 (Bijoli), with an average of (Mean sd)1239.37777.03 per village. From 30% (Chhikari) to 86% (Nahtoli), the literacy rate ranged; the mean literacy rate per village with standard deviation was 64.5612.69. The average number of men in each village (Mean sd) was higher than the average number of women in each village (540.51 362.68).

Table 3: General Profile of Study Villages (n=27)

Location	Village name	Elevation (m)	Male population	Female population	Literacy rate (%)	Total
Gwalior	Badagaon	197	1486	1190	65	2676
	Bandholi	103	1055	876	62	1931
	Chhikari	197	377	254	30	631
	Hastanapur	213	1226	1030	63	2256
	Bamor	197	193	157	60	350
	Pawata	197	156	97	65	253
	Rairu	197	959	773	63	1732
	Ramaua	197	537	446	47	983
	Shankrupur	197	225	199	67	424
	Sigora	213	1187	1037	70	2224
	Sitholia	197	564	320	64	884
	Bijoli	213	1626	1338	63	2964
Morena	Sikroda	176	356	132	56	488
	Sunawali	500	672	583	72	1255
	Khera	177	113	69	84	182
	Aroli	175	1096	852	57	1948
	Barhana	177	452	348	61	800
	Gadora	178	986	703	59	1689
	Husainpur	176	942	715	51	1657
	Kheda Mangarh	190	721	623	58	1344
Bhind	Baghedi	152	789	561	57	1350
	Rayatpora	151	560	441	69	1001
	Amratpura	165	200	170	93	370
	Baghpura	154	2111	51	65	362
	Barohi	157	993	819	84	1812
	Mahewa	158	655	503	72	1158
	Nahtoli	153	432	307	86	739
Overall Mean±sd			765.51 ±490.10	540.51±362.68	64.56±12.69	1239.37±777.03

The characteristics of the homes are very important in the spread of zoonotic illnesses. Household characteristics include the kind of housing (concrete, mud brick, earthen, and so on), the water supply (internal, external), and agriculture (Plate 2) feature of the homes examined at the research locations throughout the study period (Table 4.22) The majority of homes were made of concrete (49.15%), with a mean sd of 145.667. Mud bricks made up 32.84 percent of homes, with an average (Meansd) of 97.333 23.692. With an average (Meansd) 53.000 6.245, 17.99% of dwellings were composed of soil and manure. Similarly, tube wells, canals, and streams served as the primary source of water for 47.99% of the homes examined. the average (Meansd) was 141.66759.501 whereas the average (Meansd) was 154.33359.501 because 52.19 percent of homes had a water source within the home. At the research location, about 70.19% of the population worked in agriculture, with an average (Meansd) of 208.00027.185. 69. The average

(Meansd) for the 6% of the population that routinely irrigate their crops was 202.00014.422.

- **Physio-chemical characteristics of water**

When determining the quality and level of water pollution, physio-chemical properties of the water are important to consider. The current study was carried out in the Gandhi Zoological Park in Gwalior during the 2016–17 bird flu outbreak. For the investigation of the water quality at the study area, four sampling stations—S1, S2, S3, and S4—were chosen. Temperature, pH, Total Dissolved Solids, Calcium, Magnesium, Alkalinity, Potassium, Do, Copper, Iron, Sulphate, Chlorides, and Total Hardness For the analysis of the water of Gandhi Zoological Park, the Standard Plate Count (SPC), Total Coliform Count (TCC), Indole Production Test, and Citrate Utilization Test were chosen. In Table 4.39, the results for various water parameters are displayed. They include mean, maximum, minimum, standard error, and standard deviation.

Table 4: Physio- Chemical Analysis of water in Gandhi Zoological Park

Parameters	Unit	S1	S2	S3	S4	BIS	Mean±sd	Max	Min	Std. Error
Temperature	(°C)	23.2	23.5	22.8	23.1		23.15±0.41	23.500	22.50	0.21
pH		8.0	6.5	7	9.2	6.5-8.5	7.67±1.19	9.20	6.50	0.59
EC	(µs/m)	0.65	0.32	0.43	0.37	NA	0.44±0.14	0.65	0.32	0.07
Total Dissolvedsolids	(mg/L)	450	460	400	410	500	430.00±29.43	460.00	400.00	14.72
Calcium	(mg/L)	30	63	65	65	75	55.75±17.19	65.00	30.00	8.59
Magnesium	(mg/L)	54	214	30	150	14-125	112.00±85.51	214.00	30.00	42.75
Alkalinity Bicarbonates	(mg/L)	102	120	112	118	200	113.00±8.08	120.00	102.00	4.04
Total hardness as CaCO3	(mg/L)	60	330	100	500	60- 180	247.50±206.13	500.00	60.00	103.06
Chlorides	(mg/L)	110	150	100	105	250	116.25±22.86	150.00	100.00	11.43
Sodium	(mg/L)	0	06	0	0	200	1.50±3.00	6.00	0.00	1.50
Potassium	(mg/L)	02	0	0	0	10	0.50±1.00	2.00	0.00	0.50
Do	(mg/L)	08	07	08	08	NA	7.75±0.50	8.00	7.00	0.25
Copper	(mg/L)	0.02	0.02	0.02	0.04	0.6	0.02±0.01	0.04	0.02	0.00
Iron	(mg/L)	0.8	1	1.4	0.8	0.3	1.00±0.28	1.04	0.80	0.14
Sulphate	(mg/L)	80	75	78	70	250	75.75±4.34	80.00	70.00	2.17

BIS= Bearu of Indian Standard, S1. S2. S3. S4= represents the sampling sites

CONCLUSION

The Gwalior Chambal region is home to the majority of zoonotic illnesses, which have contributed to local mortality and morbidity. In these regions, the respondents reported cases of rabies, malaria, dengue, chikungunya, swine flu, bird flu, and dengue fever. The majority of responders are unaware of the fundamental causes and remedies for the ailments. Despite the fact that they are aware that mosquitoes and dog bites, respectively, are the sources of rabies and malaria transmission. Animal bite victims may get medical care and treatment at any of the district health centres in the study region that have dedicated rabies sections. The frequency of these illnesses is directly correlated with low living conditions and illiteracy. People who are discovered to have frequent intimate contact with pets run the risk of contracting a variety of zoonotic illnesses. The incidence and transmission of illnesses in a region are correlated with the local temperature change. The majority of illnesses that affect the victims are brought on by human-animal interaction and irresponsible treatment of such creatures. The health department has to take action immediately to promote awareness about zoonotic illnesses.

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