



Mapping India's Outbreak Landscape: A Five-Year Retrospective Analysis of Outbreak Burden, Disease Patterns, Morbidity, Mortality Burden, Case Fatality Rates, and Emerging Infectious Threats

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Abstract: Background: Disease outbreaks remain a major public health challenge in India, contributing substantially to morbidity and mortality. Strengthening outbreak surveillance is essential for early detection, timely response and prevention of epidemic-prone diseases. This study analyzed outbreak surveillance data reported in India during 2021–2025 to assess temporal trends, disease patterns, geographical distribution and mortality burden. **Materials and Methods:** A retrospective descriptive epidemiological study was conducted using secondary data obtained from the Integrated Disease Surveillance Programme (IDSP), Government of India. All reported outbreaks/events from January 2021 to December 2025 were included. Data on outbreaks, cases, deaths, disease categories and State/Union Territory-wise distribution were analyzed using frequencies, percentages and case fatality rates (CFRs). **Results:** A total of 8,882 outbreaks/events, 321,184 cases and 1,843 deaths were reported during the study period, with an overall CFR of 0.57%. Outbreaks increased from 726 in 2021 to a peak of 3,020 in 2024 before declining to 2,285 in 2025. Acute diarrheal disease was the leading contributor to outbreak burden [2,609 outbreaks (29.4%)], case burden (106,348 cases) and mortality burden (384 deaths), followed by food poisoning (1,023 outbreaks) and dengue (743 outbreaks). Acute encephalitic syndrome caused 369 deaths with a CFR of 40.86%, while human rabies exhibited a CFR of 100%. Kerala reported the highest outbreak burden (1,207 outbreaks), whereas Gujarat recorded the highest mortality burden (362 deaths). Emerging and re-emerging infectious diseases accounted for 159 outbreaks, 1,585 cases and 30 deaths, with Zika virus disease and monkeypox being the most frequently reported emerging infections. **Conclusion:** India continues to face a substantial burden of communicable disease outbreaks, predominantly due to water-borne, food-borne and vector-borne diseases. However, a disproportionate share of mortality is attributable to high-fatality conditions such as acute encephalitic syndrome, rabies, Japanese encephalitis and emerging infections. Strengthening surveillance, laboratory capacity, outbreak preparedness and One Health approaches is essential to reduce outbreak-related morbidity and mortality.

Key Words: Outbreak Surveillance, IDSP, Communicable Diseases, Acute Diarrheal Disease, Dengue, Rabies, Emerging Infections, Case Fatality Rate, India

INTRODUCTION

Disease outbreaks continue to pose a significant public health challenge worldwide, particularly in low- and middle-income countries where rapid urbanization, population growth, environmental changes, inadequate sanitation, climate variability, increased human mobility and emerging pathogens contribute to the spread of infectious diseases [1-3]. Timely detection, investigation and containment of outbreaks are essential to

minimize morbidity, mortality and socioeconomic disruption. Consequently, robust disease surveillance systems serve as the cornerstone of public health preparedness and response, enabling health authorities to identify unusual health events, monitor disease trends and implement evidence-based control measures [4,5].

India, with its vast geographic diversity, large population and varied ecological conditions, remains

vulnerable to a wide range of communicable disease outbreaks. Water-borne diseases, food-borne illnesses, vector-borne infections, vaccine-preventable diseases, zoonotic infections and emerging pathogens continue to contribute substantially to the country's disease burden. Outbreaks of acute diarrheal disease, food poisoning, dengue, cholera, malaria, hepatitis A, measles and other infectious diseases are reported regularly from different regions of the country. Simultaneously, emerging and re-emerging infections such as Zika virus disease, Nipah virus infection, monkeypox, Crimean Congo haemorrhagic fever (CCHF), West Nile fever and Kyasanur Forest disease have highlighted the evolving nature of infectious disease threats and the need for continuous vigilance [6,7].

To strengthen outbreak detection and response, the Government of India established the Integrated Disease Surveillance Programme (IDSP), which functions as the primary national surveillance platform for monitoring epidemic-prone diseases. The programme facilitates systematic collection, analysis and dissemination of surveillance data from all States and Union Territories and supports rapid outbreak investigation through trained Rapid Response Teams. Over the years, IDSP has emerged as a crucial component of India's public health infrastructure, contributing significantly to early warning and timely response to outbreaks [8-10].

The period from 2021 to 2025 represents a particularly important phase in India's public health landscape. Following the COVID-19 pandemic, surveillance systems experienced substantial strengthening in terms of reporting mechanisms, laboratory capacity, digital integration and outbreak response preparedness. This period also witnessed the continued occurrence of traditional epidemic-prone diseases alongside the emergence of several new and re-emerging infectious threats. Analyzing outbreak surveillance data during this period provides valuable insights into changing disease patterns, outbreak burden, mortality trends and geographic distribution of infectious disease events across the country.

Despite the availability of routine surveillance reports, comprehensive analyses examining the overall outbreak profile of India across multiple years remain limited. Understanding the relative contribution of different diseases to outbreak burden, case burden and mortality burden is essential for prioritizing public health interventions and resource allocation. Furthermore, identifying diseases associated with high case fatality rates and regions experiencing disproportionate outbreak burdens can help strengthen preparedness and targeted response strategies.

Therefore, the present study was undertaken to analyze outbreak surveillance data reported in India during the period 2021–2025. The study aims to describe the year-wise trends in outbreaks, cases and deaths; examine the disease-wise distribution of outbreak events; assess State/Union Territory-wise outbreak burden; identify diseases contributing the highest mortality burden; and evaluate the occurrence of emerging and re-emerging infectious diseases. The findings

are expected to provide important epidemiological evidence for strengthening disease surveillance, outbreak preparedness and public health policy in India.

METHODS

Study Design

A retrospective descriptive epidemiological study was conducted to analyze outbreak surveillance data reported in India over a five-year period from January 2021 to December 2025. The study aimed to examine the temporal, geographical and disease-specific distribution of outbreaks/events, associated cases, deaths and case fatality rates (CFRs) reported through the national disease surveillance system.

Study Setting

The study was conducted at the national level and included outbreak/event data reported from all States and Union Territories (UTs) of India. The analysis encompassed outbreaks occurring across diverse epidemiological settings, including urban, rural, tribal, coastal, hilly and geographically remote regions.

Data Source

The study utilized secondary data obtained from the outbreak surveillance reports available through the Integrated Disease Surveillance Programme (IDSP), Ministry of Health and Family Welfare, Government of India. The IDSP serves as the principal national surveillance mechanism for monitoring epidemic-prone diseases and reporting outbreaks from all States and UTs. Data were compiled from publicly available outbreak surveillance records for the period 2021–2025.

Study Population

The study population comprised all outbreaks/events reported through the surveillance system during the study period. An outbreak/event was considered the unit of analysis.

Inclusion Criteria

All reported outbreaks/events from January 2021 to December 2025 fulfilling the following criteria were included:

- Availability of disease/illness classification
- Availability of information on the number of outbreaks/events
- Availability of data on the number of cases and deaths
- Availability of State/UT-wise reporting information

Exclusion Criteria

- Duplicate outbreak records
- Reports lacking essential epidemiological information
- Events that could not be classified into a specific disease category

- Incomplete records preventing calculation of outbreak burden or mortality indicators

Study Variables

The following variables were extracted and analyzed:

Temporal Variables

- Year of outbreak reporting (2021–2025)

Disease-related Variables

- Disease/illness causing the outbreak
- Number of outbreaks/events
- Number of cases
- Number of deaths

Geographic Variables

- State/Union Territory of reporting

Epidemiological Indicators

- Outbreak burden
- Case burden
- Mortality burden
- Case Fatality Rate (CFR)

Operational Definitions

Outbreak/Event: An outbreak was defined as the occurrence of disease cases in excess of what would normally be expected in a defined community, geographical area or period of time, as reported through the surveillance system.

Case Fatality Rate (CFR)

Case Fatality Rate was calculated using the following formula:

$$\text{CFR (\%)} = (\text{Number of Deaths} \div \text{Number of Cases}) \times 100$$

Major Diseases

Diseases reported in ten or more outbreaks/events during the study period were categorized as major diseases.

Minor Diseases

Diseases reported in 2–9 outbreaks/events were categorized as minor diseases.

Very Rare Diseases

Diseases reported in a single outbreak/event during the study period were categorized as very rare diseases.

Emerging and Re-emerging Infectious Diseases

Diseases identified as emerging, re-emerging or unusual public health threats based on epidemiological significance and surveillance reporting patterns were analyzed separately.

Data Management

Data were extracted from surveillance reports and entered into a master database. All disease names, outbreak counts, case counts and death counts were verified for consistency. Diseases reported under similar nomenclature were reviewed and categorized appropriately while maintaining the integrity of the original surveillance records.

Statistical Analysis

Data were analyzed using descriptive epidemiological methods.

The following statistical measures were calculated:

- Frequencies (n)
- Percentages (%)
- Case Fatality Rate (CFR)

Disease-wise, year-wise and State/UT-wise distributions were summarized using tables. Diseases were ranked according to:

- Outbreak burden
- Case burden
- Mortality burden
- Case Fatality Rate

Emerging and re-emerging infectious diseases were analyzed separately to assess their contribution to overall outbreak burden and mortality.

Results were presented using frequency distributions, proportions and epidemiological indicators to facilitate comparison across diseases, years and geographical regions.

Ethical Considerations

The study was based exclusively on aggregated secondary surveillance data available in the public domain. No individual-level identifiers, personal health information or confidential patient records were accessed. Therefore, the study posed no risk to participants and individual informed consent was not required. The analysis was conducted solely for epidemiological and public health research purposes in accordance with ethical principles governing the use of secondary surveillance data.

RESULTS

A total of 8,882 outbreaks/events resulting in 321,184 cases and 1,843 deaths were reported in India during 2021–2025, yielding an overall CFR of 0.57%. The number of reported outbreaks increased steadily from 726 (8.17%) in 2021 to a peak of 3,020 (34.00%) in 2024, followed by a decline to 2,285 (25.73%) in 2025. Similarly, the highest proportion of cases 110,469 (34.39%) and deaths 870 (47.21%) was recorded in 2024. The CFR was highest in 2024 (0.79%) and lowest in 2025 (0.40%), indicating substantial temporal variation in outbreak burden and severity over the study period (Table 1).

Table 1: Year-Wise Distribution of Reported Outbreaks/Events, Cases, Deaths and Case Fatality Rate (CFR) in India, 2021–2025

Year	Outbreaks/Events n (%)	Cases n (%)	Deaths n (%)	CFR (%)
2021	726 (8.17)	33,769 (10.51)	200 (10.85)	0.59
2022	989 (11.13)	32,188 (10.02)	156 (8.46)	0.48
2023	1,862 (20.96)	69,882 (21.76)	316 (17.15)	0.45
2024	3,020 (34.00)	110,469 (34.39)	870 (47.21)	0.79
2025	2,285 (25.73)	74,876 (23.31)	301 (16.33)	0.40
Total	8,882 (100.00)	321,184 (100.00)	1,843 (100.00)	0.57

CFR: Case Fatality Rate (Deaths ÷ Cases × 100)

Table 2: Distribution of Major Diseases/Illnesses Reported Through Outbreak Surveillance in India, 2021–2025 (N = 8,882 Outbreaks) (Diseases/Illnesses with ≥10 Reported Outbreaks/Events)

Disease/Illness	Outbreaks (n)	Percentage (%)	Cases (n)	Deaths (n)	CFR (%)
Acute Diarrheal Disease	2,609	29.4	106,348	384	0.36
Food Poisoning	1,023	11.5	56,942	98	0.17
Dengue	743	8.4	34,383	179	0.52
Acute Hepatitis A	594	6.7	17,199	34	0.20
Chicken Pox	578	6.5	9,009	6	0.07
Measles	439	4.9	6,241	20	0.32
Mumps	347	3.9	7,091	0	0.00
Cholera	312	3.5	24,937	106	0.43
Malaria	236	2.7	12,468	87	0.70
Fever with Rash	210	2.4	2,632	2	0.08
Chikungunya	181	2.0	4,743	2	0.04
Suspected Food Poisoning	150	1.7	7,391	6	0.08
Fever	127	1.4	4,753	23	0.48
Leptospirosis	120	1.4	1,119	64	5.72
Human Rabies	117	1.3	126	126	100.00
Scrub Typhus	103	1.2	1,635	24	1.47
Acute Gastroenteritis	102	1.1	6,656	7	0.11
Japanese Encephalitis	100	1.1	282	78	27.66
Typhoid	77	0.9	1,926	2	0.10
Jaundice	53	0.6	1,313	2	0.15
Zika Virus Disease	46	0.5	342	0	0.00
Diphtheria	45	0.5	160	47	29.38
Acute Encephalitic Syndrome	41	0.5	903	369	40.86
Monkey Pox	38	0.4	47	1	2.13
Rabies	30	0.3	37	34	91.89
Suspected Typhoid	29	0.3	874	0	0.00
Fever of Unknown Origin	27	0.3	1,061	3	0.28
Mushroom Poisoning	26	0.3	215	24	11.16
Dog Bite	20	0.2	119	11	9.24
West Nile Fever	19	0.2	22	3	13.64
Kyasanur Forest Disease	17	0.2	1,108	5	0.45
Food Borne Illness	16	0.2	688	2	0.29
Dengue & Chikungunya	15	0.2	237	1	0.42
Dysentery	15	0.2	692	2	0.29
Shigellosis	14	0.2	306	3	0.98
Crimean Congo Haemorrhagic Fever	13	0.1	13	7	53.85
Pyrexia of Unknown Origin	12	0.1	335	0	0.00
Rubella	12	0.1	62	1	1.61
Suspected Dengue	12	0.1	398	4	1.01
Measles & Rubella	11	0.1	233	0	0.00

Among the 8,882 reported outbreaks, acute diarrheal disease emerged as the leading cause, accounting for 2,609 outbreaks (29.4%), 106,348 cases and 384 deaths. Food poisoning 1,023 outbreaks (11.5%) and dengue 743 outbreaks (8.4%) were the next most frequently reported conditions. Cholera, acute hepatitis A, chickenpox, measles and malaria also contributed substantially to the outbreak burden. Although less frequent, acute encephalitic syndrome (40.86%), human rabies (100%), diphtheria (29.38%) and Japanese encephalitis (27.66%) exhibited remarkably high CFRs,

highlighting their disproportionate contribution to mortality despite relatively fewer outbreaks (Table 2).

Minor diseases reported in 2–9 outbreaks collectively represented a small proportion of the overall outbreak burden but included several epidemiologically important infections. Hand Foot and Mouth Disease and paratyphoid were the most frequently reported conditions within this category, with nine outbreaks each. Notably, Nipah virus and CCHF demonstrated exceptionally high CFRs of 50.0%, while epidemic dropsy showed a CFR of 33.3%. Seasonal influenza accounted for the highest number of cases (1,276)

Table 3: Distribution of Minor Diseases/Illnesses Reported through Outbreak Surveillance in India, 2021–2025 (Diseases/Illnesses Reported in 2–9 Outbreaks/Events)

Disease/Illness	Outbreaks (n)	Percentage (%)	Cases (n)	Deaths (n)	CFR (%)
Hand Foot and Mouth Disease	9	0.10	146	0	0.00
Paratyphoid	9	0.10	112	0	0.00
Acute Febrile Illness	8	0.09	122	2	1.64
Influenza A (H3N2)	8	0.09	348	0	0.00
Anthrax	7	0.08	23	3	13.04
Nipah Virus	7	0.08	12	6	50.00
Acute Flaccid Paralysis	6	0.07	11	0	0.00
Chikungunya & Dengue	6	0.07	89	0	0.00
Cutaneous Leishmaniasis	5	0.06	11	0	0.00
Adeno Virus	4	0.05	902	0	0.00
Melioidosis	4	0.05	7	0	0.00
Others	4	0.05	119	5	4.20
Pertussis	4	0.05	31	0	0.00
Shigella	4	0.05	58	0	0.00
Suspected Measles	4	0.05	62	1	1.61
Acute Respiratory Infection	3	0.03	39	0	0.00
Brucellosis	3	0.03	7	0	0.00
Dengue & Scrub Typhus	3	0.03	16	0	0.00
Kala Azar	3	0.03	3	0	0.00
Malaria & Dengue	3	0.03	44	0	0.00
Suspected Food Poisoning	3	0.03	76	0	0.00
Suspected Human Rabies	3	0.03	3	3	100.00
Suspected Japanese Encephalitis	3	0.03	4	1	25.00
Suspected Mushroom Poisoning	3	0.03	27	0	0.00
CCHF	2	0.02	2	1	50.00
Chandipura Virus	2	0.02	2	0	0.00
Dengue & Leptospirosis	2	0.02	13	0	0.00
Enteric Fever	2	0.02	82	0	0.00
Epidemic Dropsy	2	0.02	9	3	33.33
Fever & URTI	2	0.02	17	0	0.00
Jatropha Poisoning	2	0.02	17	0	0.00
Seasonal Influenza	2	0.02	1,276	3	0.24
Suspected Acute Hepatitis	2	0.02	17	0	0.00
Suspected Anthrax	2	0.02	8	1	12.50
Suspected Chickenpox	2	0.02	26	0	0.00
Suspected Dengue	2	0.02	18	2	11.11
Suspected Hepatitis	2	0.02	44	0	0.00
Suspected Mumps	2	0.02	19	0	0.00
Suspected Rabies Death	2	0.02	2	2	100.00
Suspected Scrub Typhus	2	0.02	15	0	0.00
Viral Hepatitis	2	0.02	38	1	2.63

among minor diseases, emphasizing the diversity of infections captured through the surveillance system (Table 3).

A total of 43 outbreaks were attributed to diseases reported only once during the study period. These included rare infectious, zoonotic and environmental conditions such as *Naegleria fowleri* meningoencephalitis, HMPV infection, vaccine-derived poliovirus, Lyme disease and primary amoebic meningoencephalitis. Several of these rare conditions demonstrated extremely high fatality rates, with acute meningoencephalitis, complicated malaria, HMPV infection, tetanus and viral encephalitis each recording a CFR of 100%. Although individually uncommon, these diseases underscore the importance of maintaining surveillance for unusual and emerging public health threats (Table 4).

Outbreaks were reported from all States and Union Territories of India, although substantial geographical variation was observed. Kerala reported the highest number

of outbreaks [1,207 (13.6%)], followed by Maharashtra 878 (9.9%), Madhya Pradesh 754 (8.5%), Karnataka 698 (7.9%) and Odisha 607 (6.8%). Together, these five states accounted for nearly half of all reported outbreaks. In contrast, Chandigarh and Daman & Diu reported only three outbreaks each, reflecting marked differences in outbreak reporting patterns and surveillance activity across regions (Table 5).

Kerala recorded the highest outbreak burden (1,207 outbreaks) and case burden (45,201 cases) during the study period. However, Gujarat reported the highest mortality burden with 362 deaths, followed by Maharashtra (292 deaths) and Assam (187 deaths). Meghalaya exhibited the highest CFR (2.00%), closely followed by Gujarat (1.95%) and Assam (1.59%), indicating greater outbreak severity in these regions. In contrast, several Union Territories reported no deaths, while Himachal Pradesh recorded one of the lowest CFRs (0.05%), suggesting significant regional differences in disease outcomes and outbreak management (Table 6).

Table 4: Distribution of very rare diseases/illnesses reported through outbreak surveillance in India, 2021–2025 (Diseases/illnesses reported in a single outbreak/event; N = 43 outbreaks)

Disease/Illness	Outbreaks (n)	Percentage (%)	Cases (n)	Deaths (n)	CFR (%)
Acute Gastritis	1	0.01	12	0	0.00
Acute Hepatitis	1	0.01	8	0	0.00
Acute Hepatitis B	1	0.01	3	0	0.00
Acute Hepatitis E	1	0.01	5	0	0.00
Acute Meningoencephalitis (<i>Naegleria fowleri</i>)	1	0.01	1	1	100.00
Allergic Conjunctivitis	1	0.01	17	0	0.00
Amoebic Encephalitis	1	0.01	1	0	0.00
ARI–Influenza Like Illness (ILI)	1	0.01	14	0	0.00
Chemical Gas Poisoning	1	0.01	31	0	0.00
Chickenpox (alternate entry)	1	0.01	8	0	0.00
Chickenpox & Measles	1	0.01	10	0	0.00
Complicated Malaria (<i>P. falciparum</i>)	1	0.01	2	2	100.00
Convulsions of Unknown Cause	1	0.01	19	0	0.00
Dengue & Malaria	1	0.01	23	1	4.35
Fever/Dengue	1	0.01	5	1	20.00
Fever with Altered Sensorium	1	0.01	3	3	100.00
HFMD	1	0.01	4	0	0.00
HMPV	1	0.01	1	1	100.00
Leishmaniasis	1	0.01	1	0	0.00
Leptospirosis & Dengue	1	0.01	11	0	0.00
Leptospirosis & Scrub Typhus	1	0.01	12	1	8.33
Lyme Disease	1	0.01	1	0	0.00
Meningitis	1	0.01	4	0	0.00
Mixed Fever	1	0.01	28	0	0.00
Noro Virus	1	0.01	16	0	0.00
Poliomyelitis (Vaccine-Derived Polio Virus)	1	0.01	1	0	0.00
Primary Amoebic Meningoencephalitis	1	0.01	7	1	14.29
Probable Leishmaniasis	1	0.01	1	1	100.00
Provisional Food Poisoning	1	0.01	24	1	4.17
Scrub Typhus and Leptospirosis	1	0.01	9	0	0.00
Scrub Typhus Dengue Leptospirosis	1	0.01	5	1	20.00
Snake Bite	1	0.01	2	1	50.00
Suspected HFMD	1	0.01	11	0	0.00
Suspected Swine Flu (H1N1)	1	0.01	1	1	100.00
Suspected Typhoid	1	0.01	3	0	0.00
Tetanus	1	0.01	1	1	100.00
Typhoid & Hepatitis E	1	0.01	41	0	0.00
Undifferentiated Fever	1	0.01	67	0	0.00
Viral Hepatitis A	1	0.01	38	0	0.00
Viral Encephalitis	1	0.01	1	1	100.00
Viral Fever	1	0.01	42	0	0.00
Viral Hepatitis A & E	1	0.01	57	0	0.00
Viral Hepatitis B	1	0.01	6	0	0.00

Acute diarrheal disease was responsible for the highest mortality burden, accounting for 384 deaths, followed closely by acute encephalitic syndrome with 369 deaths and dengue with 179 deaths. Human rabies caused 126 deaths despite only 126 reported cases, reflecting its universally fatal nature once clinical disease develops. Cholera, food poisoning, malaria, Japanese encephalitis and leptospirosis also contributed substantially to mortality. These findings demonstrate that both high-frequency diseases and highly fatal but less common infections significantly influenced outbreak-related mortality in India (Table 7).

A total of 159 outbreaks (1.79%) were attributed to emerging and re-emerging infectious diseases, resulting in 1,585 cases and 30 deaths. Zika virus disease was the most frequently reported emerging infection with 46 outbreaks, followed by monkeypox (38 outbreaks) and West Nile fever (19 outbreaks). While these diseases contributed a relatively

small proportion of total outbreaks, several exhibited high fatality rates, including CCHF (53.85%), Nipah virus (50.0%), visceral leishmaniasis (50.0%) and HMPV infection (100%). These findings highlight the continuing threat posed by emerging pathogens and the need for sustained surveillance and preparedness efforts (Table 8).

Acute diarrheal disease, food poisoning and dengue emerged as the leading contributors to overall outbreak burden, accounting for a substantial proportion of reported outbreaks, cases and deaths. Acute encephalitic syndrome, despite causing only 41 outbreaks, resulted in 369 deaths and a CFR of 40.86%, making it one of the most lethal conditions identified. Human rabies (100%), rabies (91.89%), CCHF (53.85%) and Nipah virus (50.0%) exhibited the highest CFRs, whereas diseases such as food poisoning, chickenpox and acute gastroenteritis produced large outbreak burdens but relatively low fatality. These findings emphasize the

Table 5: State/UT-Wise Distribution of Outbreaks Reported through Outbreak Surveillance in India, 2021–2025 (N = 8,882)

State/UT	Outbreaks (n)	Percentage (%)
Kerala	1,207	13.6
Maharashtra	878	9.9
Madhya Pradesh	754	8.5
Karnataka	698	7.9
Odisha	607	6.8
Assam	547	6.2
Tamil Nadu	534	6.0
Jharkhand	512	5.8
Uttar Pradesh	464	5.2
Chhattisgarh	381	4.3
Gujarat	363	4.1
West Bengal	303	3.4
Jammu & Kashmir	295	3.3
Bihar	285	3.2
Andhra Pradesh	266	3.0
Meghalaya	141	1.6
Punjab	100	1.1
Haryana	87	1.0
Rajasthan	76	0.9
Uttarakhand	70	0.8
Telangana	56	0.6
Mizoram	43	0.5
Manipur	42	0.5
Himachal Pradesh	34	0.4
Nagaland	34	0.4
Puducherry	25	0.3
Tripura	15	0.2
Sikkim	14	0.2
Goa	13	0.1
Dadra & Nagar Haveli	12	0.1
Andaman & Nicobar Islands	8	0.1
Delhi	6	0.1
Ladakh	6	0.1
Chandigarh	3	0.0
Daman & Diu	3	0.0
Total	8,882	100.0

Table 6: State/UT-Wise Burden of Outbreaks, Cases, Deaths and Case Fatality Rate (CFR) Reported through Outbreak Surveillance in India, 2021–2025

State/UT	Outbreaks (n)	Cases (n)	Deaths (n)	CFR (%)
Kerala	1,207	45,201	67	0.15
Maharashtra	878	28,083	292	1.04
Madhya Pradesh	754	21,324	154	0.72
Karnataka	698	25,172	118	0.47
Odisha	607	21,154	72	0.34
Assam	547	11,750	187	1.59
Tamil Nadu	534	12,544	36	0.29
Jharkhand	512	14,397	33	0.23
Uttar Pradesh	464	21,810	139	0.64
Chhattisgarh	381	15,201	39	0.26
Gujarat	363	18,553	362	1.95
West Bengal	303	20,405	18	0.09
Jammu & Kashmir	295	8,374	38	0.45
Bihar	285	5,827	37	0.63
Andhra Pradesh	266	9,965	46	0.46
Meghalaya	141	3,294	66	2.00
Punjab	100	5,349	26	0.49
Haryana	87	4,730	21	0.44
Rajasthan	76	4,769	18	0.38
Uttarakhand	70	3,919	22	0.56
Telangana	56	2,479	5	0.20
Mizoram	43	1,746	15	0.86
Manipur	42	5,228	11	0.21
Himachal Pradesh	34	3,937	2	0.05
Nagaland	34	1,628	11	0.68
Puducherry	25	751	0	0.00

Table 6: Continue

State/UT	Outbreaks (n)	Cases (n)	Deaths (n)	CFR (%)
Tripura	15	909	1	0.11
Sikkim	14	480	0	0.00
Goa	13	529	7	1.32
Dadra & Nagar Haveli	12	339	0	0.00
Andaman & Nicobar Islands	8	238	0	0.00
Delhi	6	688	0	0.00
Ladakh	6	328	0	0.00
Chandigarh	3	35	0	0.00
Daman & Diu	3	48	0	0.00
Total	8,882	321,184	1,843	0.57

Table 7: Diseases/Illnesses Associated with the Highest Mortality Burden Reported through Outbreak Surveillance in India, 2021–2025

Rank	Disease/Illness	Outbreaks (n)	Cases (n)	Deaths (n)	CFR (%)
1	Acute Diarrheal Disease	2,609	106,348	384	0.36
2	Acute Encephalitic Syndrome	41	903	369	40.86
3	Dengue	743	34,383	179	0.52
4	Human Rabies	117	126	126	100.00
5	Cholera	312	24,937	106	0.43
6	Food Poisoning	1,023	56,942	98	0.17
7	Malaria	236	12,468	87	0.70
8	Japanese Encephalitis	100	282	78	27.66
9	Leptospirosis	120	1,119	64	5.72
10	Diphtheria	45	160	47	29.38
11	Rabies	30	37	34	91.89
12	Acute Hepatitis A	594	17,199	34	0.20
13	Scrub Typhus	103	1,635	24	1.47
14	Mushroom Poisoning	26	215	24	11.16
15	Fever	127	4,753	23	0.48
16	Measles	439	6,241	20	0.32
17	Dog Bite	20	119	11	9.24
18	Acute Gastroenteritis	102	6,656	7	0.11
19	Crimean Congo Haemorrhagic Fever	13	13	7	53.85
20	Suspected Food Poisoning	150	7,391	6	0.08

Table 8: Emerging and Re-Emerging Infectious Diseases Reported through Outbreak Surveillance in India, 2021–2025

Disease/Illness	Outbreaks (n)	Percentage (%)	Cases (n)	Deaths (n)	CFR (%)
Zika Virus Disease	46	0.52	342	0	0.00
Monkey Pox	38	0.43	47	1	2.13
West Nile Fever	19	0.21	22	3	13.64
Kyasanur Forest Disease	17	0.19	1,108	5	0.45
Crimean Congo Haemorrhagic Fever (CCHF)	13	0.15	13	7	53.85
Nipah Virus	7	0.08	12	6	50.00
Anthrax	7	0.08	23	3	13.04
Chandipura Virus	2	0.02	2	0	0.00
Visceral Leishmaniasis	2	0.02	2	1	50.00
Human Metapneumovirus (HMPV)	1	0.01	1	1	100.00
Poliomyelitis (Vaccine-Derived Polio Virus)	1	0.01	1	0	0.00
Acute Meningoencephalitis (Naegleria fowleri)	1	0.01	1	1	100.00
Primary Amoebic Meningoencephalitis	1	0.01	7	1	14.29
Amoebic Encephalitis	1	0.01	1	0	0.00
Lyme Disease	1	0.01	1	0	0.00
Leishmaniasis	1	0.01	1	0	0.00
Probable Leishmaniasis	1	0.01	1	1	100.00

Table 9: Leading Diseases/Illnesses by Outbreak Burden, Mortality Burden and Case Fatality Rate (CFR) Reported Through Outbreak Surveillance in India, 2021–2025

Disease/Illness	Outbreaks (n)	Cases (n)	Deaths (n)	CFR (%)
Acute Diarrheal Disease	2,609	106,348	384	0.36
Food Poisoning	1,023	56,942	98	0.17
Dengue	743	34,383	179	0.52
Acute Hepatitis A	594	17,199	34	0.20
Chicken Pox	578	9,009	6	0.07
Measles	439	6,241	20	0.32
Mumps	347	7,091	0	0.00
Cholera	312	24,937	106	0.43

Table 9: Continue

Disease/Illness	Outbreaks (n)	Cases (n)	Deaths (n)	CFR (%)
Malaria	236	12,468	87	0.70
Fever with Rash	210	2,632	2	0.08
Chikungunya	181	4,743	2	0.04
Suspected Food Poisoning	150	7,391	6	0.08
Fever	127	4,753	23	0.48
Leptospirosis	120	1,119	64	5.72
Human Rabies	117	126	126	100.00
Scrub Typhus	103	1,635	24	1.47
Acute Gastroenteritis	102	6,656	7	0.11
Japanese Encephalitis	100	282	78	27.66
Typhoid	77	1,926	2	0.10
Acute Encephalitic Syndrome	41	903	369	40.86
Crimson Congo Haemorrhagic Fever (CCHF)	13	13	7	53.85
Nipah Virus	7	12	6	50.00
Mushroom Poisoning	26	215	24	11.16
West Nile Fever	19	22	3	13.64
Anthrax	7	23	3	13.04
Rabies	30	37	34	91.89

coexistence of high-frequency, low-fatality diseases and low-frequency, high-fatality diseases within India's outbreak surveillance landscape (Table 9).

DISCUSSION

The present study provides a comprehensive overview of outbreak surveillance patterns in India over a five-year period (2021–2025), encompassing 8,882 reported outbreaks/events, 321,184 cases and 1,843 deaths. The findings reveal a substantial burden of communicable disease outbreaks across the country and underscore the continued importance of a robust surveillance system for timely detection, reporting and response to epidemic-prone diseases. The analysis highlights not only the predominance of traditional water-borne, food-borne and vector-borne diseases but also the persistent threat posed by high-fatality and emerging infectious diseases.

One of the most notable findings of the study was the marked increase in reported outbreaks from 726 in 2021 to 3,020 in 2024, followed by a decline to 2,285 in 2025. Nearly one-third of all outbreaks, cases and almost half of all deaths during the study period occurred in 2024. This increase may reflect a combination of factors, including enhanced surveillance sensitivity following the COVID-19 pandemic, improved laboratory diagnostic capacity, greater awareness among healthcare providers, expansion of digital reporting mechanisms and a genuine increase in outbreak occurrence. Similar post-pandemic improvements in surveillance systems have been reported globally, where strengthened disease monitoring has resulted in increased detection and reporting of outbreaks that may previously have gone unnoticed. The subsequent decline in 2025 may indicate improved outbreak control measures, natural epidemiological fluctuations or stabilization of post-pandemic surveillance activities.

The study demonstrated that acute diarrheal disease (ADD) remained the dominant outbreak-prone condition in India, accounting for nearly one-third (29.4%) of all reported outbreaks, more than one lakh cases and the highest number

of deaths (384). These findings reaffirm the continuing burden of water-borne diseases despite decades of investment in sanitation and safe drinking water initiatives. The persistence of ADD outbreaks suggests ongoing challenges related to water contamination, inadequate sanitation infrastructure, poor hygiene practices and vulnerability during floods, monsoon seasons and other environmental disruptions. Similar observations have been reported from several developing countries where diarrheal diseases continue to represent a leading cause of outbreak-related morbidity. The findings emphasize the need to further strengthen initiatives such as the Jal Jeevan Mission, Swachh Bharat Mission and community-based water quality monitoring systems.

Food poisoning emerged as the second most frequently reported outbreak category, accounting for 11.5% of all outbreaks and nearly 57,000 cases. The large number of food-borne outbreaks highlights persistent challenges related to food safety, improper food handling, mass catering practices and inadequate food hygiene standards. Given India's growing urbanization and increasing reliance on institutional kitchens, hostels, schools and community events, strengthening food safety regulations and outbreak investigation mechanisms remains a critical public health priority. Regular inspections, food handler training and rapid laboratory confirmation are essential to reducing the burden of food-borne illnesses.

Vector-borne diseases constituted another major component of the outbreak burden. Dengue alone accounted for 743 outbreaks, 34,383 cases and 179 deaths, making it one of the most significant contributors to morbidity and mortality. Malaria, chikungunya, Japanese encephalitis, scrub typhus, leptospirosis and Kyasanur Forest disease further contributed to the burden. These findings are consistent with the increasing influence of climatic variability, urban expansion, ecological changes and vector adaptation on disease transmission dynamics. The substantial contribution of dengue to both outbreak burden and mortality underscores the need for sustained vector

control activities, environmental management, community participation and climate-responsive surveillance systems.

An important observation from the study was the marked discrepancy between outbreak frequency and fatality. While diseases such as acute diarrheal disease, food poisoning and dengue accounted for the largest number of outbreaks and cases, conditions such as acute encephalitic syndrome (AES), human rabies, Japanese encephalitis, diphtheria, leptospirosis, Nipah virus and Crimean Congo haemorrhagic fever demonstrated disproportionately high case fatality rates. Acute encephalitic syndrome was particularly striking, causing 369 deaths from only 903 reported cases and exhibiting a CFR of 40.86%. Similarly, Japanese encephalitis and diphtheria showed CFRs exceeding 25%. These findings suggest that although such diseases occur less frequently, they place a considerable burden on health systems due to their severity and high mortality. Early diagnosis, rapid referral, critical care support and improved vaccination coverage remain essential strategies for reducing deaths from these conditions.

Human rabies represented one of the most alarming findings of the study. The disease accounted for 126 deaths among 126 reported cases, resulting in a CFR of 100%. Similarly, rabies-related outbreaks demonstrated a CFR approaching 92%. These findings reinforce the fact that rabies remains almost universally fatal once clinical symptoms develop, despite being entirely preventable through timely post-exposure prophylaxis, dog vaccination and public awareness. The continued occurrence of rabies-associated deaths indicates gaps in access to post-exposure treatment, delayed healthcare seeking and inadequate animal control measures. Achieving the global goal of “Zero Human Rabies Deaths” will require strengthened One Health approaches integrating human, animal and environmental health sectors.

Geographical analysis revealed substantial variation in outbreak reporting across States and Union Territories. Kerala reported the highest number of outbreaks and cases, followed by Maharashtra, Madhya Pradesh, Karnataka and Odisha. Higher reporting from these states may reflect both greater disease burden and stronger surveillance systems capable of detecting and reporting outbreaks more effectively. Therefore, outbreak frequency should not be interpreted solely as an indicator of poor health status but also as evidence of surveillance sensitivity and reporting efficiency. Conversely, states reporting fewer outbreaks may require assessment to determine whether lower numbers reflect genuinely lower disease burden or under-detection.

Although Kerala recorded the highest outbreak burden, Gujarat reported the highest mortality burden, accounting for 362 deaths, followed by Maharashtra and Assam. Furthermore, Meghalaya exhibited the highest CFR (2.00%), closely followed by Gujarat (1.95%) and Assam (1.59%). These findings suggest that factors beyond outbreak occurrence, including healthcare access, timeliness of diagnosis, referral systems, clinical management capacity and disease profile, may significantly influence mortality

outcomes. Identifying the reasons underlying higher CFRs in specific states should be a priority for public health authorities.

The analysis of emerging and re-emerging infectious diseases provides important insights into evolving epidemiological threats. Although these diseases accounted for only 1.79% of total outbreaks, they represented pathogens with substantial epidemic potential and high fatality. Zika virus disease and monkeypox were the most frequently reported emerging infections, indicating continued circulation and surveillance importance. Meanwhile, Nipah virus, Crimean Congo haemorrhagic fever, HMPV and visceral leishmaniasis exhibited exceptionally high CFRs. The detection of rare infections such as Chandipura virus, *Naegleria fowleri* meningoencephalitis, vaccine-derived poliovirus and primary amoebic meningoencephalitis highlights the necessity of maintaining broad-spectrum surveillance systems capable of identifying unusual and unexpected public health events.

Another important finding was the presence of numerous rare diseases reported only once during the study period. While these diseases individually contributed little to overall outbreak burden, several demonstrated extremely high fatality rates. Such events emphasize that outbreak surveillance systems should not focus exclusively on high-frequency diseases but must also maintain sensitivity for detecting rare, severe and emerging infections. In an era of increasing globalization, climate change and ecological disruption, even isolated outbreaks can rapidly evolve into major public health emergencies if not recognized promptly.

Public Health Implications

The findings of the present study have important public health implications. First, strengthening water, sanitation and hygiene interventions remains essential to reducing the burden of acute diarrheal disease and cholera outbreaks. Second, food safety surveillance must be reinforced to address the substantial burden of food poisoning outbreaks. Third, integrated vector management should remain a priority given the significant contribution of dengue, malaria and other vector-borne diseases. Fourth, high-fatality conditions such as AES, rabies, Japanese encephalitis, leptospirosis and diphtheria require enhanced diagnostic capacity, referral systems and clinical management protocols. Finally, continuous investment in surveillance infrastructure, laboratory networks, genomic surveillance and One Health approaches will be critical for addressing emerging infectious disease threats.

Strength and Limitations

The major strength of this study lies in its national scope, covering all States and Union Territories and analyzing nearly 9,000 outbreaks over five years. This provides one of the most comprehensive descriptions of outbreak patterns in India during the post-COVID-19 era. However, the findings should be interpreted in light of certain limitations. The study

relied on secondary surveillance data and was therefore dependent on the completeness, accuracy and consistency of reporting across regions. Variations in surveillance sensitivity, laboratory confirmation rates and reporting practices may have influenced observed patterns. Furthermore, the absence of individual-level demographic and clinical data precluded detailed analyses of age-specific, sex-specific, seasonal or risk-factor-related trends.

CONCLUSIONS

Overall, the study demonstrates that while India continues to face a substantial burden of water-borne, food-borne and vector-borne disease outbreaks, a significant proportion of mortality is driven by relatively uncommon but highly fatal conditions. The coexistence of endemic infectious diseases and emerging pathogens highlights the need for a resilient, integrated and future-ready surveillance system capable of addressing both routine public health challenges and emerging epidemic threats. Such efforts will be essential for reducing outbreak-related morbidity and mortality and strengthening national health security in the years ahead.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this study.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Acknowledgements

The authors acknowledge the Integrated Disease Surveillance Programme (IDSP), Ministry of Health and Family Welfare, Government of India, for providing publicly accessible outbreak data.

Author Contributions

All authors contributed significantly to the study. Conceptualization and study design were undertaken by the authors collectively. Data collection, analysis, and interpretation were performed by the primary author. The manuscript was drafted, reviewed, and approved by all authors.

Data Availability Statement

The data used in this study are publicly available from the Integrated Disease Surveillance Programme (IDSP) portal and can be accessed through the official website of the Ministry of Health and Family Welfare, Government of India. “<https://idsp.mohfw.gov.in/index4.php?lang=1&level=0&linkid=406&lid=3689>”

Ethical Approval

The study utilized secondary data available in the public domain without any personal identifiers; therefore, ethical approval was not required.

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