BURDEN OF VECTOR BORNE DISEASE IN INDIA: A COMPREHENSIVE ANALYSIS OF MALARIA, DENGUE, CHIKUNGUNYA, JAPANESE ENCEPHALITIS (JE), KALA AZAR

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Introduction:

Vector borne disease: Transmitted by vectors (Mosquito, sandflies, ticks, fleas), cause approximately 7 lakh deaths annually (WHO), account for over 17% of infectious disease globally, and thrive in tropical and subtropical regions due to favorable conditions.

Types:

- Protozoan (malaria, leishmaniasis)
- Viral (Dengue, Japanese encephalitis)
- Bacterial (Plague, Lyme disease)

In India VBD impact both health and economic productivity and persist despite national programs and require continuous monitoring along with innovative, community-based intervention for effective management.

The study mainly focuses on Malaria, Dengue, Chikungunya, JE, Kala-Azar as they have shared traits such as Mosquito/Sandfly transmission, seasonal outbreaks and similar regional concentration, epidemiological features and need for holistic analysis for improved policy & control strategies.

Research Question:

- What is the current burden of malaria, dengue, Chikungunya, JE, and Kala Azar in India, and how has it evolved over time?
- How effective are the existing control programs and intervention strategies?

Objectives:

1. To analyze the epidemiological trends of malaria, dengue, Chikungunya, JE, and Kala Azar in India over 5 years.
2. To evaluate the effectiveness of national programs and state-level interventions.
3. To identify the gaps in vector control measures and recommend strategies for improved prevention and management.

METHODOLOGY

STUDY DESIGN:

- Secondary data analysis

STUDY SETTING:

- IIHMR University, Jaipur

STUDY POPULATION:

- Inclusion Criteria: Published data from government databases and state health departments.
- Exclusion Criteria: Non relevant sources.

SAMPLE SIZE:

- Data from national and state surveillance systems over 5 years.

SAMPLING TECHNIQUE:

- Purposive sampling of relevant data sources.

DATA COLLECTION PROCEDURE:

- Data will be collected from secondary sources.

DATA ANALYSIS PLAN:

- Quantitative Data: Descriptive statistics, Normalization, trend analysis using MS Excel.

ETHICAL CONSIDERATIONS:

- The study will use publicly available secondary data from reliable sources so proper permissions and acknowledgments will be ensured wherever required. Unbiased analysis and Patient data privacy will be ensured.

Literature review:

Title	Summary
Malaria control initiatives that have the potential to be gamechangers in India's quest for malaria elimination	The paper highlights India's progress in reducing malaria but identifies challenges in surveillance, treatment of *P. vivax* malaria, drug resistance, diagnostics and vector control, proposing solutions like digital tools, tafenoquine, improved diagnostics, alternative antimalarials, and novel vector control methods.
The resurgence of dengue epidemic and climate change in India	The paper explores factors driving the rise in dengue cases, including limited awareness, climate change, and their impact on transmission and healthcare. It highlights the need for early treatment and addressing socioeconomic factors to reduce disease burden.

Seropositivity of chikungunya in hospital setting, India: A systematic review and meta-analysis	This study aims at highlighting the significant burden of confirmed Chikungunya cases, particularly in southern India, and emphasizes the need for improved reporting and community-based surveillance to enhance disease management.
Nationwide cross-sectional surveillance of Leishmania donovani in phlebotomine sand flies and its impact on national kala-azar elimination in India	This research surveyed sand flies across India, identifying Leishmania donovani in more species than previously known, underscoring the need for enhanced vector control and surveillance to support kala-azar elimination efforts.
Impact of vaccination against Japanese encephalitis in endemic countries	The study evaluates the effects of Japanese encephalitis (JE) immunization campaigns in 23 nations on public health and Chinese Taipei, showing a significant decline in JE incidence, especially in countries that introduced vaccination before 2006. It emphasizes the need for sustained efforts and improved delivery systems to maximize vaccination effectiveness.

Global Situation:

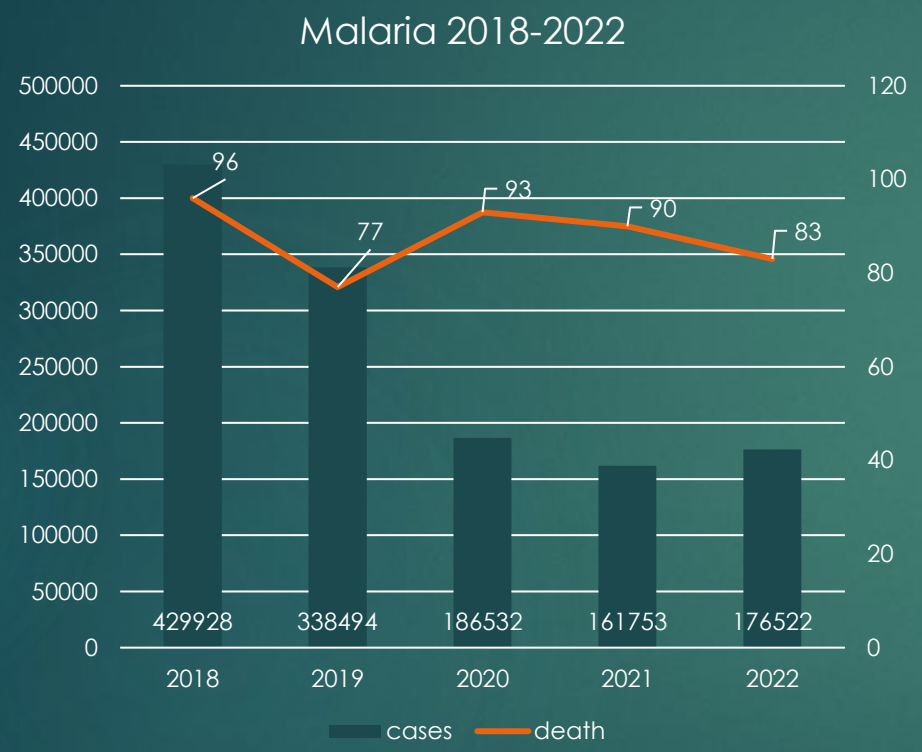
- Malaria: It affects approx 249 million people around the world annually and causes over 608,000 deaths.
- Dengue: As of April 2024, over 7.6 million cases of dengue were reported globally among them 3.4 million cases were confirmed along with 16000 severe cases and above 3000 fatalities.
- Chikungunya: Being reported in over 110 countries there were 18.7 million chikungunya cases caused 1.95 million DALYs from 2011 to 2020 and economic impact of 2.8 billion dollar and 47 billion dollars of indirect cost globally.
- Kala-Azar: 50,000 to 90,000 newly coming cases globally each year. Though only 25%-45% cases are reported to WHO.
- JE: Main case of viral encephalitis along with 100,000 of the clinical cases reported annually with case fatality reaching around 30%-50%.

Situation in India:

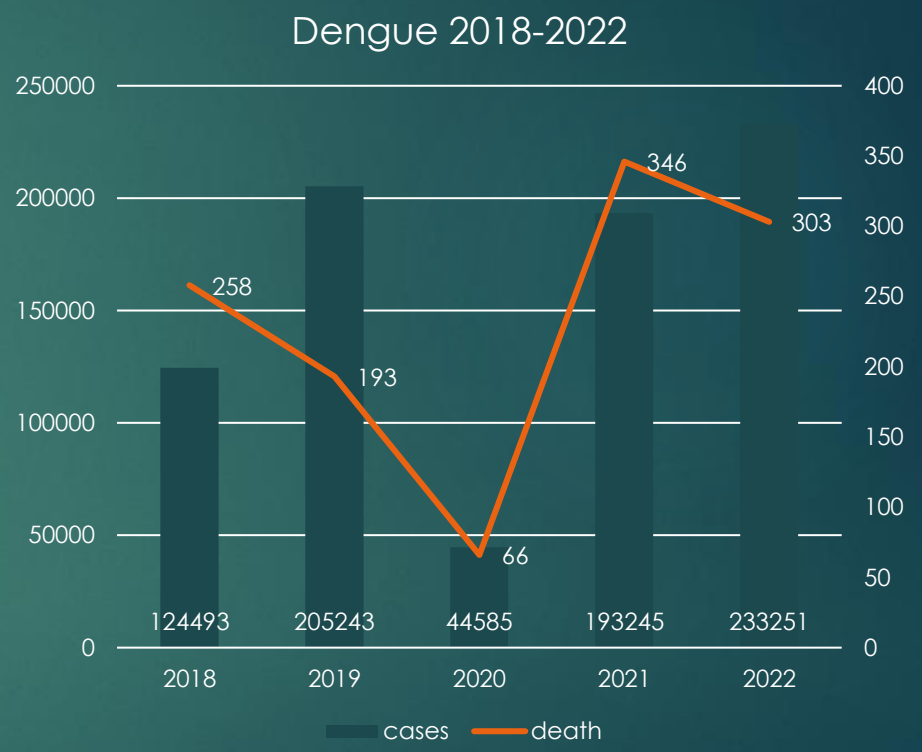
VBD continue to pose a major public health challenge in India, with significant impacts on health, productivity, and economic development. To control these diseases, India has implemented several national programs such as:

- National vector borne disease control program
- National malaria elimination program
- The urban malaria scheme
- National Kala-Azar elimination program
- Kala-Azar elimination Initiative

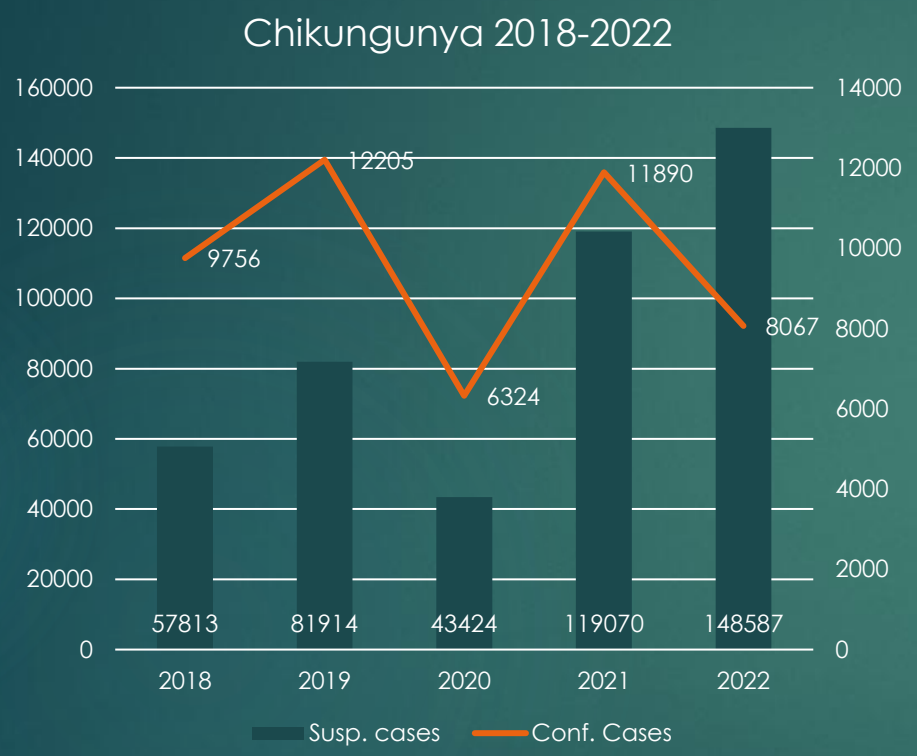
Malaria



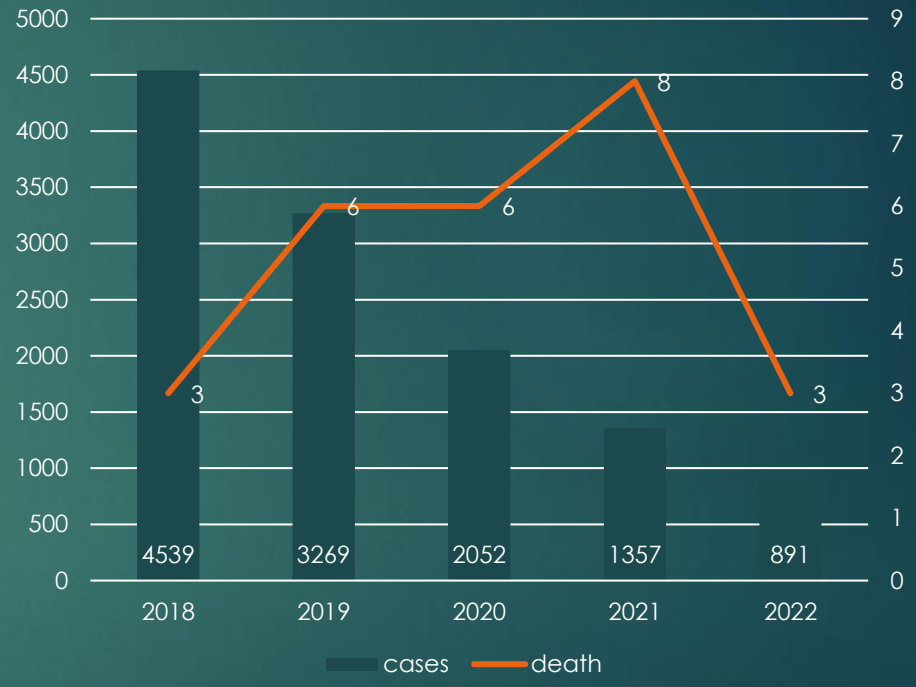
Dengue



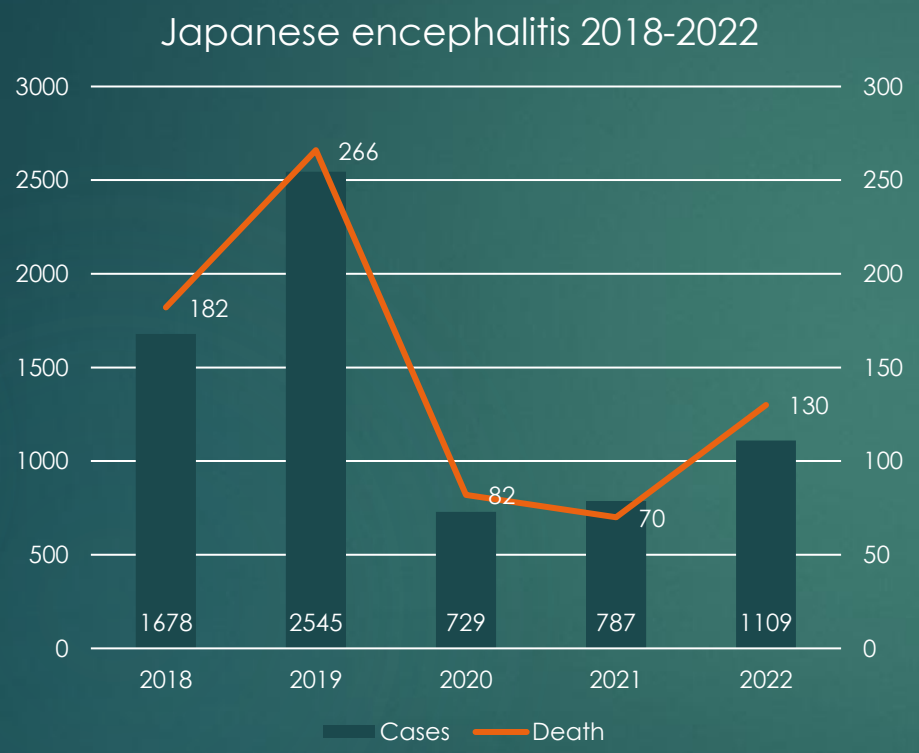
Chikungunya



Kala-Azar



Japanese encephalitis



We can see through all these trends in India between 2018-2022 reveals that there is complex interplay of success and persistent challenges in controlling and managing these diseases.

Comprehensive analysis of states:

Steps used:
Step 1:
Calculate the **percentage distribution of disease cases** for each state.
(Each state's cases ÷ total cases × 100)
Step 2:
Normalize these percentage values so all values fall between 0 and 1.
Step 3:
Repeat Steps 1 and 2 for **each of the 5 years (2018-2022)**.
Step 4:
Since high values are **bad**, subtract each value from 1
(to turn it into a positive indicator).
Step 5:
Add the 5 yearly values of each state for each disease and divided it by 5
(to get the **average final score**).

Worst-Performing States:

	2018	
S.N.	State/UT	Average
1	Uttar Pradesh	0.6335
2	West Bengal	0.6780
3	Karnataka	0.7351
4	Odisha	0.7459
5	Bihar	0.7475
6	Jharkhand	0.7622
7	Gujarat	0.7800
8	Maharashtra	0.7814

	2019	
S.N.	State/UT	Average
1	Uttar Pradesh	0.6748
2	Karnataka	0.7113
3	West Bengal	0.7117
4	Bihar	0.7238
5	Assam	0.7961
6	Jharkhand	0.8310
7	Odisha	0.8372
8	Chattisgarh	0.8501

	2020	
S.N.	State/UT	Average
1	Karnataka	0.6906
2	Uttar Pradesh	0.7041
3	Bihar	0.7672
4	West Bengal	0.7717
5	Odisha	0.7793
6	Maharashtra	0.7934
7	Assam	0.7969
8	Punjab	0.7992

	2021	
S.N.	State/UT	Average
1	Uttar Pradesh	0.6486
2	Jharkhand	0.6749
3	West Bengal	0.6933
4	Karnataka	0.7258
5	Gujarat	0.7317
6	Bihar	0.7563
7	Odisha	0.7612
8	Chattisgarh	0.7881

	2022	
S.N.	State/UT	Average
1	West Bengal	0.5534
2	Bihar	0.7449
3	Karnataka	0.7547
4	Assam	0.7932
5	Jharkhand	0.7972
6	Chattisgarh	0.8350
7	Uttar Pradesh	0.8439
8	Odisha	0.8483

Results:

- The study explored epidemiological trends of the malaria, chikungunya, dengue, JE and kala azar along with effectiveness and gaps in the national programs and their intervention strategies.
- Uttar Pradesh, West Bengal, Bihar, Karnataka, Odisha appeared in all five years suggesting long standing vulnerabilities in these regions followed by Jharkhand that appeared in 4 out of five years where Chhattisgarh and Assam appeared in 3 out of 5 years.
- Applying the 80/20 rule, we can infer that a significant portion of the vector-borne disease burden can be effectively reduced by focusing targeted efforts on just six key states (U.P., West Bengal, Bihar, Karnataka, Odisha and Jharkhand).

Vector resistance and inconsistent control measures has led to fluctuating cases and shows the requirement of continues surveillance, monitoring of resistance patterns and improved reporting system.

Socioeconomic Factors such as poverty, poor sanitation, and improper healthcare access contributes significantly to persistence of vector-borne diseases.

Gaps in diagnostic efficiency has led to discrepancies in the disease detection and underreporting of cases.

Effect of climate change, urbanization and deforestation has influenced the dynamics of the vector borne disease cause it led to favorable conditions for the diseases and expanding their geographic range.

Recommendations:

Strengthening the vector surveillance to monitor the vector population and resistance patterns and effective application of control measures.

Improving diagnostic capacity, investment in diagnostic infrastructure and training for healthcare professionals to ensure timely and accurate disease detection.

Continue vaccination programs to ensure consistent and widespread access to vaccination for the preventable vector-borne diseases.

Improving drainage system and reducing open water bodies in slum and building resilient health system ensuring vector borne disease programs are isolated from disruptions like pandemics and incorporate contingency planning.

Early case detection and management through community-based surveillance for improved and effective treatment within primary health systems.

Climate responsive strategies and decentralized planning should be developed and implemented that addresses the climate change, urbanization and deforestation on vector borne disease dynamics.

Ultimately, this research contributes to the ongoing efforts to mitigate the burden of the vector-borne diseases and also to sustain & improve public health.

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Thank you