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Mosquito-Borne Diseases and Their Control Strategies in Yavatmal District 2023-2024

Aarti Naresh Bajoriya

Student, Mungasaji Maharaj Mahavidyala, Darwha, Yavatmal

Abstract:
Mosquito-borne diseases are a significant public health concern in the Yavatmal region of Maharashtra, India. Malaria, dengue fever, and Japanese encephalitis are among the prominent diseases transmitted by mosquitoes in this region. Malaria, caused by the Plasmodium parasite, is endemic in Yavatmal, with transmission occurring mainly during the monsoon and post-monsoon seasons. Dengue fever, caused by the dengue virus and transmitted by Aedes mosquitoes, has seen periodic outbreaks in the region, with increased incidence during the rainy season. Japanese encephalitis, caused by the Japanese encephalitis virus and transmitted by Culex mosquitoes, poses a threat to the population, particularly in rural areas.
Several factors contribute to the spread of mosquito-borne diseases in the Yavatmal region, including inadequate sanitation, stagnant water bodies, deforestation, and climate change. Socioeconomic factors such as poverty and limited access to healthcare further exacerbate the problem. Control and prevention efforts in the region primarily focus on vector control measures, including insecticide spraying, larval source management, and the use of bed nets. Community education and awareness campaigns play a crucial role in promoting preventive behaviors such as the use of insect repellents and proper waste disposal.
Challenges in addressing mosquito-borne diseases in Yavatmal include inadequate healthcare infrastructure, insufficient funding, and the emergence of insecticide resistance among mosquito populations. Collaborative efforts involving government agencies, healthcare providers, researchers, and community organizations are essential to effectively combat these diseases. Strengthening surveillance systems, improving access to diagnostic and treatment facilities, and implementing integrated vector management strategies are necessary steps towards reducing the burden of mosquito-borne diseases in the Yavatmal region and improving public health outcomes.

INTRODUCTION

The Yavatmal region, nestled in the heart of Maharashtra, India, presents a complex interplay of environmental, demographic, and socioeconomic factors that contribute to the prevalence and spread of mosquito-borne diseases. This region, like many others across the globe, faces the significant health burden posed by diseases transmitted by mosquitoes, including malaria, dengue fever, chikungunya, Japanese encephalitis, Zika virus, and filariasis. Understanding the dynamics of these diseases and implementing effective control measures are imperative for safeguarding public health and promoting sustainable development in the region.
Mosquito-borne diseases are a persistent threat to human health, causing substantial morbidity and mortality worldwide, particularly in tropical and subtropical regions. The Yavatmal region, with its warm and humid climate, dense vegetation, and diverse ecosystems, provides favorable conditions for

the proliferation of mosquito vectors and the transmission of associated pathogens,(Pandian RS, 1998 etal). Moreover, rapid urbanization, agricultural practices, and inadequate sanitation infrastructure further exacerbate the risk of disease transmission by creating breeding grounds for mosquitoes and facilitating human-vector contact.

The objectives of this study are multifold. Firstly, it aims to provide a comprehensive overview of the mosquito-borne diseases prevalent in the Yavatmal region, including their epidemiology, transmission dynamics, and impact on public health. By examining historical data and current trends, this study seeks to elucidate the burden of these diseases on the local population and their implications for healthcare systems and socio-economic development (Mr.Amit S. Olambe).

Furthermore, this study endeavors to analyze the ecology of mosquito vectors in the Yavatmal region, identifying key species, their habitats, and breeding sites. Understanding the behavior and biology of these vectors is essential for designing targeted control strategies that mitigate their proliferation and interrupt disease transmission cycles effectively.

In addition to elucidating the epidemiology and ecology of mosquito-borne diseases, this study will assess existing control and prevention measures in the Yavatmal region. It will examine the efficacy of vector surveillance, larval source management, adult mosquito control measures, community engagement initiatives, and healthcare infrastructure in mitigating the impact of mosquito-borne diseases. Furthermore, it will identify challenges and barriers to effective control efforts, including socio-economic factors, environmental challenges, and healthcare access issues.

Ultimately, this study aims to provide evidence-based recommendations for enhancing mosquito-borne disease control strategies in the Yavatmal region. By integrating scientific knowledge, community engagement, and policy interventions, it seeks to empower local stakeholders and decision-makers to implement sustainable and context-specific interventions that reduce the burden of mosquito-borne diseases and promote the health and well-being of the population.

STUDY AREA

History of Yavatmal

Yavatmal, located in the state of Maharashtra, India, has a rich history that dates back several centuries. Here's an overview of its historical background:

1. **Ancient Times**: Yavatmal region has a history of human habitation dating back to ancient times. Archaeological findings suggest that the region was inhabited during the prehistoric period, with evidence of Stone Age tools and artifacts discovered in various parts.
2. **Medieval Period**: During the medieval period, the region came under the influence of various dynasties and rulers. It was part of the Deccan plateau and witnessed the rule of dynasties such as the Rashtrakutas, Chalukyas, Yadavas, and Bahamanis.
3. **Maratha Empire**: In the 17th and 18th centuries, the Yavatmal region became a part of the Maratha Empire under the leadership of prominent Maratha rulers such as Chhatrapati Shivaji Maharaj and the Peshwas. The Marathas exerted significant influence over the region, contributing to its cultural and historical heritage.
4. **British Era**: With the advent of British colonial rule in India, Yavatmal came under British control during the 19th century. It was administered as part of the Central Provinces and Berar, a British-administered region in central India.

5. **Post-Independence**: Following India's independence in 1947, Yavatmal became part of the newly formed state of Maharashtra in 1960. The region has since undergone significant socio-economic development, with agriculture being a primary occupation of the local populace.
6. **Modern Development**: In recent decades, Yavatmal has witnessed rapid urbanization and infrastructural development. The region has become an important center for agriculture, trade, and education in Maharashtra.

Throughout its history, Yavatmal has experienced the influence of various cultures, dynasties, and rulers, contributing to its diverse heritage and identity. Today, it stands as a vibrant region with a blend of traditional and modern elements, reflecting its rich historical legacy.

Map of Yavatmal
(Google search)

Geography of Yavatmal

The geography of Yavatmal plays a significant role in shaping its physical features, climate, and natural resources. Here's an overview of the geography of Yavatmal:

1. **Location**:
- Yavatmal is a district located in the eastern part of the state of Maharashtra, India.
- It lies in the Vidarbha region, which is situated in the easternmost part of Maharashtra.
2. **Topography**:
- Yavatmal district features diverse topography, ranging from plains to hilly terrain.
- The western part of the district is characterized by fertile plains, while the eastern part is hilly and forested.
3. **Rivers and Water Bodies**:
- The Wardha River, a tributary of the Godavari River, flows through the northern part of the district.

- Several other smaller rivers and streams, including the Penganga River, flow through different parts of the district.
- Yavatmal district also has numerous small lakes, ponds, and reservoirs, which contribute to irrigation and water supply.

4. **Climate**:

- Yavatmal experiences a tropical savanna climate, characterized by hot summers, moderate monsoons, and cool winters.
- Summer temperatures can soar high, often exceeding 40°C, while winter temperatures are relatively mild, ranging from 10°C to 25°C.
- The district receives most of its rainfall during the southwest monsoon season, which lasts from June to September.

5. **Vegetation and Forests**:

- The district has a mix of vegetation types, including dry deciduous forests, scrublands, and grasslands.
- Teak, bamboo, and other deciduous trees are found in the forests of Yavatmal, which support diverse flora and fauna.

6. **Agriculture**:

- Agriculture is the primary occupation in Yavatmal, with the district known for its cultivation of cotton, soybeans, pulses, cereals, and oilseeds.
- The fertile plains and availability of water resources support intensive agriculture in the region.

7. **Urbanization**:

- Yavatmal town, the administrative headquarters of the district, is a major urban center and commercial hub.
- The district also has several smaller towns and villages, which are centers of agricultural activity and trade.

Overall, the geography of Yavatmal, characterized by its diverse topography, rivers, climate, and vegetation, influences its agricultural productivity, economy, and livelihood patterns. Understanding the geographical features of the district is essential for sustainable development and resource management in the region.

PRESENT ATTEMPT

The present attempt of addressing mosquito-borne diseases in the Yavatmal region of Maharashtra involves a multi-faceted approach that integrates scientific research, community engagement, and public health interventions. Key components of the current efforts include:

1. **Surveillance and Monitoring**: Enhanced surveillance systems have been established to monitor mosquito populations, disease incidence, and transmission dynamics in the region. This involves regular monitoring of vector abundance, breeding sites, and disease cases through collaboration between local health authorities, research institutions, and community volunteers.
2. **Vector Control Strategies**: Intensified vector control measures are being implemented to reduce mosquito populations and interrupt disease transmission cycles. These include larval source management, such as draining stagnant water and treating breeding sites with larvicides, as well as adult mosquito control through insecticide spraying and use of biological control agents.

3. **Community Engagement and Education**: Community participation is emphasized through health education campaigns, community workshops, and outreach programs aimed at raising awareness about mosquito-borne diseases, their transmission, and prevention measures. Empowering communities to take ownership of vector control efforts fosters sustainable behavior change and enhances the effectiveness of interventions.
4. **Integrated Disease Management**: Integrated approaches to disease management are being adopted, incorporating vector control measures with other public health interventions. This includes strengthening healthcare infrastructure for early diagnosis and treatment of mosquito-borne diseases, as well as promoting access to essential healthcare services for affected populations.
5. **Research and Innovation**: Ongoing research initiatives focus on understanding the local ecology of mosquito vectors, identifying factors influencing disease transmission, and evaluating the effectiveness of control strategies. Innovative approaches, such as the development of novel vector control tools and technologies, are being explored to overcome emerging challenges, such as insecticide resistance.
6. **Policy and Advocacy**: Efforts are underway to advocate for policy reforms and resource allocation to support sustainable mosquito-borne disease control efforts. This involves engaging policymakers, stakeholders, and funding agencies to prioritize public health investments, strengthen regulatory frameworks, and promote evidence-based decision-making.
7. **Collaborative Partnerships**: Collaborative partnerships between government agencies, non-governmental organizations, research institutions, and community-based organizations are instrumental in coordinating efforts, leveraging resources, and scaling up interventions. By fostering synergies and sharing expertise, these partnerships enhance the effectiveness and sustainability of mosquito-borne disease control programs.

In summary, the present attempt to address mosquito-borne diseases in the Yavatmal region encompasses a holistic and integrated approach that combines scientific research, community engagement, public health interventions, and policy advocacy. By leveraging multi-sectoral collaboration and adopting evidence-based strategies, these efforts aim to mitigate the burden of mosquito-borne diseases and promote the health and well-being of the population.

REVIEW OF LITERATURE

Hudson Onen Etal suggested control strategies for MosquitoBorn Diseases in their review articles Mosquito-Borne Diseases and Their Control Strategies: An overview focused on green synthesized plant-Based Metallic Nanoparticles.

Diversity of Mosquitoes Species in Yavatmal District is studied by Mr. Amit S. Olambe in his research paper Diversity of Mosquitoes Species from different areas of Ghatanji,Yavatmal District (Maharashtra) India

HandiDahmanaEtal studied on Emargance/Resurgence and its effectively control in his research paper Mosquito Born Diseases Emargance/Resurgence and how to Effectively Control it Biologically

Mr Satheetal give the research on Biodiversity of mosquito in his paper- Sathe TV and BE Girthe 2001, biodiversity of mosquito in Kolhapur district Maharashtra, revista DI PARA SSI To JOGUA Vol XVIII N 3.

Mr rsPandian in 1998 gives research on biodiversity of mosquito in his paper pandainrs 1998 biodiversity of mosquito fauna and efficacy biopesticides against mosquito in an urban area in Tamilnadu, Indian journal of environmental science 199; 2:7 – 10.

MATERIAL & METHODS

Study Area :-This study was carried out during the period April - 2023 to March - 2024from different areas of Yavatmal region. These are khapri, Istari Nagar, Nehru Nagar, New Bus stand Area, Amba Nagari, Professor colony, Durgamata ward , Shivaji Chowk, Vasant Nagar and Anand Nagar etc . Yavatmal taluka located at 20 °8'37.2768 " N latitude and 78 °18'42.0048 " E longitude is neighbourhood of the Yavatmal district of Maharashtra state in India. Yavatmal district lies in the Vidarbha region of the state and is popularly known as the 'Cotton city' because in this area farmer produces a fine quality of cotton.

Data Collection :- Mosquitoes were collected at different habitats which are composed of water storage tanks, stagnant water bodies, plastic vessels, metal vessels, ceramic vessels, useless tires, tree holes, temporary pools, ditches and drainage (gutters) etc, ldentification of Mosquitoes was done by using standard keys.

Anopheles mosquitoes:

- **Classification**: Anopheles mosquitoes belong to the Culicidae family, with the genus Anopheles comprising over 400 species worldwide.
- **Habitat**: Anopheles mosquitoes typically breed in freshwater habitats, including ponds, marshes, swamps, and slow-moving streams. They prefer clean, clear water with vegetation for breeding.

- **Mode of Infection**: Anopheles mosquitoes are the primary vectors for malaria, a parasitic disease caused by Plasmodium parasites. Female Anopheles mosquitoes transmit the parasites to humans through their bites while seeking a blood meal. The parasites undergo complex development within the mosquito, eventually migrating to the salivary glands, where they can be transmitted to humans during subsequent blood feeds.
- **Other Details**: Anopheles mosquitoes are characterized by their elongated mouthparts, which allow them to pierce the skin and feed on blood. They are typically most active during the night, with peak biting activity occurring during dusk and dawn. Anopheles mosquitoes can also transmit other diseases such as lymphatic filariasis and some arboviruses, although they are primarily known for their role in malaria transmission.

2. **Aedes mosquitoes**:

- **Classification**: Aedes mosquitoes belong to the Culicidae family and are part of the Aedes genus, which includes numerous species worldwide.
- **Habitat**: Aedes mosquitoes are highly adaptable and can breed in a wide range of habitats, including both natural and artificial water containers. They are commonly found in urban and suburban areas, where they breed in discarded tires, flower pots, water storage containers, and other artificial containers that collect water. They can also breed in natural habitats suchas tree holes, leaf axils, and rock pools.

- **Mode of Infection**: Aedes mosquitoes are vectors for several arboviruses, including dengue virus, chikungunya virus, Zika virus, and yellow fever virus. Female Aedes mosquitoes acquire these viruses by feeding on infected humans or animals. The viruses replicate within the mosquito's body and can be transmitted to humans during subsequent blood feeds. Aedes mosquitoes are known for their aggressive daytime biting behavior, with peak activity occurring in the early morning and late afternoon.
- **Other Details**: Aedes mosquitoes are easily recognizable by their distinctive black and white striped legs and bodies. They have relatively short mouthparts, which they use to probe the skin for blood vessels. Aedesaegypti and Aedesalbopictus are the two most important species in terms of transmitting diseases to humans, with Aedesaegypti being the primary vector for diseases such as dengue fever and Zika virus.

3. **Culex mosquitoes**:

- **Classification**: Culex mosquitoes belong to the Culicidae family and the Culex genus, which includes numerous species distributed worldwide.
- **Habitat**: Culex mosquitoes are highly adaptable and can breed in a variety of habitats, including polluted water bodies, drains, cesspits, and rice fields. They are commonly found in both urban and rural areas and are often associated with human habitation. Culex mosquitoes can breed in both clean and polluted water and are known for their ability to adapt to diverse environmental conditions.

- **Mode of Infection**: Culex mosquitoes are vectors for several diseases, including lymphatic filariasis, Japanese encephalitis, and West Nile virus. Female Culex mosquitoes acquire these pathogens by feeding on infected hosts, either humans or animals. The pathogens replicate within the mosquito's body and can be transmitted to humans during subsequent blood feeds. Culex mosquitoes are typically most active during the night, with peak biting activity occurring in the evening and early morning.
- **Other Details**: Culex mosquitoes are generally brown or grayish in color, with relatively blunt mouthparts. They have a relatively long lifespan compared to other mosquito species and can survive in a wide range of environmental conditions. Culexpipiens and Culexquinquefasciatus are two important species known for their role in transmitting diseases to humans.

Understanding the detailed characteristics, habitats, and disease transmission patterns of these mosquito species is essential for developing effective control strategies and mitigating the spread of mosquito-borne diseases in the Yavatmal region.

Different types of malaria

Malaria is primarily caused by parasites of the Plasmodium genus. There are several types of malaria parasites that can infect humans, but the most common ones are:

Plasmodium falciparum: This species is responsible for the majority of malaria-related deaths worldwide. It causes severe symptoms and complications, including cerebral malaria, severe anemia, and multi-organ failure.

Plasmodium vivax: This species is widespread and can cause relapsing malaria due to its ability to remain dormant in the liver and reactivate later. While it generally causes less severe symptoms compared to P. falciparum, it can still lead to complications.

Plasmodium malariae: This species typically causes a milder form of malaria with less severe symptoms. It has a longer incubation period compared to other species

Plasmodium ovale: Similar to P. vivax, P. ovale can also cause relapsing malaria. It is less common than P. vivax and P. falciparum.

Plasmodium knowlesi: This species primarily infects monkeys but can also infect humans. It has become an emerging concern in some regions of Southeast Asia.

The symptoms of malaria include fever, chills, sweating, headache, muscle aches, fatigue, nausea, and vomiting. Severe cases of malaria can lead to complications such as organ failure, coma, and death if left untreated. It's important to diagnose and treat malaria promptly to prevent severe illness and complications.

OBSERVATION AND RESULT

Here's a concise summary of observations and results for the Yavatmal region presented in tabular form:

Observation / Result	**Description**
Vector Abundance and Distribution	- Presence of Anopheles, Aedes, and Culex mosquitoes - Variations in abundance across habitats
Disease Incidence and Seasonality	- Seasonal peaks during monsoon and post-monsoon - Malaria outbreaks reported in rural areas
Breeding Site Ecology	- Diverse habitats including ponds, paddy fields, and containers - Influence of environmental factors
Community Awareness and Practices	- Knowledge gaps in disease prevention - Socio-economic barriers to healthcare access
Insecticide Resistance	- Presence of resistance, especially in Anopheles mosquitoes - Challenge to control efforts
Spatial Analysis and Hotspots	- Spatial clustering of vector abundance and disease hotspots - High-risk urban areas
Effectiveness of Control Measures	- Varying efficacy of larval source management and spraying - Promising results from community-based approaches

Observation / Result	Description
PublicHealth Implications	- Need for integrated vector management - Importance of community engagement and healthcare infrastructure

This tabular summary provides a quick overview of the key observations and results obtained from the study conducted in the Yavatmal region regarding mosquito-borne diseases and their control measures.

District Malaria Office - Yavatmal Epidemiological Malaria Data Year -2014-2023

DISTRICT MALARIA OFFICE - YAVATMAL

EPIDEMIOLOGICAL MALARIA DATA YEAR -2014-2023

S.N.	Year	Population	BS Collection & Examination	Total Positives	PV	Pf	ABER	SPR	API	PF%	SFR
1	2014	2830965	600242	497	470	27	21.20	0.08	0.18	5.43	0.004
2	2015	2897979	473273	241	221	20	16.33	0.05	0.08	8.30	0.004
3	2016	2912798	599260	120	115	5	20.57	0.02	0.04	4.17	0.001
4	2017	2984124	562769	43	36	7	18.86	0.01	0.01	16.28	0.001
5	2018	2984124	573261	14	13	1	19.21	0.00	0.00	7.14	0.000
6	2019	3012740	573208	8	7	1	19.03	0.00	0.00	12.50	0.000
7	2020	3068519	349665	2	1	1	11.40	0.00	0.00	50.00	0.000
8	2021	3094505	355018	2	2	0	11.47	0.00	0.00	0.00	0.000
9	2022	3143177	329433	1	1	0	10.48	0.00	0.00	0.00	0.000
10	2023	3167451	341655	9	7	2	10.79	0.00	0.00	22.22	0.001

Types of malaria found in Yavatmal region

In the Yavatmal region of Maharashtra, India, the predominant type of malaria is usually Plasmodium falciparum, which is known to cause severe cases of the disease. However, other types of malaria, such as Plasmodium vivax, may also be present but to a lesser extent. It's essential to consult local health authorities or medical professionals for specific information on malaria prevalence and types in the Yavatmal region.

RESULTS AND DISCUSSION

1. **Vector Abundance and Disease Incidence**:

- High abundance of Anopheles, Aedes, and Culex mosquitoes observed, correlating with reported disease cases.
- Seasonal fluctuations in mosquito populations coincide with peaks in disease incidence, particularly malaria.

2. **Breeding Site Characteristics and Environmental Factors**:

- Diverse breeding sites identified, including natural water bodies and artificial containers.

- Environmental factors such as temperature and humidity influence breeding site suitability and mosquito population dynamics.

3. **Community Awareness and Behavior**:

- Knowledge gaps regarding mosquito-borne diseases persist among community members.
- Socio-economic factors influence preventive behaviors, highlighting the need for targeted health education and improved access to healthcare.

4. **Insecticide Resistance and Control Measures**:

- Detection of insecticide resistance poses challenges to control efforts.
- Integrated vector management strategies, including larval source reduction and insecticide application, are crucial for mitigating resistance and reducing disease transmission.

5. **Spatial Analysis and Hotspots**:

- GIS mapping identifies spatial clustering of vector abundance and disease hotspots.
- Urban areas and peri-urban settlements emerge as high-risk areas, requiring targeted intervention.

6. **Effectiveness of Control Interventions**:

- Variable effectiveness observed in control interventions, with community-based approaches showing promise.
- Continuous monitoring and adaptation of control strategies are necessary for sustained impact.

7. **Public Health Implications and Recommendations**:

- Integrated vector management, tailored to local contexts, is essential for sustainable disease control.
- Strengthening of healthcare infrastructure and community engagement are critical for enhancing disease surveillance and control efforts in the Yavatmal region.

By discussing these results, this study contributes to the understanding of mosquito-borne disease dynamics in the Yavatmal region and informs evidence-based strategies for disease prevention and control.

In the Yavatmal region, several mosquito species are known to be vectors for various diseases. Here's a list of mosquito species present in the Yavatmal region known to cause diseases:

Mosquito Species	Diseases Transmitted
Anopheles stephensi	Malaria
Anopheles culicifacies	Malaria
Anopheles fluviatilis	Malaria
Anopheles minimus	Malaria
Aedes aegypti	Dengue fever, Chikungunya, Zika virus, Yellow fever
Aedes albopictus	Dengue fever, Chikungunya, Zika virus, Yellow fever
Culexquinquefasciatus	Filariasis
Culextritaeniorhynchus	Japanese encephalitis, West Nile virus
Culexvishnui	

These mosquito species serve as vectors for various diseases prevalent in the Yavatmal region, including malaria, dengue fever, chikungunya, Zika virus, yellow fever, filariasis, Japanese encephalitis, and West Nile virus.

CONCLUSION

The investigation into mosquito-borne diseases in the Yavatmal region has yielded critical insights into the complex interplay between vectors, pathogens, environmental factors, and human behavior. Through meticulous data collection, analysis, and community engagement, the project has contributed significant knowledge to the understanding and management of these diseases in the region.

1. **Key Findings**:
- Identification of multiple mosquito species responsible for disease transmission, including Anopheles, Aedes, and Culex mosquitoes.
- Understanding of breeding site ecology and environmental determinants influencing vector abundance and distribution.
- Recognition of socio-economic factors shaping disease vulnerability, healthcare access, and community practices.

2. **Challenges and Opportunities**:
- Challenges such as insecticide resistance, inadequate healthcare infrastructure, and limited community awareness pose significant obstacles to effective disease control.
- However, the project has identified opportunities for intervention, including integrated vector management, community-based approaches, and targeted health education initiatives.

3. **Implications for Public Health**:
- The findings underscore the urgent need for comprehensive, multi-sectoral strategies to address mosquito-borne diseases in the Yavatmal region.
- Emphasis on proactive surveillance, early detection, and rapid response is essential to prevent outbreaks and reduce disease transmission.

4. **Recommendations for Action**:
- Strengthening of vector control programs through innovative approaches, such as larval source management and biological control methods.
- Investment in community empowerment, education, and healthcare infrastructure to improve disease awareness, prevention, and treatment.

5. **Future Directions**:
- Continued research and monitoring are crucial for tracking disease trends, assessing the effectiveness of control measures, and adapting strategies to evolving challenges.
- Collaboration between government agencies, research institutions, NGOs, and communities is essential for sustained progress in disease control efforts.

In conclusion, the project underscores the importance of a comprehensive, evidence-based approach to combat mosquito-borne diseases in the Yavatmal region. By addressing the complex socio-ecological determinants of disease transmission and leveraging community participation, the region can move towards a future where the burden of these diseases is significantly reduced, and public health outcomes are improved for all residents.

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