

# The impact of COVID-19 followed by extreme flooding on vector borne diseases in Pakistan: A mini narrative review

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## Abstract

While the Coronavirus pandemic continues to spread havoc across the world, countries like Pakistan are faced with another challenge: the steady rise of vector borne diseases alongside a spike in COVID-19 cases. Moreover, signs and clinical manifestations of multiple arbovirus infections mimic those experienced in COVID-19, causing further complications in management and diagnosis. Without urgent adequate management and testing equipment, the recent surge of COVID-19 along with the steady rise in Vector Borne Diseases (VBDs) could collapse the exhausted Pakistani healthcare system. This article explores the impact of COVID-19 on the management, diagnosis, and treatment of the common arbovirus infections of Pakistan, including dengue (DENV), malaria, chikungunya (CHIKV), and other foreign infections that are on a hazardous rise.

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**Keywords:** Chikungunya, COVID-19, dengue, malaria, Pakistan, vector-borne diseases

**Original Submission:** 28 July 2022; **Revised Submission:** 15 December 2022; **Accepted:** 20 December 2022

**Article published online:** 27 December 2022

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## I. Introduction

In January of 2020, the cause of unknown pneumonia cases in China was identified as COVID-19, and on March 11, it was declared a global pandemic [1]. To date, over 545 million cases have been identified worldwide, including 6 million deaths [2]. In Pakistan, with over 30,000 deaths and 1,536,479 total confirmed cases since 2021, the COVID-19 pandemic proved to be burdensome on the fragile healthcare infrastructure [3]. The highest number of confirmed cases were in the province of Sindh, closely followed by Punjab. In contrast, the lowest

number of cases were noted in the provinces of Baluchistan and Gilgit-Baltistan (GB) [3].

Vector-Borne Diseases (VBDs) are infections transmitted by infested arthropods biting humans, such as mosquitoes, ticks, and sandflies [4]. From the 17th to 20th century, VBDs such as the plague were a major cause of morbidity and mortality around the world [5]. VBD burden is highest in tropical and subtropical climates, and disproportionately affect poverty-ridden populations that are unable to access clean drinking water and sanitation [6], [7]. Examples of VBDs endemic to Asia include dengue fever (DENV), malaria, leishmaniasis, Chikungunya (CHIKV), Crimean-Congo Hemorrhagic Fever (CCHF), and West Nile virus (WNV).

The total population of Pakistan was reported to be above 225 million in 2021 [8]. The most recent statistics on poverty state that about 34% of the Pakistani population lives on just 3.2 USD a day [9]. Over 2 million people fell below the poverty line just in 2020, which may be linked to the lockdowns and restrictions placed during the pandemic [10]. Regardless of the cause, the consequences of widespread poverty include poor

sanitation, limitations in healthcare services, and a lack of general knowledge about common dangerous pathogens, leading to a continual rise in the number of DENV and malaria cases in Pakistan [11]. Malaria is the second most prevalent disease in the country, holding 12.5% of the overall national disease burden [12]. Endemic to Baluchistan and Sindh, 21,000 to 45,000 cases of cutaneous leishmaniasis are reported annually [13], [14].

The clinical features of COVID-19 and various VBDs such as malaria, DENV, and CHIKV show substantial overlap, resulting in multiple occasions of misdiagnosis and mismanagement around the world. These include symptoms of headache, fever, fatigue, muscle aches, nausea, vomiting, and laboratory findings like leukopenia and thrombocytopenia [11]. It is particularly challenging to distinguish mild COVID-19 cases with normal chest radiography from VBDs, since both present with similar symptoms. Reports from Italy and Madrid note the similarities in dermal manifestations, such as petechiae and rashes, present in COVID-19 and dengue patients [1]. This poses a serious threat in distinguishing dengue and other VBDs from COVID-19, particularly in tropical regions where VBDs are on the rise, like Pakistan [1].

Along with instigating clinical perplexity, the pandemic has caused a 30% decline in the surveillance and screening of suspected VBD cases, particularly due to nationwide lockdowns and resource allocation towards preventing COVID-19 [15]. Due to the alarming rise of various VBDs plus COVID-19 cases in Pakistan, complicated further by similar clinical manifestations of both, urgent intervention is required to mitigate this situation before it becomes a crisis difficult to maintain. Thus, this narrative review describes the rise of VBDs, their clinical overlap with COVID-19, and preventative measures to alleviate this dilemma before the debilitated healthcare system completely collapses.

## 2. Methodology

For this narrative review, the databases “PubMed” and “Google Scholar” have been used to explore published content. The key terms used include, “dengue AND Pakistan AND covid-19,” “malaria AND Pakistan AND covid-19,” “chikungunya AND Pakistan AND covid-19,” “west Nile virus AND Pakistan” “Japanese encephalitis virus AND Pakistan,” “leishmaniasis AND Pakistan,” and “Pakistan AND flood AND covid-19.” Literature comprised of data specific to Pakistan was included. Literature unrelated to Pakistan and diseases that were not vector-borne were excluded, along with duplicates and any literature published in any language except English.

## 3. Current situation of VBDs

CHIKV, DENV, and ZIKV are diseases spread by *Aedes* mosquitoes; malaria is transmitted by female *Anopheles* mosquitoes, and JEV and WNV are transmitted by *Culex* mosquitoes [6]. Due to various underlying causes discussed previously, VBD cases are rising annually in Pakistan. In 2005, only 395 cases of DENV were confirmed in the city of Karachi and it was not a common VBD before 2005, restricted only to this city [16]. However, emigration of dengue-positive people into unaffected areas from the years 2006-2017 caused various outbreaks to occur in all provinces of Pakistan unrelated to each other [16]. In 2019, 47,120 people were infected with DENV and just one year before, only 3204 cases were reported [17]. From January 1st to November 25th, 2021, 48,906 DENV cases were reported [18]. A rise in the number of cases was reported in the capital of Islamabad, which put severe pressure on healthcare workers (HCWs) and health officials especially with COVID-19 cases also increasing [18].

Pakistan also shares 98% of the total malaria burden in the WHO Eastern Mediterranean region, along with seven other countries [11]. According to a 2016 report published by the Pakistani government, almost 97% of the population is at risk of contracting malaria [12]. Yearly, 3 million cases of malaria are reported with approximately 50,000 deaths [12](11). Just in the province of Sindh, 97,000 cases of malaria were confirmed in the first 9 months of 2021 [19]. In the last few decades, transmission of malaria has been highest in northern areas especially in KPK (20). A study conducted in KPK in 2020 found 13.8% positivity for malaria, predominantly of the *P. vivax* strain [20].

Cutaneous leishmaniasis is caused by the bite of a female sandfly and causes papules which may ulcerate [13]. In the province of Baluchistan, 4072 cases of leishmaniasis were suspected from August 2018 to December 2019 [21]. Just two months later, an outbreak of leishmaniasis in the province of Khyber-Pakhtunkhwa (KPK) was reported with 21,000 cases [22].

CCHF is a tick-borne virus caused by *Ixodid* ticks which commonly reside in livestock animals. Outbreaks of CCHF have a 40% fatality rate and death occurs from hemorrhage [23]. The incidence of CCHF has heightened in Pakistan throughout the years but fortunately remains low. Between January 2014 and May 2020, nearly 356 CCHF patients were reported from all the provinces of Pakistan, with a 25% mortality rate [24]. Of these patients, 38% were from Baluchistan, 23% from Punjab, and 14% from Sindh [24].

In December 2016, the first case of CHIKV was reported in Karachi, Sindh. Between December 19, 2016, and April 14, 2017, 1419 suspected cases of CHIKV were recorded in

Karachi's different districts. Fortunately, no deaths have been reported yet [25]. The most recent outbreak of WNV in Sindh was reported in 2015-16 with 105 participants out of 998 having WNV IgM antibodies, indicating active infection. Of those 105 participants, over 70% had co-infection with Japanese encephalitis virus, another VBD [26]. In 2019, a study found WNV-specific antibodies in 33.3% of the general Pakistani population [27]. Currently, reports of another outbreak are circulating [27]. These epidemics of CHIKV and WNV are believed to incite a Zika (ZIKV) virus outbreak as well [16].

Co-infection of various VBDs is a common occurrence since the vectors for various VBDs are the same. In the years 2016-18, research conducted in the cities of Lahore, Rawalpindi, and Peshawar showed a total of 11.8% of 590 DENV-infected samples were also positive for CHIKV [28]. Furthermore, in 2012, the concurrent DENV and malarial infection in Lahore has been also reported. According to the findings of diagnostic testing for both DENV and malaria in 85 patients, 5 individuals had isolated DENV infection, 18 had isolated Plasmodium infection, and 17 had DENV-malaria co-infection [29].

#### 4. Challenges aggravating the VBD situation

The co-epidemic of COVID-19 and VBDs in Pakistan has given rise to many public health concerns, and such complex combinations have not only complicated diagnosis, but have also placed a double load on Pakistan's already strained healthcare system [11]. The healthcare industry is now beset by chronic underfunding, a major workforce deficit, inefficient operational coordination, and medical equipment shortages [30]. Control operations such as source reduction, community education, and bed net distribution have been halted due to government services being disrupted (by COVID-19 related lockdowns or redeployment of government staff) [31]. Efforts to limit the spread of COVID-19 in residential and commercial buildings by providing more outdoor spaces has increased mosquito exposure and the risk of VBD transmission [31]. Lockdowns have disrupted detection and reporting of cases by routine surveillance systems [32]. Among those infected individuals who do seek treatment, availability of testing has been restricted as many laboratories are prioritizing COVID-19 testing in the face of overwhelming demand [33].

Due to similarity in clinical presentations of early COVID-19 and VBD infections, diagnosis without adequate testing is incomplete. However, false-positive findings in serological testing have been discovered as DENV, which was subsequently confirmed as COVID-19. It is possible that cross-reactivity between DENV and SARS-CoV-2 may result in false-positives,

further complicating adequate diagnosis. Therefore, only assays detecting antibodies targeting specific epitopes must be used to avoid misdiagnosis [34]. For those unfortunate patients who were misdiagnosed, incorrect interventions led to an increase in the prevalence of VBDs with adverse consequences [30]. In addition, co-infection of COVID-19 and VBDs (especially DENV) are attributed to increased mortality in patients. In 2020, a study was conducted in Pakistan having 20 patients positive for COVID-19 out of which 5 were found to be co-infected with DENV [35].

In tropical regions like Pakistan, June, July, and August are the months in which monsoon rains shower across the country, creating collections of water that serve as perfect breeding sites for mosquitos [16]. To add, climate change has been correlated with a surge in VBD cases [16]. Between 2010 and 2011, the temperature in Pakistan was the highest in 3 decades, and the highest number of DENV cases were reported throughout the country during this time [16]. Arthropods, which make up majority of VBD vectors, are dependent on external heat sources for survival, explaining their precedence for warm climates. Climate change will raise the temperatures in areas with previously cooler temperatures, allowing the expansion of VBDs into non-immune host populations around the world, especially in countries like Pakistan that is home to many VBDs [5].

Karachi's hot and humid climate, as well as inadequate hygienic standards make it ideal for vector-borne illnesses [16]. These characteristics, when combined with the ongoing development of viral and bacterial variations as well as the issue of drug resistance, promote the frequent occurrence and spread of infection [36]. For example, the use of chloroquine for medication against the Plasmodium falciparum strain of malaria is prohibited in Pakistan due to widespread drug resistance [37]. In addition, due to the lack of a competitive countrywide surveillance system, the size and spread of these illnesses are poorly recognized [16]. Scarcity of vital supplies such as gloves, medical masks, respirators, goggles, face shields, gowns, and aprons have made it difficult to treat VBDs and COVID-19 alike, since both have infective periods where proper use of PPEs and isolation is mandatory [38]. In addition, Pakistan is home to the largest port of South Asia, and increased trade and travel have introduced new avenues for global disease spread to non-endemic areas [16].

Urbanization has caused massive migration to urban areas for industrialization, and has resulted in the spread of infected mosquitoes, intensifying the danger of disease outbreaks [16]. The introduction of artificial water sources as part of urban development has provided breeding grounds for vectors [16]. The annual percentage of urbanization in Pakistan increased between 2009 and 2012, and so did the number of VBD cases

throughout the country [16]. The inappropriate use of insecticides has also given rise to many insecticide-resistant vector strains, which plays a role in the re-emergence of VBDs [5].

Disease burden is exacerbated by limited access and the non-presentation of many patients to any health-care provider, as well as lack of effective control measures [5]. Despite increasing awareness about ticks as serious disease vectors, effective vaccines against most tick-borne infections are not available [39]. In addition, Pakistan's healthcare system lacks the resources and expertise to perform research into the development of effective vaccines, which is another obstacle in safeguarding the vulnerable population [32].

## 5. Discussion

As compared to Pakistan, its neighboring countries are faced with a similar VBD challenge. In Bangladesh, leishmaniasis is the most prevalent VBD, where 147 million people are at risk [40]. 871 million people are exposed to lymphatic filariasis, and almost 1.4 billion are at risk of malaria [40]. DENV and CHIKV cases appear annually, with recent reports indicating the introduction of WNV, JEV, and Zika virus [41]. In 2019, Bangladesh experienced the largest dengue outbreak, with over 100,000 hospitalizations in less than a year [42].

India is endemic to 6 VBDs including leishmaniasis, JEV, malaria, CHIKV, filariasis, and dengue. All have shown decline over the years except CHIKV, which has been rampant since 2005 [43]. Since 2021, India has reported over 1,64,000 dengue cases, and 2,05,243 cases were reported in 2019 [44]. India represents only 3% of the global malaria burden, and cases are declining due to a robust response. The country was able to decrease its malaria incidence by 24% in 2017 compared to 2016 [45].

A similar prevalence of VBDs is noted in Afghanistan, with malaria being the major VBD of the country [46]. Due to a severe lack of surveillance, other potentially deadly VBDs such as CCHF may not be reported or recognized. Leishmaniasis cases rise from April to October, and the risk is limited to rural and peri urban areas [46].

## 6. Efforts and recommendations

To combat these jeopardizing diseases, the Government of Pakistan is untiringly making efforts for COVID-19 vaccination of civilians, a total of 258,021,731 vaccine doses have been administered as of June 19, 2022 [47]. Since one important

intervention for VBD prevention is vector control (removal of eggs, larvae, and adult forms), the Department of Fisheries in Punjab will use mosquito-eating fish to fight against rising malaria and DENV cases [48](49). These fish consume 100 to 300 mosquito larvae per day. Every year, around 1,60,000 fish are collected from the Manawan Hatchery Centre for this purpose [49].

In Punjab, under the implementation of the integrated vector management initiative, the province witnessed a substantial drop in the number of DENV cases, from 22,000 in 2011 to just 325 with no deaths reported in 2012 [50]. The major features of this successful initiative included proper indoor and outdoor vector surveillance by highly trained epidemiologists, entomologists, and environmental inspectors, and larval source, waste, and environmental management [50]. In Sindh, limited logistics and human resources have resulted in the initiative focusing only on thermal fogging and larvicide control. Due to the rise in leishmaniasis cases in KPK, the government has initiated vector control for both leishmaniasis and DENV. However, the programs are financially distraught, leading to limited success. The conditions are similar in the province of Baluchistan, with programs mainly focusing on space spraying and using insecticidal nets with limited capacity and resources for proper vector surveillance [50].

The government must improve the operational capacity of health services in Pakistan and introduce a competitive national surveillance system for the control and identification of VBDs [51]. To help regulate and limit the burden early on, efficient and accessible diagnostic screening, as well as coordinated initiatives for real-time data-driven decisions, are essential [52]. Many diseases, including VBDs, necessitate a multifaceted strategy to control and prevent. The strategy must consist of an integrated approach of vector control programs throughout the country, preventative measures such as the use of mosquito repellants, and comprehensive health education.

Health education and providing knowledge about vector transmission, their life cycles, and how to prevent infections is crucial to prevent the mortality of millions of people [53]. In addition, the appropriate use of insecticides, especially by those who live near livestock and vector-friendly environments, must be instigated to prevent the rise of insecticide-resistant viruses. The invention and proper use of vaccines against VBDs is crucial in preventing large-scale morbidity and mortality amongst the general population. In addition, COVID-19 vaccine hesitancy amongst the population must be removed by providing awareness in the benefits of proper vaccination.

The government should allocate proper funds and must avoid negligence in the proper management of VBDs and COVID-19 to avoid the deaths of millions of people. The

province with the most number of VBDs yet the lowest number of funds was Sindh, and adequate management and prevention of VBDs is most crucial in this province.

## 7. Conclusion

The emergence of COVID-19 alongside the steady rise in VBD cases in Pakistan has caused much strain on the already failing healthcare system. The clinical similarity between these illnesses causes misdiagnosis as well as an inability to distinguish co-infection. The Pakistani government and international organizations must take this growing VBD epidemic seriously to avoid the deaths of millions. Proper resource allocation and finding must be provided to vector control programs throughout the country to avoid the emergence of epidemics and insecticide and medication resistant strains of viruses.

## Author's contribution

Conceptualization, Methodology, Visualization: Zainab Syeeda Rahmat.

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## Funding

None.

## Declaration of competing interest

None.

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