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ABSTRACT

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DENGUE FEVER SURVEILLANCE — PAKISTAN, 2020–2025

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This review examines dengue surveillance and outbreak investigations in Pakistan during 2020–2025 using publicly available reports from the World Health Organization and the National Institute of Health of Pakistan. The review compares national notifications, field investigations and laboratory findings while considering differences in case definitions, reporting periods and geographical coverage. Reported dengue cases increased from 3,442 in 2020 to 48,906 in 2021, with 183 deaths reported in 2021. The cited annual surveillance figure for 2022 was 62,995 confirmed cases and 62 deaths; an earlier report covering January to September documented a pronounced increase in September following widespread flooding. Subsequent surveillance recorded continued transmission in 2023 and 2024. Local investigations identified 5,374 suspected cases in Kech in 2024, 409 cases in Charsadda in 2025 and 48 laboratory-confirmed cases in Bagh in 2025. Molecular surveillance documented circulation of multiple dengue virus serotypes, particularly DENV-2. Interpretation is limited by differences in diagnostic confirmation, geographic coverage and completeness of reporting. National annual figures cannot be directly compared with local outbreak totals. Integrated clinical, laboratory, entomological and environmental surveillance, standardized case definitions and prompt district-level investigations are needed to improve early warning and dengue prevention.

Keywords: *dengue; Pakistan; surveillance; Aedes aegypti; outbreaks; vector control; epidemiology*

РЕЗЮМЕ

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ЭПИДЕМИОЛОГИЧЕСКИЙ НАДЗОР ЗА ЛИХОРАДКОЙ ДЕНГЕ — ПАКИСТАН, 2020–2025 ГГ.

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В обзоре рассмотрены эпидемиологический надзор за лихорадкой денге и расследования вспышек в Пакистане в 2020–2025 годах по опубликованным материалам Всемирной организации здравоохранения и Национального института здравоохранения Пакистана. Сопоставлены национальные сводки, результаты полевых расследований и лабораторных исследований с учётом различий в определениях случаев, периодах регистрации и территориальном охвате. Число зарегистрированных случаев увеличилось с 3442 в 2020 году до 48 906 в 2021 году; в 2021 году зарегистрировано 183 смерти. В использованных материалах за 2022 год

приведены 62 995 подтверждённых случаев и 62 смерти; более ранняя сводка за январь–сентябрь свидетельствовала о резком росте заболеваемости в сентябре после масштабных наводнений. Передача инфекции продолжалась в 2023 и 2024 годах. В локальных расследованиях выявлены 5374 предполагаемых случая в округе Кеч в 2024 году, 409 случаев в Чарсадде в 2025 году и 48 лабораторно подтверждённых случаев в Багхе в 2025 году. Молекулярный надзор выявил циркуляцию нескольких серотипов вируса, прежде всего DENV-2. Интерпретацию ограничивают различия в лабораторном подтверждении, полноте регистрации и географическом охвате. Национальные годовые показатели нельзя напрямую сопоставлять с данными локальных вспышек. Для раннего выявления и профилактики необходимы единые определения случаев, интеграция клинического, лабораторного, энтомологического и экологического надзора и своевременное расследование вспышек на районном уровне.

Ключевые слова: *денге; Пакистан; эпидемиологический надзор; вспышки; переносчики; профилактика.*

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ХУЛОСА

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НАЗОРАТИ ЭПИДЕМИОЛОГИИ ТАБЛАРЗАИ ДЕНГЕ ДАР ПОКИСТОН, СОЛҲОИ 2020–2025

Донишгоҳи давлатии тиббии Тоҷикистон ба номи Абӯалӣ ибни Сино, Душанбе, Тоҷикистон

Донишгоҳи федералии урдуи санъат, илм ва технология, Карочӣ, Покистон

Дар ин мақолаи шарҳӣ назорати эпидемиологии табларзаи денге ва таҳқиқи хуруҷи он дар Покистон дар солҳои 2020–2025 дар асоси маълумоти нашршудаи Созмони ҷаҳонии тандурустӣ ва Институти миллии тандурустии Покистон баррасӣ шудаанд. Маълумоти умумимиллӣ, натиҷаҳои таҳқиқоти саҳроӣ ва ташхисҳои лабораторӣ бо дарназардошти фарқияти таърифи ҳолатҳо, даврaҳои бақайдгирӣ ва фарогирии ҷуғрофӣ муқоиса гардиданд. Шумораи ҳолатҳои ба қайд гирифташуда аз 3442 дар соли 2020 то 48 906 дар соли 2021 афзуда, дар соли 2021 183 фавт сабт шудааст. Тибқи маълумоти истифодашуда, соли 2022 62 995 ҳолати тасдиқшуда ва 62 фавт ба қайд гирифта шудааст; гузориши пешина барои моҳҳои январ–сентябр афзоиши шадиди ҳолатҳоро дар моҳи сентябр пас аз обхезиҳои васеъ нишон медиҳад. Интиқоли сироят дар солҳои 2023 ва 2024 низ идома дошт. Дар таҳқиқоти маҳаллӣ соли 2024 дар ноҳияи Кеч 5374 ҳолати эҳтимолӣ, соли 2025 дар Чарсадда 409 ҳолат ва дар Багҳ 48 ҳолати бо озмоишгоҳ тасдиқшуда муайян гардид. Назорати молекулавӣ гардиши якчанд серотипи вирус, махсусан DENV-2-ро нишон дод. Тафсири маълумот бо сабаби фарқияти усулҳои ташхис, пуррагии бақайдгирӣ ва фарогирии ҷуғрофӣ маҳдуд аст. Нишондиҳандаҳои солонаи миллӣ бо натиҷаҳои хуруҷи маҳаллӣ мустақиман муқоисашаванда нестанд. Барои огоҳсозии барвақт ва пешгирӣ истифодаи таърифҳои ягонаи ҳолатҳо, ҳамгироии назорати клиникӣ, лабораторӣ,

энтомологӣ ва муҳити зист, инчунин таҳқиқи саривақтии хуруҷҳо дар сатҳи ноҳия зарур мебошад.

Калидвожаҳо: *денге; Покистон; назорати эпидемиологӣ; хуруҷ; ҳашароти интиқолдиҳанда; пешгирӣ.*

Introduction:

Dengue is a viral disease caused by mosquitoes, mainly Aedes aegypti. Pakistan is a dengue-endemic country, and according to the WHO, dengue transmission in Pakistan occurs year-round, with most cases being recorded between September and December. From historical data, there has been considerable variability in the number of dengue cases every year, ranging from 3,442 cases in 2020 to 48,906 cases and 183 deaths in 2021. Various factors affecting dengue transmission include rainfall, temperature, urbanization, water storage, waste disposal, vector abundance, human migration, and the efficiency of surveillance and vector control activities. In 2022, WHO reported 25,932 cases and 62 deaths by September 27, with 74% of cases having been recorded in September following the unexpected floods beginning in June. This paper reviews surveillance and outbreak investigation data from 2020 to 2025.

Literature Review:

Dengue fever is a vector-borne disease caused by the dengue virus (DENV). It consists of four serotypes: DENV-1, DENV-2, DENV-3, and DENV-4. Dengue fever can cause different types of symptoms, such as from asymptomatic infection up to severe dengue with signs of plasma leakage, bleeding, shock, and even death. It is transmitted mainly by Aedes aegypti mosquitoes, while less frequently by Aedes albopictus. There are several factors contributing to the prevalence of dengue in Pakistan, such as its hot and tropical climate, rapid urbanization, lack of proper drainage systems, water storage methods, and seasonally occurring monsoon rains [1].

Dengue surveillance is a crucial activity that provides information about the number of cases, their geography, high-risk populations, detection of outbreaks, and serotypes of circulating viruses. In Pakistan, dengue surveillance is based on suspected and laboratory-confirmed cases, observation in hospitals, laboratory analysis, and mosquito-vector surveillance. The differences in diagnostic facilities, reporting, and healthcare accessibility may influence reported cases. The time period ranging between 2020 and 2025 is especially significant for evaluating dengue surveillance as it includes the COVID-19 pandemic, the outbreak of dengue in 2021 and 2022, the flooding in 2022, and the process of surveilling recurrence. Evaluation of the literature that exists on the subject matter allows finding patterns in the epidemiology of dengue, identifying limitations of current surveillance, and determining priority areas of dengue prevention in Pakistan.

Dengue Surveillance During 2020: The recent coronavirus outbreak has presented various issues regarding communicable disease surveillance across the globe. In Pakistan, all the efforts in terms of testing, management, and emergency response focused on COVID-19 and possibly affected the process of surveillance of other diseases that might have spread in the region. Moreover, lockdown and changes in the behavior of people in seeking healthcare services also had an impact on the surveillance of dengue fever. However, a decrease in the number of cases reported in any specific period should not automatically reflect a decrease in

the number of actual cases. Dengue fever infections may go unreported when people do not exhibit symptoms at all or do not seek any medical attention. Therefore, surveillance results from 2020 should be interpreted in light of possible changes in diagnostics and reporting [2].

The 2021 Dengue Outbreak: Pakistan experienced a significant dengue outbreak in 2021. According to the WHO Regional Office for the Eastern Mediterranean [3], Pakistan recorded 293,579 suspected cases of dengue fever, of which 47,439 were laboratory-confirmed cases, with 236 deaths. This outbreak highlighted the need to distinguish between suspected and laboratory-confirmed cases of infection. Suspected cases helped to trace transmission and diagnose patients needing treatment, while laboratory confirmation helped better categorize the cases epidemiologically. Nevertheless, the number of confirmed cases was determined by several factors, such as testing availability, eligibility criteria, and the diagnostics themselves.

Table 1: 2021 Counts

Item	Estimate 1: interim WHO report	Estimate 2: full-year WHO regional summary
Reporting period	1 January–25 November 2021	January–December 2021
Total reported cases	48,906	293,579 suspected cases
Laboratory-confirmed cases	Not separately stated in this report	47,439
Reported deaths	183	236 in the WHO EMRO information page; 326 in its 2021 annual regional summary
Source	WHO Disease Outbreak News, 14 December 2021	WHO EMRO information resources and 2021 regional outbreak summary
Interpretation	Interim cumulative count of reported dengue cases	Full-year count of suspected cases, with laboratory-confirmed cases reported as a subset

Another important aspect that became evident during the 2021 outbreak was the timely communication between the hospitals, the diagnostic laboratories, and the public health service agencies. The surveillance data were not detailed enough to define the infected districts, find an increase in the incidence of disease, and plan appropriate measures for vector control. Moreover, there was a significant difference between suspected and confirmed cases, which made the need for clear specification of case definition and testing even more evident [2].

The 2022 Outbreak and the Impact of Flooding: The dengue outbreak in 2022 was one of the major public health events during the selected time period. According to WHO, there were 25,932 confirmed cases and 62 deaths from January 1 to September 27, 2022. Around 74% of the reported cases were during September alone, indicating a marked seasonal spike. The dengue outbreak happened during unprecedented monsoon flooding, which damaged infrastructure and healthcare facilities [1]. As mentioned in the WHO report, the cases were

reported in provinces like Sindh, Punjab, Khyber Pakhtunkhwa (KP), and Balochistan, meaning that the dengue transmission was not restricted to only one province. Monsoon flooding increased the chances of dengue transmission by providing breeding grounds for mosquitoes; however, there is a complex relationship between rainfall/flooding and dengue incidence due to other factors, including water storage, temperature, etc.

Table 2: 2022 national totals and deaths against the cited WHO/EMRO reports

Measure	Interim outbreak report	Full-year regional summary
Observation period	1 January–27 September 2022	Calendar year 2022
Reported cases	25,932	62,995
Case definition stated by WHO	Confirmed dengue cases	Confirmed dengue cases
Reported deaths	62	62
Case-fatality proportion	62 / 25,932 = 0.239% (approximately 0.24%)	62 / 62,995 = 0.0984% (approximately 0.10%)
Source	WHO Disease Outbreak News, 13 October 2022	WHO Regional Office for the Eastern Mediterranean, 2022 annual outbreak summary

The surveillance efforts involved laboratory and hospital surveillance, vector surveillance, clinical readiness, and setting up dengue counters at health facilities. This highlighted how the use of surveillance data can help in allocating diagnostic capacity and healthcare workers during the outbreak. The gap in the number of cases reported on different dates through different surveillance summaries was significant and brought to light one crucial methodology that needed to be noted: comparisons can be made only under conditions where the reporting period, geographical area, and case definition are uniform. In addition, the year 2022 experience showed that meteorology, entomology, and human cases need to be combined for early outbreak predictions [1].

Dengue Surveillance in 2023: Dengue was one of the most serious public health problems faced by Pakistan in 2023. According to the global dengue situation assessed by WHO, Pakistan reported high transmission in 2023, with 20,072 dengue cases reported [2]. As such, the presence of dengue even after the major 2022 outbreak indicated that in Pakistan there is a need for dengue surveillance year-round, especially during monsoon and post-monsoon seasons. Limiting the surveillance to peak outbreak periods can be counterproductive since it will miss early transmission, low-level transmission, and geographic spread of cases.

Another important aspect is distinguishing between imported and local dengue infections as well as identifying outbreaks in districts that report fewer dengue cases. This can enable public health authorities to locate new dengue transmission zones and target vector control efforts to areas at risk. Climate variability, urbanization, human mobility, and limitations in surveillance capacity were also some of the factors identified by WHO in their international publications in 2023 that could contribute to making outbreaks difficult to detect and respond to. These findings justified the use of more timely and comprehensive geographic-specific surveillance of dengue in Pakistan [2].

Surveillance Trends in 2024: Some information about the dengue virus strains circulating in Pakistan was also obtained through molecular and genomic surveillance in 2024. The National Institute of Health (NIH) in Islamabad prepared a dengue genomic surveillance report from January 1 to October 31, 2024. In the report, out of the suspected cases of dengue, 70% turned out to be positive by PCR. Through serotyping, it was found that 94% of the samples were DENV-2, and the remaining 6% were DENV-1 [4]. These findings are important because these tests can give useful information in addition to just counting the number of cases. However, these results cannot be used to determine prevalence in the general national population. The samples collected by the reference laboratory can have an overrepresentation from areas of the outbreak, referral hospitals, or certain districts. In other words, the distribution of serotypes mentioned in the WHO report can be specific to the tested samples but not all of the dengue infections in Pakistan. The 2024 information highlights the importance of extending molecular surveillance in all provinces, improving the representativeness of laboratory samples, and linking laboratory results with epidemiological and clinical information.

Dengue Surveillance in 2025: Throughout 2025, dengue transmission and outbreaks were recorded through the surveillance reports. The NIH of Pakistan released the results of its field investigations regarding outbreaks in Khyber Pakhtunkhwa (KPK) and Azad Jammu and Kashmir (AJK) [5]. Another study [6] conducted in Union Council Rajjar-1, District Charsadda, found a rise in the number of cases of dengue during July and August 2025 through case line-listing, facility record review, household investigation, and entomological assessment. The other investigation [5] revealed a cluster in Bagh District, AJK, which highlights the importance of investigating an outbreak in an area where transmission may be less commonly recognized.

During 2025, dengue transmission continued across Pakistan, with national surveillance documenting a substantial annual disease burden alongside geographically distinct local outbreaks. According to a March 2026 report citing the National Institute of Health (NIH), Pakistan recorded 33,394 laboratory-confirmed dengue cases nationally in 2025 (Junaidi, 2026). This retrospective national figure should be distinguished from findings of individual outbreak investigations.

An NIH investigation in Union Council Rajjar-1, District Charsadda, Khyber Pakhtunkhwa, identified 409 dengue cases between July 13 and August 29, 2025. The investigation used active case finding, healthcare facility record reviews, household investigations, and entomological assessment. The reported attack rate was 2.27%, calculated using the study's defined population denominator of 17,993; older age groups had higher age-specific attack rates (National Institute of Health [NIH], 2025a). Separately, an NIH-supported investigation in Bagh District, Azad Jammu and Kashmir, documented 48 laboratory-confirmed cases during an outbreak in July–August 2025 (NIH, 2025b). This outbreak highlighted the importance of extending surveillance and vector investigations to areas where dengue transmission may previously have been less commonly recognised.

The Charsadda and Bagh findings represent separate local outbreak investigations and should not be added to, or substituted for, the national annual total. Differences in geographic coverage, investigation periods, and case ascertainment also mean that the local findings cannot be directly compared with national surveillance totals without accounting for their respective definitions and reporting windows.

It is obvious that field epidemiology helps in improving the notification system. Active case detection helps in detecting infections that would have been under-recognized otherwise, whereas household and environmental investigations help in detecting possible breeding areas. A retrospective molecular surveillance study [8] also sheds light on the years 2021-2025. Among the 1,162 cases of dengue infection detected through quantitative reverse-transcription PCR (qRT-PCR), 78.4% were caused by DENV-2, 21.4% by DENV-1, and 0.09% by DENV-3. DENV-2 was predominant in 2021 and 2022; DENV-1 was the predominant serotype in 2023 temporarily, while DENV-2 regained its dominance in 2024 and 2025 [4,7]. The majority of the cases detected were in September and October. Though not within the timeframe, this study provides valuable historical information regarding serotype changes. Although it supports continued molecular surveillance, the sample of this study can be used to confirm neither the distribution of dengue serotypes across Pakistan nor the disease burden.

Dengue Surveillance Systems in Pakistan: There are different methods for conducting dengue surveillance in Pakistan. One of them is passive surveillance, which entails hospitals reporting suspected or confirmed cases of dengue fever through the health information and disease surveillance network. The method is helpful in identifying disease trends; however, underreporting of the number of patients could occur since some patients might fail to seek medical assistance. Laboratory-based surveillance is also conducted using diagnostics in which tests for dengue include NS1 antigen testing, serology, and molecular methods. The other type, active surveillance, consists of extra actions aimed at discovering new cases by examining hospital records, contacting communities, carrying out house-to-house surveys, and looking into clusters. The examples of outbreak investigations in 2025 show the importance of the approach when dealing with local transmission.

Entomological surveillance is focused on studying mosquito populations and their breeding sites. Some common metrics for entomological surveillance are the house index, the container index, and the Breteau index. The latter three can be useful in identifying regions where intervention on vectors is needed; however, they should be considered together with epidemiologic and environmental factors and cannot be viewed as a measure of human infection directly.

Molecular/genomic surveillance provides information about the prevalence of different serotypes and virus genotypes. The example provided in the NIH's report in 2024 demonstrates how useful laboratory surveillance can be in gaining insight into viral circulation not available with only case reporting [4].

Major Challenges in Dengue Surveillance: Despite improvements in outbreak investigation and laboratory monitoring, several limitations as follows, affect the effectiveness of dengue surveillance in Pakistan:

Underreporting and Incomplete Case Detection: Surveillance systems based on routine reporting may miss persons with either mild or asymptomatic infections, those who do not visit health-care centers, or patients who are admitted to health-care centers that do not report cases regularly. An assessment conducted in 2026 using laboratory data from 2012 to 2022 showed that there was underreporting, lack of complete data, and variations in testing as major problems in assessing the incidence of dengue fever in Pakistan [9].

Differences in Diagnostic Procedures: Differences in diagnostic procedures among various healthcare facilities may influence the quality of data collected from surveillance.

Different testing procedures such as NS1 antigen testing, serological tests, and PCR have different uses as well as applicability at different stages of infection. There is a need for standardization of testing procedures, correct sample collection, and correct definition of suspected and confirmed cases.

Inconsistency of Geographical Coverage: Data obtained nationally through surveillance may not necessarily indicate consistency in data reporting within the provinces and districts. Urban centers tend to have better testing facilities and reporting systems compared to rural areas. In addition, data obtained from reference laboratories may tend to be from areas where more samples are sent for testing. According to the 2025c NIH surveillance bulletin, integrated disease surveillance reporting compliance was 78% in 158 implemented districts during week 38. The level of compliance differed widely among the regions. This demonstrates one of the problems with reporting data. Compliance in this case referred to general disease surveillance reporting compliance and not dengue reporting specifically.

Inadequately Integrated Surveillance Data: The information from case reports by humans, laboratory data, data from mosquito surveillance, climate data, and the results from hospitals is not always integrated. Inadequate integration may hinder the timely identification of hotspot areas and the inability to understand the environment in which transmission is increasing. An integrated approach for surveillance will help identify hotspot areas and implement interventions.

Insufficient Molecular Surveillance: While routine case reporting can give data regarding the number of cases and their distribution, it is inadequate in determining the serotypes of the dengue virus present. The genomic surveillance in 2024 and subsequent studies prove the importance of ongoing molecular surveillance to detect changes in serotypes of the virus [10,8].

Research Methodology:

The dengue surveillance data were obtained from WHO Disease Outbreak News, WHO Eastern Mediterranean Regional reports, and the Pakistan NIH IDSR public health bulletins. NIH bulletin system offers weekly information on priority disease detection, notification, data management, analysis, preparedness, and response. The national-level data were given separately from individual outbreak investigation results. As there were differences in surveillance definition, period of reporting, laboratory confirmation, and geographical coverage among the data sources over different years, the yearly national statistics could not be combined statistically. The descriptive comparison was carried out to find out the important trends temporally and geographically. For the selected outbreak investigations, the epidemiological indicators provided by NIH were used.

Results:

Dengue is endemic in Pakistan, and transmission occurs year-round, with peak outbreaks usually seen during and after the monsoon season. Dengue outbreaks have occurred in Punjab, Sindh, KP, Baluchistan, and many other regions. Official surveillance statistics reveal considerable fluctuations in the dengue burden between 2020 and 2025, including a significant national dengue outbreak in 2021 and a large post-flooding dengue outbreak in 2022. Studies conducted in the field between 2024 and 2025 found evidence of localized transmission of the disease in Balochistan, KP, and AJK. Dengue control in Pakistan needs continuous surveillance rather than a seasonal response to emergencies; improvement of vector control before the monsoon, laboratory confirmation, investigation of outbreaks,

environmental management, and early warning at the district level would contribute to a timely response.

National Surveillance and Temporal Pattern: The transmission of dengue varied considerably on a yearly basis. According to WHO's analysis of the surveillance system in Pakistan, there were 3,442 cases of dengue in 2020, while in 2021, there were 48,906 cases of dengue, which included 183 deaths. Between January 1 and November 25, 2021, there had been 48,906 cases and 183 deaths due to dengue across the country. Among them, Punjab had reported 24,146 cases and 127 deaths, KP had reported 10,223 cases and 10 deaths, Sindh had reported 5,548 cases and 24 deaths, while Islamabad Capital Territory had reported 5,261 cases and 21 deaths. The 2022 epidemic had an extremely seasonal pattern. WHO later reported 62,995 confirmed cases and 62 deaths. The dengue epidemic started around week 36 of the epidemic and peaked around week 42, while it declined after week 43.

Geographic Distribution: There were significant changes in the geographic pattern of dengue infection among individuals during each epidemic period. In 2022, the greatest contributions made by province-level data were from Sindh, then Punjab/Islamabad, KP, and Balochistan. WHO pointed out that the increase in 2022 took place due to flooding, which created worries about dengue and other infectious diseases. The geographic pattern remained heterogeneous after the big national epidemics. In NIH field studies, transmission of dengue was recorded in places not well-reflected in the national data. In April–May 2024, the NIH study in Union Council Absor, Kech District, Balochistan included screening 20,936 people, of whom 5,374 people had suspected dengue. There were 13 deaths linked to this epidemic, which gave a case fatality ratio of 0.24% [11]. An entomological survey detected mosquito breeding at 348 out of 4,070 houses examined in Absor, resulting in a house index of 8.6%. In July-August 2025, a dengue outbreak investigation in Union Council Rajjar-1 of Charsadda District, KP, was conducted by NIH (2025b). A total of 409 cases were detected between July 13 and August 29, resulting in an attack rate of 2.27%. Laboratory testing found the serotype of the dengue virus to be type 2. Persons in the age group ≥70 years and the age group 60–69 years had the highest age-specific attack rates. Another NIH investigation carried out in Bagh district, AJK, during July-August 2025 revealed a total of 48 laboratory confirmed cases up to August 26. The median age was 34 years, 64.5% of the cases were males, and the overall attack rate was 0.26% [5].

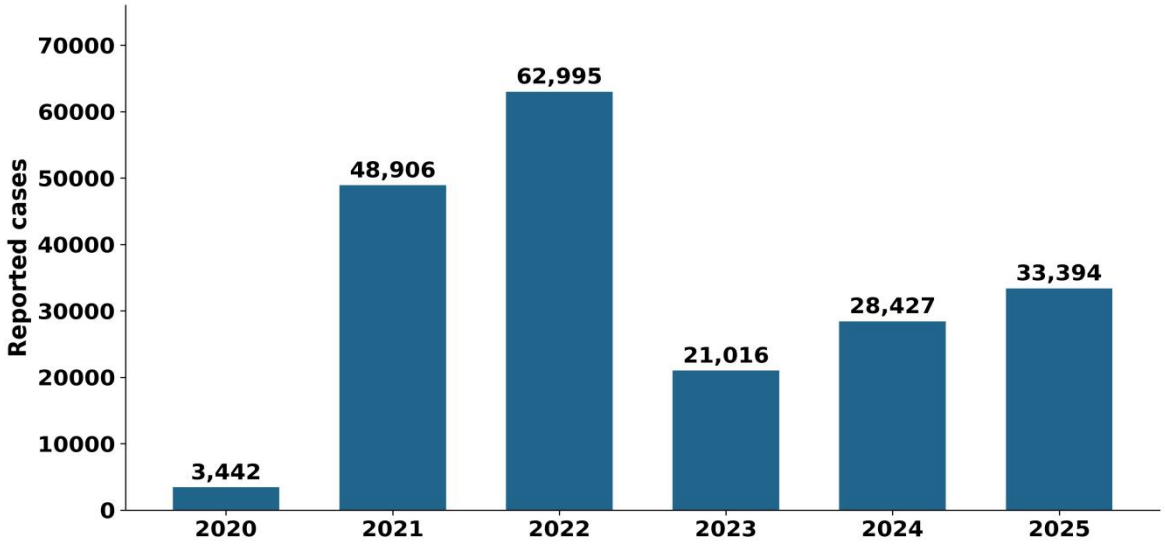

Figure 1. Reported dengue cases in Pakistan, 2020–2025

Note: Figures reflect differing case definitions and reporting periods; 2021 data are through 25 November, while 2025 is a later reported total. Do not interpret the bars as directly standardized incidence estimates.

Seasonality and Environmental Conditions: All the available evidence points to a seasonal increase in dengue. According to WHO, Pakistan has endemic transmission throughout the year; however, there is a peak season in which most of the cases arise. This is exemplified by the 2022 outbreak, where 74% of the cases recorded for this particular year were found to be reported during September. Environmental conditions facilitating the transmission process were identified through field investigation. In Charsadda, stagnant water and uncovered water vessels emerged as key exposure conditions, while in Bagh, stagnant water, open drainage channels, and inappropriate water storage were some of the critical factors.

Table 3: Reported dengue burden in Pakistan, 2020–2025

Year	Dengue cases	Deaths	Source and reporting period	Key observation
2020	3,442	Not established here	WHO EMRO retrospective summary; annual figure	Lower reported burden before the 2021 epidemic.
2021	47,439 confirmed; 293,579 suspected	326	WHO EMRO; January–December 2021	Major epidemic; suspected and confirmed cases must be distinguished.
2022	62,995 confirmed	62	WHO EMRO; annual total	Major outbreak during the year of catastrophic flooding.
2023	20,072 confirmed	Not verified	WHO; 2023 situation report	WHO-reported count; later NIH reporting gives 21,016 cases.
2024	Unresolved: 28,427 versus 24,182	Not verified as a full-year total	Retrospective molecular surveillance publication versus later NIH surveillance summary	Confirm the national annual total before final publication.
2025	33,394 laboratory-confirmed	Not verified	NIH surveillance figures reported by Dawn in March 2026; retrospective annual count	Later surveillance reporting indicates continued transmission.

Discussion:

The surveillance data reveal that dengue is not limited to one stable geographic focal point in Pakistan. Rather, it takes place in various provinces and territories and is capable of becoming severe very quickly under suitable environmental and climatic conditions. The 2021 outbreak is an example of this potential capability of dengue outbreaks to cause substantial morbidity and mortality on a national level. In 2022, there was another

characteristic feature of dengue outbreaks demonstrated during the epidemic – the rapid growth of transmission following major environmental disturbance. Three-quarters of cases reported during September 2022 took place after the unprecedented floods when the seasonal transmission intensity increased. Further investigations conducted in 2024 and 2025 also confirmed that the national aggregates could disguise the significant transmission at a local level.

Table 4: Selected Dengue Outbreak Investigations, Pakistan, 2024–20251

Year	Location	Cases	labelled indicator	Important epidemiologic finding
2024b	**Kech, Balochistan (MC Turbat)**	**5,374 suspected**	**Reported attack rate: 51 per 10,000; denominator requires confirmation**	**13 deaths; mosquito breeding detected in 348 of 4,070 inspected houses (house index 8.6%).**
2025	**Charsadda, KP**	**409**	**Reported attack rate: 2.27%; verify the study population denominator**	**DENV-2 identified; older adults reportedly had higher age-specific attack rates.**
2025a	**Bagh, AJK**	**48 confirmed**	**Reported attack rate: 0.26%; verify the study population denominator**	**High entomological indices; no deaths reported.**

The implications of the above results are clear with respect to surveillance strategy. A surveillance strategy relying mainly on reactive measures in the presence of many clinical cases is unlikely to offer enough time for vector control actions. The consistent link between dengue outbreaks and stagnant water, poor water storage conditions, poor drainage facilities, and high entomological indices indicates that a combination of epidemiologic and vector surveillance as well as environmental surveillance should be used. Pakistan currently possesses a surveillance infrastructure via its NIH surveillance program. The weekly IDSR bulletin system is already in place for regular disease intelligence and outbreak surveillance. The most important aspect is the rapid translation of information gathered at provincial and district levels into interventions.

Limitations:

There are certain limitations to this study. It is possible that there were no identical surveillance estimates by year due to different definitions used. Also, the suspected, confirmed, and laboratory-confirmed cases could not be compared with one another across all the surveillance systems. The outbreaks of dengue in 2024 and 2025 are local cases and do not reflect the annual national estimate, as there may be underreporting and lack of testing capacity, which would lead to the underestimation of dengue transmission. The public surveillance estimates available did not contain a single unified dataset for calculating the standardized incidence rate or national seasonality curves each year.

Implications for Public Health Practice:

[1] This table presents local outbreak investigations as national annual totals.

The approach to dengue surveillance in Pakistan needs to shift from being primarily focused on outbreak response to being based on ongoing early warning systems. District-level surveillance should include clinical notifications, laboratory testing, entomological parameters, environmental data, and geographic analysis. Vector control in the pre-monsoon season should target areas with endemic transmission and high breeding indices instead of resorting only to emergency spraying. The 2022 outbreak and later localized epidemics show the need to maintain preparedness despite low overall national case numbers. Early identification of localized transmission, environmental control measures, and community involvement can prevent it from turning into an outbreak.

Conclusion:

From 2020 through 2025, dengue has continued to be an important public health issue in Pakistan. From the 2021 dengue outbreak to the rise in dengue cases in the 2022 monsoon and post-monsoon seasons to the continued transmission in 2023, the advances in molecular surveillance in 2024, and the localized outbreaks analyzed in 2025, the need for surveillance has been emphasized. It is evident that reporting of dengue cases alone cannot be used to identify the true burden of dengue because of under-reporting, lack of consistency in the process of diagnosis, geographical differences in reporting capacity, and lack of integration of information about the laboratory, environment, and epidemiology. For better dengue surveillance, a comprehensive approach involving proper case reporting, availability of laboratory confirmation of dengue cases, entomological and molecular surveillance, integration of digital data, and prompt outbreak investigation will be required.

Recommendations for Strengthening Dengue Surveillance:

Based on the reviewed evidence, the following measures should be prioritized:

Standardize National Reporting: Utilize common case definitions, diagnostic standards, and reporting forms throughout the country and healthcare institutions.

ii. Improve Laboratory Capacities: Enhance accessibility of confirmatory testing and specimen referral mechanisms, especially in underdeveloped districts.

iii. Facilitate Real-Time Reporting: Introduce interoperable electronic surveillance systems that enable timely exchange of case numbers, laboratory findings, and outbreak notifications.

iv. Enhance Entomological Surveillance: Carry out monitoring of mosquito breeding sites and vector indices in conjunction with case notifications, especially during and before monsoon seasons.

v. Use Climate and Epidemiological Data: Use rainfall, temperature, humidity, and environmental data together with case data to better predict outbreaks.

vi. Conduct Prompt Outbreak Investigations: Make use of active case identification, house surveys, and geographic mapping of transmission foci for more efficient targeting of control measures.

vii. Enhance Molecular Surveillance: Perform systematic serotyping and sequencing in representative geographic regions to track viral circulation.

viii. Enhance Community Involvement: Encourage public awareness, early seeking of health care, removal of breeding sites, and effective household water storage.

ix. Improve Surveillance Performance: Continuously evaluate the completeness, timeliness of reporting, turnaround time of laboratory tests, outbreak detection rate, and proportion of cases that get proper confirmation.

Research gaps and future directions:

Several recurring instances of dengue outbreaks and increasing interest in surveillance techniques utilizing molecular and field approaches have been identified by recent research. Nevertheless, many areas remain unexplored. It is necessary to conduct longitudinal studies across Pakistan, including all its provinces and territories, to differentiate real variation in dengue infection incidence from artificial variation caused by varying test results and reports. It would be beneficial to explore links between climate, urbanization, water and sanitation, mosquito density, and dengue transmission at the district level. Also, an assessment of the sensitivity and timeliness of the existing surveillance approach would give an idea about the pace of detection of dengue outbreaks and factors that cause any possible delay in reporting. Moreover, an incorporation of clinical data into epidemiologic and molecular research would help to understand the link between serotypes of infection, illness severity, and death rate.

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