DENGUE EPIDEMIC REPORT 2024

PATIENT CARE AND OPERATIONAL OPTIMIZATION

DEPARTMENT OF INFECTIOUS DISEASES

RAWALPINDI MEDICAL UNIVERSITY


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DENGUE EPIDEMIC REPORT 2024

Rawalpindi Medical University

PATIENT CARE
&
OPERATIONAL OPTIMIZATION

Holy Family Hospital

Benazir Bhutto Hospital

Rawalpindi Teaching Hospital

Dr. Muhammad Mujeeb Khan
FCPS (Med.)
Dip. DM (UK), Dip. Nutrition (Pak),
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Department of Infectious Diseases
Rawalpindi Medical University, Rawalpindi

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Message from Vice Chancellor
Rawalpindi Medical University

Prof. Dr. Muhammad Umar (SI), (HI) FCPS, FRCP (Glasgow)
FRCP (UK), FACG (USA), FAGA (USA)
Vice Chancellor
RMU & Allied Hospitals, Rawalpindi

As we reflect on 2024, it is evident that the evolving challenges in public health demand adaptability, resilience, and collaboration. While the COVID-19 pandemic has reshaped global healthcare systems, it has also offered critical lessons in preparedness and rapid response - principles that continue to guide our approach to the recurrent threat of dengue fever.

This year, the dengue epidemic has once again tested our healthcare infrastructure, particularly in regions like Rawalpindi, which bear a significant brunt of the disease.

Despite these challenges, Rawalpindi Medical University has upheld its commitment to to delivering exemplary patient care, advancing research, and fostering community engagement to combat this endemic.

Our focus on leveraging innovative tools and technologies, from enhanced diagnostic methods to the development of effective vaccines, reflects our unwavering determination to reduce the burden of this disease. While promising strides in vaccine development are underway, equitable access remains a priority, ensuring that these advancements benefit all segments of our population.

This report is a comprehensive account of the epidemiological trends, clinical insights, and collaborative efforts undertaken in 2024. It also serves as a testament to the dedication of our faculty, students, and healthcare workers, whose tireless efforts form the backbone of our response to this public health challenge.

I extend my heartfelt gratitude to the healthcare teams, administrative staff, and the district authorities for their unwavering support and coordination. Your contributions have been instrumental in managing this epidemic and ensuring patient safety and care. To the affected families, I express my deepest appreciation for your trust and cooperation with the healthcare system.

Dengue Epidemic 2024

The year 2024 has witnessed a significant increase in dengue fever cases across Pakistan, including Rawalpindi. As the epidemic continues to challenge healthcare systems, Rawalpindi Medical University (RMU), along with its Department of Infectious Diseases, plays a pivotal role in combating this public health crisis.

The university has been at the forefront of efforts aimed at both prevention and management, contributing to local and national health initiatives.

The Department of Infectious Diseases at RMU has been actively involved in surveillance, early diagnosis, and treatment of dengue cases. Faculty and medical staff have collaborated closely with local hospitals, healthcare providers, and the Rawalpindi District Health Department to ensure prompt identification and effective management of patients. RMU's state-of-the-art diagnostic facilities have facilitated accurate testing, helping in the swift detection of dengue virus and the classification of cases into severe and non-severe categories.

Further, RMU has played an educational role offering continuous professional development programs for healthcare workers on the latest diagnostic techniques and treatment protocols for dengue. In line with its commitment to public health, the university has also engaged in community awareness campaigns, disseminating vital information regarding dengue prevention methods such as eliminating mosquito breeding grounds and using protective measures like nets and repellents.

Additionally, RMU's research initiatives are contributing to understanding the epidemiology of dengue in Rawalpindi. Through collaborative research, the university aims to develop more effective strategies for controlling the spread of the virus and mitigating its impact.

In conclusion, Rawalpindi Medical University and the Department of Infectious Diseases remain key players in the ongoing battle against the dengue epidemic, ensuring the well-being of the community and advancing medical knowledge to combat future outbreaks.

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Dr. Muhammad Riaz Akbar

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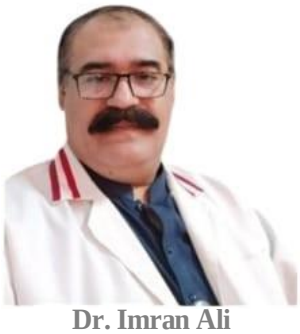
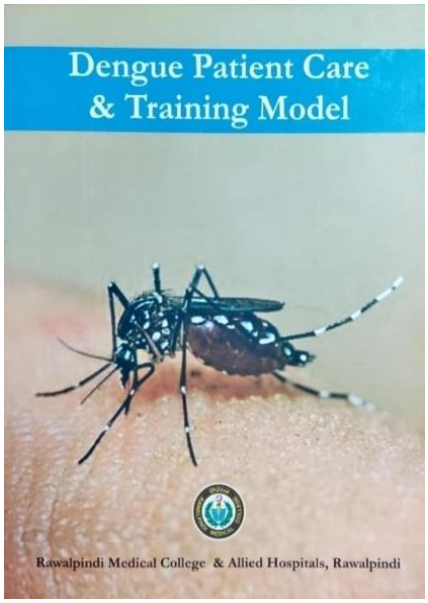


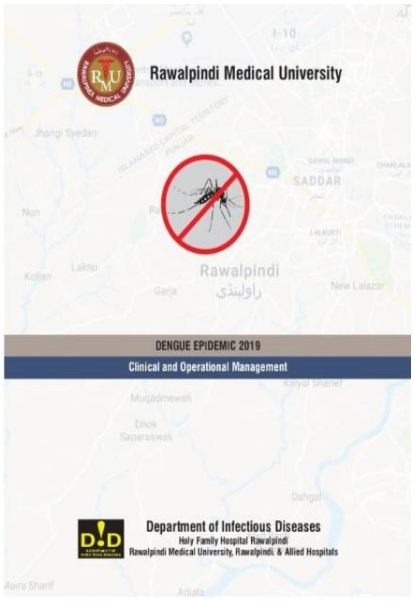
Dr. Imran Ali

Introduction

Dengue fever poses a significant global health challenge, with approximately half of the world's population at risk. Each year, an estimated 100–400 million infections occur, with about 100 million manifesting clinically, leading to approximately 21,000 deaths. While many individuals infected with dengue remain asymptomatic, a considerable number develop symptoms ranging from mild illness to severe conditions such as dengue hemorrhagic fever or dengue shock syndrome. These severe manifestations are now classified under the broader categories of uncomplicated or severe dengue.

Dengue viruses are members of the Flavivirus genus within the Flaviviridae family. This genus encompasses several other mosquito - borne viruses responsible for human diseases, including yellow fever, West Nile virus, Japanese encephalitis, and tick - borne encephalitis.





RMU and Allied Hospitals Rawalpindi

Established in 1948, Holy Family Hospital has been affiliated with Rawalpindi Medical University since 1977.

Located in Satellite Town, it is a 1,000-bed facility providing comprehensive health care services.

Benazir Bhutto Hospital, situated along the bustling situated along the bustling Murree Road, is an integral part of this network. It offers a broad range of medical specialties, including Medicine, Surgery, Pediatrics, Gynecology & Obstetrics, ENT, Ophthalmology, Urology & Dermatology.

The Rawalpindi Teaching Hospital serves the inner city of Rawalpindi and operates as a referral center for trauma cases. Key departments include Medicine, Surgery, Neurosurgery, Chest Diseases, Orthopedics, Gynecology and Obstetrics, Ophthalmology, Otorhinolaryngology and more.

Holy Family Hospital

Benazir Bhutto Hospital

Rawalpindi Teaching Hospital

Dengue fever, an endemic issue in the region, continues to pose significant challenges. This year has seen a notable surge in both suspected and confirmed cases. To address the increasing burden, 1,000 beds have been allocated exclusively for dengue patients. These are distributed across the newly incorporated Allied Hospitals, specifically designated for dengue care.

DEPARTMENT OF INFECTIOUS DISEASE (DID)
RAWALPINDI MEDICAL UNIVERSITY

Rawalpindi Medical University (RMU) stands as the sole public university in Pakistan equipped with a dedicated Department of Infectious Diseases (DID). Established in August 2015 under the direct supervision of the Vice Chancellor, Prof. Dr. Muhammad Umar the department is led by Associate Professor Dr. Muhammad Mujeeb Khan. DID plays a crucial role in managing various epidemics and treating a broad spectrum of endemic infectious diseases nationwide. Its responsibilities encompass addressing outbreaks of dengue, influenza, Crimean-Congo hemorrhagic fever, tuberculosis, leptospirosis, among others. Situated within Holy Family Hospital, Rawalpindi — a tertiary care facility affiliated with Rawalpindi Medical University — the department offers both inpatient and outpatient services.

The primary objective of the Department of Infectious Diseases is to provide patient-centered and evidence-based medical care. Additionally, the department is actively involved in teaching undergraduate and postgraduate medical students and trainees, as well as conducting medical research.

Dengue Fever Epidemics

Historically, dengue - like illnesses have been documented for centuries, with outbreaks reported in tropical and subtropical regions since the 17th century.

The virus is believed to have originated in non-human primates and was transmitted to humans through mosquito vectors. The global spread of dengue accelerated in the mid-20th century, facilitated by increased urbanization, international travel, and trade, leading to the widespread distribution of the Aedes mosquitoes responsibl for transmission. Severe dengue, also known as dengue hemorrhagic fever (DHF), was first identified during epidemics in Southeast Asia in the early 1950s, notably in Manila, Philippines, in 1953–1954. Subsequent outbreaks occurred in Thailand and other countries in the region, establishing dengue as a significant public health concern.

The disease has since become endemic in many Asian and Latin American countries, emerging as a leading cause of hospitalization and death among both children and adults. The World Health Organization (WHO) reports that dengue is now prevalent in over 100 countries, with severe dengue being a leading cause of serious illness and death in some Asian and Latin American nations.

In recent decades, the incidence of dengue has grown dramatically around the world. A combination of factors, including climate change, unplanned urbanization, and increased movement of people and goods, has contributed to the expanding reach of dengue viruses, posing ongoing challenges to public health systems globally.

Dengue Epidemics in Pakistan

The initial case of dengue fever in Pakistan was documented in 1982 in Punjab, with 12 instances identified from a sample of 174 individuals. Subsequent cases were reported in 1994, 1995, and 1997, including two fatalities in Karachi 1995. After nearly a decade, dengue resurfaced in 2005, with 395 cases reported, all confined to Karachi.

By 2006, dengue had spread to northern Pakistan, with over 5,800 cases reported nationwide, Leading to approximately 60 deaths This marked a significant increase in the disease's prevalence. The following year, in 2007, Pakistan to prior years, a major outbreak experienced a severe epidemic, resulting in notable morbidity and mortality. Although the number of cases declined by half in 2009 compared occurred in 2010-11, with over 21,204 cases reported nationwide, predominantly in Punjab. Since then, dengue epidemics have become a recurring issue, typically surfacing every three years on average.

The persistent outbreaks have strained the country's healthcare system, placing immense pressure on resources and personnel. Factors contributing to this challenge include overpopulation, poor access to clean drinking water, inadequate sanitation, and a significant refugee population — all of which sustain the cycle of dengue epidemics in Pakistan.

Dengue Epidemics in Rawalpindi Region

Dengue has become endemic in Pakistan, with Punjab bearing the brunt due to its conducive climate. Lahore and Rawalpindi are among the most severely impacted areas, where hospitals often struggle with bed shortages and an overburdened health care workforce during peak epidemic seasons.

Historical accounts suggest that dengue has existed in the District Rawalpindi long before formal documentation began. References to the disease appear in historical texts, and it is thought to have been introduced through trade routes such as the Silk Road. Advancements in diagnostic technologies have now made it possible to monitor and document the annual outbreaks more effectively.

Since 2013, there has been a marked increase in dengue cases, attributed to factors like rural-to-urban migration, rapid urbanization and inadequate healthcare policies. That year, over 1,200 confirmed cases were recorded, with subsequent years witnessing a rise in patient numbers. The increase is also linked to heightened public awareness, leading to more individuals seeking medical attention at outpatient departments (OPDs).

The epidemic reached its peak in 2015, with nearly 4,000confirmed cases. However, the ongoing outbreak has exceeded previous records, with over 8,000 cases reported this year.

Following the 2015 surge, there was a sharp decline in cases, reflecting the impact of improved surveillance, prevention efforts, and containment strategies. For instance, in 2018, around 650 cases were reported, a figure similar to the count in 2017.

These measures proved particularly effective in 2017, when the number of positive cases dropped to one-fifth of those recorded in 2016.

The Dengue Epidemic 2019

In 2019, Rawalpindi faced an unprecedented dengue outbreak, marking the most severe epidemic in both the city's and the nation's history. Healthcare facilities and personnel were stretched to their limits, with the exhausted workforce soon confronting the emerging COVID-19 pandemic. The epidemic's unexpected early onset in mid-August caught the community off guard. By late September, nearly 10,000 cases had been identified and treated. Holy Family Hospital managed an average of approximately 400 cases daily, with nearly all departments involved in dengue patient care. This immense strain led to a backlog of elective surgeries and diminished capacity to treat other medically complex patients.

While the disease burden is typically shared between the twin cities, in 2019, the suburbs of Rawalpindi were the hardest hit. Contributing factors included delays in implementing preventive measures, the circulation of a new serotype, and a lack of public awareness due to reduced awareness campaigns. Over the four-month period from August to November, approximately 15,000 patients received treatment, and nearly 80,000 individuals were screened at the outpatient departments of Rawalpindi Medical University's teaching hospitals.

Key statistics from the 2019 Dengue epidemic include:

Global Impact:
Approximately 4.7 million cases worldwide.

Pakistan:
Over 54,000 cases, the highest in its history.

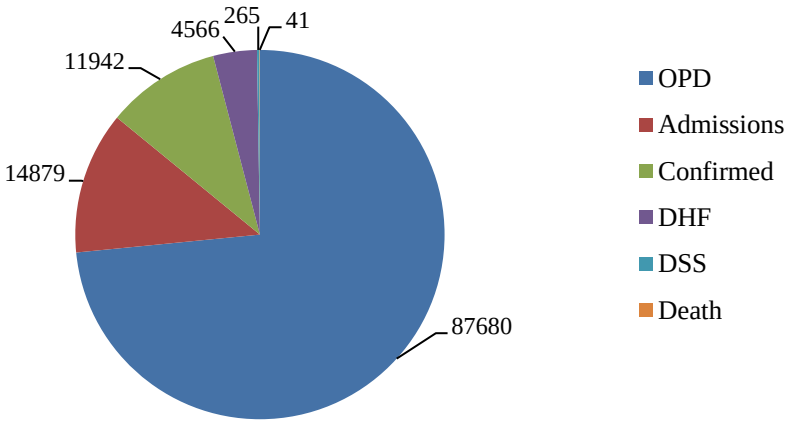
Rawalpindi Medical University (RMU):
Provided care for nearly 12,000 of these cases.

Contributing Factors:
Lapses in dengue preparedness and increased mosquito breeding areas.

Global Mortality Rate:
Ranging from 0.8% to 2.5%.

Rawalpindi Medical University Mortality Rate: 0.6%.

OPD	Admissions	Confirmed	DHF	DSS	Deaths
87680	**14879**	**11942**	**4566**	**265**	**41**



The Dengue Epidemic 2022

In 2022, following the containment of the COVID-19 pandemic and the resumption of outdoor activities, dengue cases in Rawalpindi approached pre-pandemic levels.

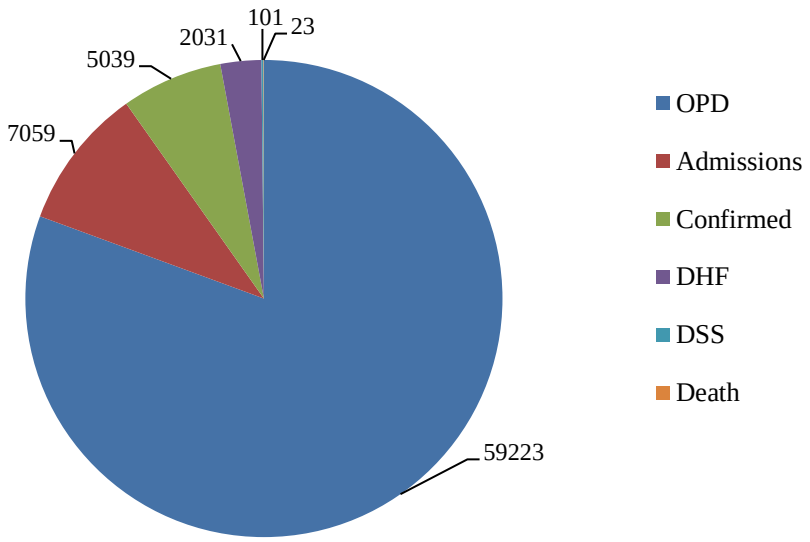
The epidemic began in August, a month earlier than usual, consistent with recent trends.

Nearly 60,000 symptomatic individuals sought care at the outpatient departments of Rawalpindi Medical University's teaching hospitals.

The low admission rate, combined with a high positivity rate among admitted patients, reflects the effectiveness of the screening algorithm.

Approximately 5,000 confirmed dengue cases were treated, with 22 fatalities, resulting in a mortality rate of 0.4%. However, this statistic does not capture the significant fiscal and economic impact on the city.

OPD	Admissions	Confirmed	DHF	DSS	Deaths
59223	**7059**	**5039**	**2031**	**101**	**23**



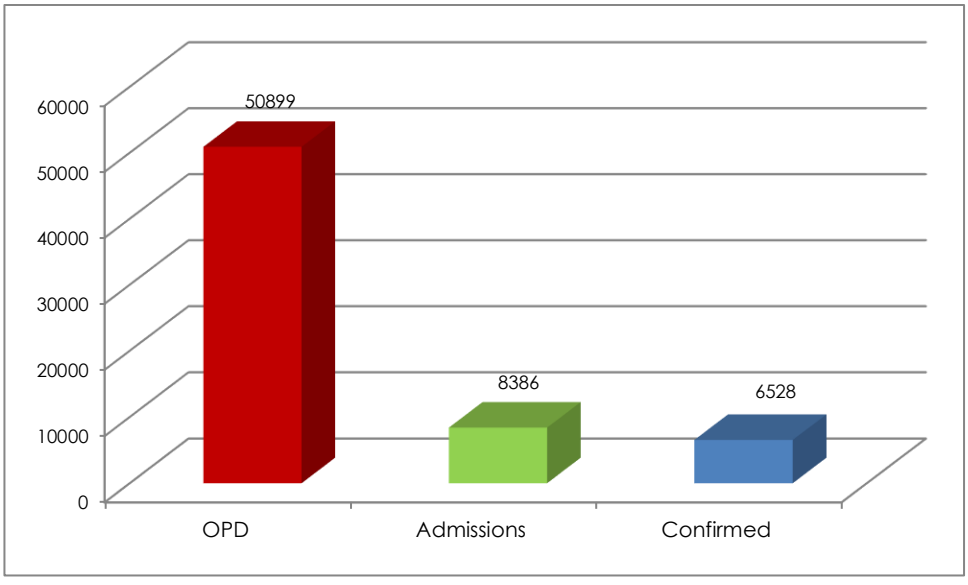
The Dengue Epidemic 2024

In 2024, with the COVID-19 pandemic under control and outdoor activities fully resumed, dengue cases surged, nearing pre-pandemic levels. The epidemic struck again in August, arriving a month earlier than expected, following the trend of recent years.

Nearly 51,000 symptomatic individuals presented to the outpatient departments of Rawalpindi Medical University's teaching hospitals.

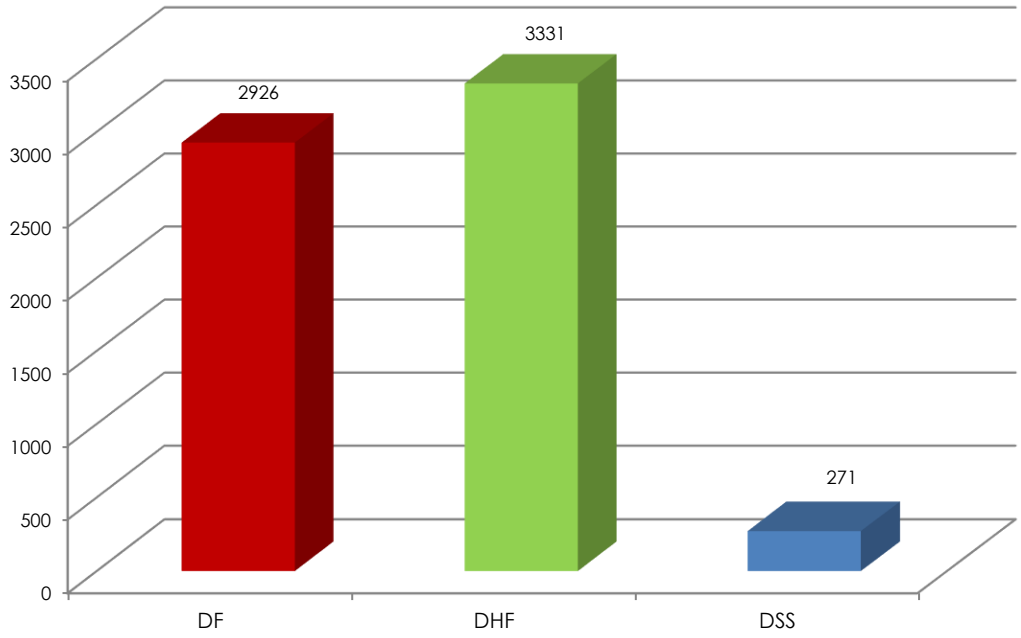
This table presents data of dengue patients for the entire year of 2024, telling us the number of patients that presented to the Outdoor Patient Department (OPD), the number of patients admitted, those confirmed having dengue, Dengue Hemorrhagic Fever (DHF) and Dengue Shock Syndrome (DSS) and total mortality as well in the Allied Hospitals of Rawalpindi Medical University Almost 50899 patients presented to the Dengue OPD of Allied Hospitals in 2024, out of which approximately 8386 were admitted and roughly 6528 of those were confirmed to have dengue fever.

SL	INFORMATION REGARDING	HOLY FAMILY HOSPITAL	BENAZIR BHUTTO HOSPITAL	RAWALPINDI TEACHING HOSPITAL	TOTAL
1	Outdoor Patient Department (OPD)	22441	21590	6868	50899
2	Admissions	4683	2693	1010	8386
3	Confirmed (Dengue Fever)	3638	2082	808	6528
4	Mortality	07	02	-	09



Dengue Patients, (1st Jan – 31st Dec 2024)

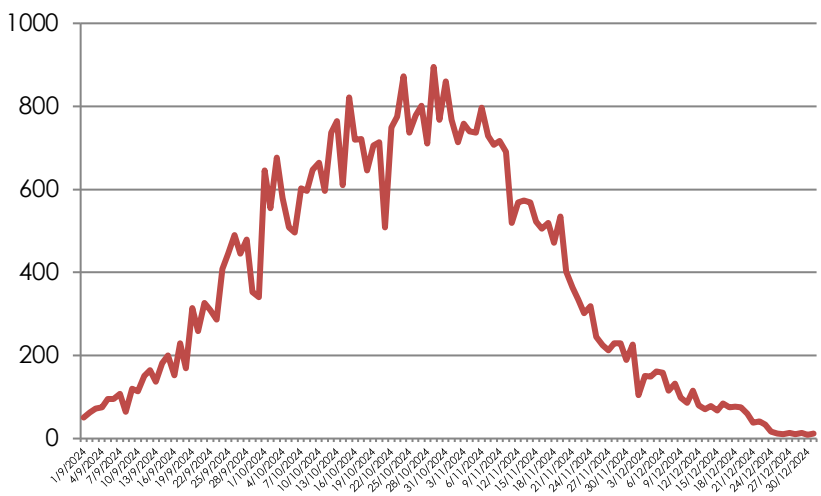
SL	INFORMATION REGARDING	HOLY FAMILY HOSPITAL	BENAZIR BHUTTO HOSPITAL	RAWALPINDI TEACHING HOSPITAL	TOTAL
1	Dengue Fever (DF)	1719 (47%)	800 (39%)	407 (50%)	2926 (45%)
2	Dengue Hemorrhagic Fever (DHF)	1771 (49%)	1175 (56%)	385 (48%)	3331 (51%)
3	Dengue Shock Syndrome (DSS)	148 (4%)	107 (5%)	16 (2%)	271 (4%)
4	Total	3638	2082	808	6528



Confirm Dengue Patients (1st Jan – 31st Dec 2024)

A total of 6528 patients were confirmed dengue cases across the Allied Hospitals, out of which 2926 patients had simple Dengue Fever, while 3331 had Dengue Hemorrhagic Fever, and 271 were found to have Dengue Shock Syndrome.

Data of the patients presenting to the Dengue OPD of all three hospitals was collected daily, which has allowed us to graph a chart of number of patients presenting to the OPD on a daily basis. We can notice that the maximum number of patients visited the Dengue OPD during the end of October and the start of November 2024.



Trend of Dengue Patients OPD, (1st Sep – 31st Dec 2024)

Similarly, the maximum number of patients admitted with dengue were during the same time period as well, i.e., end of October 2024.

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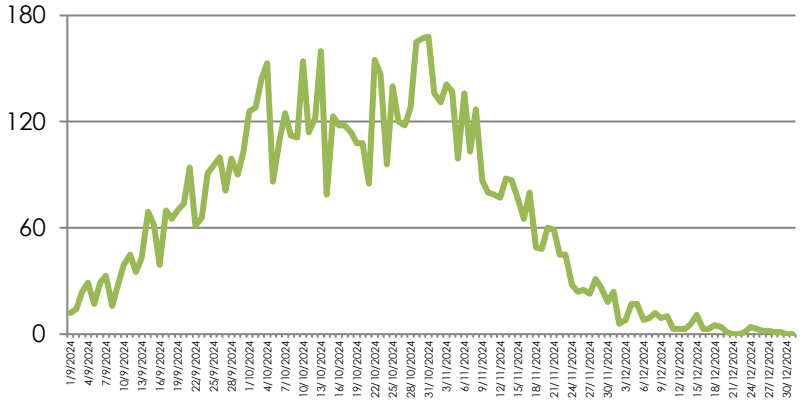


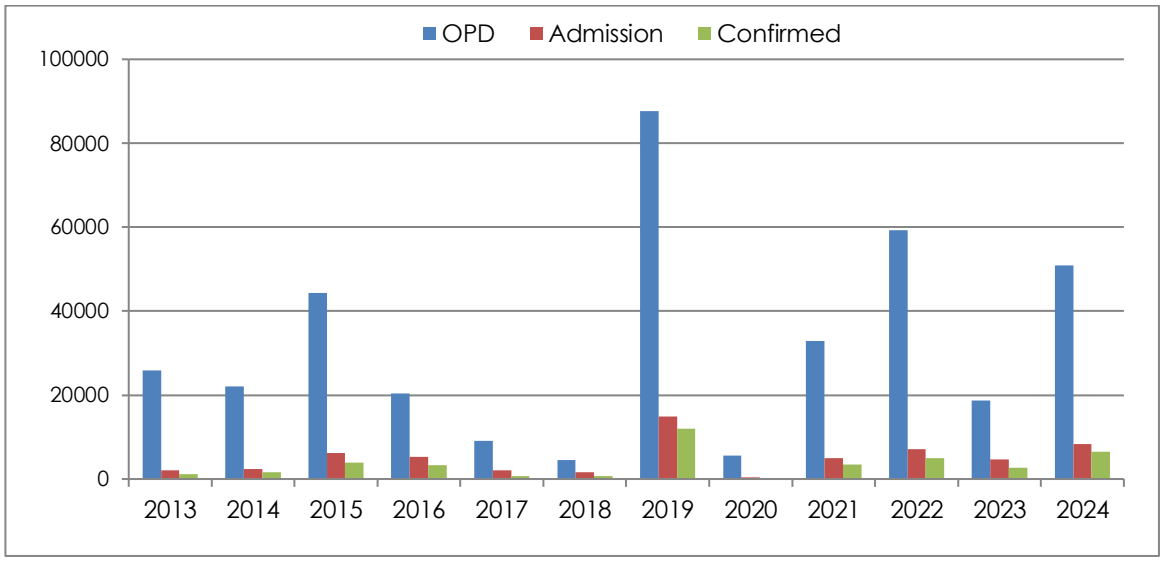
Trend of Dengue Patients Admissions, (1st Sep – 31st Dec 2024)

Trend of Dengue Patients Confirmed (1st Sep – 31st Dec 2024)

RMU & Allied Hospitals, Rawalpindi
Twelve Year Comparative Analysis of Dengue
2013 to 2024

Over the years, dengue epidemics have exhibited a recurring pattern, with significant outbreaks often succeeded by 2-3 years of milder activity. This trend is likely due to the enduring benefits of interventions implemented during major epidemics. Additionally, variations in circulating serotypes contribute to this pattern, as larger epidemics are typically associated with the presence of multiple dominant serotypes. Since data collection commenced in 2013, the ratio of patients presenting to outpatient departments (OPDs) compared to those confirmed with dengue fever has consistently been approximately 10:1, with this gap gradually widening. This widening gap reflects both the psychological impact on the public and the increasing effectiveness of awareness campaigns. The significant ratio observed in 2020 can be attributed to the concurrent COVID-19 pandemic and the stringent precautions implemented during that period.

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
OPD	25914	22126	44337	20449	9131	4516	87680	5648	32940	59223	18637	50899
Admissions		2422	6139	5258	2116	1561	14879	350	5050	7059	4621	8386
Confirmed	1223	1571	3917	3306	651	717	11942	38	3526	5039	2738	6528
DHF	339 (27.71%)	570 (36.28%)	1384 (35.33%)	992 (30%)	217 (33.33%)	120 (16.73%)	4566 (38.23%)	18 (47.36%)	1714 (48.61%)	2031 (40.30%)	711 (25.96%)	3331 (51.02%)
DSS		32 (2.03%)	84 (2.14%)	55 (1.66%)	13 (1.99%)	1 (0.13%)	265 (2.21%)	1 (2.63%)	92 (2.60%)	101 (2%)	66 (2.41%)	271 (4.15%)
Expiries	7	2	8	3	3	2	41	0	24	23	-	09
Expiry %	0.57%	0.12%	0.20%	0.09%	0.46%	0.27%	0.34%	Nil	0.68%	(0.44%)	-	(0.13%)
Predominant Genotype	DEN-2	DEN-3 (85.9%)	DEN-2 (62%)	DEN-2 (45.16%) DEN-3 (42.18%)	DEN-2 (72%)	NA	DEN 1&2	NA	DEN-2 (23%)	DEN 1 (40%) DEN 2 (60%)	DEN 1 (71%) DEN 2 (29%)	DEN 2 (90%) DEN 1 (10%)



Twelve years data of Dengue Patients

Dengue Patients Trends (2013-2024)

This graph below illustrates the 12-year epidemiological trends of dengue fever cases, showing significant fluctuations in disease incidence across Punjab. The data reveals distinct outbreak patterns and periods of disease control.

Key Observations:

Record Outbreak (2019):

Peak incidence of 11,942 cases Remains the highest annual caseload in the dataset

Post-Epidemic Decline:

Sharp drop seen in 2017, 2018 and 2020 Suggests successful containment measures after the outbreak

Recent Trends:

2020 showed the lowest incidence, potentially influenced by:

COVID-19 movement restrictions

Enhanced vector control measures

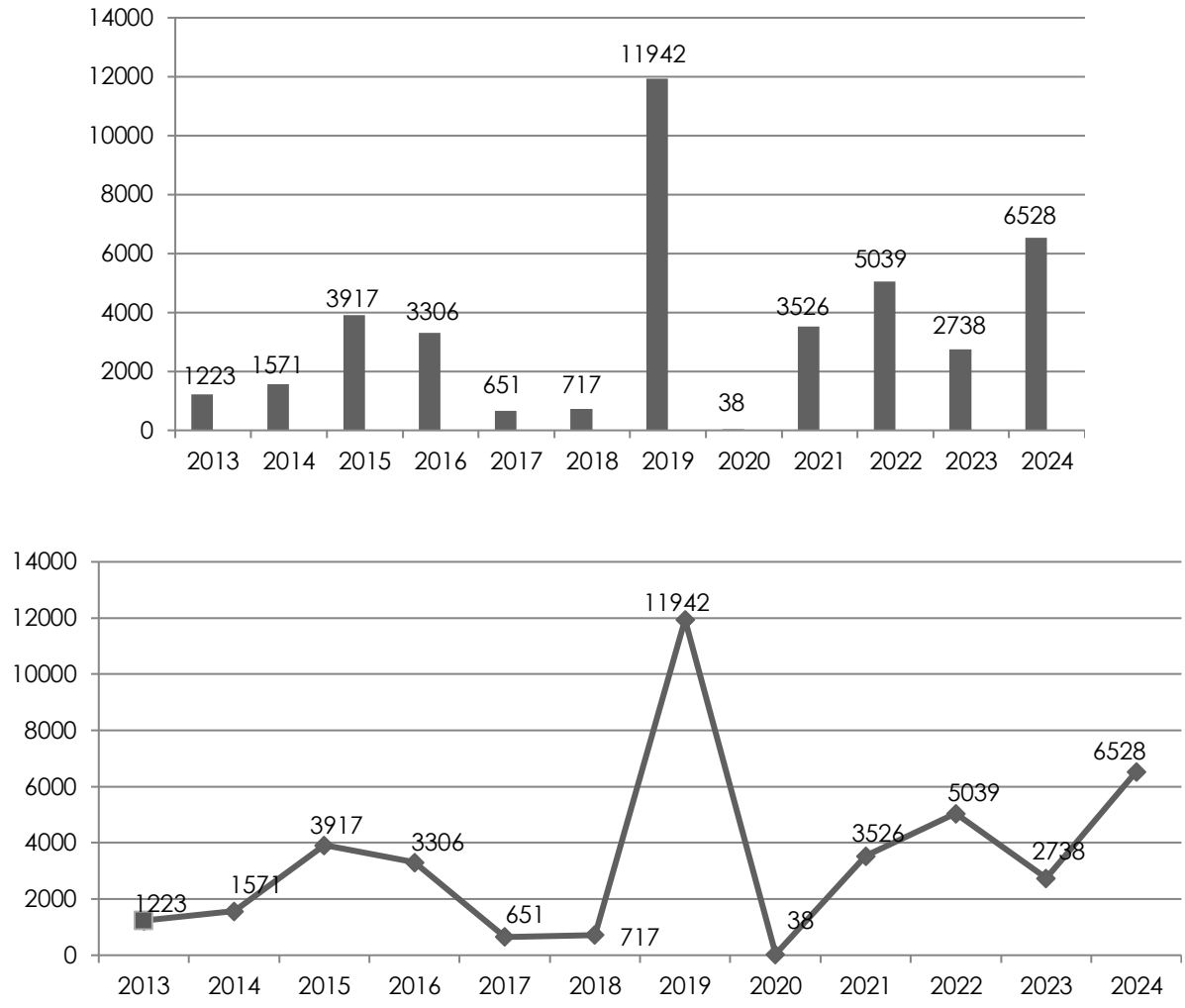
2024 resurgence (6,528 cases) indicates ongoing epidemic potential Notable Patterns:

Notable Patterns:

5-6 year cyclical pattern evident (peaks in 2013, 2018-2019, 2024)

2020-2021 showed unusually low numbers (<1,000 cases annually)

2023-2024 demonstrate a return to pre-pandemic levels



Total Dengue Patients --- Trends 2013-2024

Dengue Fever Trend 2013 – 2024

This graph provides a visual representation of the number of dengue fever cases reported each year, along with the percentage change from the previous year. Here's a breakdown of the key insights:

Fluctuating Case Numbers:

The number of dengue cases varies dramatically year to year, suggesting inconsistent outbreak patterns, possibly influenced by climate, public health measures, and mosquito control efforts.

2013–2015:

Cases dropped significantly in 2013 (884), rose in 2015 (2449), then dropped sharply again in 2017 (421).

2019 Spike:

A dramatic surge to 7,111 cases in 2019, likely indicating a major outbreak.

Pandemic Dip in 2020:

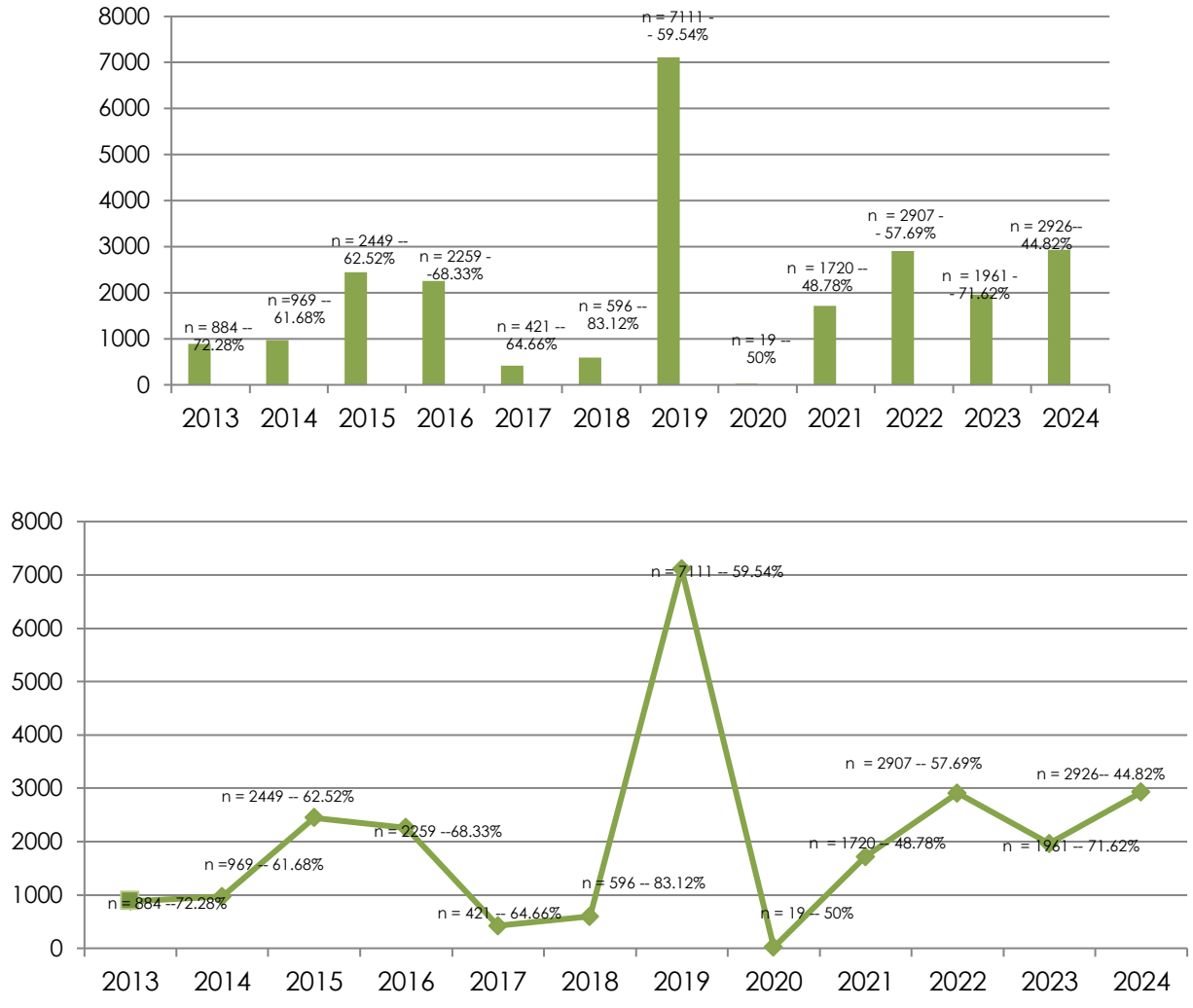
Only 19 cases were reported, possibly due to COVID-19 lockdowns reducing outdoor exposure and movement.

Rebound Years:

Case numbers bounced back in 2021 and remained variable through 2024 (2,926).

Most Volatile Year:

2018 saw an 83.12% increase, and 2023 had a steep -71.62% drop.



Dengue Fever --- Trends 2013-2024

Dengue Hemorrhagic Fever - Trend 2013-2024

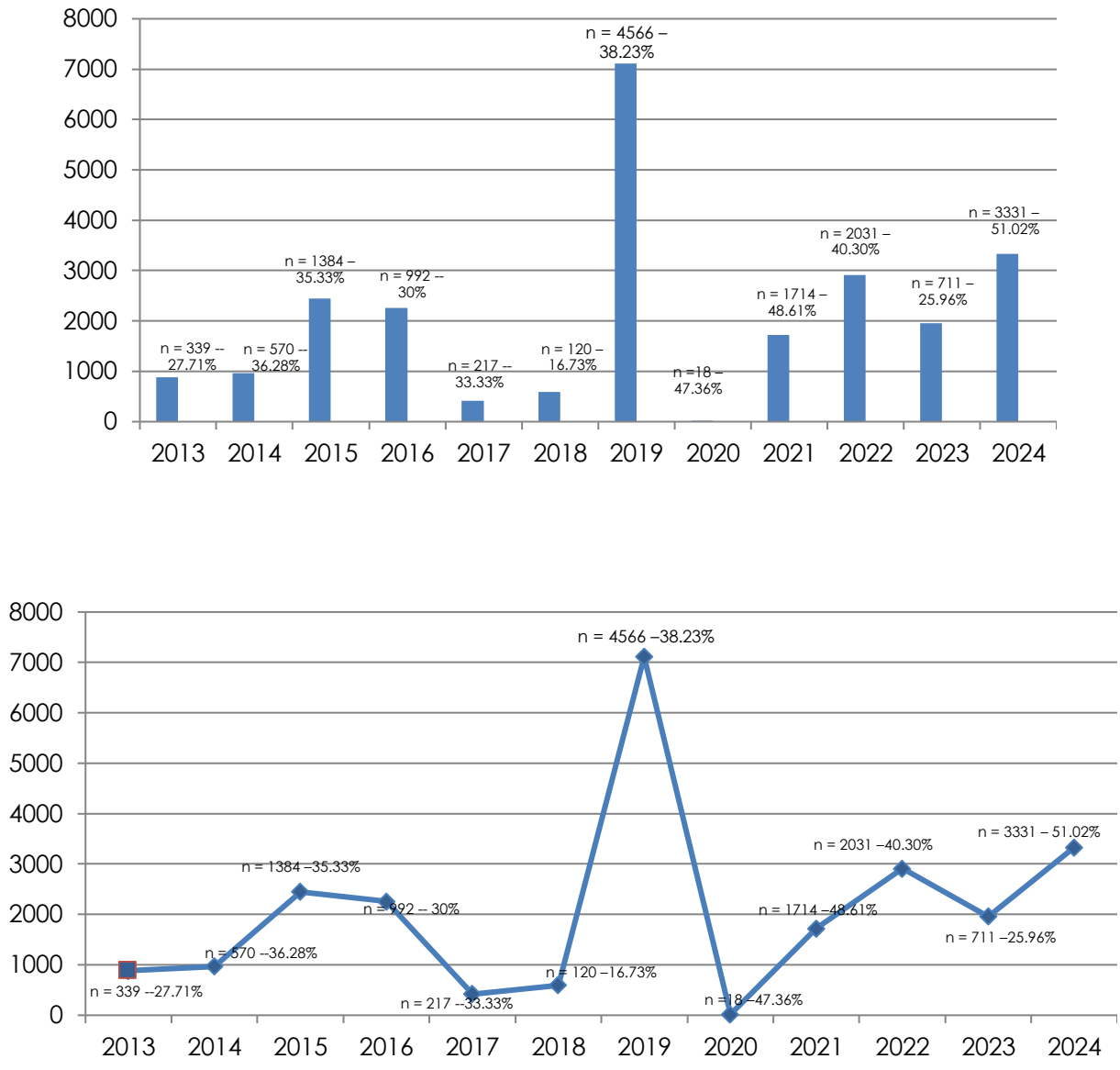
The graph presents the trends in Dengue Hemorrhagic Fever (DHF) cases and their associated percentages from 2013 to 2024. Over this 12-year period, significant fluctuations in both case numbers and severity rates are observed, reflecting the dynamic nature of DHF outbreaks.

Key observations include:

The highest number of cases was recorded in 2019 (n = 4,566), accompanied by a severity rate of 38.23%.

Peak severity rates occurred in 2024 (51.02%) indicating periods of heightened disease impact.

The lowest severity rates were observed in 2016 (16.73%) suggesting improved management or reduced virulence during these years. Recent years, such as 2021 (48.61%) and 2024 (51.02%), show a resurgence in severity, underscoring the persistent threat of DHF.



Dengue Hemorrhagic Fever --- Trends 2013-2024

Dengue Shock Syndrome - Trends 2103 – 2024

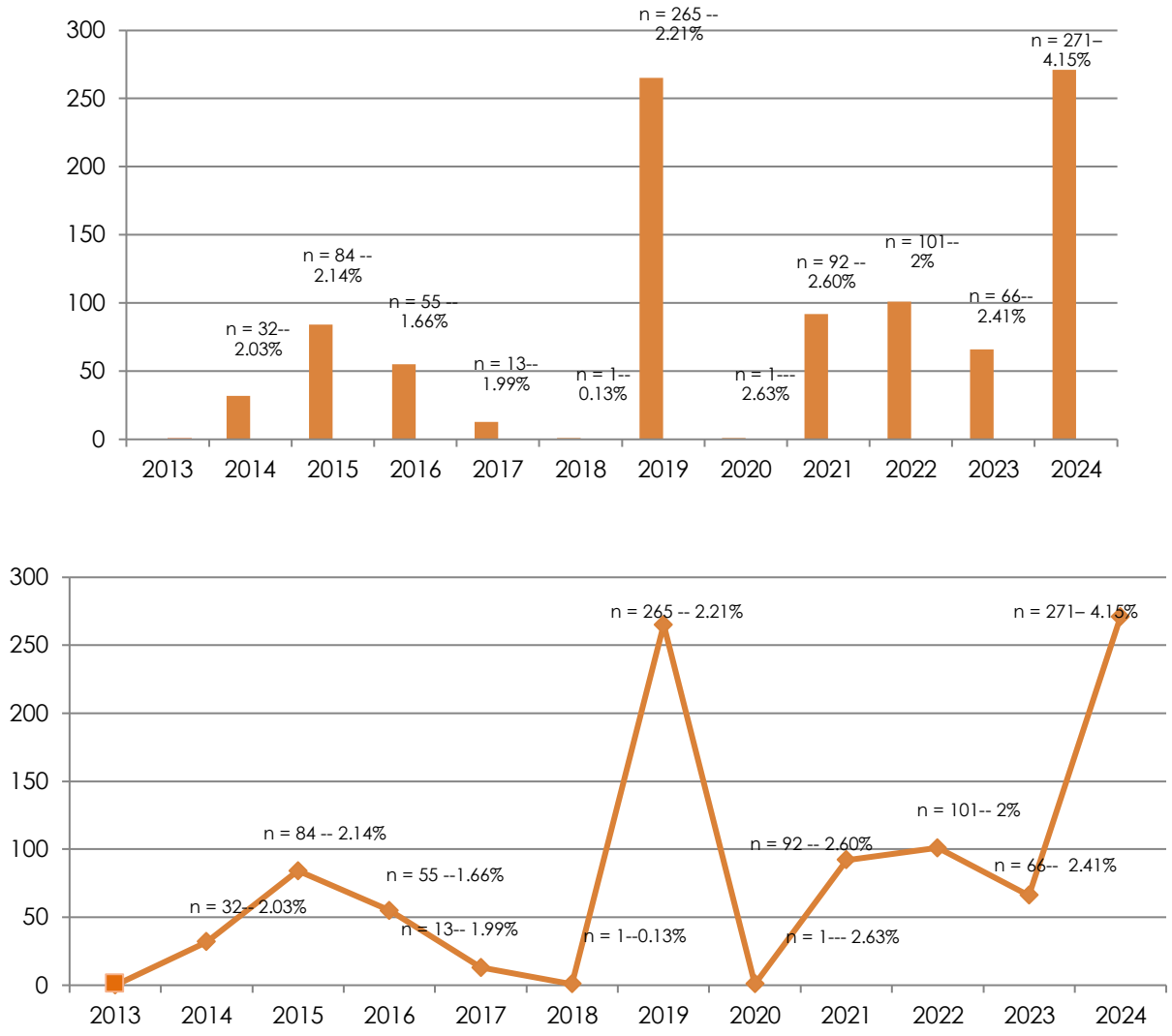
The graph illustrates the trends in Dengue Shock Syndrome (DSS) cases from 2013 to 2024, highlighting both the number of cases (*n*) and the associated mortality rates (percentage).

Over this 12-year period, fluctuations in DSS incidence and fatality rates are evident, with notable peaks and declines.

Key observations include:

Highest cases were recorded in 2019 (n = 265, 2.21%) and 2024 (n = 271, 4.15%), with a significant mortality rate in 2014.

Lowest cases occurred in 2020 (n = 1, 0.13%), reflecting a drastic reduction in incidence and fatalities.



Dengue Shock Syndrome --- Trends 2013-2024

Dengue Mortality Trends - 2013 – 2024

This graph presents key metrics related to dengue fever cases and mortality in Punjab, categorized according to established DEAG (Dengue Expert Advisory Group) criteria. The data provides insights into disease burden and outcomes over an 11-year period (excluding 2023).

Total Dengue-Related Mortality

Total mortalities in dengue patients: 29

Direct dengue-related deaths: 15

Deaths due to co-morbidities in dengue patients: 14

Early Years (2013–2018):

Dengue-related deaths remained relatively low and stable, mostly in single digits each year—peaking at 8 deaths in 2015 and dipping as low as 2 in 2014.

Sharp Spike (2019–2020):

A notable surge occurred with 24 deaths each year in 2019 and 2020. This period marks the most significant increase in the mortality rate, possibly linked to a major outbreak or strained healthcare response.

Gradual Decline (2021–2024):

Post-2020, the trend reverses:

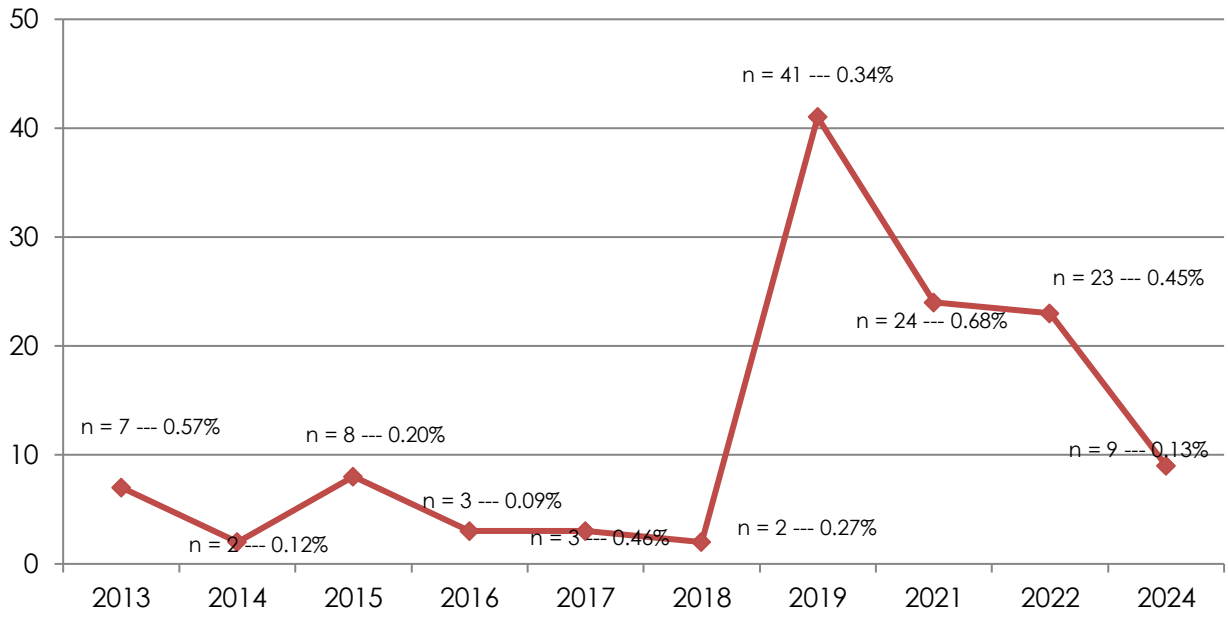
2021: 24 deaths (though it's higher in number, the rate is lower at 0.68% due to more cases).

2022: Drops to 23 deaths.

2023 & 2024:

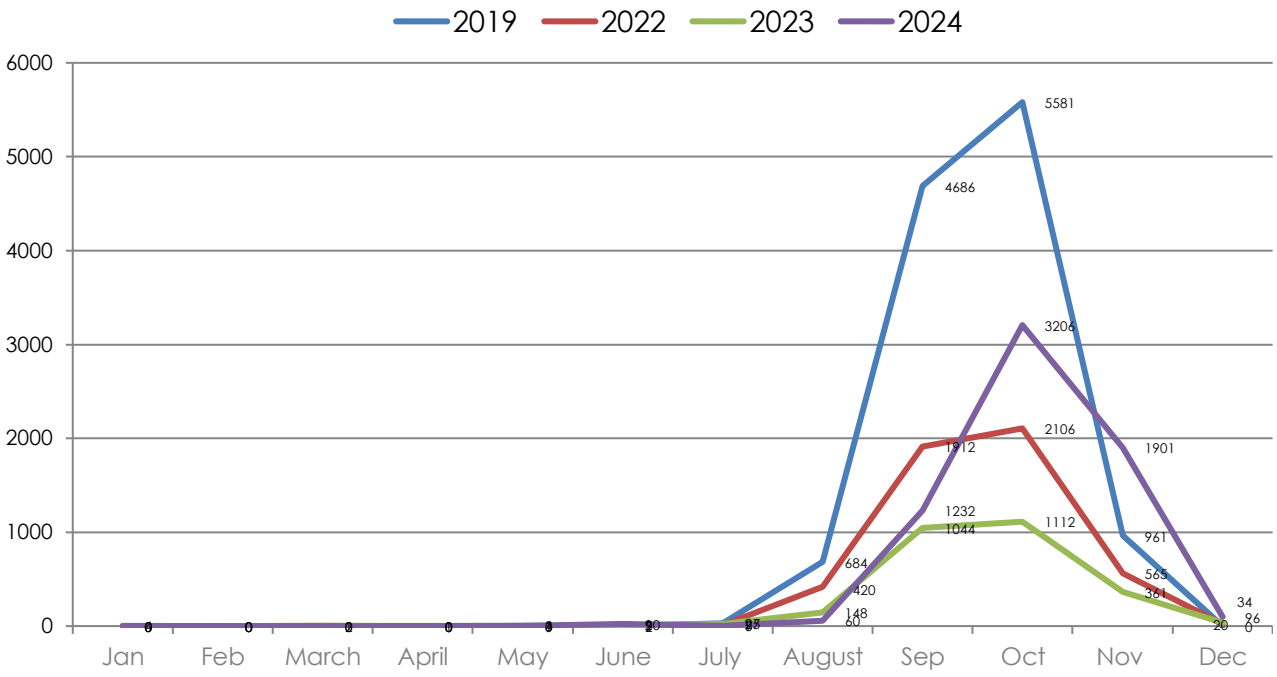
Continue to stabilize at 9 deaths each year, with consistent 0.13% mortality rate.

Dashboard deaths according to Punjab and DEAG criteria	**09 (07 HFH 02 BBH)**
Dengue related Deaths	15 (13 HFH 02 BBH)
Deaths due to co morbidities	14
Total Mortalities in Dengue Patients	29



Dengue Mortalities Trends 2013 – 2024

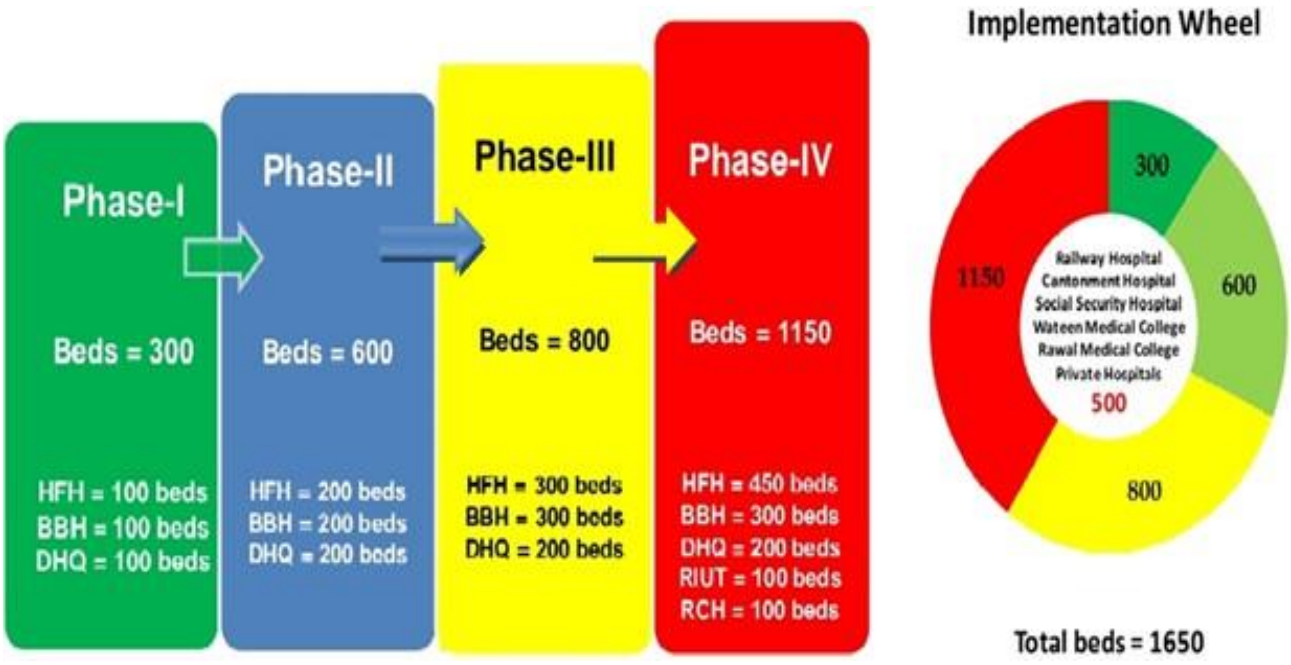
Year/ Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2019	0	0	0	0	1	2	27	**684**	**4686**	**5581**	**961**	**0**	**11942**
2022	0	0	2	0	0	5	9	**420**	**1912**	**2106**	**565**	**20**	**5039**
2023	0	0	1	1	3	9	25	**148**	**1044**	**1112**	**361**	**34**	**2738**
2024	4	0	0	0	4	20	5	**60**	**1232**	**3206**	**1901**	**96**	**6528**



Four major Dengue epidemics managed at RMU & Allied Hospitals

This here is a comparison between the years 2019, 2022, 2023 and 2024 on a monthly basis relative to the number of confirmed dengue cases.

RMU & Allied Hospitals Rawalpindi
Ramp-up Plan for Dengue Clinical Management Beds 2024



The Ramp-up Plan signifies the efforts of RMU Allied Hospitals to combat the dengue epidemic. With each phase, the number of beds dedicated in not just the Allied Hospitals, but also Rawalpindi Institute of Urology and Transplantation (RIUT) and Red Crescent Hospital (RCH) increase, with the ultimate goal of dedicating a total 1650 beds for dengue patients only.

Department of Infectious Diseases
Dengue Management Training Human Resource

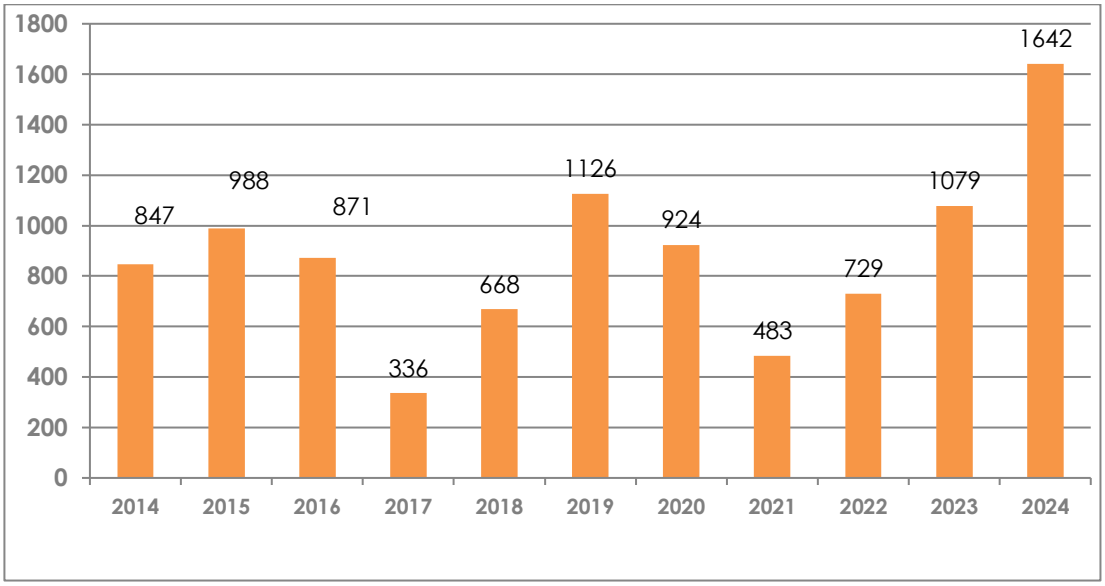
In response to these challenges, comprehensive training programs have been developed to enhance the capabilities of healthcare professionals in managing dengue cases. These programs focus on early detection, effective patient management, and the implementation of preventive measures to control the spread of the virus.

By equipping healthcare workers with the necessary skills and knowledge, the healthcare system aims to improve patient outcomes and reduce the burden of dengue epidemics in the future.

Without doctors, nurses and the paramedic staff, dengue epidemic could never be controlled.

The above tells provides an exact number of health care workers employed each year to combat this epidemic, whether government or private.

		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Doctors	**Govt.**	303	598	397	145	342	528	431	275	410	433	519
	Private	128	61	136	36	27	19	57	-	-	22	189
Nurses	**Govt.**	377	273	216	100	264	552	415	208	319	494	667
	Private	7	37	26	55	34	27	21	-	-	20	94
Paramedics	**Govt.**	11	9	79	-	-	-	-	-	-	103	155
	Private	21	10	17	-	1	-	-	-	-	07	18
Total		**847**	**988**	**871**	**336**	**668**	**1126**	**924**	**483**	**729**	**1079**	**1642**



Year wise Dengue Management Training 2014-2024

Multi Disciplinary Allied Departments Role in Dengue Patients Management

Dengue management at the Allied Hospitals of Rawalpindi Medical University (RMU) relied heavily on the unwavering support of the Radiology, Pathology, and Blood Bank departments. These departments played a pivotal role in handling the acute nature of the disease and Managing the rapid influx of patients.

The Radiology Department worked tirelessly to assess patients for signs of progression to the hemorrhagic phase, ensuring early intervention when needed. Meanwhile, the Blood Bank maintained a continuous supply of blood products, an essential resource for treating patients with hemorrhagic complications. The Pathology Department adapted quickly by establishing a makeshift unit within the Infectious Diseases Ward to provide prompt diagnostic services.

i. Radiology Services

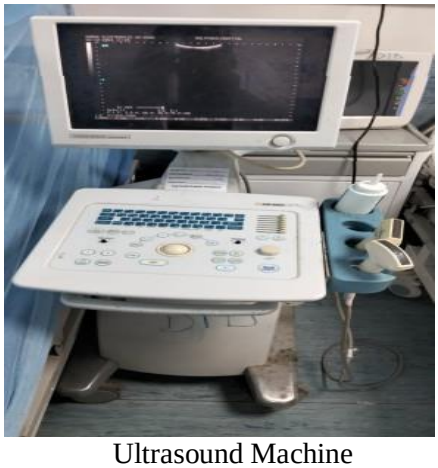
Radiology services played a crucial role in the daily management of dengue patients. Ultrasound examinations of the abdomen and chest were performed routinely for all admitted patients to identify potential complications early.

The department also provided bedside ultrasound and X-ray services to minimize complications and detect vascular leakage promptly.

During the epidemic, nearly 884 chest X-rays and 18,817 ultrasounds were conducted, with common findings including pleural fluid collection, gallbladder wall thickening, pericholecystic fluid, hepatomegaly and splenomegaly.

Dengue related Radiological Tests in 2024	
Chest X-ray	**Dengue Specific Ultrasound**
2016	21386

x-ray Machine



Ultrasound Machine

ii. Blood Bank Services

The Blood Bank services of Holy Family Hospital and other allied hospitals ensured a continuous supply of blood products for dengue patients, who are prone to severe bleeding. Especially for the dengue patients, the hospital provided blood products on a non-donor basis, making it possible to arrange and transfuse blood immediately to save lives. The blood banks of all three Allied Hospitals worked around the clock to provide all blood groups, including rare ones, ensuring no delay in patient care.

iii. Pathology Services

Pathology services were instrumental in diagnosing and monitoring dengue cases. Key diagnostic tools and practices included:

NS1 Testing: Used to detect the non-structural NS1 protein of the dengue virus in serum. Most NS1 tests utilize synthetically labeled antibodies for accurate detection.

Serology: Dengue-specific IgM and neutralizing antibodies generally develop toward the end of the first week of illness. IgM levels typically become positive starting five days post-symptom onset and may persist for up to 12 weeks or longer.

Dengue PCR Testing: During the epidemic season, PCR tests were performed for all NS1-positive patients to confirm the diagnosis and guide further management. A total of 345 PCR test were conducted during the 2024 epidemic.

Routine and Specialized Tests: The Infectious Diseases Ward is equipped with CBC counter machine, operational 24/7. Routine investigations such as RFTs, LFTs, serum electrolytes, urine R/E, PT, aPTT, and ESR were conducted daily. Special investigations, including cardiac enzymes, cholesterol, albumin levels, and arterial blood gases (ABGs), were reserved for patients with Dengue Hemorrhagic Fever (DHF) or Dengue Shock Syndrome (DSS).

Dengue Related Laboratory Tests Conducted in 2024			
Blood CP	Viral Serology		
	NS1	IgM	IgG
78215	8386		

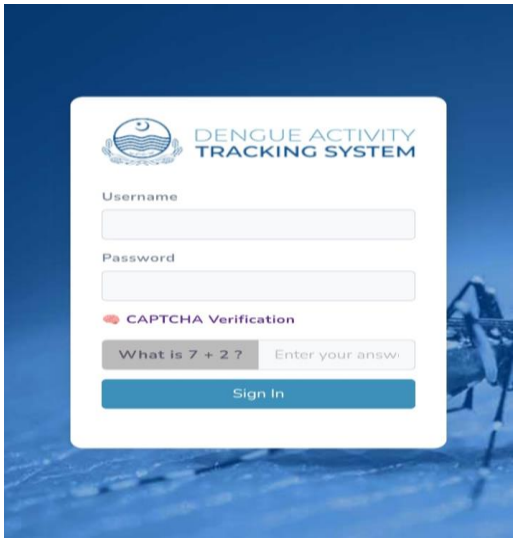
Pathology (Lab)

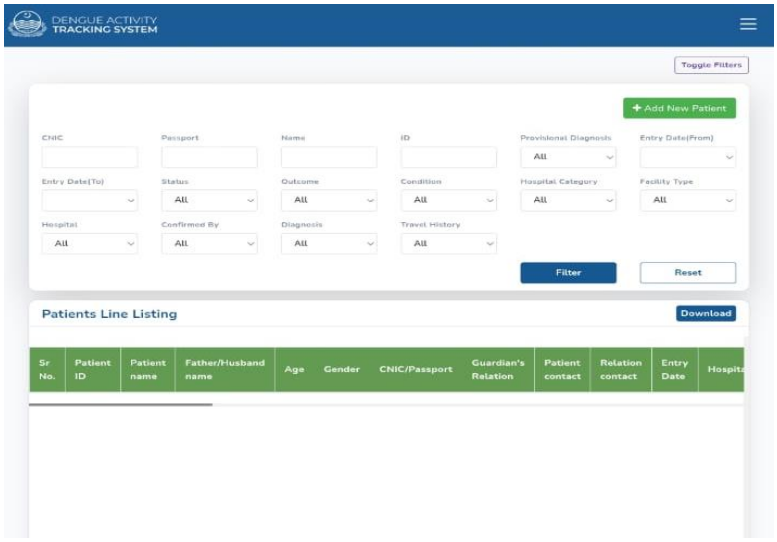
Complete Blood Picture Machine

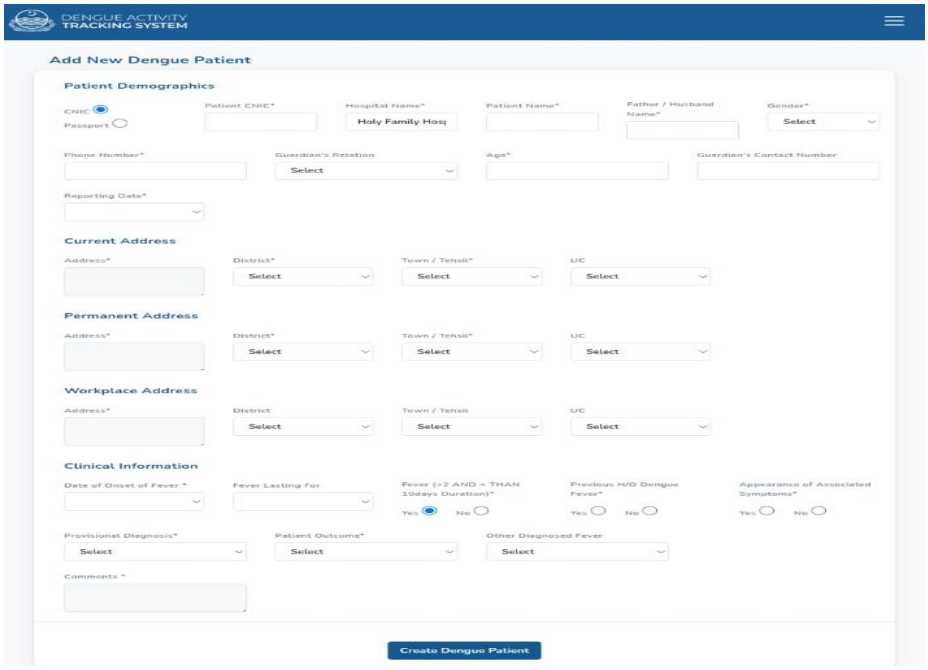
Information Technology and Dengue Live Dashboard

RMU's Information Technology department established dedicated stations in the dengue wards of Allied Hospitals. These stations were linked to the Punjab Information Technology Board (PITB) live dashboard, which was updated in real time with patient data. Notifications from the dashboard alerted the primary healthcare department, activating the prevention team.

The team utilized demographic data to visit affected areas, assess disease prevalence, and inspect for mosquitoes and larvae. Preventive measures, including spraying, eliminating breeding grounds, and community education, were implemented promptly. These efforts were integral in controlling the source of the epidemic, raising public awareness, and preventing further spread of dengue.







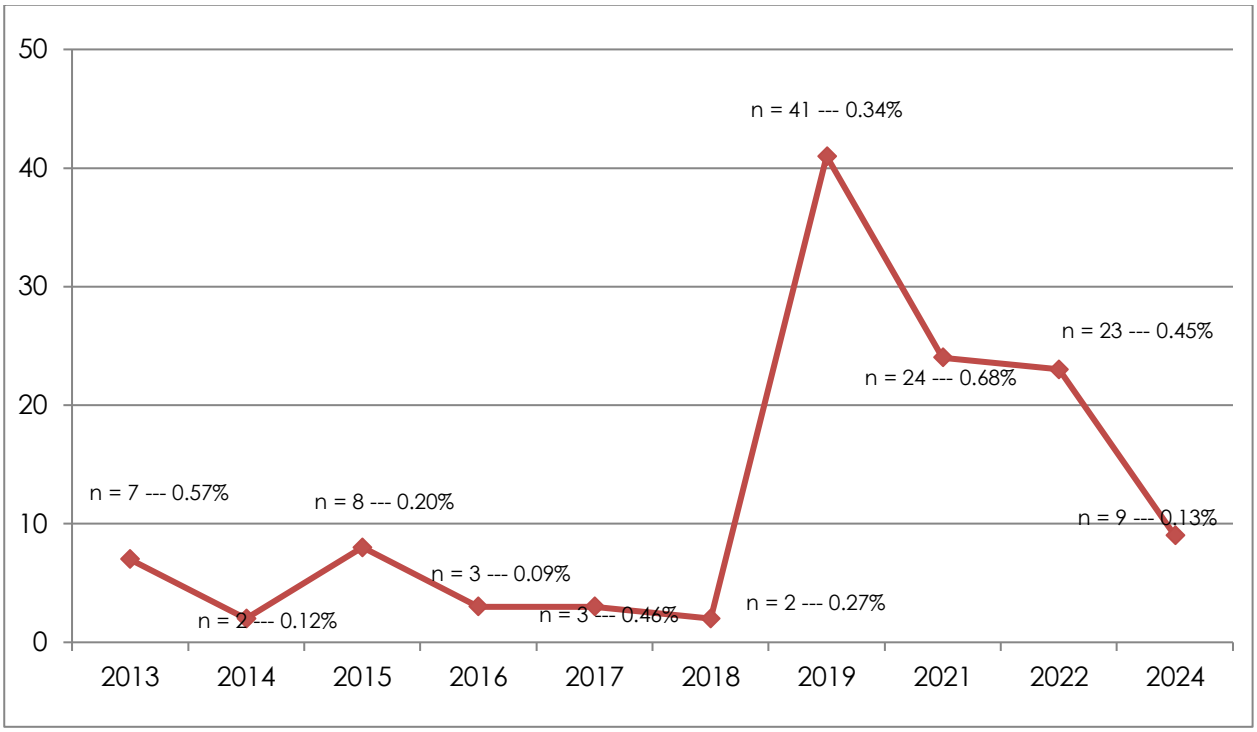
Dengue Mortality Trends

Dengue typically has a low mortality rate, with simple dengue fever presenting a mortality of less than 1%, dengue hemorrhagic fever ranging from 2-5%, and dengue shock syndrome carrying a significantly higher mortality of nearly 50%.

Rawalpindi Medical University (RMU) has achieved an exceptional mortality rate of less than 0.1%, with all recorded fatalities attributed to cases of dengue shock syndrome. Each death underwent thorough review in mortality meetings held at the respective hospitals.

Clinical mortality audits were submitted to the Dengue Expert Advisory Group (DEAG) and the Punjab Health Department using the prescribed mortality forms.

Dashboard deaths according to Punjab and DEAG criteria	**09 (07 HFH 02 BBH)**
Dengue related Deaths	15 (13 HFH 02 BBH)
Deaths due to co morbidities	14
Total Mortalities in Dengue Patients	29



12 years Comparative Mortality Trends
Rawalpindi Medical University & Allied Hospitals

Financial Burden of Dengue Disease
RMU & Allied Hospitals

The financial strain of dengue management has intensified due to rising inflation and the economic downturn, which have contributed to increasing healthcare costs. Rawalpindi Medical University has meticulously itemized and audited the total expenses associated with dengue care. Efforts are underway to collaborate with clinicians and administrators to reduce costs while maintaining the quality of healthcare services.

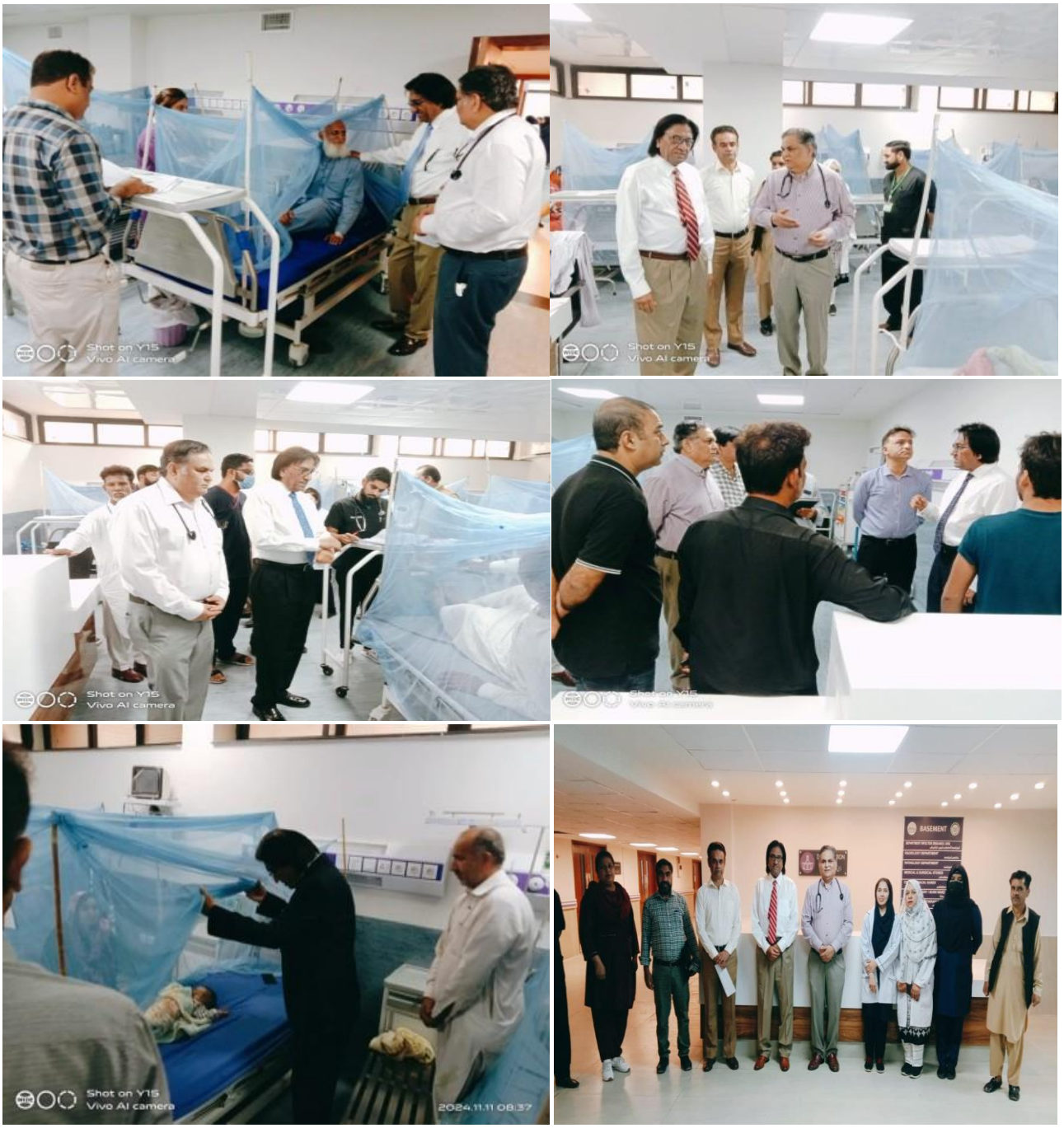
	HFH	BBH	RTH	TOTAL
Cost (in Rs)	1,57,39592 (15.73 million)	1,12,86935 (11.28 million)	1,21,04689 (12.10 million)	3,91,31216 (39.13 million)

RMU & Allied Hospitals Dengue Epidemics

During the dengue epidemic, the Vice Chancellor of Rawalpindi Medical University prioritized hands-on involvement by visiting the wards of all three Allied Hospitals at least twice daily early in the morning and at midnight. His routine often included three visits a day, even on Sundays and public holidays. Each morning, he chaired a strategic meeting with Professors of Medicine / Infectious Diseases, Pathology, and Radiology, as well as the Medical Superintendent (MS), Assistant Medical Superintendent (AMS), and Deputy Medical Superintendent (DMS) of each hospital to evaluate the situation and make decisions.

The Vice Chancellor actively participated in both administrative and clinical aspects of epidemic management. He personally assessed challenges, implemented solutions, and ensured smooth operations. During rounds, he interacted with on-duty doctors, addressing their concerns, and consulted with patients in the wards and outpatient departments (OPDs) to gather feedback. His proactive leadership was instrumental in securing resources and optimizing patient care during the crisis.

Prof. Dr. Muhammad Umar conducted a visit to the Dengue Ward, accompanied by the Head of the Department of Infectious Diseases



Prof. Dr. Muhammad Umar, Vice Chancellor of RMU,
conducted multiple visits to the Dengue Ward at various times, accompanied
by the Head of the Department of Infectious Diseases and other supporting staff

Dengue Specific Daily Morning Meeting
Department of Infectious Diseases

In 2024, Holy Family Hospital's Department of Infectious Diseases implemented daily morning meetings to enhance patient care during the dengue epidemic.

Led by Vice Chancellor Prof. Dr. Muhammad Umer, these meetings convened key personnel, including department heads such as Prof. Dr. Muhammad Khurram (Medical Unit 2), Dr. Muhammad Mujeeb (Infectious Diseases), Dr. Saima Ambreen (Medical Unit 1), and Dr. Ibrar Ahmed (Medical Intensive Care Unit), along with on-call senior registrars, postgraduate trainees, medical officers, the head of nursing staff, and other essential team members.

The primary focus of these meetings was to review critical patients, discuss management strategies and analyse mortalities.

This collaborative approach facilitated informed decision-making and the implementation of necessary measures to improve healthcare delivery. The initiative proved instrumental in optimizing patient outcomes and resource allocation during the crisis. The success of these meetings underscores the importance of structured, interdisciplinary communication in healthcare settings, particularly during public health emergencies. By fostering collaboration among various departments and professionals, Holy Family Hospital was able to respond more effectively to the challenges posed by the dengue epidemic.

Prof. Dr. Muhammad Umar, Vice Chancellor of RMU, conducted daily morning meetings in the Dengue Ward conference room, accompanied by the Head of the Department of Infectious Diseases, Heads of other departments, Doctors, and supporting staff.

Standard Operating Procedure (SOPS)
Dengue Management

A detail of Dengue epidemic Standard Operating Procedure (SOPs) which were followed in true letter and spirit.

SOPS For Dengue Ward/Unit

Vice Chancellor, Rawalpindi Medical University

Vice chancellor Prof Dr. Muhammad Umar Is administrative as well as clinical Incharge of epidemic management.

Hospital Administration

MS/AMS/DMS

Ensures smooth running of the Dengue Ward, including;

1. Provision of adequate staff
2. Availability of investigations
3. Arrangement of blood products
4. Availability of medication
5. Maintenance of cleanliness
6. Provision of patient files and papers
7. Compliance with inter-unit calls
8. Compilation of data and statistics
9. Coordination with other departments, health authorities and district administration
10. Security Management.

- Ensures a mosquito free, clean and aesthetically maintained environment.
- Conducts rounds in each shift with documentation focusing on patient satisfaction and patient satisfaction and provision of facilities (medications, cleanliness, toilets, and other services)
- Ensures dengue prevention steps are displayed and educational clips are played depending on feasibility.
- Coordinates with other departments whenever required.
- Arranges dengue markers urgently if required and not available through routine channels.

Consultant Infectious Diseases/ Medicine

- Incharge of the unit regarding patient management, smooth running of the unit, and research.
- Conducts ward rounds with proper documentation during duty hours.

  Remains on call and attends patients whenever requested by the Senior Registrar (SR).
- Contacts other DDEAG members for clinical issues.
- Coordinates with Hospital Management for administrative issues and smooth running of the unit.

Senior Registrar

- Available on the floor 24 hours in duty shifts.
- Conduct morning, evening, and night rounds with proper documentation.
- Reviews every new or problematic patient as required; problematic patients are reviewed at least twice during each duty shift.
- Attends patients whenever requested by the on duty.
- Supervised the Dengue OPD.
- Works under the supervision of the DID consultant.
- May contact DDEAG members for clinical issues.
- Coordinates with Hospital Management for administrative issues.

Medical Officers

- Are responsible for running the Dengue OPD and managing OPD patients.
- Clinically evaluate, investigate and admit patients during duty hours as per DEAG guidelines.

- Document patient history, clinical examination, differential diagnoses, and complete all necessary paper work/forms related to patient management
- Directly transfer critically ill patients to the HDU without delay and hand them over to the treating doctors.
- Manage admitted patients, ensuring clinical evaluation, investigations, and treatment in accordance with DEAG guidelines.
- Place progress notes at least twice per patients during duty hours with increased frequency for severe cases (2-3 times for DHF, and 3-4 times for DSS) and as clinically indicated.
- Supervise Nursing Staff regarding patient management, documentation and completion of forms.
- Prepare appropriate discharge slips and provide dengue prevention counseling to patients and attendants.
- Seek guidance from the on call Senior Registrar for any clinical issues.
- Coordinate with hospital administration for matters related to the smooth functioning of the Dengue ward.
- Ensure that a Dengue Performa is completing for every diagnosed Dengue patient.

Nursing Staff

- Ensure patient management is carried out according to DEAG guidelines.
- Complete all paperwork, arrange investigations, and support the smooth running of the Dengue Ward in coordination with hospital administration and duty doctors.
- Display the name of the concerned staff nurse and the shift for each room outside the room.
- Upon patient admission, record vital signs and general condition, inform the duty doctor, prepare the patient file, and provide it to the concerned doctor.
- Monitor DF patients every 4–6 hours, and monitor DHF/DSS patients every 1 hour or every 15 minutes, depending on severity. In case of non-improving or problematic patients, promptly involve the duty doctor.
- Ensure CBC/HCT is performed at least once daily for every patient. For patients in the critical period perform the test at least twice daily (morning and evening), and additionally as directed by the duty doctor.
- Senior Sister conducts morning and evening rounds to assess patient satisfaction and documents the findings.
- Ensure Dengue Performa completion, accurate record keeping, and data entry into SPSS with the assistance of the ward clerk.
- Sister Incharge maintains and updates the dengue information board.

Medical Unit

- Provides PGTs and HOs as require/requested by DID consultant.
- Consultants supervise the working of unit wherever required

Radiology Team

- Ensure that ultrasound (USG) or chest X-ray (CXR), when advised, is performed at the earliest.
- Attend critical patients within half an hour of request.
- Perform USG for non-critical patients within 3 hours of request.
- Provide written preliminary reporting of CXR/CT scan immediately by the on-duty doctor.

- Ensure subsequent urgent reporting of CXR/CT scan by the Radiology Consultant.
- Provide statistics on a shift, daily, weekly, and total basis.

Laboratory Staff

- Responsible for the earliest, prompt, and timely provision of investigations.
- Provide statistics on a shift, daily, weekly, and total basis.
- Report CBC within 15 minutes for critical patients and within 1 hour for non-critical patients.

Dashboard Team

- Keep the PITB/Dashboard personnel updated.
- Responsible for record keeping and file maintenance, including DDEAG communications.

  Ensure completion of the Dengue Performa, proper record keeping, and entry into SPSS.
- Prepare and make available a daily updated report of admitted patients by 8:30 a.m., including details such as name, age, gender, address, recent travel history, results of dengue markers, dengue diagnosis, duration of hospital stay, and comorbidities (if any). Assistance from the Sister Incharge is sought for this process.

Blood Bank Team

- Make sure of blood / product arrangement if necessary.
- Provided statistics on weekly basis.

Community Medicine Team

- Provides preventive information to patients attendants and general public.
- Records of these are maintained.

Divisional Dengue Expert Advisory Group

- Conducts clinical audits of all dengue-related deaths reported in the assigned districts and sends the report, along with the DEAG algorithm for declaration of dengue death to the Central DEAG.
- Takes appropriate actions regarding patient management issues.
- Maintains records of dengue mortalities and keeps them available for any further review.

Human Resource/Infrastructure/ Medications Human Resource

Following yardstick was suggested for dedicated human resource provision;

For 10 patients:

- Medical Officer: 1 per shift (3 shifts) + 1 reliever
- Nurses: 2 per shift (3 shifts) + 1 reliever
- Senior Registrar: 1 per shift (3 shifts) + 1 reliever (required when patient load reaches 50-75 Patients)

For 100 patients:

- Pathologist and Hematology Technician: 1 per shift (3 shifts) + 1 reliever
- Ultra-sonographer: 1 per shift (3 shifts) + 1 reliever

Additionally, ancillary staff, including ward boys, clerks, janitorial service personnel, and security personnel, are required for smooth functioning of the Dengue Ward.

INFRASTRUCTURE

EQUIPMENT

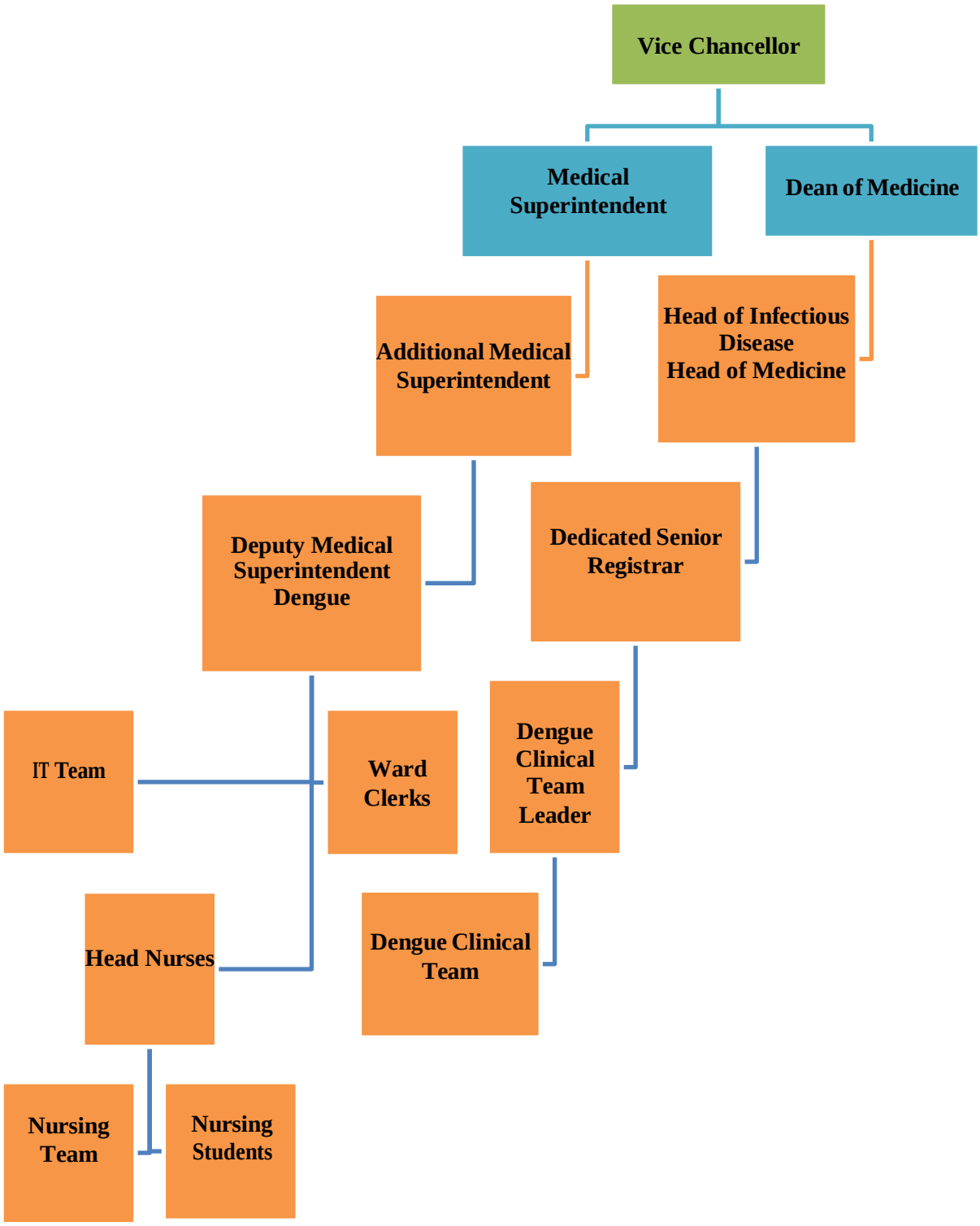
During periods of increased patient load, hospital beds may become saturated. The Dengue Ward/DID has a capacity of 100 beds. Once this capacity is reached, additional patients are accommodated in Medical Units and other designated units.

For the management of 100 patients, a CBC analyzer and an ultrasound machine with backup (in case of equipment failure) are available at the DID.

MEDICATION

A stock of 40 Dextran units is available. Additional supply is expedited by the hospital administration as needed.All other required medications are ensured to be available and provided free of cost to patients

Management Hierarchy of Dengue Epidemic 2024
RMU & Allied Hospitals



Dengue Awareness, Prevention and Management Training Program for Health Care Professionals: Rawalpindi Medical University (RMU)

Rawalpindi Medical University (RMU) has implemented comprehensive strategies to combat dengue fever, focusing on healthcare professional training, public awareness, and effective patient management protocols. Annually, RMU organizes seminars for healthcare staff to discuss the latest developments, treatment updates, and emerging challenges related to dengue. These seminars serve as invaluable tools for keeping the medical team informed and fostering teamwork. Regular training sessions, led by senior faculty members and aligned with the Dengue Expert Advisory Group (DEAG) guidelines, are conducted for local staff and visiting personnel from provincial hospitals. These initiatives ensure that healthcare professionals are well-equipped to manage dengue cases effectively.

Prof. Dr. Muhammad Umar
Vice Chancellor, RMU

Prof. Dr. Muhammad Khurram
Dean of Medicine, RMU

Dr. Muhammad Mujeeb Khan
HOD DID, RMU

Prof. Dr. Muhammad Umar, Vice Chancellor, RMU & Allied Hospitals, accompained by the Head of Department of Infectious Disease, Guests Speaker and Faculty Members

RMU Model of Dengue Patient Management and Algorithms

When a patient presents with symptoms indicative of dengue at the designated counter, they are directed to the Dengue Outpatient Department (OPD). Here, nursing staff records the patient's vital signs before the patient consults with a senior physician — such as a Medical Officer, Postgraduate trainee, Senior Registrar, Assistant Professor, or Professor — who conducts a thorough medical history review and, if necessary, a physical examination. Following the completion of the "O Form" and its entry into the Live Dashboard, a Complete Blood Count (CBC) is ordered.

If results indicate bi-cytopenia or thrombocytopenia, admission to the dengue ward is recommended. Upon arrival in the ward an admission file is prepared, with the type determined by the patient's condition:

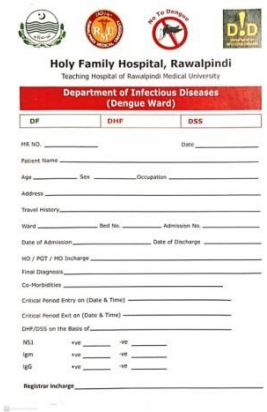
Red File: Assigned to patients diagnosed with Dengue Shock Syndrome (DSS) or Dengue Haemorrhagic Fever (DHF).

Green File: Assigned to patients with Dengue Fever (DF).

The patient is then assigned a bed, and continuous monitoring is initiated, encompassing vital signs and fluid intake/output charting. All observations are meticulously documented.

Prescribed medications are listed on the medication chart and administered promptly by healthcare staff. Additionally, patients may undergo a Chest X-Ray (CXR) and an Abdominal Ultrasound (USG), with the frequency of these investigations tailored to the patient's clinical status. Daily morning rounds are led by Dr. Mujeeb, Head of the Department of Infectious Diseases (HOD DID), with subsequent rounds conducted by on-duty physicians throughout the day and evening.

Green File

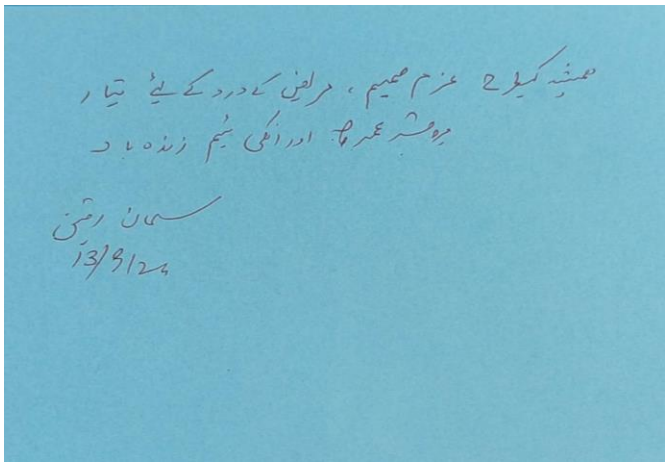


Red File

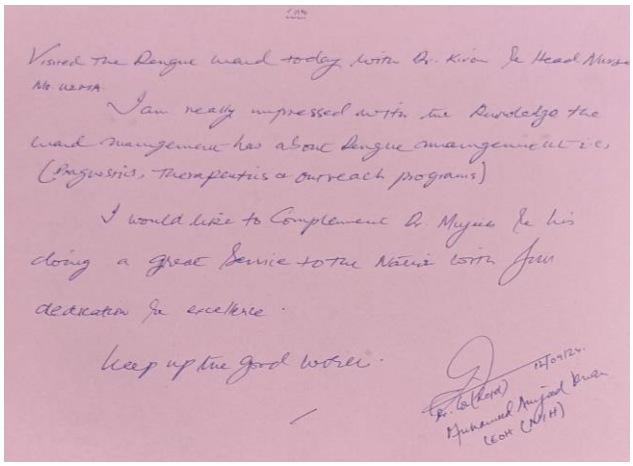
O Form

R Form

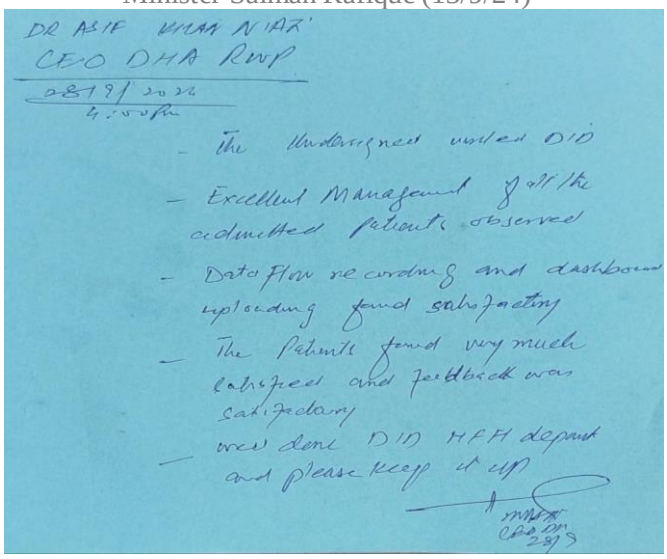
Comments of Visitors 2024



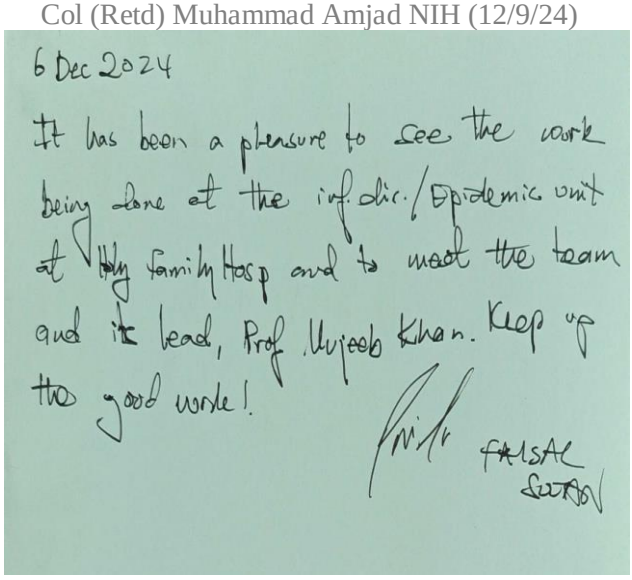
Minister Salman Rafique (13/9/24)



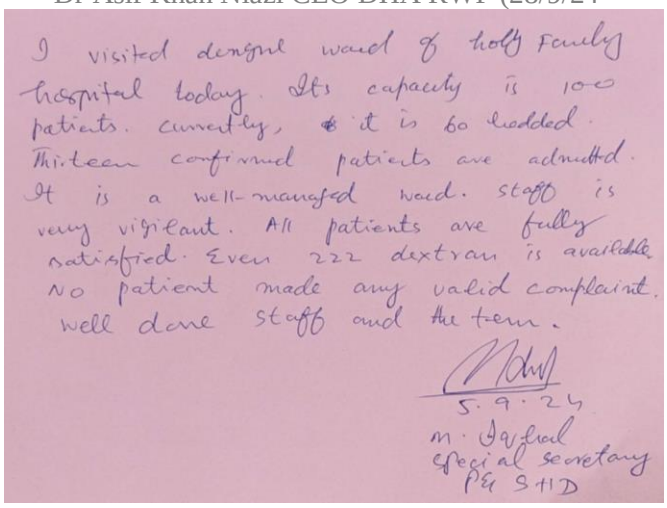
Col (Retd) Muhammad Amjad NIH (12/9/24)



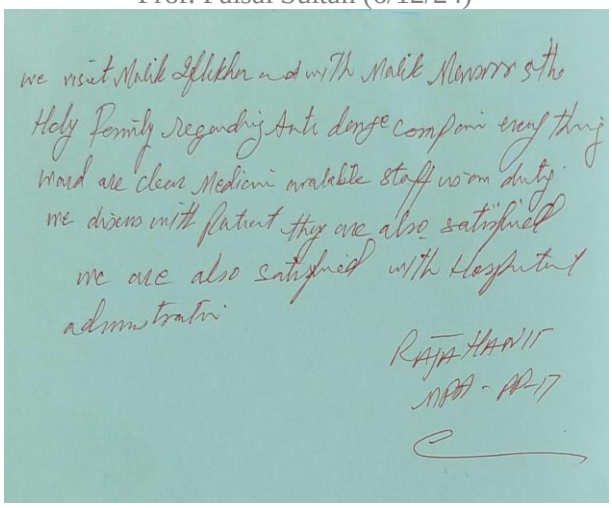
Dr Asif Khan Niazi CEO DHA RWP (28/9/24



Prof. Faisal Sultan (6/12/24)

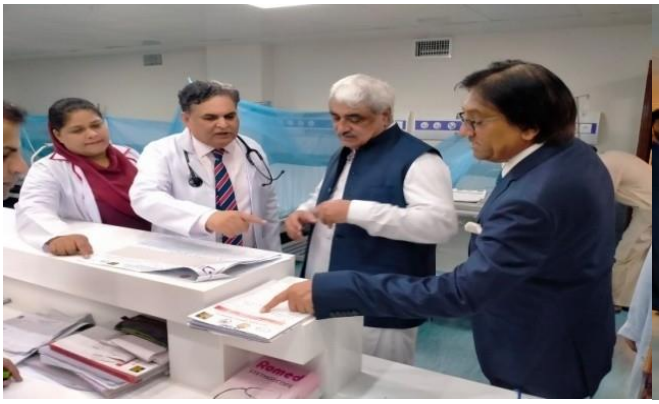


M Iqbal Special Secretary P&SHD (5/9/24)



Raja Hanif MPA PP-17

Visitors' Gallery 2024




Minister Khawaja Salman Rafique


Minister Sardar Ramesh Singh Arora

Prof. Muhammad Imran Hassan Khan

Raja Hanif MPA PP-17

Prof. Faisal Sultan

Col (Retd) Muhammad Amjad NIH

Department of Infectious Disease
Dengue Research Publications 2014-2024

1. **Research Output (2014–2025):**
   - 51 dengue-related articles published by RMU, totaling 481 citations.
   - Top themes: Diagnostics (17 articles), Epidemiology (15), Pathogenesis (10), Prevention (8), and Climate (1).
2. **Clinical Insights:**
   - **Epidemiology:** Urban outbreaks dominated (70% of studies); DHF patients showed 66.2% male predominance.
   - **Pathogenesis:** Elevated ALT levels linked to severe dengue; rare cases of HLH complicating dengue-malaria co-infections.
   - **Diagnostics:** Raman spectroscopy identified 12 unique biomarkers for dengue, achieving 85-100% accuracy in some studies.
3. **Mortality & Trends:**
   - RMU achieved <0.1% dengue mortality (vs. global DSS mortality of ~50%).
   - 2013 recorded the highest cases (11,942), while 2020 saw the lowest (651).
4. **Innovations:**
   - Machine learning (SVM, Random Forest) applied to Raman spectra for rapid dengue detection.
   - Ultrasonography validated for detecting plasma leakage in DHF.
5. **Gaps & Future Directions:**
   - Need for rural-focused studies, biomarkers for early severity prediction, and climate-resilient control strategies.

Sr. No.	Research Article	Year	Journal and IF
1	Khurram M, Qayyum W, ul Hassan SJ, Mumtaz S, Bushra HT, Umar M. Dengue hemorrhagic fever: comparison of patients with primary and secondary infections. Journal of infection and public health. 2014 Nov 1;7(6):489-95.	2014	Journal of Infection and Public Health (4.7)
2	Khurram M, Qayyum W, Faheem M, Umar M, Bushra HT, Khan MU, Khan N. Characteristics of dengue shock syndrome during 2014 dengue epidemic in Rawalpindi, Pakistan. Rawal Medical Journal 1970 Jan 1;41(2):142-.	2014	Rawal Medical Journal (0.4)
3	Khurram M, Faheem M, Umar M, Yasin A, Qayyum W, Ashraf A, Zahid Khan J, Hasnain Yasir A, Ansari Y, Asad M, Khan I. Hemophagocytic lymphohistiocytosis complicating dengue and Plasmodium vivax coinfection. Case Reports in Medicine. 2015; 2015(1):696842.	2015	Case Reports in Medicine (0.8)
4	Khurram M, Qayyum W, Umar M, Jawad M, Mumtaz S, Khaar HT. Ultrasonographic pattern of plasma leak in dengue haemorrhagic fever. J Pak Med Assoc. 2016 Mar 1;66(3):260-4.	2016	Journal of the Pakistan Medical Association (0.8)
5	Khan S, Ullah R, Khurram M, Ali H, Mahmood A, Khan A, Ahmed M. Evaluation of Raman spectroscopy in comparison to commonly performed dengue diagnostic tests. Journal of Biomedical Optics. 2016 Sep 1;21(9):095005-.	2016	Journal of Biomedical Optics. (3.0)

6	Bilal M, Saleem M, Bilal M, Ijaz T, Khan S, Ullah R, Raza A, Khurram M, Akram W, Ahmed M. Raman spectroscopy- based screening of IgM positive and negative sera for dengue virus infection. Laser Physics. 2016 Oct 21;26(11):115602	2016	Laser Physics (1.2)
7	Khan S, Ullah R, Khan A, Wahab N, Bilal M, Ahmed M. Analysis of dengue infection based on Raman spectroscopy and support vector machine (SVM). Biomedical optics express. 2016 Jun 1;7(6):2249-56.	2016	Biomedical optics express (2.9)
8	Amin A, Ghouri N, Ali S, Ahmed M, Saleem M, Qazi J. Identification of new spectral signatures associated with dengue virus infected sera. Journal of Raman Spectroscopy. 2017 May;48(5):705-10.	2017	Journal of Raman Spectroscopy (2.4)
9	Bilal M, Bilal M, Saleem M, Khurram M, Khan S, Ullah R, Ali H, Ahmed M, Shahzada S, Khan EU. Raman spectroscopy based investigation of molecular changes associated with an early stage of dengue virus infection. Laser Physics. 2017 Feb 17;27(4):045601.	2017	Laser Physics (1.2)
10	Bilal M, Ullah R, Khan S, Ali H, Saleem M, Ahmed M. Lactate based optical screening of dengue virus infection in human sera using Raman spectroscopy. Biomedical optics express. 2017 Feb 1;8(2):1250-6.	2017	Biomedical optics express (2.9)
11	Khan S, Ullah R, Khan A, Sohail A, Wahab N, Bilal M, Ahmed M. Random forest-based evaluation of Raman spectroscopy for dengue fever analysis. Applied spectroscopy. 2017 Sep;71(9):2111-7.	2017	Applied spectroscopy (2.2)
12	Ayaz F, Furrukh M. Assessment of severity of dengue fever by deranged alanine aminotransferase levels. Cureus. 2020 Sep;12(9).	2021	Cureus Journal of Medical Science (1.0)
13	Shamshad S, Khan S, Raja GK, Ahmad MS, Asad MJ, Zainab T. Correlation of C-reactive protein levels, gene polymorphism and platelets count in Dengue infection. JPMA. The Journal of the Pakistan Medical Association. 2021 Feb 1;71(2 (A):429-33.	2021	The Journal of the Pakistan Medical Association (0.8)
14	Raza FA, Javed H, Khan MM, Ullah O, Fatima A, Zaheer M, Mohsin S, Hasnain S, Khalid R, Salam AA. Dengue and Chikungunya virus co-infection in major metropolitan cities of provinces of Punjab and Khyber Pakhtunkhwa: A multi-center study. PLoS Neglected Tropical Diseases. 2021 Sep 23;15(9):e0009802.	2021	PLoS Neglected Tropical Diseases (3.4)
15	Hassan M, Ali S, Saleem M, Sanaullah M, Fahad LG, Kim JY, Alquhayz H, Tahir SF. Diagnosis of dengue virus infection using spectroscopic images and deep learning. PeerJ Computer Science. 2022 Jun 1;8:e985.	2022	PeerJ Computer Science (3.5)
16	Syed F, Arif MA, Mansoor VB, Usman M, Arif SA. Evolving Spectrum of Dengue: A Two-Year Experience From a Tertiary Care Hospital in Pakistan. Cureus. 2024 Feb;16(2).	2024	Cureus Journal of Medical Science (1.0)
17	Riaz M, Harun SN, Mallhi TH, Khan YH, Butt MH, Husain A, Khan MM, Khan AH. Evaluation of clinical and laboratory characteristics of dengue viral infection and risk factors of dengue hemorrhagic fever: a multi-center retrospective analysis. BMC Infectious Diseases. 2024 May 17;24(1):500.	2024	BMC Infectious Diseases (3.4)

Sr. No.	Research Article	Year	Citations
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4	Shams N, Amjad S, Yousaf N, Ahmed W, Seetlani NK, Qaisar N. Predictors of Severity of Dengue Fever in Tertiary Care Hospitals. Journal of Liaquat University of Medical & Health Sciences. 2016 Oct 1;15(4).	2016	06
5	Nadeem M, Shafiq MM, Manzoor MS, Ahmed SI. Serum ferritin: an indicator of disease severity in patients with dengue infection. JRMC. 2016;20:165-7.	2016	08
6	Faheem M, Osama M, Khurram M, Khan MM, Ur H, Rehman SA, Anjum N, Hamid S, Umar M. Dengue Fever Induced Fulminant Hepatic Failure. Journal of Rawalpindi Medical College (JRMC). 2016;20(4):331-2.	2016	02
7	Khurram M, Faheem M, Masood F, Manzoor S, Khan MM, Masood N, Umar M. Management of adult dengue shock syndrome patients not improving with DEAG guidelines based therapy. Journal of Rawalpindi Medical College. 2016 Mar 30;20(1).	2016	02
8	Khurram M, Qayyum W, Umar M, Jawad M, Mumtaz S, Khaar HT. Ultrasonographic pattern of plasma leak in dengue haemorrhagic fever. J Pak Med Assoc. 2016 Mar 1;66(3):260-4.	2016	22
9	Khan S, Ullah R, Khurram M, Ali H, Mahmood A, Khan A, Ahmed M. Evaluation of Raman spectroscopy in comparison to commonly performed dengue diagnostic tests. Journal of Biomedical Optics. 2016 Sep 1;21(9):095005-.	2016	19
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12	Ashfaq MW, Nadeem M, Khalid MA, Shafiq MM, Ahmad SI. Liver biochemistry: difference between dengue fever and non dengue febrile illnesses. JIMDC. 2016;5:10-3.	2016	02
13	Zaman S, Mahmud MR, Khalid MA, Zahid A, Khalid S, Kabir I, Manzoor S, Zaman HZ, Mahmud MR, Khalid MA, Zahid A. Effectiveness of vitamin D in prevention of dengue haemorrhagic fever and dengue shock syndrome. Journal of Rawalpindi Medical College. 2017 Sep 30;21(3).	2017	12

14	Amin A, Ghouri N, Ali S, Ahmed M, Saleem M, Qazi J. Identification of new spectral signatures associated with dengue virus infected sera. Journal of Raman Spectroscopy. 2017 May;48(5):705-10.	2017	33
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18	Mahmud MR, Zaman S, Naseem N, Iqbal N, Tanveer N, Khalid MA, Mahmud HZ, Zaman S, Naseem N, Iqbal N, Tanveer N. Comparison of vitamin D levels in patients with dengue haemorrhagic fever and dengue fever. Journal of Rawalpindi Medical College. 2018 Jun 30;22(2).	2018	03
19	Sarfraz M, Rabbani A, Manzoor MS, Sarfraz HZ, Rabbani A, Manzoor MS, Zahid H. Electrolyte disturbances in patients with dengue fever. Journal of Rawalpindi Medical College. 2018 Jun 30;22(2).	2018	03
20	Fayyaz T, Yasin M, Tariq A, Mughal A, Bukhari MH, Ms K. Knowledge About Dengue Fever Prevention Among People Visiting Benazir Bhutto Hospital. Journal of Rawalpindi Medical College. 2020 Dec 12;24(1):23-6.	2020	01
21	Ayaz F, Furrukh M. Assessment of severity of dengue fever by deranged alanine aminotransferase levels. Cureus. 2020 Sep;12(9).	2021	02
22	Asghar RM, Ashraf RR, Saheel K, Hussain A. An Evaluation of Haematological Changes in Paediatric Dengue Fever Patients at a Tertiary Care Hospital Rawalpindi during 2019 Outbreak. Journal of Rawalpindi Medical College. 2021 Jun 30;25(2).	2021	07
23	Shamshad S, Khan S, Raja GK, Ahmad MS, Asad MJ, Zainab T. Correlation of C-reactive protein levels, gene polymorphism and platelets count in Dengue infection. JPMA. The Journal of the Pakistan Medical Association. 2021 Feb 1;71(2 (A)):429-33.	2021	01
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25	Malik J, Batool M, Yasmeen T, Manzoor S, Bhatti HW, Mumtaz S. Correlation of serological markers and thombocytopenia in Dengue infection-a cross sectional study from 2019 epidemic in Rawalpindi, Pakistan. The Professional Medical Journal. 2022 May 31;29(06):764-9.	2022	02
26	Ahmed M, Mehmood M, Tahir MJ, Javed H, Ahmed S. Awareness of Dengue Fever in Non-Medical University Students in Punjab. Pakistan Armed Forces Medical Journal. 2022 Apr 30;72(2):440-3.	2022	02
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29	Gul N, Gul S, Anwar GM, Ali M, Gul M, Ahmad E. Epidemiological parameters of dengue infections in Pakistan. Pakistan Journal of Medical & Health Sciences. 2023 Mar 25;17(02):296-.	2023	01
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31	Karimi S, Akhtar N, Katiana O, Haider S, Ahmed B, Khan M, Umer M. Decoding Dengue: A Comprehensive Analysis of Cases at Holy Family Hospital (2019–2023) and Anticipating Pakistan's Future Dengue Dynamics under Climate Change. Journal of Islamabad Medical & Dental College. 2024 Jul 20;13(2):345-54.	2024	02
32	Syed F, Arif MA, Mansoor VB, Usman M, Arif SA. Evolving Spectrum of Dengue: A Two-Year Experience From a Tertiary Care Hospital in Pakistan. Cureus. 2024 Feb;16(2).	2024	02
33	Riaz M, Harun SN, Mallhi TH, Khan YH, Butt MH, Husain A, Khan MM, Khan AH. Evaluation of clinical and laboratory characteristics of dengue viral infection and risk factors of dengue hemorrhagic fever: a multi-center retrospective analysis. BMC Infectious Diseases. 2024 May 17;24(1):500.	2024	11
	Total citations		481

Dengue Related Current Research Projects

During this dengue epidemic following research projects have been initiated under the supervision of Vice Chancellor Rawalpindi Medical University, Rawalpindi.

1. Outcome Predictors in Dengue Shock Syndrome:
   A Comparative Study of Survivors and Fatalities during the 2024 Rawalpindi Epidemic.
2. Dengue in Rawalpindi: A Decade of Changing Patterns, Severity, and Virus Serotypes (2013-2024)
3. Dengue Sere markers in Healthcare Personnel: Insights from Holy Family Hospital
4. Decadal Dengue Virus Serotypes: A View from Rawalpindi Medical University, 2013-2024
5. Evaluating Competency in Dengue Management: An MCQ – Based Assessment of Clinical Knowledge
6. Comparing Clinical Outcomes in Dengue Shock Syndrome: A Study of the 2024 Rawalpindi Epidemic
7. Rapid Detection of Dengue Infection: A Validation Study of RDT Kits Against ELISA During the Dengue Season 2024-2025
8. Impact of Delayed Presentation on Dengue Severity and Outcomes

Summary of Resource Utilization

	HFH	BBH	RTH	Total	Remarks
Human Resource	247	248	81	576	182 Physicians , 16 Administrators 303 Nurses, 81 Paramedics, Janitorial Staff, Guards
CBC	29160	37168	11887	78215	
Dengue Serology	4540	2435	934	7909	
USG	10117	7074	4195	21386	
Cost (in Rs)	1,57,39592 (15.73 Millions)	1,12,86935 (11.28 Millions)	1,21,04689 (12.10 Millions)	3,91,31216 (39.13 Millions)	

Dengue serotype Shift, Rawalpindi 2022 – 2024

Serotype Shift:

In 2022, DENV-2 (58%) and DENV-1 (42%) were the predominant serotypes. By 2023, DENV-1 increased to 85%, while DENV-2 accounted for only 15%. However, during the current season (Sep-Oct 2024), there has been a significant shift, with DENV-2 comprising 95% of cases, largely replacing DENV-1, which now makes up only 5%. Historical data suggests that DENV-2 infections are often linked to increased severity, likely due to heightened immune responses, including cytokine activity (e.g., TNF-α, IFN-γ).

Genomic Analysis:

Whole-genome sequencing of DENV-2 samples collected in September 2024 shows high homology (99.1–99.9%) among the strains, all aligning with the Cosmopolitan genotype, clade IV-A1. Phylogenetic analysis reveals that these strains are closely related to DENV-2 strains from Pakistan's 2022-2023 outbreaks and share similarities with strains from previous outbreaks in China and Singapore. DENV-1 samples have been identified as Genotype III, resembling earlier local strains.

Secondary Infections:

Of the 67 dengue serotyped samples tested for IgG antibodies (ELISA) at NIH during Sep-Oct 2024, 25 (37%) were IgG-positive, all for DENV-2, indicating a significant prevalence of secondary infections. This is particularly concerning given the increased severity often associated with secondary infections involving different serotypes.

Virological Insights into Primary Dengue Infections and Fatalities in Rawalpindi:

A study conducted in 2011 assessed the incidence of primary dengue viral infection among healthy adults in Rawalpindi, Pakistan. The research found that primary dengue infections were prevalent in the population, highlighting the need for effective surveillance and preventive measures.

Additionally, a case-control study in 2017 identified risk factors for dengue fever in urban areas of Rawalpindi. The study found that contact with a confirmed dengue case, storing water in open containers at home, and ravel to a dengue outbreak area were significant risk factors. Conversely, using mosquito repellents and having a regular water supply at home were protective factors.

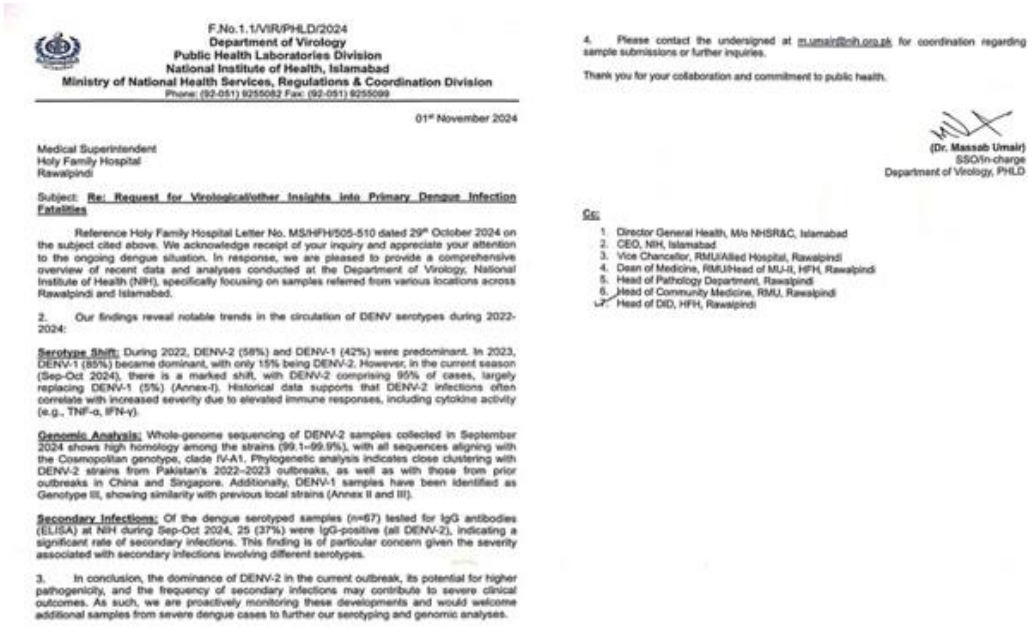
These findings underscore the importance of public health initiatives in Rawalpindi to mitigate primary dengue infections. Such initiatives should focus on reducing mosquito breeding sites, promoting the use of mosquito repellents, and ensuring regular water supply to prevent the storage of water in open containers.

Regarding fatality rates, a notable outbreak occurred between September and December 2019, with 53,498 cases and 95 deaths reported, resulting in a case fatality ratio of approximately 0.18%.

In the current season (Sep-Oct 2024), Rawalpindi has reported 6,250 dengue cases with 11 fatalities, indicating a case fatality ratio of approximately 0.18%.

These statistics highlight the critical need for ongoing surveillance, timely medical intervention, and public health measures to control the spread of dengue and reduce mortality rates in the region.

Year	Predominant Serotype	Percentage Distribution	Notes on Shift and Impact
2022	DENV-2	58%	Co-circulated with DENV-1 (42%)
	DENV-1	42%	Presence of both serotypes.
2023	DENV-1	85%	Dominance shift from DENV-2 to DENV-1. DENV-2 decreased to 15%.
	DENV-2	15%	Minor circulation.
2024	DENV-2	95%	Significant shift back to DENV-2 dominance, with increased severity associated with secondary infections
	DENV-1	5%	Minimal presence



F.No.1.1/VIR/PHLD/2024
Department of Virology
Public Health Laboratories Division
National Institute of Health, Islamabad
Ministry of National Health Services, Regulations & Coordination Division
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01st November 2024

Medical Superintendent
Holy Family Hospital
Rawalpindi

Subject: **Re: Request for Virological/other Insights into Primary Dengue Infection Fatalities**

Reference Holy Family Hospital Letter No. MS/HFH/505-510 dated 29th October 2024 on the subject cited above. We acknowledge receipt of your inquiry and appreciate your attention to the ongoing dengue situation. In response, we are pleased to provide a comprehensive overview of recent data and analyses conducted at the Department of Virology, National Institute of Health (NIH), specifically focusing on samples referred from various locations across Rawalpindi and Islamabad.

2. Our findings reveal notable trends in the circulation of DENV serotypes during 2022-2024:

Serotype Shift: During 2022, DENV-2 (58%) and DENV-1 (42%) were predominant. In 2023, DENV-1 (85%) became dominant, with only 15% being DENV-2. However, in the current season (Sep-Oct 2024), there is a marked shift, with DENV-2 comprising 95% of cases, largely replacing DENV-1 (5%) (Annex-I). Historical data supports that DENV-2 infections often correlate with increased severity due to elevated immune responses, including cytokine activity (e.g., TNF-α, IFN-γ).

Genomic Analysis: Whole-genome sequencing of DENV-2 samples collected in September 2024 shows high homology among the strains (99.1–99.9%), with all sequences aligning with the Cosmopolitan genotype, clade IV-A1. Phylogenetic analysis indicates close clustering with DENV-2 strains from Pakistan's 2022–2023 outbreaks, as well as with those from prior outbreaks in China and Singapore. Additionally, DENV-1 samples have been identified as Genotype III, showing similarity with previous local strains (Annex II and III).

Secondary Infections: Of the dengue serotyped samples (n=67) tested for IgG antibodies (ELISA) at NIH during Sep-Oct 2024, 25 (37%) were IgG-positive (all DENV-2), indicating a significant rate of secondary infections. This finding is of particular concern given the severity associated with secondary infections involving different serotypes.

3. In conclusion, the dominance of DENV-2 in the current outbreak, its potential for higher pathogenicity, and the frequency of secondary infections may contribute to severe clinical outcomes. As such, we are proactively monitoring these developments and would welcome additional samples from severe dengue cases to further our serotyping and genomic analyses.

4. Please contact the undersigned at m.umair@nih.org.pk for coordination regarding sample submissions or further inquiries.

Thank you for your collaboration and commitment to public health.

(Dr. Massab Umair)
SSO/In-charge
Department of Virology, PHLD

Cc:
1. Director General Health, M/o NHSR&C, Islamabad
2. CEO, NIH, Islamabad
3. Vice Chancellor, RMU/Allied Hospital, Rawalpindi
4. Dean of Medicine, RMU/Head of MU-II, HFH, Rawalpindi
5. Head of Pathology Department, Rawalpindi
6. Head of Community Medicine, RMU, Rawalpindi
7. Head of DID, HFH, Rawalpindi

References:

1. Khurram M, Qayyum W, ul Hassan SJ, Mumtaz S, Bushra HT, Umar M. Dengue hemorrhagic fever: comparison of patients with primary and secondary infections. J Infect Public Health. 2014 Nov;7(6):489-95.
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16. Syed F, Arif MA, Mansoor VB, Usman M, Arif SA. Evolving Spectrum of Dengue: A Two-Year Experience From a Tertiary Care Hospital in Pakistan. Cureus. 2024 Feb;16(2):e53931.
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