Metro Manila: An Urban Breeding Site for Dengue Disease in the Philippines

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ABSTRACT

Dengue, a globally significant public health issue, affects over 390 million people annually in tropical and subtropical regions. The economic burden, escalating from 505,430 cases in 2000 to 5.2 million in 2019, underlines its severity. Southeast Asia, including the Philippines, faces unique challenges due to climate and geography, making it an endemic region. Urbanization and climate change further complicate Dengue control, with its impact on human lives evident in Southeast Asia's rising mortality and morbidity. Metro Manila, a Dengue hotspot since 1953, witnessed recurring epidemics and the emergence of Dengue Hemorrhagic Fever (DHF), notably affecting Filipino children. The Department of Health responded with surveillance, public awareness, and vector control. Rapid urbanization, creating breeding grounds in slums, and climate change intensify Dengue transmission. The impact on urban communities, particularly in Metro Manila, is substantial, overwhelming healthcare facilities and imposing economic burdens. A study estimates an annual societal cost, emphasizing its disproportionate impact on marginalized communities. Dengue prevention policies involve surveillance, public health education, and medical treatments, including the controversial Dengvaxia vaccine. Despite progress, the dynamic nature of Dengue requires continuous vigilance. The ongoing battle against Dengue in Metro Manila underscores the importance of integrated strategies, community involvement, and proactive measures to combat this persistent public health threat. Resilience is crucial in addressing challenges like climate change, urbanization, and emerging strains. Ongoing research and a multifaceted approach are imperative for effective Dengue management in Metro Manila and globally.

Keywords: *Dengue, Metro Manila, Urbanization, Department of Health.*

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Introduction

Dengue's global and national significance as a public health issue is undeniable, supported by substantial numerical data and various compelling factors. Dengue imposes a high disease burden globally, with an estimated 390 million people infected annually. This widespread prevalence is evident in over 100 countries, primarily in tropical and subtropical regions, highlighting its global reach and affecting a significant portion of the world's population. The disease's severity varies, with mild cases such as Dengue Fever (DF) and more severe forms like Dengue Hemorrhagic Fever (DHF) and Dengue Shock Syndrome (DSS). The economic burden of Dengue is well-documented, encompassing healthcare costs, lost productivity, and expenses related to vector control measures and public health campaigns, potentially overwhelming healthcare systems during outbreaks.

On a global scale, the burden of Dengue has surged in recent decades, with a dramatic increase in reported cases from 505,430 in 2000 to 5.2 million in 2019.[1] However, underreporting is a significant challenge due to asymptomatic or mild cases and misdiagnosis, complicating accurate reporting and diagnosis. Modeling estimates suggest as many as 390 million Dengue virus infections annually, with approximately 96 million manifesting clinically. A substantial 3.9 billion people are at risk of Dengue virus infection, emphasizing its widespread potential. Dengue is now endemic in over 100 countries across WHO regions, with Asia bearing approximately 70% of global Dengue cases.

The alarming trend of Dengue spreading to new areas, including non-endemic regions like France and Croatia, is noteworthy. The year 2019 marked a grim milestone with the largest number of Dengue cases globally, showcasing its unpredictability and capacity for expansion. In 2023, the Americas and the Caribbean reported over 3.3 million Dengue cases, with Brazil and Peru experiencing extensive outbreaks.[2] The region faced challenges with all four Dengue virus serotypes circulating, adding complexity to the disease dynamics. Dengue outbreaks were also reported in Asia, with India, Bangladesh, Afghanistan, Cambodia, China, Laos, Malaysia, Nepal, the Philippines, Singapore, Sri Lanka, Thailand, and Vietnam affected. In Africa, Dengue cases were reported in several countries, emphasizing the

[1] World Health Organization. Dengue and severe dengue. 17 March 2023. https://www.who.int/news-room/fact-sheets/detail/dengue-and-severe-dengue.

[2] European Centre for Disease Prevention and Control. Dengue Worldwide Overview. 23 August 2023. https://www.ecdc.europa.eu/en/dengue-monthly.

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disease's potential to expand into new areas influenced by local factors.[3] These regional outbreaks highlight Dengue's widespread and diverse impact on populations globally.

Southeast Asia is a region of the Asian continent characterized by its unique climate, strategic location, and varying temperatures. The area is near the equator; thus, it has a tropical climate with high temperatures and humidity year-round. According to Mainguy, in 2009, the region experienced two main seasons: the wet season, marked by heavy rainfall and occasional monsoons, and the dry season, featuring clear skies and lower humidity. Meanwhile, the average temperatures typically range from 25°C to 35°C (77°F to 95°F). Among its nations is the Philippines, an archipelago of over 7,000 islands, which exhibits a climate and temperature profile reflecting Southeast Asia's geographical position and topographical diversity.

Dengue is among the Philippine's most prevalent vector-borne infections. *Dengue fever* is a pressing global health issue that has captured the attention of healthcare professionals, researchers, and policymakers worldwide. It is a viral infection from the dengue virus (DENV) transferred to humans through the bites of infected female mosquitoes, primarily the Aedes aegypti mosquito that thrives in tropical and subtropical climates (WHO 2023, 1). In addition, the dengue virus replication within the mosquito vector and the human host is more efficient in warmer temperatures. Most people who are infected are asymptomatic; however, those who do often present with flu-like symptoms such as high fever, severe headache, joint and muscle pain, and rash; its extreme forms, known as dengue hemorrhagic fever and dengue shock syndrome, can pose life-threatening complications to an individual, including internal bleeding and organ failure. According to Global Health Estimates 2014, dengue-related combined mortality and morbidity in Southeast Asia increased from 436,000 in 2000 to 606,000 in 2012. The Philippines has 80,318 reported dengue cases as of 15 July 2023.

Consequently, several interconnected factors contribute to Dengue's prominence as a global health issue —urbanization and climate change. The expansion of urbanization and population growth has created fertile ground for Aedes mosquito breeding, leading to increased virus transmission. Controlling the Aedes species is rather complicated and requires an extensive implementation of standardized control methods and quality control activities, monitoring protocols, community-based interventions, and emergency vector control strategies. All of these are proven to be difficult when societal challenges such as unplanned urbanization are present. Climate change has also played a pivotal role in the spread of the disease.

[3] European Centre for Disease Prevention and Control. Dengue Worldwide Overview.

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Unexpected weather patterns brought on by climate change can result in dangerous circumstances. It will cause the geographic distribution of certain human infectious illnesses transmitted by vectors to grow. It has been one of the many factors that led to the growth of DENV itself.

In turn, the significance of Dengue as a global health issue becomes even more evident when considering its impact on human lives. This viral infection substantially affects our healthcare systems in terms of treatment costs and the strain on medical facilities in case of outbreaks. Dengue has unquestionably earned its position as a global health priority. However, decades of battling Dengue in Metro Manila transformed the Department of Health (DOH) into an effective organization against this relentless dengue virus.

As mentioned before, Dengue is a mosquito-borne viral disease. Prevention, diagnosis, and management of Dengue requires having a deep understanding of the intricacies of the viral infection. Dengue exhibits a range of clinical classifications, namely, Dengue Fever (DF), Dengue Hemorrhagic Fever (DHF), and Dengue Shock Syndrome (DSS). Dengue Fever is the mildest form of dengue. Symptoms include high fever, severe headache, joint and muscle pain, and a characteristic skin rash. Although dengue fever is generally non-fatal, it can cause considerable discomfort. Meanwhile, Dengue Hemorrhagic Fever is a severe form of Dengue. Hemorrhagic manifestations such as nosebleeds, gum bleeding, or easy bruising are evident in this form of Dengue. As the disease progresses, patients may experience abdominal pain, vomiting, and a drop in platelet count. It can be life-threatening if not treated properly. The most severe and critical form of Dengue is Dengue Shock Syndrome (DSS). Its symptoms include a rapid drop in blood pressure, leading to shock, and can result in more damage, such as organ failure or death.

Historical Approach and the Challenge and Response Theory

Applying a qualitative historical approach in researching the Dengue epidemic in the Philippines offers a nuanced understanding of the issue by delving into its historical context. This method allows for a thorough exploration of the intricate interplay among historical events, policies, and societal changes that have significantly shaped the trajectory of Dengue over time. Drawing from diverse data sources (including archival records, government documents, newspapers, and personal narratives), historical research enables researchers to construct a comprehensive narrative, capturing the multifaceted nature of Dengue's evolution. The triangulation

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of information from various perspectives enhances the richness and depth of the analysis.

By examining historical data and events over an extended period, researchers gain a longitudinal perspective that proves invaluable in identifying trends, patterns, and critical turning points in the history of the dengue epidemic within the Philippines. This temporal lens contributes to a nuanced understanding of how the disease has manifested, evolved, and interacted with public health policies. Furthermore, this historical approach has the unique capacity to reveal hidden or overlooked factors that have played pivotal roles in influencing the trajectory of Dengue. Social, political, economic, and cultural factors are brought to the forefront, allowing researchers to discern their impact on the spread of the disease and the effectiveness of public health interventions.

In the specific context of Dengue, applying the Challenge and Response Theory is a valuable analytical tool. This theory aids in comprehending how societies and healthcare systems respond to the persistent challenge posed by Dengue outbreaks, particularly in regions like Metro Manila. Dengue outbreaks are framed as significant public health challenges, and this theory helps dissect the responses of entities such as the Department of Health in the Philippines.

Through the Challenge and Response Theory lens, researchers can conduct a detailed analysis of how government health agencies have navigated and responded to Dengue outbreaks over time. The evolution of policies and strategies becomes a focal point of exploration, shedding light on how responses have adapted to the changing nature of Dengue epidemics. Moreover, employing the Challenge and Response Theory enables the assessment of the effectiveness of various policy responses to Dengue outbreaks, spanning preventive measures, public health campaigns, and treatment strategies. This approach provides a structured framework for understanding the dynamic interaction between the challenge posed by Dengue and the responses formulated by public health entities.

In the broader context, this historical approach and the Challenge and Response Theory application contribute to a holistic understanding of how Dengue has shaped public health dynamics in the Philippines. Insights gleaned from this research can inform future policy decisions, improve outbreak response strategies, and enhance overall public health resilience in the face of persistent health challenges. In the broader context, this historical approach and the Challenge and Response Theory application contribute to a holistic understanding of how Dengue has shaped public health dynamics in the Philippines. Insights gleaned from this research can inform future

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policy decisions, improve outbreak response strategies, and enhance overall public health resilience in the face of persistent health challenges.

Metro Manila: An Urban Hotspot for Dengue

Metro Manila is the capital region of the Philippines that has been a hotspot for Dengue outbreaks since the early 1950s. The first recorded dengue epidemic in Southeast Asia happened in Manila in 1954. This epidemic marked the beginning of Dengue's presence in the region. Another significant dengue epidemic struck Metro Manila in 1966; 217 dengue infections and 54 strains of dengue virus of three types were recorded. In 1983, Metro Manila faced yet another dengue epidemic, where a recorded statistics of 377 Filipino children were infected with DENV out of a total of 5,427 admissions. The 1998 epidemic had the highest recorded incidence rate (60.9 cases per 100,000 population) and case fatality rate (Bravo et al. 2014, 1).[4] Since then, Dengue has been a prominent disease in the Philippines, specifically in Metro Manila.

According to Gubler,[5] Dengue was first recorded in the Philippines in 1953. Since then, the country has experienced intermittent outbreaks characterized by sporadic patterns and infrequent but often substantial epidemics. During these years, Dengue viruses likely became endemic in tropical urban centers. This was evident from the fact that non-immune individuals who arrived in these areas would invariably contract Dengue-like illnesses within months of their arrival.

Dengue Hemorrhagic Fever (DHF) Emergence: The first known epidemic of Dengue Hemorrhagic Fever (DHF) occurred in Manila, Philippines, from 1953 to 1954. This marked a crucial turning point in the country's Dengue landscape. Within two decades, DHF had spread throughout Southeast Asia, making the Philippines one of the early epicenters of this severe form of Dengue. By the mid-1970s, DHF had become a leading cause of hospitalization and death among Filipino children. As Gubler pointed out:

> The ecologic disruption in the Southeast Asia and Pacific theaters during and following World War II created ideal conditions for increased transmission of mosquito-borne diseases. In this setting, a global pandemic of Dengue began. With increased epidemic transmission, hyperendemicity (the

[4] Bravo, Lulu, Vito G. Roque, Jeremy Brett, Ruby Dizon, and Maïna L'Azou. "Epidemiology of Dengue Disease in the Philippines (2000-2011): A Systematic Literature Review." PLOS Neglected Tropical Diseases (2014). https://doi.org/10.1371/journal.pntd.0003027.

[5] Gubler, D. "Dengue and Dengue Hemorrhagic Fever." Clinical Microbiology Reviews vol. 11, no. 3 (1998). 480–496. DOI: 0893-8512/98/$04.0010.

> cocirculation of multiple dengue virus serotypes) developed in Southeast Asian cities, and epidemic dengue hemorrhagic fever (DHF), a newly described disease, emerged.[6]

Dengue has persisted as a significant health challenge in the Philippines, with recurring outbreaks and varying intensity levels. The country has also grappled with co-circulating multiple Dengue virus serotypes, adding complexity to the disease dynamics. The Philippines experienced a resurgence of cases during the 1980s and 1990s, aligning with the global trend of increasing Dengue activity. It saw the geographic expansion of both the mosquito vectors and the Dengue viruses and an elevated disease incidence due to more frequent epidemic transmission. During this period, the emergence of DHF in many new countries, including the Philippines, mirrored the experiences in Southeast Asia. As such, these outbreaks had a substantial impact on public health across all regions and have led to widespread incidences, increasing rates of hospitalization, and morbidity among Filipinos, particularly children.

These dengue epidemics in Metro Manila have burdened the country considerably. The Department of Health (DOH) in the Philippines has responded by implementing various measures to combat Dengue, including public awareness campaigns, vector control strategies, and strengthening healthcare infrastructure to manage dengue cases effectively. Before 2006, the National Epidemiology Center (NEC) of the Department of Health (DoH) oversaw the National Epidemic Sentinel Surveillance System, which maintained surveillance of notifiable diseases like dengue fever.

Urbanization and its Implications on Epidemiology

The rapid urbanization of the global population has led to various challenges in city planning and public health.[7] Differences in living conditions within cities, the proliferation of infectious diseases, and the adaptation of pathogens to urban environments all highlight the importance of addressing health disparities and improving infrastructure and sanitation in urban areas. Local knowledge, awareness, and targeted interventions are essential in managing these complex urban health challenges.

The urban population is a diverse group living in various conditions, and cities worldwide exhibit significant disparities in living standards among their residents. These disparities are not confined to different cities; even within the same city, there can be stark differences in infrastructure and social support. For instance, living in slums, as opposed to more affluent

[6] Gubler, Dengue and Dengue Hemorrhagic Fever, 480-481.

[7] Neiderud, C. "How urbanization affects the epidemiology of emerging infectious diseases." *Infection Ecology & Epidemiology* vol. 5, no. 1 2015. DOI:10.3402/iee.v5.27060.

neighborhoods within the same city, exposes inhabitants to varying levels of risk. While urban areas can offer advantages over rural settings, such as improved access to services, they can also pose health hazards under certain circumstances.

One of the challenges associated with rapid urbanization is overcrowding, which can lead to the emergence of slums and shanty towns. These informal settlements typically have inadequate housing, limited access to clean water, and poor sanitation facilities. Such conditions not only threaten the health of residents but can also serve as breeding grounds for infectious diseases. Slums tend to be in less desirable areas outside city centers, where residents often lack social and economic opportunities compared to other city dwellers. In some regions, a substantial portion of the urban population resides in such slums, with high child mortality rates compared to other parts of the city. Providing equal and adequate healthcare services to these populations poses significant challenges for community and healthcare providers.

Certain infectious diseases, like cholera, have been linked to slums with high population density and low income. These diseases often have a higher prevalence in urban areas with overcrowded housing. Tuberculosis, for instance, traditionally showed higher rates in urban centers than rural areas, but the patterns can vary by country. Knowledge about these diseases and their spread is crucial for residents and local physicians.

City planning faces significant challenges due to rapid urbanization, as the influx of migrants can lead to overcrowding, straining local governments' capacity to provide essential services like safe housing, drinking water, and sanitation facilities. While progress has been made in improving access to safe drinking water and sanitation, a significant portion of the global population still needs these necessities, with urban areas experiencing an increase in the number of people without access.

Furthermore, urban environments can favor the proliferation of vectors that transmit diseases. For example, rats in cities can carry various pathogens, leading to diseases like leptospirosis. The lack of proper control measures can spread zoonotic infections, and local knowledge is essential for addressing these issues effectively. Traditionally, rural infectious diseases have now become urban concerns due to global urbanization trends. Neglected tropical diseases like lymphatic filariasis have found their way into urban areas due to poor sanitation facilities. Mosquito-borne diseases like Dengue have thrived in urban environments, driven by urbanization and inadequate mosquito control.

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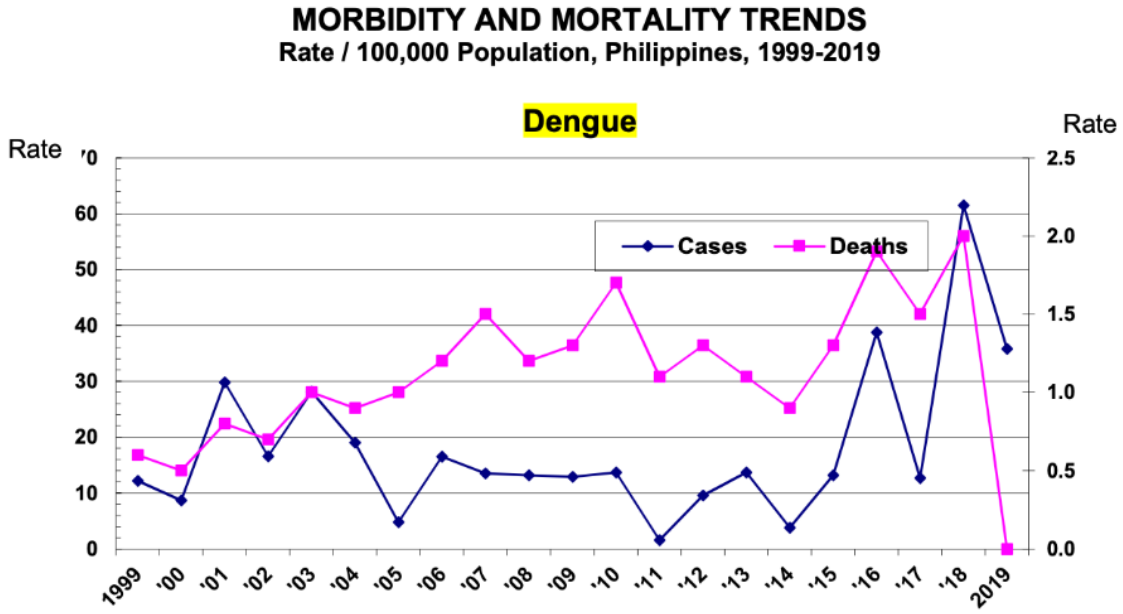
Prevalence of Dengue in Urban Metro Manila

The incidence of dengue disease in the Philippines varies by region and year. The Philippines is divided into 17 regions across Luzon, Visayas, and Mindanao. A substantial portion of the population (37.3%) resides in three key regions: Calabarzon, Metro Manila (NCR), and Central Luzon. Bravo et al. identified that the highest reported cases were observed in densely populated urban areas like the National Capital Region (NCR).[8]

Figure 1: Morbidity and Mortality Trends in the Philippines, 1999-2019



Notably, the incidence of dengue disease per 100,000 population shows variations over time and across regions. For instance, the NCR had the highest incidence rates in 2000, CAR in 2001, Region VI in 2002, Region VII in 2007, Region XI in 2003, 2004, 2008, and 2009, and Region XII in 2005 and 2006. In 2010, Western Visayas (Region VI) reported the highest number of cases; in 2011, NCR, particularly Quezon City, had the highest number of cases.[9] Fatal dengue disease cases were most prevalent in the NCR in 2001, 2003, 2004, 2005, and 2006. However, in 2002, Central Visayas (Region VII) recorded the highest number of fatal dengue disease cases.

Interestingly, despite similar population sizes (2.7 million in Quezon City and 2.5 million in Rizal in 2011), Quezon City reported significantly more dengue cases than Rizal. Both regions experienced increased cases over the study period, with peaks in 2006, 2008, 2010, and 2011. Local dengue disease

[8] Bravo et al., Epidemiology of Dengue Disease in the Philippines, 5–9.
[9] Bravo et al., Epidemiology of Dengue Disease in the Philippines, 8.

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outbreaks were reported yearly across all regions except Regions VIII and XIII. The regions with the most reported local outbreaks were CAR (10 outbreaks), Region III (five outbreaks), Region IV (four outbreaks), and Region X (four outbreaks). The largest outbreak occurred in Zamboanga City, Region IX 2010, with 2122 cases and 22 fatalities.

Based on unpublished statistical data provided by the Department of Health (see Figures 1 and 2), the highest recorded number of cases in NCR from 2008 to 2022 was in 2012, with a whopping 71,119 cases and 284 deaths. The second-highest record was in 2019, with 40,769 cases and 193 deaths recorded. Unfortunately, data dating earlier than 2008 is unavailable and, therefore, requires further investigation with local government units and their respective health offices, which the researcher hopes to achieve in a greater capacity and research project.

The absence of data before 2008 is a notable limitation, preventing a comprehensive understanding of the region's longer-term trends and historical context of health challenges. The acknowledgment of this gap underscores the need for more extensive research involving collaboration with local government units and health offices to access earlier data. This commitment to further investigation reflects a recognition of the importance of a comprehensive understanding of the health landscape in the NCR. The impact of these statistics on Philippine society is multifaceted. First and foremost, the high numbers of cases and deaths in specific years indicate potential vulnerabilities in the healthcare system or public health infrastructure. It raises questions about the adequacy of healthcare resources, disease surveillance mechanisms, and the effectiveness of public health interventions during those specific periods.

Moreover, the fluctuations in the number of cases and deaths over the years may point to evolving health challenges and the dynamic nature of infectious diseases or other health threats. Understanding these patterns is crucial for devising responsive and adaptive public health strategies. The overall impact on Philippine society extends beyond just health considerations. High incidences of diseases can strain healthcare resources, impact workforce productivity, and contribute to economic burdens. Considering these statistics, the need for sustained and robust healthcare planning, resource allocation, and preventive measures becomes evident.

Figure 2: Total Number of Cases in NCR, 2008-2022

2008	14,186
2009	12,643
2010	23,405
2011	28,068
2012	71,119
2013	23,377
2014	8,824
2015	26,738
2016	16,924
2017	26,072
2018	29,423
2019	40,769
2020	7,338
2021	10,368
2022	26,425

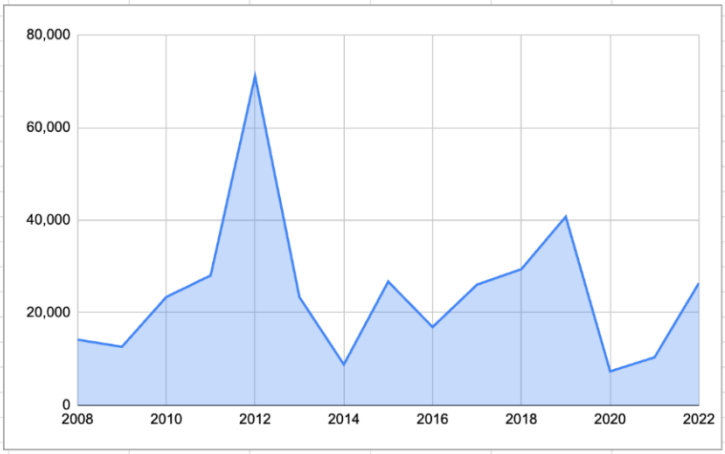
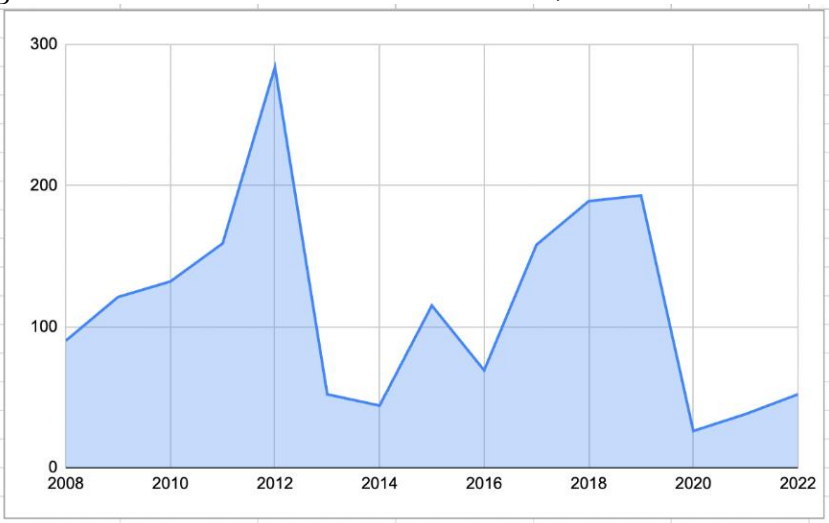


Figure 3: Total Number of Deaths in NCR, 2008-2022

2008	90
2009	121
2010	132
2011	159
2012	284
2013	52
2014	44
2015	115
2016	69
2017	158
2018	189
2019	193
2020	26
2021	38
2022	52



Moreover, regarding age groups affected by dengue disease, children aged 5–14 consistently had the highest proportion of cases during the review period. Data from different years showed that this age group accounted for a substantial portion of cases, followed by those aged 15–49 years and 1–4 years. In 2010–2011, the most significant proportion of cases occurred in individuals aged 1–10, making up around 36.8%. Incidence rates in 2000, 2003, and 2005 were highest in the 5–14-year age group but shifted to the 0–4-year age group in 2006. In both Quezon City and Rizal, an upward trend in dengue cases was observed across all age groups, with the highest cases in individuals aged 1–9 years, followed by those aged 10–19 years.

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The Impact of Dengue on Urban Communities in Metro Manila

The impact of Dengue on urban communities in Metro Manila is a matter of significant concern, as revealed by the comprehensive study discussed earlier. Dengue, a mosquito-borne viral infection, poses health and economic challenges for this densely populated urban region in the Philippines.

As highlighted in the previous section, Dengue substantially burdens the healthcare system in Metro Manila. Studies and reports have estimated a considerable number of hospitalized and ambulatory dengue cases, with annual averages of 401,191 and 239,497, respectively, projected from 2016 to 2020. This represents a 26.71% decrease from observed cases in the years leading up to 2014. Such high case numbers place a considerable strain on the city's healthcare facilities, potentially overwhelming resources and leading to challenges in providing adequate care.

Aside from this, the economic repercussions of Dengue are also substantial. From the societal perspective, the study calculates the direct medical costs of ambulatory and hospitalized dengue cases and indirect costs related to productivity losses. These costs are projected to amount to millions of USD annually, with hospitalized cases incurring significantly higher expenses. This economic burden affects individuals and families and places financial stress on the healthcare system and government resources. For PhilHealth, the government's health insurance provider, the annual cost of covering dengue hospitalizations is projected to reach USD 139 million. This underscores the need for effective strategies to manage and reduce dengue cases in Metro Manila.

Moreover, direct hospitalized cost, case fatality rate, and hospitalization rate significantly influence the total societal impact of the disease—factors that inadvertently impact marginalized sectors and communities more than more affluent communities. These findings emphasize the importance of targeted interventions to address these specific parameters and mitigate the economic impact of the disease. For instance, efforts to reduce hospitalization costs or improve healthcare access and quality can substantially affect the overall economic burden.

In addition to the direct health and economic consequences, Dengue has broader implications for Metro Manila's urban planning and public health infrastructure. The study highlights the challenges posed by the rapid urbanization of the region, as overcrowding and limited access to safe drinking water and sanitation facilities can contribute to the transmission of Dengue. Efforts to control the spread of Dengue must consider the urban

environment, focusing on factors like stagnant water sources and effective vector control measures.

Cheng, in his study, *Estimating the Burden of Dengue in the Philippines Using a Dynamic Transmission Model*,[10] it was estimated that from 2016 to 2020, annual dengue hospitalizations averaged 401,191 cases, while ambulatory cases reached 239,497. The economic costs associated with these cases are substantial. PhilHealth, the national health insurance program, faced an average annual cost of USD 139 million (PhP 5.9 billion) for bedridden cases. Direct medical costs for ambulatory cases amounted to USD 19 million (PhP 827 million) annually. The direct medical cost to society for hospitalized cases reached USD 239 million (PhP 10 billion), while ambulatory cases incurred USD 30 million (PhP 1.3 billion). It was further determined that an annual societal cost of approximately PhP 820 million for combined hospitalized and ambulatory cases was incurred from Dengue cases alone, highlighting the broader economic impact of the disease.

This, therefore, underscores the importance of accurate epidemiological data for effective disease management. While limitations exist in the availability of dengue-related data in the Philippines, the study's use of expansion factors and consultations with experts help address some of these gaps. Nevertheless, ongoing efforts to improve data collection and reporting are essential to refine disease models and enhance preparedness. Moreover, it highlights the need for proactive dengue control programs, improved public health education, community engagement, and enhanced health-seeking behaviors among Filipinos. Addressing knowledge gaps, promoting community participation, and mitigating economic burdens are crucial steps toward effectively combating the socio-economic impacts of Dengue in the Philippines.[11]

Dengue significantly impacts urban communities in Metro Manila, affecting both public health and the economy. Addressing the challenges posed by Dengue in this urban context requires a multifaceted approach aimed at reducing transmission, improving healthcare access, and alleviating the economic burdens faced by individuals and the healthcare system. Vector control measures play a crucial role in addressing the spread of Dengue in

[10] Cheng, Kent, et al. "Estimating the Burden of Dengue in the Philippines Using a Dynamic Transmission Model." *Acta Medica Philippina* vol. 52 no. 2: 2018. doi: https://doi.org/10.47895/amp.v52i2.427.

[11] Guad, Rhanye Mac, et al. "Different domains of dengue research in the Philippines: A systematic review and meta-analysis of questionnaire-based studies." *PloS one* vol. 16,12 e0261412. 20 December 2021, DOI: 10.1371/journal.pone.0261412

urban areas like Metro Manila. Given the presence of Aedes mosquitoes as the primary vectors, strategies such as eliminating breeding sites, using insecticides, and promoting community awareness become essential. Urban planning also comes into focus, as efforts to reduce stagnant water sources and maintain clean and well-maintained public spaces can significantly impact dengue transmission rates.

Rapid urbanization of the global population has led to various challenges in city planning and public health.[12] Differences in living conditions within cities, the proliferation of infectious diseases, and the adaptation of pathogens to urban environments all highlight the importance of addressing health disparities and improving infrastructure and sanitation in urban areas. Local knowledge, awareness, and targeted interventions are essential in managing these complex urban health challenges.

The urban population is a diverse group living in various conditions, and cities worldwide exhibit significant disparities in living standards among their residents. These disparities are not confined to different cities; even within the same city, there can be stark differences in infrastructure and social support. For instance, living in slums, as opposed to more affluent neighborhoods within the same city, exposes inhabitants to varying levels of risk. While urban areas can offer advantages over rural settings, such as improved access to services, they can also pose health hazards under certain circumstances.

One of the challenges associated with rapid urbanization is overcrowding, which can lead to the emergence of slums and shanty towns. These informal settlements typically have inadequate housing, limited access to clean water, and poor sanitation facilities. Such conditions not only threaten the health of residents but can also serve as breeding grounds for infectious diseases. Slums tend to be located in less desirable areas outside city centers, where residents often face a lack of social and economic opportunities compared to other city dwellers. In some regions, a substantial portion of the urban population resides in such slums, with high child mortality rates compared to other parts of the city. Providing equal and adequate healthcare services to these populations poses significant challenges for community and healthcare providers.

Certain infectious diseases, like cholera, have been linked to slums with high population density and low income. These diseases often have a higher prevalence in urban areas with overcrowded housing. Tuberculosis, for

[12] Neiderud, C. "How urbanization affects the epidemiology of emerging infectious diseases." *Infection Ecology & Epidemiology* vol. 5, no. 1 (2015). DOI:10.3402/iee.v5.27060.

instance, traditionally showed higher rates in urban centers compared to rural areas, but the patterns can vary by country. Knowledge about these diseases and their spread is crucial for both residents and local physicians.

City planning faces significant challenges due to rapid urbanization, as the influx of migrants can lead to overcrowding, straining local governments' capacity to provide basic services like safe housing, drinking water, and sanitation facilities. While progress has been made in improving access to safe drinking water and sanitation, a significant portion of the global population still lacks these necessities, with urban areas experiencing an increase in the number of people without access.

Furthermore, urban environments can favor the proliferation of vectors that transmit diseases. For example, rats in cities can carry various pathogens, leading to diseases like leptospirosis. The lack of proper control measures can lead to the spread of zoonotic infections, and local knowledge is essential for addressing these issues effectively.

Traditionally rural infectious diseases have now become urban concerns due to global urbanization trends. Neglected tropical diseases like lymphatic filariasis have found their way into urban areas due to poor sanitation facilities. Mosquito-borne diseases like dengue have thrived in urban environments, driven by factors like urbanization and inadequate mosquito control.

Aside from this, education and public awareness campaigns can be instrumental in preventing dengue outbreaks. These campaigns can inform residents about the importance of personal protective measures, such as using mosquito nets, wearing long-sleeved clothing, and applying insect repellent. Additionally, educating the public on the significance of proper waste disposal to prevent the accumulation of containers that serve as mosquito breeding sites is vital.

It is crucial to recognize that vulnerable populations, including those residing in informal settlements and low-income urban areas, may bear a disproportionate burden of Dengue. The study's findings point to the slums in Metro Manila, characterized by poor housing, inadequate sanitation facilities, and a lack of access to clean water. These conditions create an environment conducive to the spread of Dengue and other infectious diseases. Efforts to address Dengue in urban areas must include targeted interventions to improve living conditions and access to healthcare for these vulnerable communities.

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Department of Health Dengue Prevention Policies and Programs

The National Epidemic Sentinel Surveillance System, which monitored hospital cases and deaths across 250–400 selected sentinel hospitals throughout the Philippines, did not distinguish between dengue fever (DF), dengue hemorrhagic fever (DHF), or dengue shock syndrome (DSS) until 2005.[13] A significant change was implemented in 2005 to enhance the surveillance of dengue cases, whereby the system began to report cases of DF, DHF, and DSS separately. By 2007, the focus of the Sentinel Surveillance System expanded considerably. It comprised a network of 1,622 disease-reporting units, including sentinel hospitals, private hotels, and rural health facilities. It created a compilation of an all-case report system comprising suspected and probable dengue cases. This movement pioneered the establishment of the Philippines Integrated Disease Surveillance and Response System. Furthermore, in 2008, an innovative virological surveillance system for Dengue was introduced to healthcare institutions to improve the monitoring and understanding of DENV activity.

In most of the responses regarding medical treatments, a plant locally known as *tawatawa* has been commonly used to treat Dengue from the early 1980s until today. In 2016, another form of treatment was introduced through a vaccine known as Dengvaxia, localized and licensed in the Philippines during President Aquino's reign. The Department of Health (DOH) provided 3.5 billion Philippine pesos for this vaccine and launched the National Immunization Program. Approximately 830,000 children aged nine and older received at least one dose of the vaccine. However, in 2017, Sanofi, the manufacturer of Dengvaxia, released a statement that the vaccine may increase some people's chance of developing a more severe form of Dengue, causing turmoil for 800,000 school children. Several people asserted that the vaccine killed many children and that corrupt health officials were in charge. In 2019, the Philippines revoked Sanofi's product license for Dengvaxia.

Currently, dengue cases are continuously rising; health authorities advise the public to take the appropriate precautions. The World Health Organization (WHO) estimates that 100-400 million infections occur yearly. In the latest Surveillance report of the Department of Health (DOH) in the Philippines in 2023, Metro Manila recorded the highest number of dengue cases with 6,395 patients. There is no accepted anti-dengue medicine in the Philippines yet (Montoya, 2021, 1). However, a project is being done in partnership with De La Salle Medical and Health Sciences by Researchers from the Pharmalytics Corporation. In 2020, the Phase 1 clinical trial for the drug was conducted at the Gentri Medical Center Hospital in General Trias

[13] Bravo et al., Epidemiology of Dengue Disease in the Philippines, 1.

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Cavite with a budget of PhP 4.69 million. In an article by Arayata, Phase 1 of the clinical trial was said to be successful. The researchers determined the maximum dose of drugs that could be administered to healthy volunteers without manifesting any adverse drug reaction. The article also mentioned that Phase 2 clinical trials are underway. They will focus on testing the drug's safety and efficacy on a much larger number of volunteers. Department of Science and Technology (DOST) currently provides the Phase 2 clinical trial budget. Once the tests are cleared, the drug will be registered with the Food and Drug Administration (FDA) before distribution. Adopting this drug's technology would ultimately depend on the Department of Health (DOH) or other private sectors.

While progress has been made, the battle against Dengue in Metro Manila remains ongoing. Challenges such as climate change, urbanization, and the emergence of new dengue strains continue to test the DOH's response capabilities. In conclusion, Dengue's global significance as a public health issue is undoubtedly widespread and an economic burden. The DOH's response to dengue problems in Metro Manila from 1953 to 2022 has evolved significantly, with an increasing emphasis on integrated strategies that cover prevention, diagnosis, treatment, and community involvement. Despite the progress, the dynamic nature of Dengue requires continuous vigilance and rigorous research. We can only combat this persistent threat by studying it.

Conclusion

The journey of battling Dengue in Metro Manila from 1953 to 2022 has been marked by significant challenges, evolving responses, and a growing recognition of the complexity surrounding this mosquito-borne viral disease. Dengue's global significance as a public health issue is undeniable, with its widespread prevalence, economic burden, and potentially life-threatening complications, making it a priority for healthcare professionals, researchers, and policymakers worldwide.

As an urban hotspot for Dengue, Metro Manila has witnessed the alarming impact of the disease, with recurrent epidemics, varying intensity, and considerable health and economic consequences. The region's unique climate, rapid urbanization, and increasing population density have created an environment conducive to breeding Aedes mosquitoes, the primary vectors of Dengue. The historical perspective reveals the Philippines' early encounters with Dengue, with Manila experiencing the first recorded epidemic in Southeast Asia in 1954. Subsequent outbreaks, particularly in Metro Manila, underscored the endemic nature of Dengue viruses in tropical urban centers. The emergence of Dengue Hemorrhagic Fever (DHF) marked

a critical turning point, leading to increased hospitalization and mortality among Filipino children.

The Philippines' Department of Health (DOH) responded to the growing threat by implementing various measures, including surveillance systems, public awareness campaigns, and vector control strategies. The National Epidemic Sentinel Surveillance System underwent significant changes, distinguishing between dengue fever, DHF, and DSS and expanding its focus to create a comprehensive disease reporting network.

Urbanization and climate change emerged as interconnected factors contributing to Dengue's prominence. Rapid urbanization led to challenges in city planning, creating disparities in living conditions and providing breeding grounds for mosquitoes. Climate change further intensified the spread of the disease, emphasizing the need for targeted interventions and community engagement. The impact of Dengue on urban communities in Metro Manila is substantial, affecting both public health and the economy. High incidence rates, hospitalizations, and economic costs strain healthcare facilities, highlighting the importance of effective strategies in disease management. The study estimates the annual societal cost of Dengue, emphasizing the broader economic implications and the disproportionate burden on marginalized communities.

In the face of persistent challenges, including climate change, urbanization, and emerging dengue strains, the DOH's response has evolved, emphasizing integrated strategies covering prevention, diagnosis, treatment, and community involvement. While progress has been made, the dynamic nature of Dengue requires continuous vigilance, rigorous research, and a multifaceted approach. The ongoing battle against Dengue in Metro Manila is a testament to the resilience required to combat this persistent threat to public health.

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