

Perspective

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Dengue fever in Egypt: Current situation and future risks

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Dengue or dengue fever (DF) is an acute infectious disease of a febrile nature. It is caused by the dengue virus (DENV), which belongs to the family Flaviviridae and has four antigenically distinctive serotypes (DENV-1, DENV-2, DENV-3 and DENV-4). DENV is regarded as one of the most prevalent fast-emerging mosquito-borne viruses, which has a wide distribution in many tropical and subtropical regions worldwide. The virus is typically transmitted following the bite of an infected female mosquito of the species, *Aedes (Ae.) aegypti* and *Ae. albopictus*[1]. According to the World Health Organization (WHO) statistical records, the global spread of dengue has witnessed substantial growth in recent decades, posing an alarming public health challenge. The number of cases expanded from 505 430 cases in 2000 to 5.2 million in 2019, documenting a ten-fold surge in the detected worldwide cases[1,2].

Egypt is located in north-eastern Africa, sharing a Mediterranean Sea border. Hence, it belongs to the WHO's Eastern Mediterranean Region (EMR), where *Ae. aegypti* is recognized as the primary vector transmitting all four DENV serotypes due to its wide distribution, spread and abundance[3]. Furthermore, Humphrey *et al.* mapped the country-level occurrence of *Ae. aegypti* and *Ae. albopictus* in the Middle East and North Africa. Based on their work, *Ae. aegypti* was the primary mosquito vector in Egypt, with no indication of *Ae. albopictus* spread[4]. Yet, in recent years, the invasive vector, *Ae. albopictus*, has spread in some countries, such as Lebanon[5] and Morocco[6].

Throughout history, Egypt has suffered multiple periodic dengue outbreaks. The earliest records date back to the late eighteenth century in Cairo and Alexandria. Several others followed these outbreaks in Port Said, the Nile Delta and the Suez Canal[7]. During the fourth decade of the twentieth century, specifically in 1937, around 2 594 dengue cases were reported in Cairo. A sharp decline in the disease burden was achieved following the introduction of dichlorodiphenyltrichloroethane (DDT), contributing to a massive eradication of the mosquito population. As a result, Egypt's elimination of *Ae. aegypti* was declared in 1963[8]. However, other *Aedes* species like; *Ae. detritus* and *Ae. caspius* were still prevalent in the southern Governorate of Assiut[9].

Following a decades-long absence of reported cases from Egypt, dengue fever unexpectedly re-emerged in 2010 amongst Italian tourists returning from a Red Sea resort in Southern Egypt. The reporting of these two travel-associated dengue cases from Egypt has raised concerns about the re-infestation of different Egyptian localities with *Ae. aegypti* mosquito[7]. Five years later, the WHO documented a DF outbreak in the Dayrout District of Assiut Governorate. In October 2015, 253 cases were admitted to Dayrout Fever Hospital suffering from acute febrile illness, but without serious complications or fatalities. The diagnosis was confirmed using ELISA and PCR, identifying DENV type-1. Moreover, field-based vector surveillance revealed the proliferation of *Ae. aegypti* adult and larval stages in traditional Egyptian clay water containers, which the villagers use to store drinking water[7]. To investigate the dengue outbreak that occurred in Upper Egypt between June and December 2016, Gaber *et al*. screened the diversity of DENV serotypes using a reverse-transcription loop-mediated isothermal amplification (RT-LAMP) assay. Based on their analysis, DENV-1 was the most prevalent serotype circulating in both human and mosquito populations. The study documented evidence of the resurgence of *Ae. aegypti* in the Upper Egypt Governorates of Assiut, Qena, and the Red Sea[10].

Over 2 000 dengue cases were reported in the 2017 outbreak that took place in the Red Sea city of Al-Quseir. During the outbreak, Egypt's Health Ministry documented only one fatality. Unlike the

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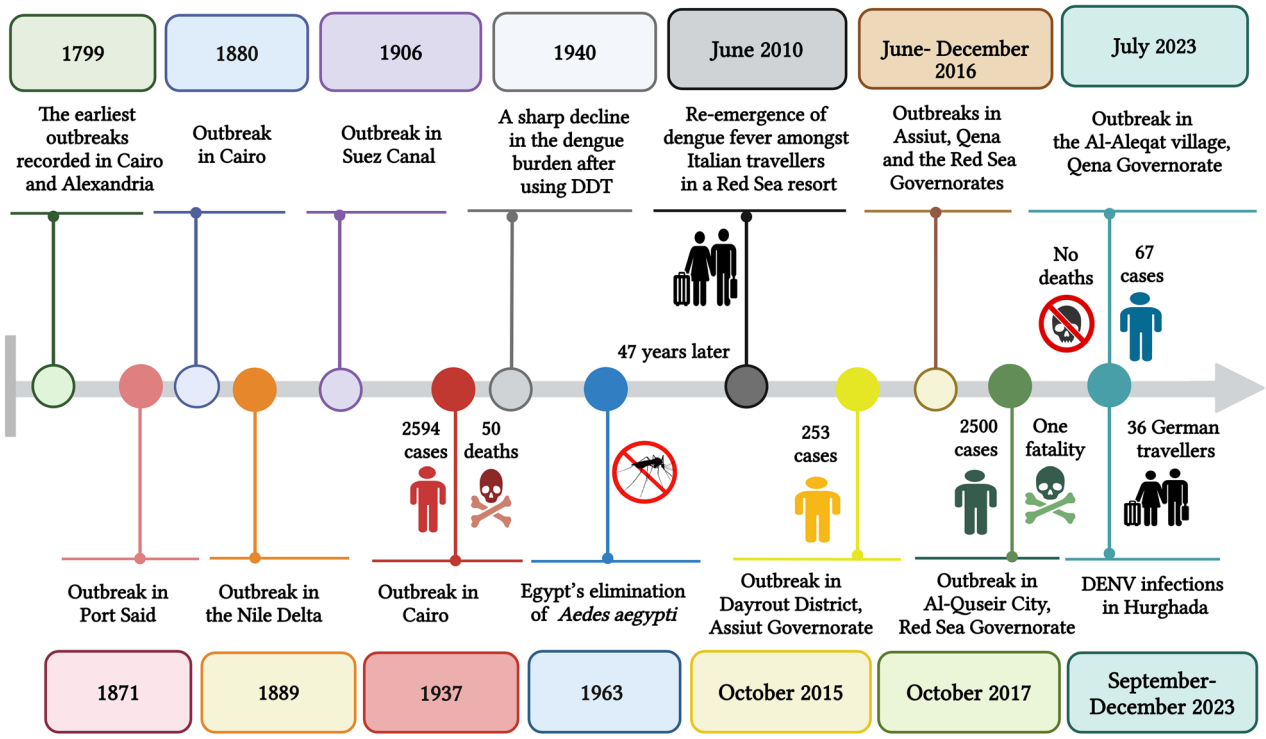

Figure 1. A schematic presentation depicting the timeline of dengue fever in Egypt.

2015 outbreak of Dayrout District, the viral serotype revealed in the 2017 epidemic was DENV-2, sparking concerns about introducing a new dengue serotype into Egypt[8].

On Tuesday, the 18th of July 2023, the Egyptian authorities announced a dengue outbreak in Nagaa Sandal of Upper Egypt's Province of Qena. Nagaa Sandal belongs to the village of Al-Aleqat in the Centre of Qus in Qena Governorate. The speculations about the outbreak began when over 60 villagers started to develop symptoms of fever, vomiting, headache and joint pain. Antibody and DNA testing of the suspected cases turned out positive for DENV. The infection didn't cause any fatalities. Entomological surveillance and larval analysis verified the presence of *Ae. aegypti* in the area. Uncovered drains and exposed sewage-collection tanks in Qus District are among the reasons for stagnant water collections, enhancing the proliferation of *Aedes* mosquito[11]. During the months from September through December of the same year, the German public health authorities issued a notification of DENV infections in cases imported from Egypt. In 2023, 36 patients (16 men and 20 women) were exposed to the virus. Yet, none died. Over 90% of the tourists had stayed in Hurghada City, indicating an intriguing increase in dengue transmission on the Egyptian Red Sea coast[12]. These latest observations fit with the worldwide dengue upsurge reports. The year 2023 marked a historical rise of over 6.5 million dengue cases globally, with more than 7 300 deaths reported[1].

Despite the previously outlined details about the chronological spread of DF in Egypt, as shown in Figure 1, many outbreaks remain largely uncharacterized. This could be attributed to poor diagnostic facilities, non-reporting of illness symptoms and inadequate human or mosquito surveillance. These factors limit early DENV detection, leading to delayed outbreak recognition. Thereby, there is an urgent need to establish a sound network system for continued reporting of dengue cases and follow-up of febrile patients. It is also imperative to consider community-based engagement, including public awareness campaigns and health education programmes[3].

To conclude, Egypt might not be a typical hotspot for DF. However, given the effects of climate change and extreme weather, the risk of dengue seems alarming, which prompts the Egyptian health authorities to face the disease burden in the future, especially as its source is still present. Accordingly, integrated control activities should be intensified to eradicate local mosquito populations, limit virus transmission and de-escalate emerging cases.

Conflict of interest statement

There is no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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