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Review

Yellow fever outbreak in Kenya: A review

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ABSTRACT

Yellow fever (YF) is a viral acute hemorrhagic illness caused by infected mosquitoes of the flavivirus family. The first yellow fever outbreak in Kenya was in 1992. Similar outbreaks were recorded in the western part of the country in 1993, 1995, and 2011, particularly in the Rift Valley province of Kenya. In early 2022, the viral acute illness resurfaced and hit Kenya. On January 12, 2022, the first case was discovered, with over 14 patients suffering from fever, jaundice, and joint and muscle pains. On March 4, 2022, a yellow fever outbreak re-emerged in Kenya, affecting 11 wards in Isiolo County. The fatality rate recorded was 11.3% (six deaths), with Chari accounting for 39.6% of the total 21 cases, Cherab 14 (26.4%), and 5 Garba Tulla (9.4%).

This has the potential to further endanger the nation's economic growth while also negatively impacting people's daily lives in a part of the world that is already dealing with the catastrophic impacts of the coronavirus pandemic. However, there is no curative therapy for yellow fever. The only options for curbing its spread are through vaccination and preventive measures.

Hence, Kenya's government must take responsibility for requiring vaccination of its citizens, implement an active national disease surveillance protocol, and set up anti-yellow fever campaigns in the country.

1. Introduction

Yellow fever (YF) is considered an acute and tropical illness. It's transmitted through the bites of flavivirus family infected mosquitoes, namely Haemogogus and Aedes mosquitoes [1]. The fever was named "Yellow fever" due to its presentation with pyrexia, yellowish skin, and sclera. It can range from a mild, self-limiting illness to a severe hemorrhagic illness, with muscle aches or gastrointestinal symptoms. This fever is diagnosed serologically with polymerase chain reaction (PCR). Treatment for yellow fever is usually supportive, and its prevention is through an effective vaccine.

YF cases have been reported in America and Africa over the last century. However, in the 1980s and early 1990s, and until the most recent outbreak in March 2022, a higher case number recorded in the African region, particularly within the yellow fever belt, was significantly associated with vaccination [2].

Currently, the incidence of yellow fever outbreaks in Kenya is of utmost significance, requiring brisk intervention [2]. Yellow fever has been causing epidemics in East Africa, with hundreds of thousands of cases and fatalities in various Kenyan regions (See Fig. 1). To prevent a recurrence of YF in various countries, many organizations, like WHO and UNICEF, alongside other health partners, began executing the

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Eliminate Yellow Fever Epidemics strategy with objectives aimed at improving response and preventing future outbreaks with the goal of having over 1 billion individuals protected by the vaccine against Yellow Fever [3].

Yellow fever causes a lot of unpredicted hardship, incredible damage, and economic disruption at every stage of human development among African, European, and American populations. This virus has caused economic damage, as well as misery and an economic setback for developing countries [28].

Between the 18th and 19th centuries, yellow fever was considered the deadliest disease and also remains a public health problem across Africa [29]. Over 13 countries in Central and South America, as well as more than 33 countries in Africa, are at high risk of becoming endemic for yellow [32]. Although YF is a vaccine-preventable disease, it is still a public health issue.

It is estimated that YF causes over 81,000 deaths worldwide each year [30]. Thus, over 20,000 deaths each year and more than 150, 000 cases account for about 89% of all deaths in Africa. It is estimated that 30% to 50% of individuals diagnosed with yellow fever die from it, which has disrupted the economy and health care systems globally [31].

As a result, this review focuses on the current outbreak of yellow fever in Kenya by reviewing the epidemiology of yellow fever; economic impact, the existing relationship between COVID-19 and yellow fever; its complications and medical gap; management; and the current effort to mitigate yellow fever in Kenya, especially in this time of the pandemic.

2. The epidemiology of the yellow fever outbreak in Kenya

In 1992, Kenya experienced its first yellow fever outbreak. Similar cases were reported in the western part of Kenya in 1993, 1995, and 2011, especially in the Rift Valley province [4]. In addition, two imported cases of yellow fever in Kenya from Angola were reported and recorded in 2016 [5]. In nine (9) countries in the WHO African region, Kenya reported human laboratory-confirmed cases of yellow fever with a high risk of death and a history of transmission and outbreaks primarily in Africa's West and Central regions [3,5]. However, it should be noted that the overall burden of the disease in Kenya is underestimated because of a lack of reporting in some of the cases, according to WHO estimates.

The Ministry of Health, Kenya declared and reported an outbreak of yellow fever in the county of Isiolo on March 4th, 2022 as seen in Fig. 2. Eleven wards within Isiolo County were the most affected, with 21 cases reported in Chari, amounting to 39.6% of the cases; 14 cases in Cherab (26.4%); and 5 cases found in Garba Tulla (9.4%). The report includes the 11.3% case fatality ratio (six deaths). However, 47 cases (88.7%) were male, the majority of the cases, and age 28 was the average age of the cases [3]. Furthermore, the first case was detected on January 12th, 2022. About 15 patients were confirmed with symptoms of Pyrexia, a yellowish pigment of the skin, and myalgia [7]. Six (6) samples were sent for analysis, and three (3) turned out positive through serology (immunoglobulin M) and PCR tests.

Therefore, this puts neighboring counties at high risk. Wajir, Garissa, Elgeyo Marakwet, West Pokot, Marsabit, Meru, Samburu, Baringo, and Turkana are examples [3,6]. It has had the highest number of yellow fever cases in East Africa compared to other countries in the same region [8]. The areas most affected included those that had previously undergone large-scale mass vaccination campaigns.

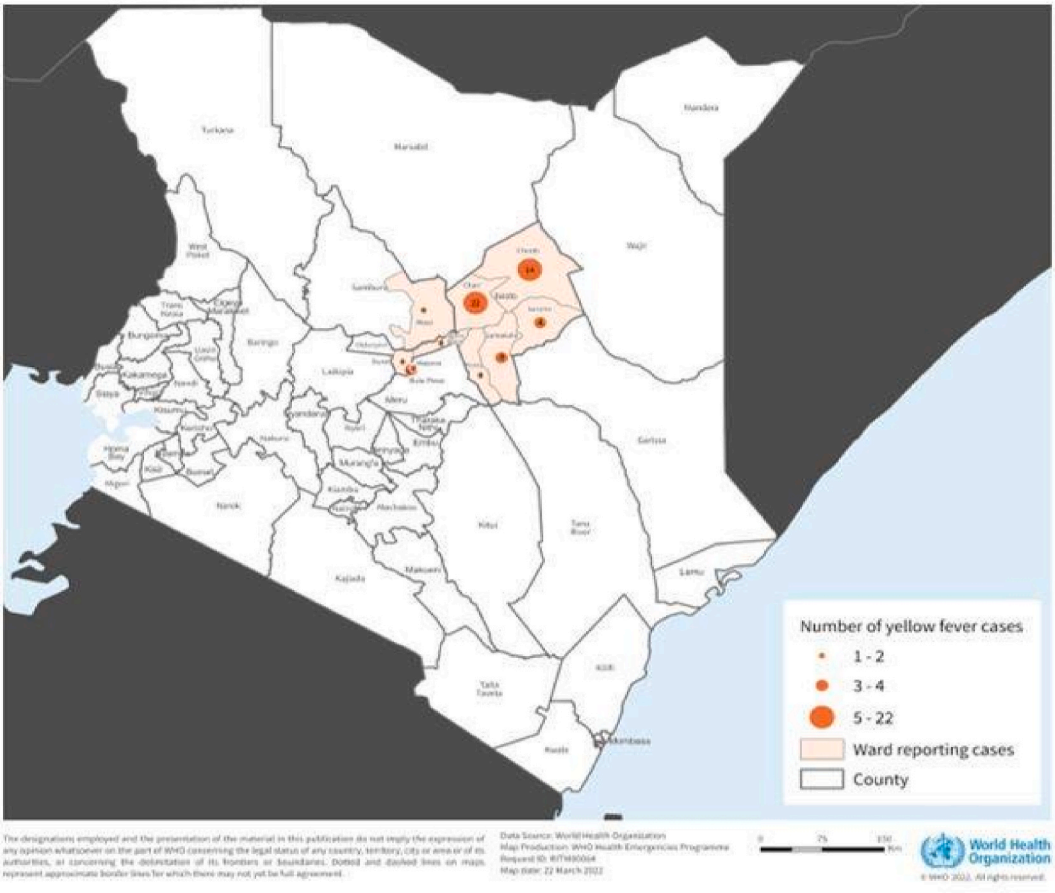

Fig. 1. Showing the regions of Kenyan affected yellow fever outbreak. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

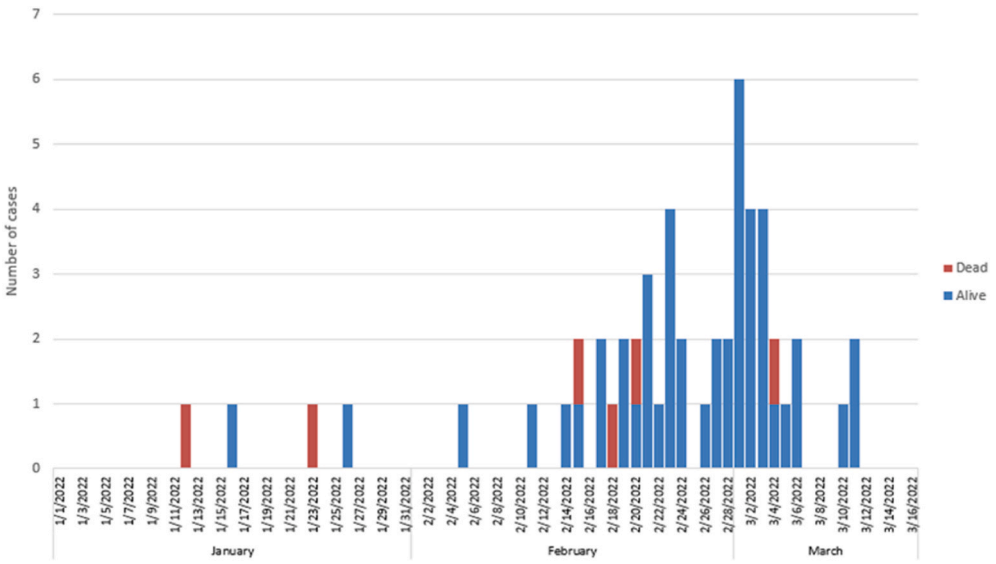

Fig. 2. Showing the epidemiological curve of yellow fever cases by date of symptoms onsets and outcome, Isolo County, Kenya 1st of January to 15 of March 2022. (n = 53). (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

3. The aetiology of yellow fever

The YF virus is an RNA virus that belongs to the genus Flavivirus. It is primarily transmitted to humans through an infected Aedes or Haemagogus mosquito bite [9]. Yellow fever has three transmission cycles (Fig. 3). The first is the sylvatic, or jungle cycle. Monkeys living in the tropical rainforest become infected through mosquito bites; the virus is transmitted from monkeys to visitors by mosquitoes [9] (see Fig. 4).

The second is the intermediate yellow fever or savannah cycle, which involves both transmission from monkeys to humans in the savannah and the direct transmission of the virus among humans through mosquitoes [2,9]. The third cycle is known as the urban cycle. It includes the transmission of the virus between humans and urban mosquitoes, mainly Aede Aegypti [1,9]. The virus is brought to the urban setting by infected jungle humans.

Outbreaks are usually triggered by sylvatic and intermediate forms in which the virus is transmitted when humans come into close contact with monkeys. Yellow fever is endemic in the sylvatic settings in Africa, majorly in East and West Africa. The sylvatic transmission mode gives a repeating epidemic pattern compared to urban transmission, which often causes unpredictable outbreaks [6].

The predisposing factors for the outbreak in Kenya could be traced to the expansion of urban areas with limited sanitary provision. This will encourage the concentration of susceptible human hosts and mosquito vectors' proliferation, making urban areas increasingly prone to massive outbreaks.

The porous nature of Kenya's borders and increasing rural-urban migration, made it easy for yellow fever to be introduced into urban Kenya from neighboring East African countries experiencing outbreaks. Recent reports also indicate a resurgence and intensified transmission of the yellow fever virus, specifically due to a lack of sustained population immunity and low vaccine uptake in the country [3].

4. The relationship between COVID-19 and Yellow fever

(see Table 1)

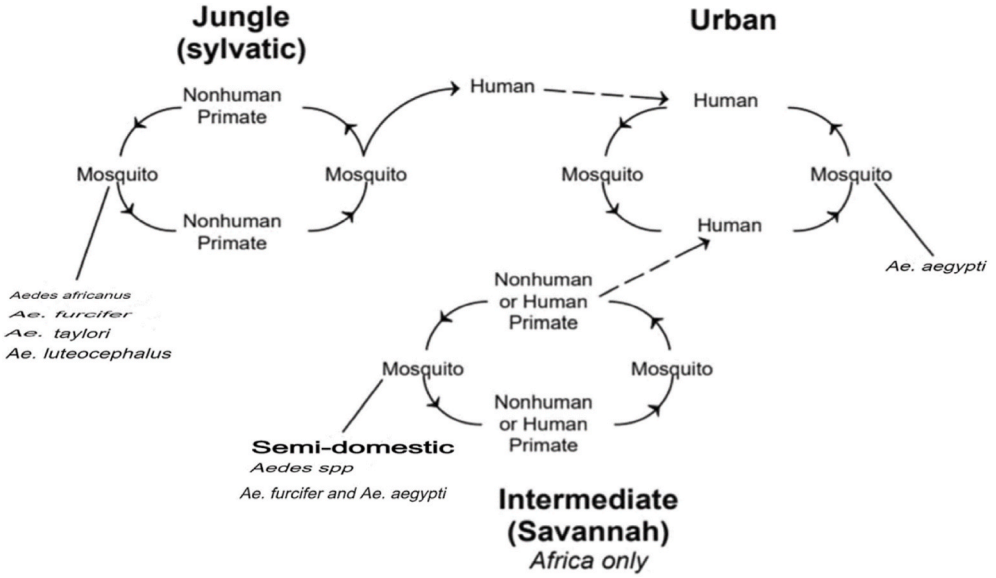

Fig. 3. Shows the transmission cycle of yellow fever.

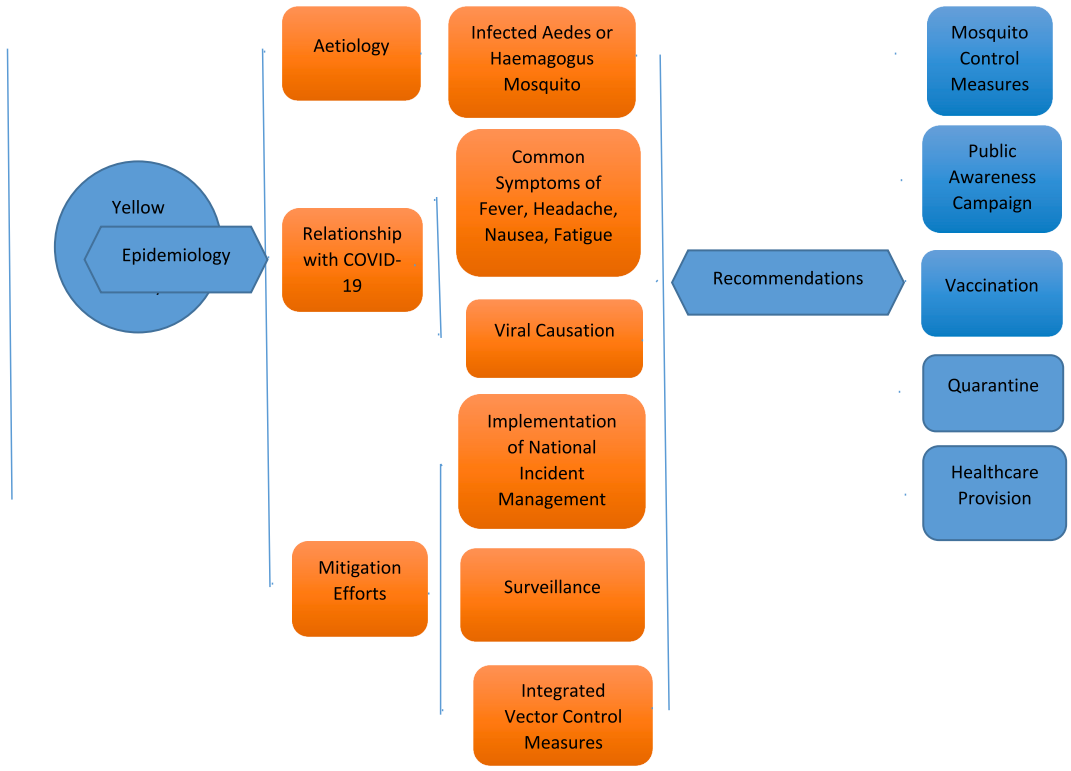

Fig. 4. The Infographic of yellow fever outbreak among Kenyan people and its relationship with COVID-19. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

Table 1
Comparison between Yellow fever and COVID-19.

Comparison between Yellow fever and COVID-19		
	Yellow fever	Coronavirus (Covid-19)
Common symptoms	Fever, headache, nausea or vomiting, fatigue	Fever, headache, nausea or vomiting, fatigue [13]
Type of disease	Endemic	Pandemic [13]
Vaccination status	7% of targeted population [3].	15.3% of total population fully vaccinated [10].
Treatment	No available treatment [9]	Several drugs are available [11].
Transmission	When infected mosquito of the species Haemagogus or Aedes bites Human [9].	Virus transmission to human occurs Mainly through close contact with an infected person [9,14,15]
Virus	RNA virus of the Flavivirus genus [9].	RNA virus belongs to the family Coronavirus [9].

5. Current efforts to mitigate Yellow fever in Kenya

Over the years, Kenya has been negatively impacted by yellow fever. During the outbreak that occurred between January 12 and March 15, 2022, a total of 53 suspected yellow fever cases, including six deaths, were reported from Isiolo County, central Kenya. Two samples tested positive by Reverse Transcription Polymerase chain reaction (RT-PCR), and six (6) were positive by enzyme-linked immunosorbent assay (ELISA), indicating probable yellow fever cases. The last reported yellow fever outbreak in Kenya was in 2011. At the national and regional levels, following the declaration of an outbreak of yellow fever in the county of Isiolo in central Kenya by the Ministry of Health (MoH) on March 4, 2022, efforts are currently in place to mitigate the spread of yellow fever. However, the government has activated its emergency response mechanism due to the deaths linked to an outbreak of yellow fever. There is currently a National Incident Management Structure implemented by the government to manage the outbreak. Currently, surveillance and rapid response teams have been deployed to affected areas to assess the severity of the outbreak, manage risk assessment, identify at-risk populations, initiate risk communication and engage community members, and implement integrated vector control measures [12].

Furthermore, the WHO and the Kenyan government mobilized resources to support response activities. A request has been sent to the international coordinating group for vaccine provision for re-active yellow fever massive vaccination in the affected region of Isiolo, with an extension to any other high-risk places, which includes Elgeyo Marakwet, Wajir, Marsabit, Mandera, Garissa, Tana River, Meru, Samburu, West Pokot, Baringo, and Turkana [12].

6. Recommendations

Yellow fever is an endemic disease in certain parts of the planet and in Kenya in particular, a humid region of the African savannah. For this outbreak of yellow fever in Kenya, the government must first inform the Kenyan population about the endemic risks of yellow fever. We urge Kenya's government to launch public awareness campaigns about the threat of yellow fever and apply World Health Organization declarations in the case of yellow fever.

Mosquito control is highly recommended for the people of Kenya, as is protection against mosquito bites through installing mosquito nets and using insecticides. However, because the country is located in the African savannah, where the rainy season is almost constant and facilitates the development of mosquitoes, the use of capsulated or filtered bottled water is recommended.

There is no curative treatment for yellow fever, so prevention and vaccination remain the only solutions to limit its spread. The government of Kenya must assume the obligation to require its citizens to be vaccinated and to possess a vaccination certificate against yellow fever before traveling. Travellers must be informed of the means of protection against vector mosquitoes and the measures to be taken during the trip

[16–21].

The clinical manifestations of the disease vary according to their severity. The government of Kenya must take care of all people with yellow fever urgently to prevent any transmission of this fever. The government must also provide this care and do so free of charge to allow any suffering person to benefit from it [22–26].

After the declaration of the yellow fever epidemic in Kenya by the health authorities, the people of Kenya must remain in quarantine (must not leave the country except in case of emergency), but those who want to leave the country must have a document certifying that they have been recently vaccinated. The mode of alert that the government and health authorities of Kenya have adopted must be observed until the end of this yellow fever epidemic [27].

7. Conclusion

As yellow fever is a vector-borne tropical disease, it remains a serious economic and public health problem in Kenya during this explosion period. However, the government of Kenya and its public health partners, can mobilize the means available to eradicate yellow fever and ensure the availability of tests and vaccines for travellers.

With yellow fever being a scourge and a public health problem these days in Kenya, only vaccination can prevent it, despite the insufficient number of vaccines. The areas most affected by the disease will have to be quarantined. This explosion of yellow fever in Kenya destabilizes the government and the health system of Kenya during this period of the Corona Virus (COVID-19). The Kenya health care system should activate epidemiological surveillance and implement all possible methods such as vaccine uptake to eradicate this disease.

This epidemic of yellow fever, which affects the extent of the national territory of Kenya at the economic level and the health system, should be taken seriously and eradicated in a short time to avoid the many deaths that this scourge causes.

Ethical approval

Not Applicable.

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None.

Author contributions

Olivier Uwishema – Conceptualization, Project administration, Writing-review and Designing.

Stanley Chinedu Eneh – Collection and assembly of data.

Olivier UWISHEMA – Reviewed and edited the first draft, supervisor.

Helen Onyeaka, Olivier Uwishema – Reviewed and edited the second draft, Supervisor. Fig. 1 and 2: Showing the regions of Kenyan affected yellow fever outbreak (Fig. 1 and 2 was adopted from [WHO] World Health Organization report on Kenya yellow fever outbreak[3]). WHO granted permission for including the figures in our article. Fig. 3: showing the transmission cycle of yellow fever from NCDC. Fig. 4. Info graphic of yellow fever outbreak among Kenyan people and its relationship with COVID-19 (Fig. 4. Was drawn, analysed and edited by Authors: Anyike, Goodness Chiburoma [1, 5]; Stanley Chinedu Eneh [1, 4] and Olivier Uwishema[1, 2, 3]*). Manuscript writing – All authors. Final approval of the manuscript –All authors

Registration of research studies

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Guarantor

Not Applicable.

Consent

Not Applicable.

Data availability statement

Not Applicable.

Declaration of competing interest

No conflicts of interest declared.

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None.

Abbreviations

1. WHO World health organization
2. UNICEF United nations international children's emergency fund
3. RNA Ribonucleic acid
4. COVID-19 Coronavirus Diseases – 2019
5. KMoH Kenya Ministry of Health
6. RT-PCR Reverse Transcription Polymerase chain reaction
7. ELISA Enzyme-linked Immunosorbent Assay
8. CDC Centres for Diseases control and Prevention

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