Dengue ”homegrown” in Europe (2022 to 2023)

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All of the current conditions in Europe suit the local transmission of dengue fever, especially in southern Europe. The conditions are: a suitable vector (*Aedes* spp.), an adequate pool of viraemic persons and suitable climatic conditions for both the survival of the vector and the development of the virus in the vector. In this editorial we will examine the situation of locally transmitted infections, also known asautochthonous cases in Europe in the years 2022 and 2023.

Aedes aegypti and *Aedes albopictus*, the two main vectors of dengue fever, are both present in Europe (see Figs. 1 and 2) [1]. In contrast to *Aedes aegypti*, *Aedes albopictus* is already prevalent in Europe (see Fig. 2). In southern Europe, more precisely in Italy, southern France, eastern Spain and on the east coast of the Adriatic Sea, the mosquito is established and is gradually spreading to the northern latitudes of Europe. By August 2023, *Aedes aegypti* was not significantly widespread in Europe (see Fig. 1). It should be noted that the data is incomplete and were only documented in Western and Central Europe. The reason for the different distributions is that, unlike *Aedes aegypti*, *Aedes albopictus* is able to settle in more temperate regions, can tolerate temperate winters and the eggs can survive temperatures of up to −10 °C [2–4].

Aedes aegypti can be distinguished from *Aedes albopictus* by the key characteristic features of a lyre-shaped thorax pattern or a typical white line on the thorax. These *Aedes* species are primarily responsible for the transmission of the dengue virus [5].

Regarding autochthonous cases (reported to national health agencies), these are cases transmitted locally within Europe - a total of 66 cases were registered in 2022 (Fig. 3), including 65 cases in France [8] and 1 in Spain [9]. In 2023 (to mid-November 2023), a total of 122 cases were reported in Europe, 76 in Italy [10], 43 in France [11] and 3 in Spain [12,13]. While the casenumbers in Spain seem to be stable, we see an increase in case numbers in Italy and a decrease in France in 2023.

In Italy the cases occurred in four provinces; Lodi, Latina, Rome and Anzio, with 37, 2, 36 and 1 cases respectively. No link between the outbreaks has been observed [10].

In France the cases are distributed along the Mediterranean coast in the regions of Occitanie, Provence-Alpes-Côte-d'Azur, Auvergne-Rhone-Alpes as well as in and around Paris (region of Ile-de-France) [11,14]. Two Cases in 2022 were found in Corsica [8].

In Spain, autochthonous cases can be found along the Mediterranean coast, in Murcia and in Madrid, as well as in the Balearic Islands. In 2023 two autochthonous dengue cases were notified in Ibiza. Prompt measures were taken to reduce spread on the islands: For 1 week, those affected and everyone in the affected dwelling had to stay at home and were only allowed to go to the doctor in the city of Ibiza. During this time, no mosquito was found in the house. After assessing the environment and considering the temperature, the risk of dengue spread was classified as low, but it was recommended to carry out entomological surveillance, remove potential breeding sites and inform the public. These cases have significant public health implications in terms of tourist movements to and from the Balearic Islands [15,16].

What all the cases have in common is that most of them are found in urban regions. In Italy in particular, we only see cases in the two most touristic regions, Milan and Rome. In France and Spain, many cases are found along the Mediterranean coast, but there are also hotspots in major cities such as Paris and Madrid. It is not surprising that ransmission often occurs in urban environments as *Aedes* thrives in cities and urban areas have large numbers of returning viraemic travellers who have visited dengue endemic regions. Since dengue often is a very mild infection many cases go unnoticed, it can be assumed that there are a high number of unreported cases and that only a fraction of cases appear in surveillance statistics.

The spike in cases in Italy in 2023 may be attributed to several factors: a rebound in incoming travellers post COVID-19, suitable outbreak conditions in August and early September and possibly more focused post-COVID-19 infection reporting.

Climatic changes can lead to better conditions for the distribution of *A. albopictus* when the annual rainfall is above 500mm, annual temperatures above 11 °C and January temperatures are above 0 °C [17]. According to the RCP scenarios employed within the IPCC framework, there is an expected increase in annual mean temperature by the end of this century ranging from 2.2 to 5.3 °C [18]. The warming will be more pronounced in southern Europe in summer in combination with more intense droughts and in northern Europe in winter in combination with increased rainfall [19].

The rising temperatures can create more favourable conditions for *A. albopictus*. In combination with increased rainfall and presence of small reservoirs such as plant pots and plant containers it creates breeding sites for the mosquitoes, this may result in an expanded range and increased activity of the mosquitos, if the vector is introduced into more European countries [20].

The rising temperatures and increased rainfall in northern Europe results in an increased risk of dengue in northwestern and central Europe and the Balkans. In a worst-case scenario, dengue will become endemic in northern Europe.

At the moment, we see an increased number of autochthonous dengue cases in Mediterranean countries such as Spain, Italy and France. In the future, summers in these areas will become hotter and drier due to climatic changes. If the total annual rainfall falls below 800 mm and summer temperatures rise above 25 °C, there will be a significant reduction in suitability for *A. albopictus*. This may result in a decreased risk in southern Europe especially in Spain, Portugal and the

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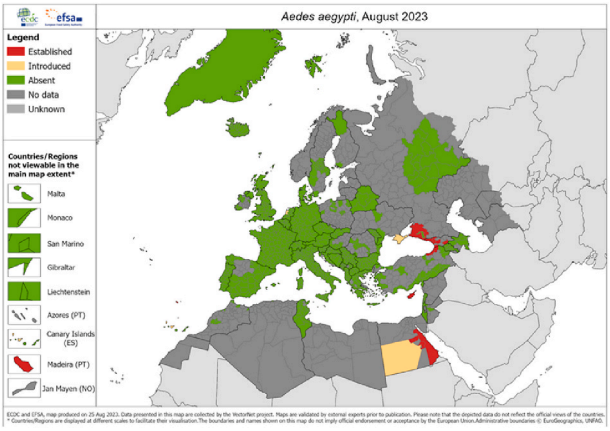

Fig. 1. The distribution of *Aedes aegypti* in Europe, status August 2023 [6].

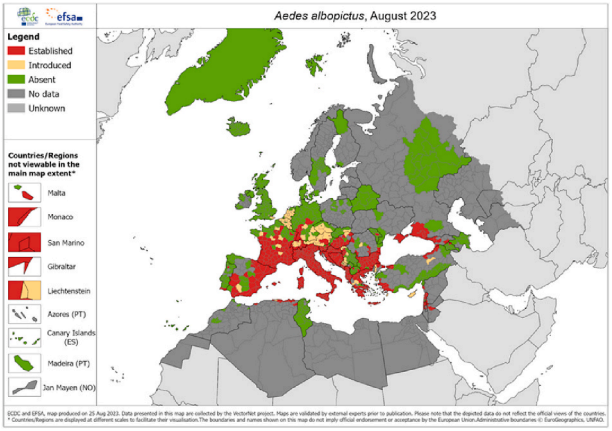

Fig. 2. The distribution of *Aedes albopictus* in Europe, status August 2023 [7].

Mediterranean islands and might limit its southward expansion [21]. At the same time, climatic changes may lead to *A. aegypti* spreading increasingly in Europe. Depending on the RCP scenario, only a few coastal areas of the Mediterranean will allow *A. aegypti* to become established or many densely populated areas in southern Europe will become risk areas [22].

When reviewing the measures taken by European countries to control and also to combat dengue, it is necessary to discuss their effectiveness. This is especially true when we consider circumstances, such as the distribution of dengue-transmitting mosquitoes and how this is influenced by climate change as well as the growing number of autochthonous cases in several southern European countries. When analysing newer case numbers, one could suggest that dengue will further spread across Europe in the coming years which creates an immediate urgency for more measures against this ongoing public health problem. Current measures recommended by the ECDC to fight *Aedes* spp. include the elimination of standing water sources [23]. These measures do not appear to have a sufficient effect necessary to tackle this problem.

We propose that certain measures are critical to stopping or at least slowing down the spread of dengue. In addition to measures to fight the mosquitoes, including insecticide spraying, adaption of *Wolbachia* programs, and larval site control, it is especially important to continue raising awareness among the public of European countries. Individual protection against mosquitoes could play a crucial role in the future to halt the spread of dengue among Europe. This could be reached by informing the public about possible individual countermeasures. We also propose international collaboration in mosquito control programs and improved surveillance systems on national as well as international levels especially among Mediterranean countries. These measures could potentially help in the fight against this emerging infection.

Another public health concern is the risk of dengue being transmitted through organ transplants and blood transfusion. This transmission pathway, although rare, poses an increasing risk as dengue becomes endemic to more regions, with some notable clusters in Brazil and Honduras. Furthermore, the anti-DENV antibodies from previous exposure to the virus are also a cause for concern, as their presence correlates with a more severe course of dengue fever and a higher mortality [24]. Dengue has been found to be transmitted through all blood components independent of the viral load and the transmission rate is estimated at 37.5 % [25].

In 2021 France reported one case of infection in an organ transplant recipient in Paris. The ECDC recommends the implementation of measures for returning travellers such as donor deferral, screening and post-donation information. Currently there are no universal dengue screening guidelines for donors in the EU [26].

Aedes albopticus is found in Italy, on the eastern Adriatic coast, eastern Spain and southern France, whereas *Aedes aegypti* was detected in more limited geographic region. The number of dengue cases rose in Europe in 2023. An increase is recorded in Italy in particular, whereas France is characterised by a decrease. However, cases in Spain have remained persistent. The evidence suggests that climate change favours the spread of dengue due to higher temperatures and increased rainfall. Current public health measures may not be sufficient to halt the march of dengue through Europe and a stricter implementation of individual measures, increased awareness among the population and coordinated holistic European programs are indicated.

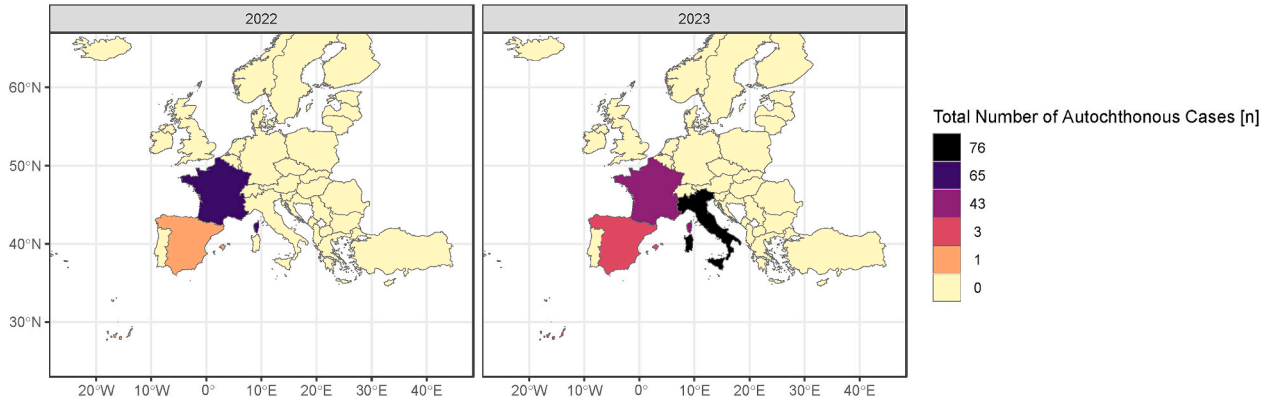

Fig. 3. Reported autochthonous cases in Europe 2022/2023 (current to the end of October 2023).

Credit author statement

All authors contributed equally.

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