



Commentary

Climate change impacts on vector-borne diseases in Europe: Risks, predictions and actions

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Climate change has an influence on the transmission of vector-borne diseases (VBDs) since a warmer climate and changing rainfall patterns may create hospitable environments for climate-sensitive vectors (such as mosquitoes and ticks) and pathogens. Although the impacts are complicated by nonlinear feedbacks, inherent in the dynamics of infections, climate change is known as a major driver influencing the epidemiology and transmission of VBDs on different time scales[1]. In Europe, exposure to occurrences of extreme heat has been worsening while their frequency, intensity and duration has increased during the last decades. Moreover, the frequency of heavy rainfall events and floods has increased, parallel with a decrease in the amounts of precipitation in the southern European countries[2].

Over the past decade, locally transmitted outbreaks of VBDs potentially influenced by the changing climate, have occurred in Europe. Since 2010, when unprecedented outbreaks of West Nile virus (WNV) occurred in southern and eastern Europe, accelerated by extreme heat[1], WNV outbreaks have been reported every summer (2011–2020) in various southern and eastern countries, facilitated by the changing climate. Recently, cases were detected even in northern Europe, in Germany[3]. These outbreaks provide evidence of an endemization process of WNV in Europe[1]. The impact of changes in rainfall patterns is more complex, depending on the local conditions and differences in mosquito species. In northern Italy, heavy precipitation has been associated with infection incidence[4] but conversely, in the Danube Delta, Romania, negative linkages were detected between drought conditions and an increase in infection rate in mosquitoes[5].

Aedes aegypti and *Ae. albopictus* are the primary vectors that transmit dengue, chikungunya, and Zika. Based on present-day climatic conditions, there is a current potential distribution of *Ae.*

aegypti and more widely of *Ae. albopictus* in southern and western Europe. Although *Ae. albopictus* causes public threats via human activities, the changing climate impact is also a factor to be considered. In recent years, local transmissions of chikungunya have been confirmed in France and in Italy. In August 2019, the first appearances of Zika virus transmission in Europe were detected in southern France. The cases had no travel history to Zika-endemic countries, which reinforces the hypothesis of autochthonous transmission[6].

Ixodes ricinus transmits a wide variety of tick-borne pathogens in Europe, including Lyme borreliosis and tick-borne encephalitis. Models predicted potential range expansions in northern Europe, with milder winter conditions such as temperature increases. Such conditions can allow more ticks to survive the winter, and increase the probability of tick bites[7].

Young children, the elderly and those with chronic health problems are at higher risk as well as migrants, refugees and populations living in poverty that might be less likely to have secure, air-conditioned homes and therefore become more susceptible to insect bites.

For Europe, it is predicted that temperatures will continue to increase in parallel with more frequent heat waves. Heavy rainstorms are projected to become more common and intense, in parallel with recurrent floods[2]. These changes will affect the transmission of some VBDs, with increases and decreases in projections depending on the region affected by disease and degree of temperature change. Projections for Europe indicate a further geographical expansion of WNV infections, mainly on the fringes of the regions of transmission[8]. For *Ae. aegypti*, a rise in populations at risk is expected, while for *Ae. albopictus*, major increases are predicted for all climate scenarios[9].

These projected changes emphasize the need for more active actions, such as:

1. Consolidating systematic epidemiological data with climatic, environmental, ecological and demographic data to develop better innovative methodologies and effective communication strategies on European, national, and local levels;
2. Developing an efficient vector control programme by monitoring the density and distribution of hosts and pathogens on urban, national and cross-border levels;
3. Health action and adaptation plans should be developed, based on the local characteristics of different regions, parallel with identifying vulnerable populations at risk;

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4. Development of early warning systems, based on predictive modelling to help decision-makers understand where or when infections will emerge or spread;
5. Strengthening the public awareness by educational programmes using the involvement of the media and community health workers and leaders.

Since 1990, greenhouse gas emissions have been steadily declining in the EU. This trend continued with emission reductions in the EU-28 falling to 26% below 1990 levels in 2019. Currently, the European Commission plans to cut net emissions by at least 55% by 2030 to becoming climate neutral by 2050[10]. Together with these positive mitigation actions, effective intervention and cross-border cooperation are essential in order to prevent the negative impacts of the changing climate on VBD transmission in Europe.

Declaration of Competing Interest

The author declares that there is no conflict of interest.

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