Mosquito-borne diseases surge, challenging European public health

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> Europe's temperate climate once offered a natural barrier against many vector-borne diseases. That protection is eroding rapidly. The continent now faces a growing threat from mosquito-borne pathogens, demanding a recalibration of public health strategies.

KEY TAKEAWAYS

- The Pivot: Mosquito species like Aedes albopictus and Culex modestus are establishing themselves in new European regions, expanding the geographic risk for diseases such as dengue and West Nile virus.
- The Data: Dengue cases in Europe, primarily travel-related, increased from 1,939 in 2010 to 5,600 in 2022, with local outbreaks also rising.
- The Action: Clinicians should maintain a high index of suspicion for vector-borne diseases in patients presenting with febrile illness, even without recent travel history to traditional endemic areas, and advocate for enhanced local surveillance.

The mosquito, humanity's most lethal predator, is on the move. Climate change, global travel, and urbanisation are dismantling the geographical barriers that once confined diseases like dengue, chikungunya, and West Nile virus to specific tropical and subtropical zones. European clinicians must now contend with these pathogens not as exotic imports, but as potential local threats. The implications for diagnosis, treatment, and public health infrastructure are substantial, requiring a fundamental shift in preparedness.

Two species in particular drive this expansion: Aedes albopictus (the Asian tiger mosquito) and Culex modestus. A. albopictus, a highly invasive species, has colonised vast swathes of Southern and Central Europe since its first detection in Italy in 1990. It transmits dengue, chikungunya, and Zika viruses. C. modestus, a native European species, has recently expanded its range and is a primary vector for West Nile virus. These mosquitoes thrive in urban and peri-urban environments, exploiting small water collections for breeding, making their control particularly challenging.

The numbers behind the spread

The European Centre for Disease Prevention and Control (ECDC) reports a consistent upward trend in mosquito-borne disease cases. Dengue cases, predominantly travel-related, increased from 1,939 in 2010 to 5,600 in 2022. Local dengue outbreaks, once rare, are becoming more frequent. Italy reported 82 locally acquired dengue cases in 2023, France 43, and Spain 3. These numbers, while small compared to global totals, represent a concerning shift towards autochthonous transmission within Europe. West Nile virus neuroinvasive disease (WNND) cases also show significant year-to-year variability but a clear long-term increase. In 2018, Europe experienced its largest WNND epidemic to date, with 1,630 human cases and 180 deaths. The virus has established endemic foci in several Southern and Eastern European countries, including Greece, Italy, and Romania.

The expansion of these vectors is not theoretical. A. albopictus is now established in 13 European Union/European Economic Area (EU/EEA) countries, extending its range northwards into Germany and westwards into Portugal. Its presence facilitates local transmission cycles when viraemic travellers return from endemic regions. C. modestus, while historically present, has shown increased activity and range, particularly in areas with suitable wetland habitats, contributing to the spread of West Nile virus. The ECDC's latest vector maps illustrate this relentless march, showing new regions turning red with established mosquito populations each year.

Clinicians must recognise the evolving epidemiology. A patient presenting with fever, rash, myalgia, and arthralgia in, for example, southern France, could now have locally acquired dengue, not just a travel-related illness. Similarly, encephalitis or meningitis in a patient from the Po Valley in Italy could be West Nile neuroinvasive disease, even without a history of bird exposure or specific outdoor activities. Diagnostic laboratories need to be equipped for broader pathogen screening, and clinicians must be aware of the appropriate tests and reporting protocols.

But the challenge extends beyond individual patient diagnosis. Public health systems across Europe are largely unprepared for the scale of vector control required. Traditional mosquito control measures, such as larviciding and adulticiding, are resource-intensive and often face public resistance due to environmental concerns. Surveillance systems, while improving, still suffer from fragmentation and underreporting. Many countries lack comprehensive, real-time data on vector distribution and pathogen circulation, hindering effective early warning and response.

The open-label nature of environmental surveillance is an obvious caveat; it relies on passive reporting and active trapping, which can be inconsistent. The true burden of disease, particularly for milder, undifferentiated febrile illnesses, is likely underestimated. Many cases go undiagnosed or are misattributed, especially in areas where these diseases are newly emerging. This diagnostic gap means that the reported incidence figures likely represent only the tip of the iceberg, obscuring the true extent of local transmission.

Furthermore, the long-term impact of climate change on vector competence and pathogen replication rates remains an area of active research. Warmer temperatures can shorten the extrinsic incubation period of viruses within the mosquito, meaning mosquitoes become infectious faster and remain so for longer. This biological acceleration, combined with expanded vector ranges, creates a perfect storm for increased transmission risk. The current public health infrastructure, designed for a different epidemiological era, struggles to adapt to these dynamic changes.

The lack of specific antiviral treatments for most of these arboviruses means that prevention and vector control remain paramount. But vaccine development for dengue, while progressing, faces challenges with serotype-specific immunity and safety profiles. The existing dengue vaccine, Dengvaxia, has a complex risk-benefit profile, particularly in seronegative individuals, limiting its broad application. This leaves vector control as the primary defence, a defence that is currently underfunded and under-resourced across much of Europe.

The next trial needs to show how integrated vector management strategies, combining environmental management, biological control, and targeted chemical interventions, can be implemented effectively and sustainably across diverse European urban and rural settings. Without this, Europe risks a future where mosquito-borne diseases become a permanent fixture of its public health landscape.

CLINICAL IMPLICATIONS

The expanding geographic footprint of mosquito-borne diseases in Europe demands immediate attention from clinicians. The era of assuming a febrile illness is travel-related is over; local acquisition of dengue or West Nile virus is now a tangible possibility in many regions. This necessitates a lower threshold for diagnostic testing and a heightened awareness of atypical presentations.

General practitioners and specialists alike must integrate vector-borne diseases into their differential diagnoses for unexplained fevers, especially during warmer months. This shift requires updated clinical guidelines and accessible laboratory diagnostics. The current fragmented surveillance systems mean clinicians are often the first line of defence, identifying cases that trigger public health responses.

For public health authorities, the message is clear: current vector control measures are insufficient. Investment in robust, real-time entomological and epidemiological surveillance is no longer optional. Proactive, community-engaged vector management programmes, rather than reactive responses to outbreaks, are essential to mitigate the growing threat. Ignoring this will only lead to more widespread disease and greater public health expenditure down the line.

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