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### R04.3 Combining key hazard- and exposure-related drivers to model the probability of occurrence of TBE human cases in Europe

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## Abstract

In the last decade, the number of tick-borne encephalitis (TBE) human cases reported in Europe has increased both in endemic and in non-endemic areas (European Centre for Disease Prevention and Control, 2022). The geographical occurrence of TBEv is fragmented with “foci of infection” (“hotspots”) that are difficult to identify and often vary in space and time (Dobler et al., 2011). To improve the capability to identify the European regions at high risk of outbreaks, we developed a spatio-temporal predictive model inferring the year-to-year probability of occurrence of TBE human cases in Europe.

We used data provided by the European Surveillance System (TESSy, ECDC) to infer the distribution of TBE human cases at the regional (NUTS3) level during the period 2017-2021. We included variables related to temperature, precipitation, land cover and ticks' hosts presence to account for the natural hazard of viral circulation. We also used indexes based on recorded intensities of human outdoor activity in forests as proxies of human exposure to tick bites. We identified the yearly probability of TBE occurrence using a boosted regression tree modeling framework.

Areas with higher probability for transmission were identified in Central-Eastern Europe and along the coastline of Nordic countries up to the Bothnian Bay. Our results highlighted a westbound and northbound spread of TBE-positive regions throughout the years. Areas at higher risks are characterized by the occurrence of key rodent reservoir and cervid species, intense human recreational activities in forests, steep drops in late summer temperatures and high annual precipitation amounts. The predictive accuracy of the model was assessed through internal and external validation (AUC = 0.84; CBI = 0.98). Our study provides an assessment of the European regions at risk of TBE human infections on a yearly basis. Our results can therefore be used to evaluate the yearly risk of occurrence of TBE human infections, at different spatial scales, and to support surveillance and prevention campaigns within endemic and potential new risk areas.

## References

Dobler, G., Hufert, F., Pfeffer, M., & Essbauer, S. (2011). Tick-borne encephalitis: From microfocus to human disease. In H. Mehlhorn (Ed.), *Progress in parasitology* (pp. 323-331). Springer Berlin Heidelberg. 10.1007/978-3-642-21396-0\_17

European Centre for Disease Prevention and Control (2022). Tick-borne encephalitis. In: ECDC. Annual epidemiological report for 2020. Stockholm: ECDC.