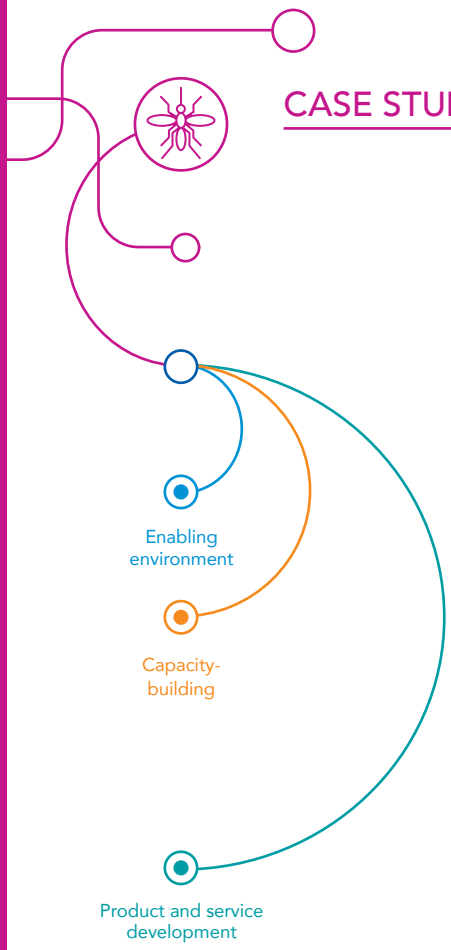

CASE STUDY 6C

EARLY WARNING SYSTEMS TO GUIDE INFECTIOUS DISEASE CONTROL IN EUROPE

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CONTEXT

Globalization and environmental change, social and demographic determinants, and weak health system capacity are significant drivers of infectious diseases. Monitoring changes in these drivers can help anticipate, or even forecast, an upsurge of disease *(21)*.

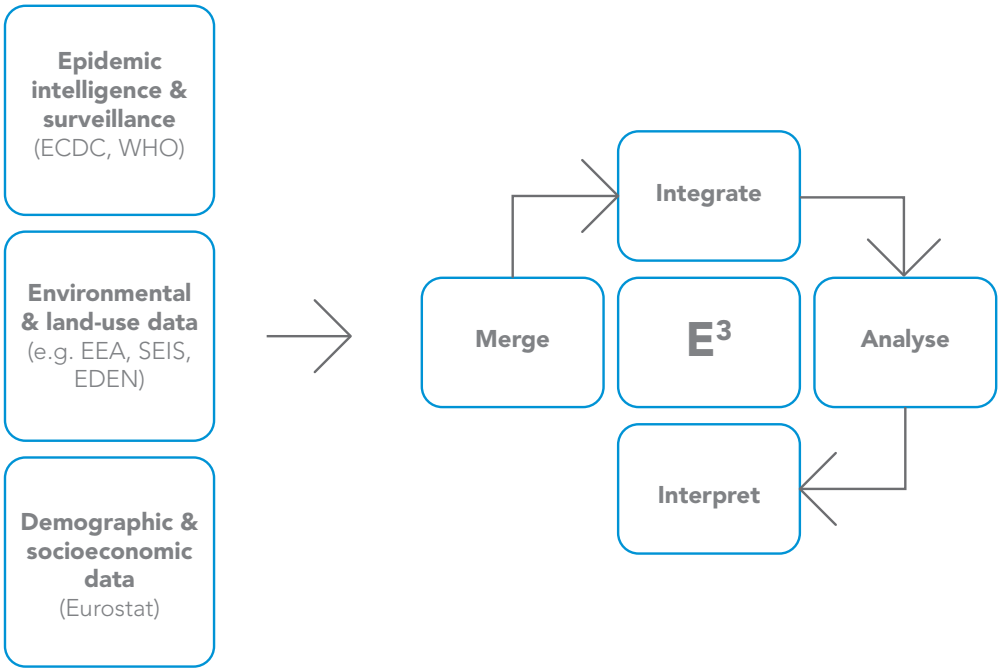
NEW APPROACHES

The European Centre for Disease Prevention and Control has developed the European Environment and Epidemiology (E3) Network to help monitor drivers related to infectious disease threats (Figure 6.7) *(22)*. A large set of climatic, environmental and social data have been aggregated, processed and stored in the E3 Network repository and are accessible through the E3 Geoportal *(22)*. For example, biophysical parameters for temperature and precipitation that have been Fourier-processed have been made available, as well as data on evapo-transpiration, vegetation, topography, etc. Estimates for 2020/50/80 scenarios for certain climatic variables are also retrievable. The overall data management and dissemination function of the E3 Network adheres to protocols, procedures and workflows with metadata standards that are based on the INSPIRE directives. The E3 metadata standards cover all the types of resources that are provided via the E3 service such as map files, documents, tools, live map services, etc. Advanced mathematical modelling (e.g. non-linear discriminant analysis) has been used to compute the risk maps and forecasting tools.

BENEFITS AND LESSONS

This resource has been applied to a number of infectious diseases in Europe. For example, it was used to predict the environmental suitability of malaria transmission in Greece *(23)*. Malaria was eliminated from Greece in 1974, but in 2009 (and subsequent years), local transmission occurred. Remotely sensed E3 data were analysed to delineate the environmental and climatic conditions where future transmission could occur in the country *(23)*. They were characterized by low elevation, warmer temperatures and intensive, year-round irrigated agriculture with complex cultivation patterns. The predictors in this model are probable contributing factors to mosquito presence and, potentially, to malaria transmission *(23)*. Defining the areas of high risk made it possible to guide the public health responses with targeted epidemiological and entomological surveillance, vector control activities, and awareness-raising among the general population and health care workers, in the areas environmentally suitable for transmission; transmission was subsequently interrupted in 2013 in these areas by using European Union structural funds for these intervention entry points.

Figure 6.8 The European Environment and Epidemiology (E3) Network.



The E3 Geoportal also operates a tool for the real-time assessment of the environmental suitability of the *Vibrio* species in the Baltic Sea (and internationally), based on sea surface temperature and salinity. Infections caused by *Vibrio* species (other than *V. cholerae*) can result in wound infections, gastroenteritis or septicaemia, with a relatively high mortality rate among immunocompromized individuals, although the overall occurrence of vibriosis in the Baltic is generally low. Significant and sustained warm water anomalies in the Baltic Sea correspond with increases in reported *Vibrio*-associated illness *(24)*. There is a highly significant association between mean summer temperature increase and the number of reported human cases of vibriosis. The output of the model presented on the E3 Geoportal delineates coastal areas with environmental conditions suitable for the occurrence of human pathogenic *Vibrio* species. that can drive the emergence of infections. The tool provides short-term forecasts, present and past environmental suitability for these *Vibrio* species. It can be used to initiate beach closures and public alerts, particularly to immunocompromized individuals who are at elevated risk from vibriosis.

Another disease of interest in Europe is West Nile fever (WNF), which is transmitted between birds via mosquito vectors, while humans are accidental dead-end hosts. Both biotic (e.g. host abundance and diversity) and abiotic (e.g. physical features of the environment) conditions are important determinants of WNF epidemiology. Since 2010, recurrent West Nile fever outbreaks have occurred in southeastern Europe. Temperature deviations from a 30-year average have been proven to be associated with these outbreaks *(25)*. Drivers of subsequent outbreaks were computed through multivariate logistic regression models and included in prediction models *(26)*. We found temperature anomalies, a water index and bird flight patterns to be predictive. Environmental monitoring for WNF should integrate these climatic and environmental variables in order to improve public health surveillance for WNF *(26)*.

To assist public health decision-making in Europe, several workshops have been held with Member State representatives to train them on the E3 functions.

Such early warning systems, based on climatic and environmental conditions, can help improve and accelerate alert and public health response capabilities and provide the evidence-base for strategic public health action *(21)*.

ACKNOWLEDGEMENTS

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