CASE STUDY

Research

Evaluation

EVALUATING PRODUCT PERFORMANCE AND SKILL

FINDING THE RIGHT THRESHOLDS TO TRIGGER ACTION IN HEAT WAVE EARLY WARNING SYSTEMS IN SPAIN

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CONTEXT

In Spain, the State Meteorological Agency (AEMET) has been successful in using weather prediction models to forecast short- and medium-range extreme temperatures, and an early warning system (Meteolerta) has been implemented in cooperation with European EUMETNET member countries (MeteoAlarm). Enhanced extreme temperature forecasts for future climate-change scenarios have significant human health implications, including increased mortality and morbidity, thus indicating a clear need to mitigate these effects and adapt to climate change. In this regard, Spain's Ministry of Health, Social Services and Equality implemented a National Plan for Preventive Actions against the Health Effects of Excess Temperatures *(8)* as long ago as 2004, from June to September annually, which is activated when the AEMET's forecasts indicate that a given threshold temperature will be exceeded.

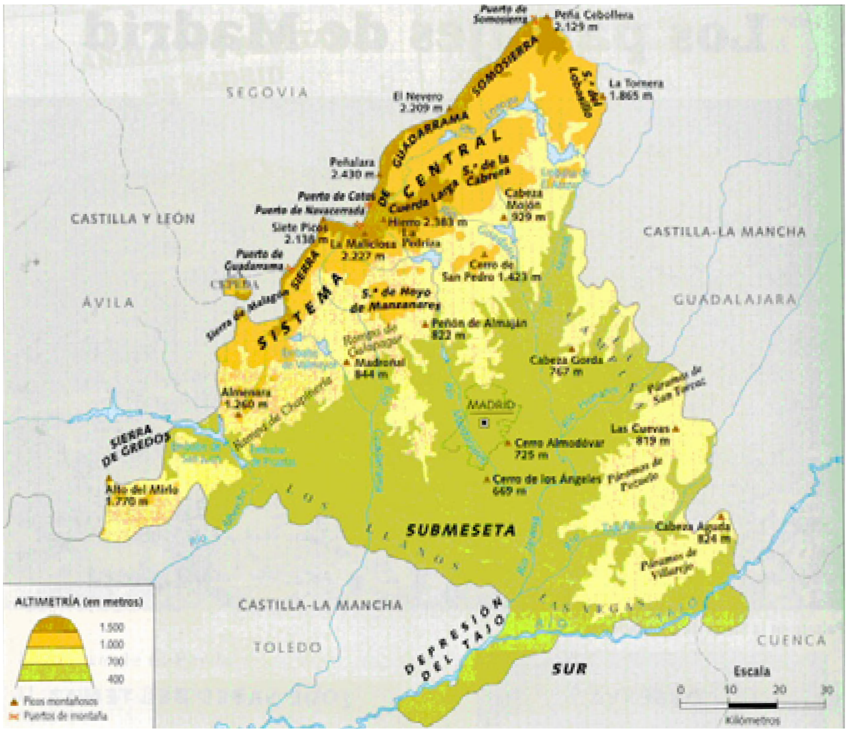
The determination of such a heat-related mortality trigger temperature is a key element, not only when it comes to impact on mortality *(9, 10)* but also for the implementation of prevention plans *(11)*. In addition, the current trend in the population pyramid, namely an expansion in the over-65 age group – a cohort that is particularly vulnerable to extreme thermal events *(12)* – means that this temperature must be re-designated on the basis of new climate and mortality data.

NEW APPROACHES

The aim of this study was thus twofold: Firstly, to determine the daily heat-related mortality trigger temperature in Madrid for the period 2001–2009 and compare it to that which had been previously calculated for the period 1986–1997; and secondly, to quantify heat-related mortality in these two periods and establish whether a change in threshold temperatures might result in a reduction in such mortality and could be assessed in economic terms.

Data on the daily number of deaths due to natural causes (ICD-10: A00-R99) in the Madrid municipal area during the period 1 January 2001 to 31 December 2009, across all age groups, were sourced from the Madrid Regional Revenue Authority. Daily maximum temperature records from the Madrid Observatory were supplied by the AEMET. A scatter-plot diagram was then constructed showing residuals obtained from daily mortality pre-whitened using a univariate ARIMA model and daily maximum temperatures and grouped in pairs. Heat-related mortality was calculated by determining the attributable risk (AR) of mortality, calculated for each period using generalized linear models (GLM) with Poisson response and link-log. We controlled the models for various confounding variables, including trend, periodicity and the autoregressive nature of the series.

Fig 7.2. Map of the area where the study was conducted.



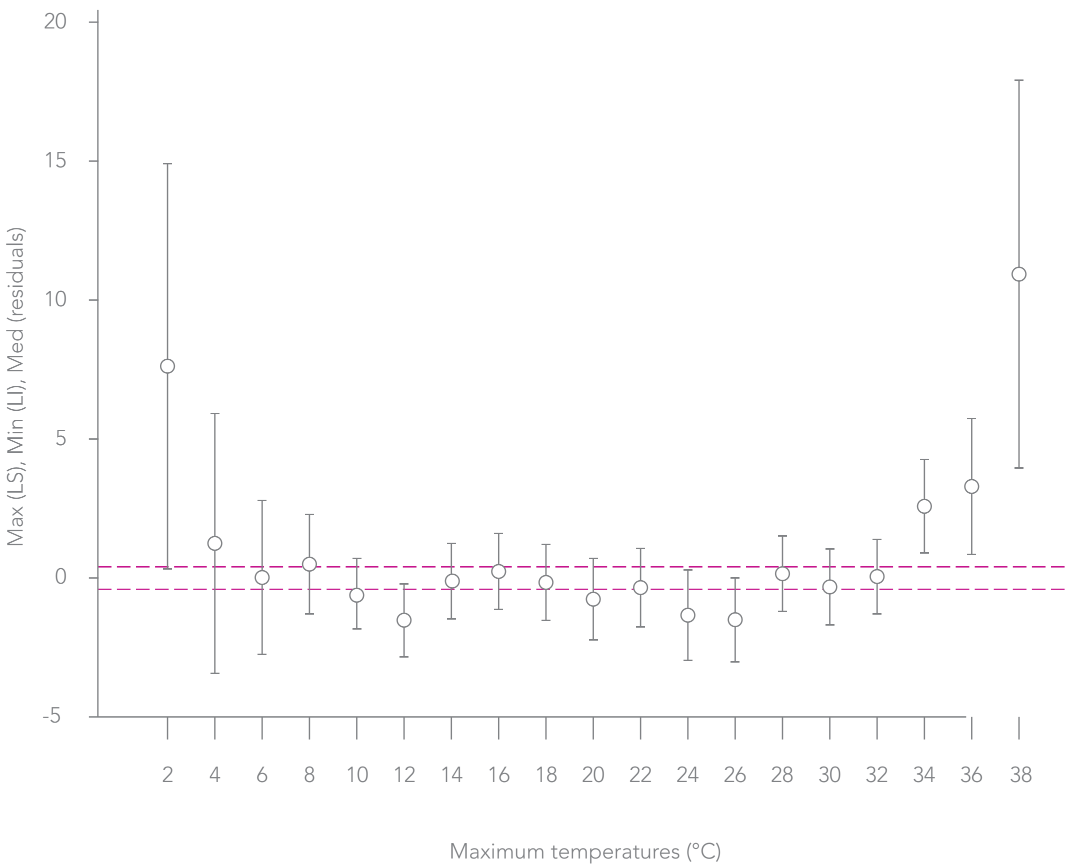
Research

Evaluation

The heat-related mortality trigger temperature in the city of Madrid across the study period was set at a daily maximum temperature of 34°C (Figure 7.3), which coincided with the 82nd percentile of the maximum daily temperature series for the summer months (i.e. June–September). In the period 1986–1997, this temperature had been 36.5°C (95th percentile). The threshold of 34°C was exceeded on 198 days, resulting in an attributable risk (AR) of 6.55% (95%CI: 4.36-8.72) excess heat-related mortality for each extra temperature degree an amounting to 1150 (95%CI: 764–1524) extra deaths. If, however, the analysis were repeated by setting the threshold at 36.5°C, then the AR would be 20.7% (95%CI: 7.57–33.24). This threshold was exceeded on 41 occasions resulting in an associated mortality of 371 (95%CI: 136–596) deaths. Hence, the avoidable mortality in response to a change in the prevention plan activation threshold would be 779 people (95% CI: 628–928).

Figure 7.3 Weather station in Madrid-Retiro used to collect temperature data for the study.

Figure 7.4 Scatter plot of daily maximum temperature and mortality residuals, for a given heat-wave definition.



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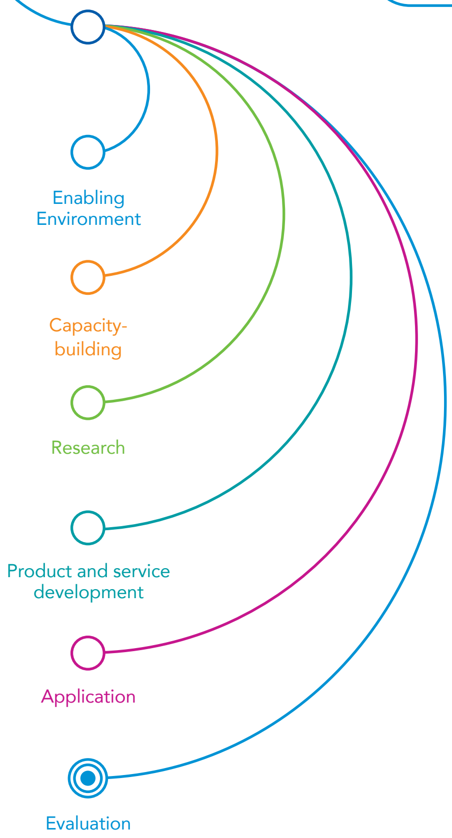
BENEFITS AND LESSONS

The use of updated climate data to determine prevention plan trigger temperatures could significantly reduce heat-related mortality and produce significant cost-savings. Our calculations suggest that over the period 2001-2009, 86 (95% CI: 70-103) deaths could have been averted. Assuming each death results in an average reduction of life expectancy of 1 year and that each year of life lost equals €90 000 *(13)*, this would have resulted in an annual economic benefit of €7.7 million (95% CI: €6.3–9.3 million), calculated based on 2013 values.

The national health authorities have been informed and have welcomed the results of the study.



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