

# EXTENSIONS OF BAYESIAN DISEASE MAPPING MODELS AND THEIR APPLICATION IN SPATIAL EPIDEMIOLOGY

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The study of geographical variations in chronic disease rates and the investigation of environmental risk factors underlying these patterns have a long history in epidemiology. Much recent work in this field has been carried out within the context of Bayesian hierarchical models.

In this paper, we consider various extensions of Bayesian disease mapping models. The first is the joint analysis of several potentially related diseases. As many diseases share common risk factors there may be advantages to carrying out a joint mapping analysis to investigate shared and divergent patterns in risk that can suggest possible risk factors associated with the diseases under study. Shared patterns of spatial variation in health outcomes such as survival from different cancers, or different so-called 'avoidable' causes of mortality, could also be indicative of regional differences in health care provision and quality.

Another recent development in Bayesian disease mapping has been the extension of purely spatial models to models for space-time analysis of disease rates. In particular, the ability to identify spatial patterns of disease risk that persist or evolve systematically over time leads to a number of benefits in terms of interpretation and potential for detection of localised excesses.

Finally, we consider how to combine the ideas of space-time analysis of a single disease and multivariate spatial disease mapping to explore the formulation and application of Bayesian models for the analysis of multiple health outcomes in space and time.

Various case studies will be discussed to illustrate the models, such as: joint analysis of COPD and lung cancer mortality in Great Britain; regional variation in relative survival rates from various cancers by Health Authority in England; spatio-temporal clusters of congenital anomalies in England; space-time analysis of mortality from various diet-related cancers in Greece, and of joint patterns of male and female lung cancer in Yorkshire.