What does the incidence of leprosy diagnosis tell us about underlying incidence and progress towards elimination?

Novel methodologies for estimating incidence accounting for the long incubation period.

NTD MODELLING CONSORTIUM

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Introduction

Leprosy is an infectious disease with long, variable periods between infection, onset of disease and subsequent diagnosis. Estimation of the numbers of undiagnosed sub-clinical and clinical infections would be useful for the management of elimination programmes.

Method

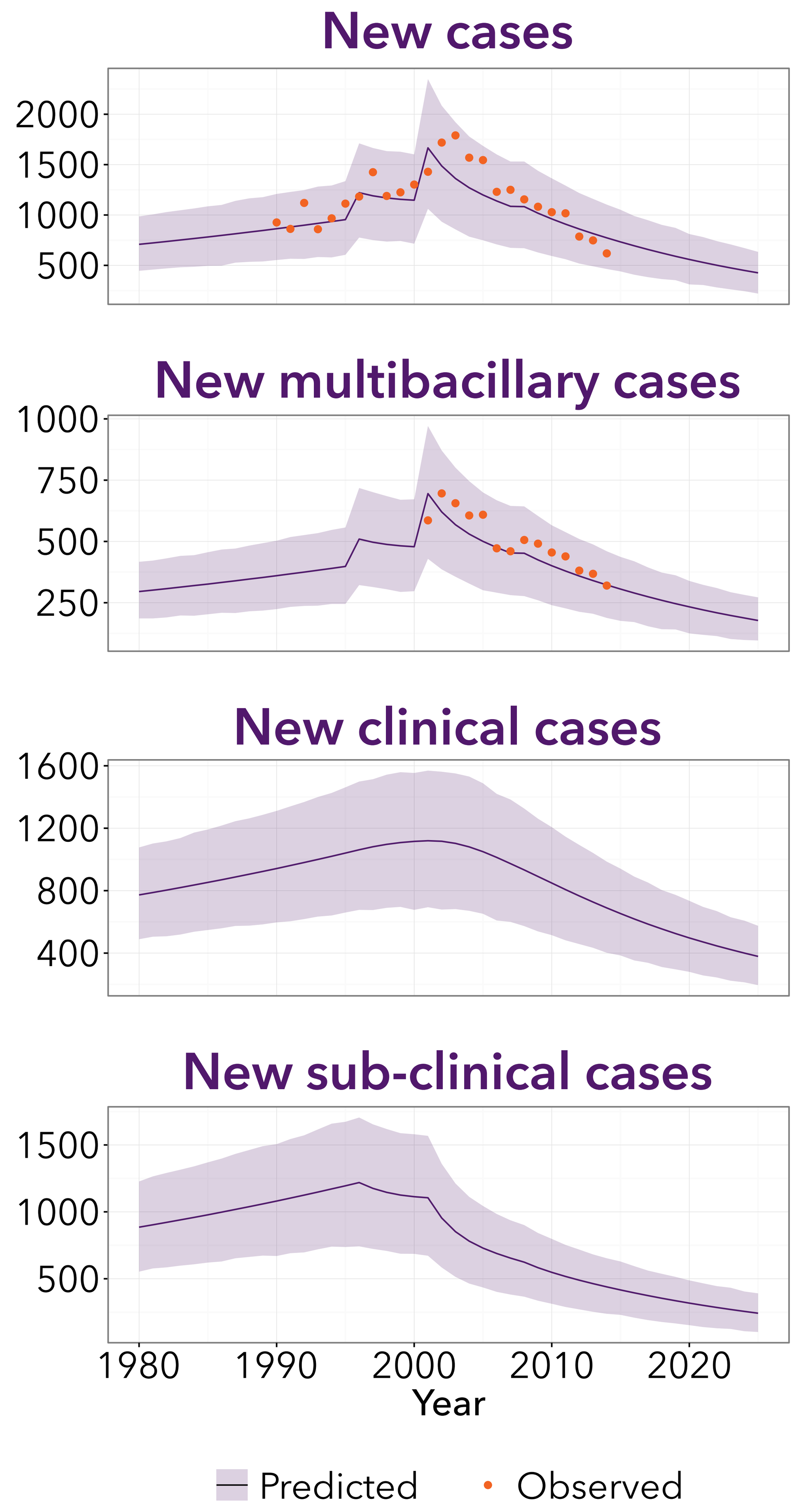
Back-calculation uses the recorded number of diagnoses and knowledge of the incubation period distribution to make inferences about the unobservable infections. By splitting the period from infection to diagnosis into an incubation period and a detection delay, we are able to make inferences about unobserved sub-clinical and undiagnosed clinical cases. We treat new infections as proportional to the number of undiagnosed clinical cases present, and allow the diagnostic hazard to vary across time periods. The model is implemented in a Bayesian framework; coded in the Stan probabalistic programming language and run via R.

Analysis

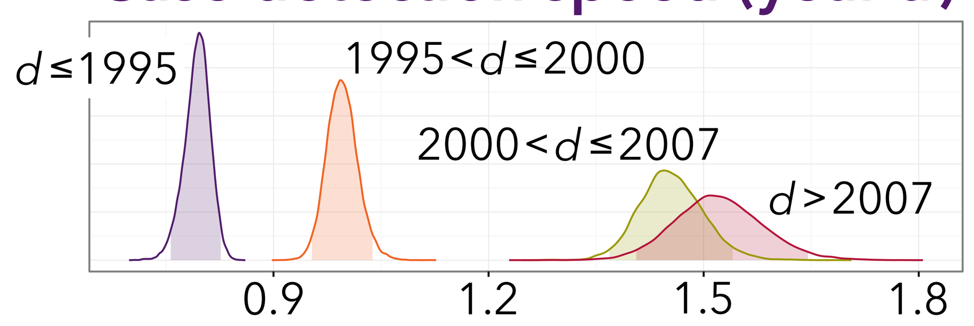
Annual state-level numbers of diagnoses for Brazil were used to illustrate inference about existing unobserved case numbers, and short-term forecasting of the probability of reaching a goal.

More detailed results are presented for Espírito Santo state*.

*Results for Espírito Santo, Brazil

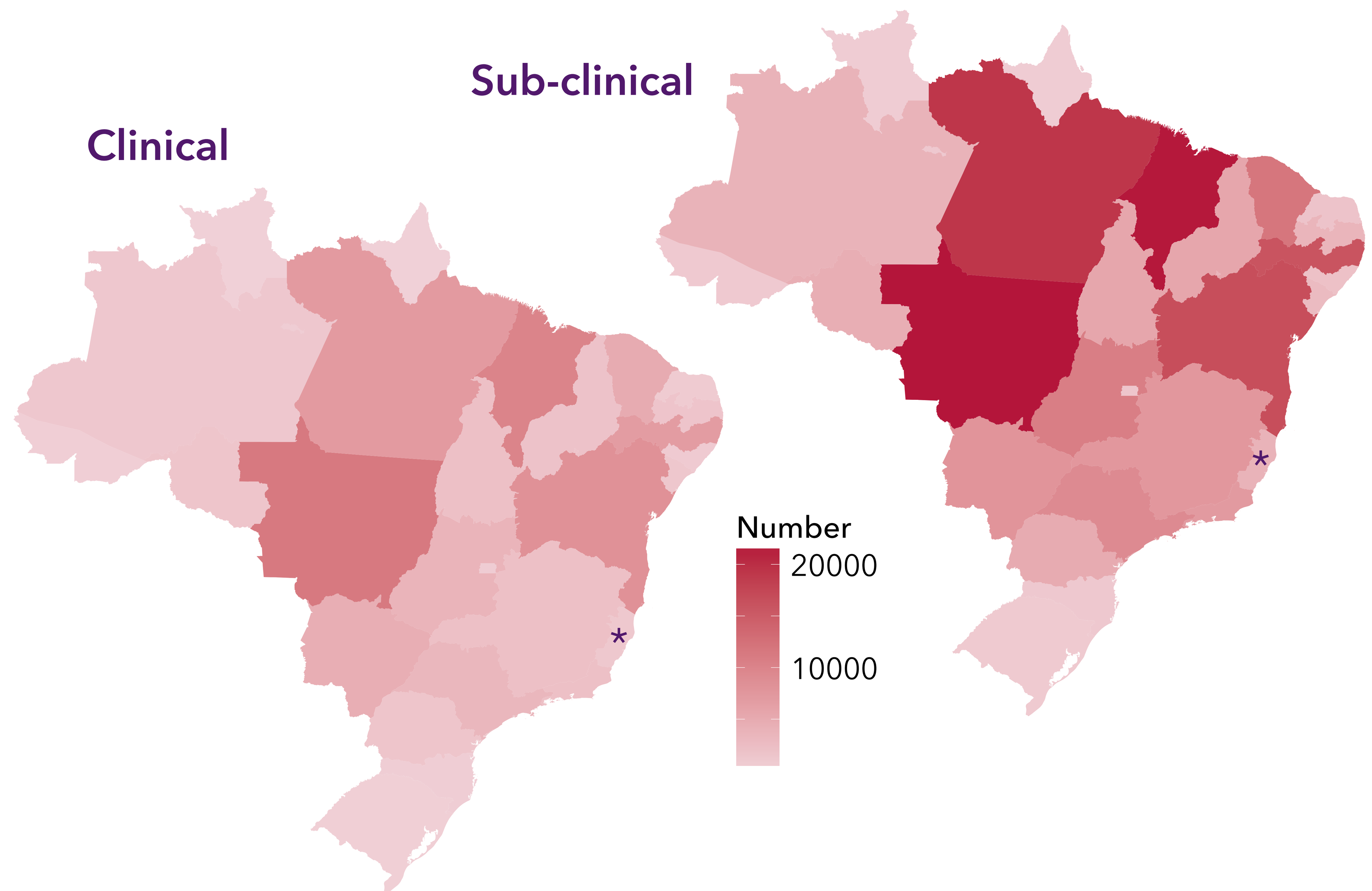


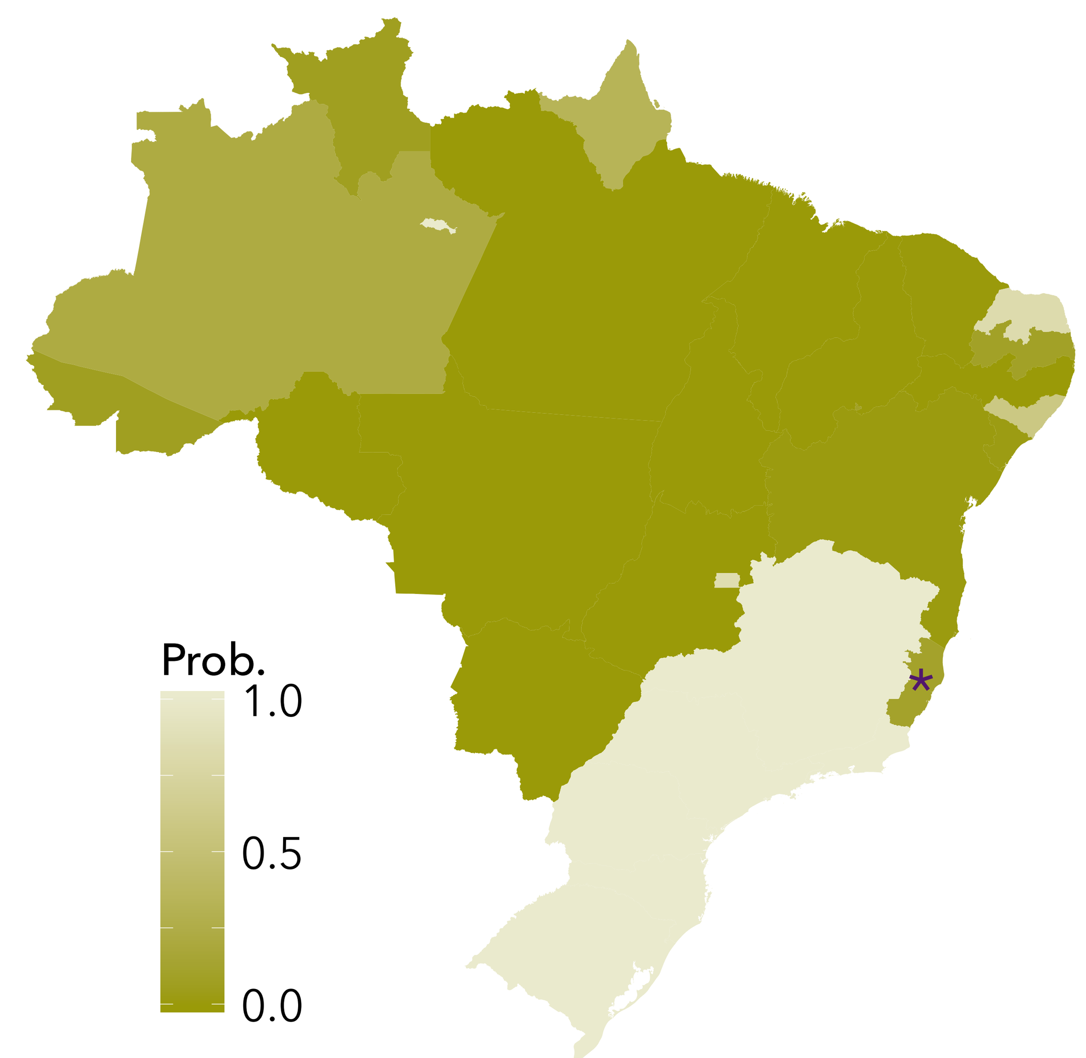
Case detection speed (year *d*)



- Estimates of time delays between onset of disease and diagnosis for different time periods shown as posterior distributions.
- Diagnostic timeliness improved dramatically 1995-2000, but there is little evidence of a subsequent improvement.
- Findings vary between states.

Most probable values of cumulative numbers of undiagnosed cases of leprosy in Brazilian states in 2014





Forecast probability of the new case detection rate in Brazilian states being below 1 per 10,000 in 2020

Summary

- Our model estimates the underlying numbers of undiagnosed leprosy cases and makes short-term future forecasts.
- This information is necessary for the assessment and management of leprosy control programmes.
- The parameters estimated include an indicator of the case detection effort or success within a time period.

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