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Modelling of prevalence for foodborne pathogens in EU countries

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PROMISE (Protection of consumers by microbial risk mitigation through combating segregation of expertise) is an EU FP 7 project with food safety as a main research focus. One of the important aims of the project is to investigate factors that influence uncertainty and variability in prevalence reporting and to develop descriptive models that aid interpretation. As the prevalence of foodborne diseases is thought to be significantly underestimated, there is a need to estimate the effectiveness of the reporting process in order to appreciate the real burden of disease. The prevalence is underestimated due to underreporting and under-diagnosis associated with passive surveillance, incorrect diagnosis and inefficient communication with authorities, as well as with the unregistered cases with mild symptoms that do not seek medical help. Prevalence is normative, characterizing the rate of cases in a population at a specific time and is easy to visualize and compare. It is measured from finite samples and cases are collected according to the binomial process; therefore uncertainty in prevalence can be described with beta distributions. Prevalence can be considered as the probability for a binomial process and the uncertainty about prevalence as the probability density of the binomial parameter which has a beta distribution. Existing belief about the prevalence can be systematically updated given the data from successive finite samples. Bayes' theorem is used to express how to rationally change a subjective belief by taking evidence into account. Model parameters affecting the prevalence reporting can be defined in order to construct a Bayesian probabilistic graphical model. Different parameters affecting the process of reporting are involved in cases of hospitalization and these correspond with a separate branch of the model. Because of the differences in symptoms and severity of the disease caused by different pathogens, as well as the differences in medical and reporting practice among EU countries, some of the parameters depend on the country and others depend on the pathogen. Parameters were modelled using linear regression based on existing data for seven foodborne pathogens in seven EU countries. Only common statistical data available for EU countries was used to model the parameter uncertainty distributions. The Monte Carlo simulations of modelled parameters were used to estimate foodborne pathogen prevalence in additional EU countries.

Key words: Foodborne pathogens, reporting, prevalence, modelling