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Campylobacter surveillance in meat production animals in Finland: a time series model approach

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Introduction

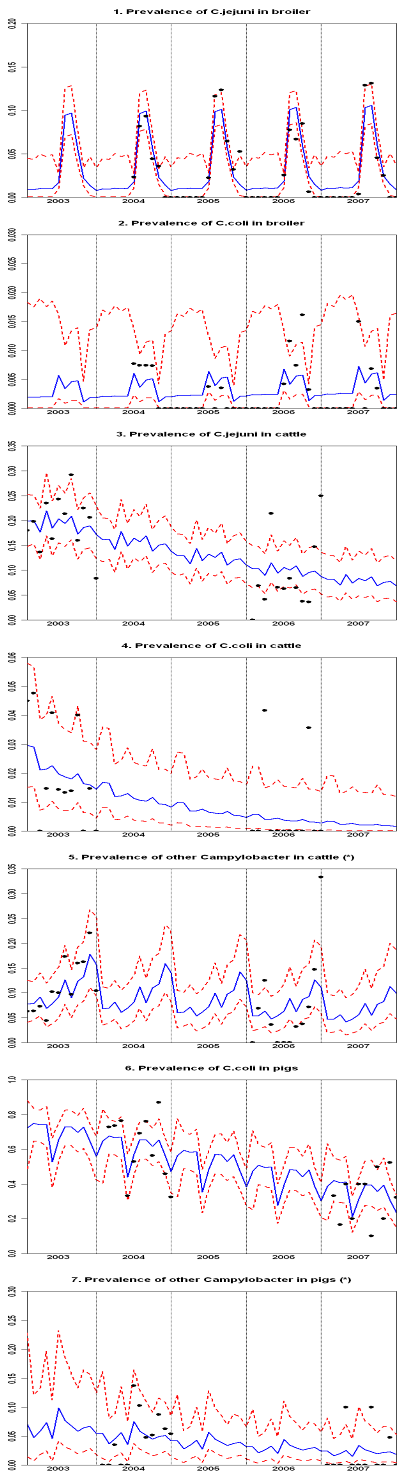
This work is part of work package 4 in CampEc-NET, a one-year network project, which in Finland is funded by Tekes, Evira, KTL and ETL. The aim of the WP is to integrate existing veterinary and medical laboratory based surveillance data, specifically towards source attribution modelling of *Campylobacter* infections. In Finland, broiler production is under regular monthly surveillance of *Campylobacter*. In comparison, other food sources are less regularly monitored, if at all. To obtain a complete view of *Campylobacter* prevalence in several food sources over a longer period, time series modelling can be used.

Data

Monthly results (*Campylobacter* positive caecal samples) from broiler surveillance were available from 2004 in Finland. In addition, data of cattle faecal samples at slaughter were available, but only for years 2003 and 2006. Likewise, data of pig faecal samples at slaughter were for years 2004 and 2007. The observation periods of cattle and pigs are mutually distinct, but they are overlapping with broiler surveillance. All *Campylobacter* isolates were identified as *C. jejuni*, *C. coli*, or “other”(*). Group “other” means all haphazard isolates, other than *C. jejuni* or *C. coli*. However, since the detection method was not specific to the other species, this group may be underestimated. Combining such data with time series models allows to integrate temporal patterns in prevalence over the entire period 2003-2007 for three *Campylobacter* groups in three production animal sources.

Results and discussion

Prevalence of *C. jejuni* in broilers shows a clear annual peak during July-August, but also *C. coli* in broilers shows a modest peak at the same time. *C. coli* in pigs shows a periodic pattern with a weak downward trend which could be due to a change in testing method. *C. jejuni* in cattle shows a weak downward trend, possibly with some seasonal effect. In general, the seasonal effects in all time series of cattle and pigs are much less obvious than in broilers. *C. jejuni* was not found in pigs for any month, and *Campylobacter* classified as “other” was likewise not reported in broilers.
The model can be used for extrapolating partially observed time series, based on a combination of a linear trend and seasonal (monthly) effects. The simple time series model was enough to capture most of the temporal patterns in the data.



Figures 1-7 show point estimates as dots (fraction of positives x/n), posterior medians and 95% Bayesian credible intervals which summarize the marginal posterior distributions for each month.

Methods

Prevalence at month i, in food source k, species group c:

$$Logit(p_{i,k,c}) = \alpha_{k,c} + i\beta_{k,c} + s_{i,k,c}$$

Conditional distribution of sample data:

$$x_{i,k,c} \mid p_{i,k,c}, n_{i,k} \sim Binomial(p_{i,k,c}, n_{i,k})$$

Priors:

$$\alpha_{k,c} \sim N(0,0.001)$$
$$\beta_{k,c} \sim N(0,0.001)$$
$$s_{j,k,c} \sim N(0,0.001)$$

Posterior is of the form:

$$P([\alpha_{k,c}],[\beta_{k,c}],[s_{i,k,c}] \mid [n_{i,k}],[x_{i,k,c}]) \propto \prod_{i=1}^{I}\prod_{k=1}^{K}\prod_{c=1}^{3} P(x_{i,k,c} \mid p_{i,k,c}, n_{i,k}) \times P(\alpha_{k,c})P(\beta_{k,c})\prod_{j=1}^{12} P(s_{j,k,c})$$

with some n and x as missing data.

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