SURVEILLANCE OF INFECTIOUS DISEASES

IN ANIMALS AND HUMANS IN SWEDEN 2022

Chapter excerpt:
Campylobacteriosis

NATIONAL VETERINARY INSTITUTE

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Cover: A cultivation of *Salmonella* at the Public Health Agency of Sweden.
Photo: Nicklas Thegerström/DN/TT. Cover design by Rodrigo Ferrada Stoehrel.

Reporting guidelines: Reporting guidelines were introduced in 2018 for those chapters related to purely animal pathogens. The guidelines build on experiences from several EU projects, and have been validated by a team of international experts in animal health surveillance. The aim is to develop these guidelines further in collaboration within the global surveillance community and they have therefore been made available in the form of a wiki on the collaborative platform GitHub (https://github.com/SVA-SE/AHSURED/wiki). Feel free to contribute!

Layout: The production of this report continues to be accomplished using a primarily open-source toolset. The method allows the source text to be edited independently of the template for the layout which can be modified and reused for future reports. Specifically, the chapter texts, tables and captions are authored in Microsoft Word and then converted to the LaTeX typesetting language using a custom package written in the R software for statistical computing. The package uses the pandoc document conversion software with a filter written in the lua language. Most figures and maps are produced using R and the LaTeX library pgfplots. Development for 2022 has focused on generalising the R package to accommodate conversion into formats other than LaTeX and PDF, with a focus on markdown files which can be published as HTML websites using the Quarto publishing system. The report generation R package and process was designed by Thomas Rosendal, Wiktor Gustafsson and Stefan Widgren.

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Campylobacteriosis

BACKGROUND

Thermophilic *Campylobacter* species (spp.) are the most common causes of human bacterial gastroenteritis in many countries. Most infections are caused by *C. jejuni*, followed by *C. coli* and a few by other *Campylobacter* spp.

Birds are considered the principal reservoir for thermophilic *Campylobacter* spp. although the intestinal tract of many other animals can be colonised by these bacteria. *Campylobacter* spp. are excreted in faeces. *Campylobacter* spp. are fragile organisms but can survive in freshwater for longer periods. The infectious dose for humans is low. Most European countries have a seasonal peak of *Campylobacter* prevalence or incidence in the summer months, both in chickens and humans. Risk factors for infection include consumption or handling of undercooked contaminated meat products (especially poultry), consuming contaminated unpasteurised milk and other dairy products, drinking from contaminated water supplies, travelling abroad, and having contact with farm animals and pets.

During 1997–2019 the incidence of human campylobacteriosis in Sweden has varied between 65 and 110 cases per 100 000 inhabitants (Figure 12). Most cases are infected abroad, but in 2014–2018 the proportion of domestic infections increased due to several major outbreaks caused by domestically produced chicken meat. The COVID-19 pandemic has resulted in both a record low incidence of campylobacteriosis in 2020–2021 and a record high proportion of domestic infections in relation to infections retrieved abroad in 2020–2021.

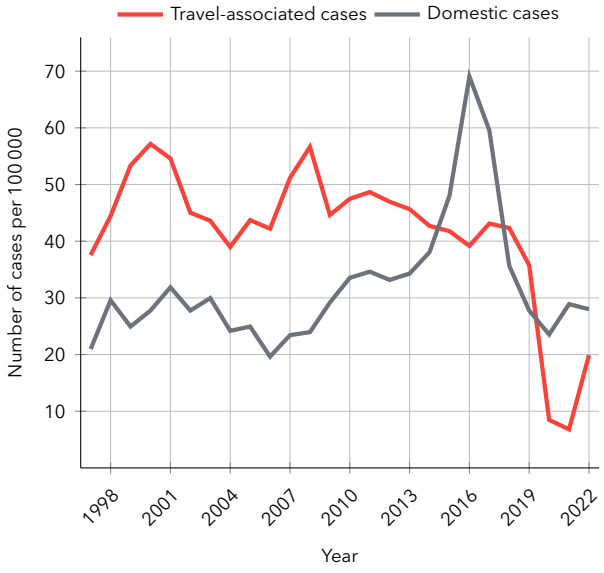

Figure 12: Incidence (per 100 000 inhabitants) of notified human cases of campylobacteriosis in Sweden, 1997–2022. Travel-associated cases are those where the patient has reported travel to another country during the incubation period prior to clinical presentation. Domestic cases are patients that have not recently travelled outside Sweden.

DISEASE

Animals

Asymptomatic carriage of thermophilic *Campylobacter* is common in several animal species, including poultry species, cattle, pigs, sheep and dogs. The prevalence is higher in younger animals.

Humans

Campylobacteriosis is an acute, usually self-limiting enteric disease that resolves within a week. In some individuals, the symptoms last longer. The symptoms are mild to severe: diarrhoea, fever, abdominal pain, nausea and malaise. The infection can be complicated by reactive arthritis, irritable bowel syndrome as well as the neurological disorder Guillain-Barré syndrome.

LEGISLATION

Animals

Findings of thermophilic *Campylobacter* spp. in meat-producing poultry are notifiable in Sweden, according to SJVFS 2021:10. In addition, *Campylobacter fetus* subsp. *venerealis*, which causes bovine genital campylobacteriosis, is notifiable.

Food

Detection of *Campylobacter* spp. in food is not notifiable. From 2018 and onwards, food business operators at abattoirs are obliged to sample neck skins of broilers for quantitative analyses of *Campylobacter* according to regulation (EG) 2073/2005 on microbiological criteria for foodstuffs. As a minimum, the Swedish Food Agency requires that weekly samples are taken from June through September.

Humans

Infection with *Campylobacter* is notifiable according to the Communicable Disease Act (SFS 2004:168 with the amendments of SFS 2022:217). A laboratory confirmed case can also include cases with samples that are only positive by PCR, i.e., where no isolate has been obtained.

SURVEILLANCE

Animals

The Swedish Poultry Meat Association has operated a monitoring programme for broiler chicken since 1991. The programme is mainly financed by the Swedish Board of Agriculture (SJVFS 2015:17, K152) and the goal is to achieve an overall annual *Campylobacter* prevalence of less than 10% in slaughter batches of chicken. Prior to 2017, the goal was 5%. In 2021, the guidelines for the programme were reviewed.

IN FOCUS: Are *Campylobacter* prevalence in broiler slaughter batches and incidence of campylobacteriosis in humans temporally related?

The incidence of human campylobacteriosis and the prevalence of *Campylobacter* in broilers show seasonality but the impact of this association is not clear. To explore this relationship, two approaches for analysing time series data were applied. Weekly, bi-weekly and monthly data from 2009 to 2019 of human campylobacteriosis cases and prevalence of *Campylobacter* spp. in broiler slaughter batches in Sweden were analysed.

The decomposition of timeseries into seasonal (S), long-term trend (T) and residual components (STL model) showed a close overlap in seasonal patterns in terms of timing and the proportional change of peaks from normalised yearly levels. Starting in 2016, when a large outbreak was reported, there was significant overlap in the trend component as well. Prior to the outbreak, the annual trend component of human cases was similar in magnitude to the annual increase in poultry meat consumption. An additive approach for timeseries counts, incorporating seasonal and epidemic components, found a positive association between human cases and broiler prevalence with an optimal lag of 2 weeks, 1 bi-week or 0 months. Considering the estimated time between slaughter and consumption, incubation time, and the time between onset of disease and testing, a 2-week lag may be consistent with transmission via handling and consumption of fresh poultry meat.

The best model included broiler prevalence as a risk factor in the epidemic model component but not in the seasonal component. The outcomes in terms of best model, optimal lags and significance of parameters, using weekly, bi-weekly or monthly data were, in general, in agreement but varied with data resolution when only a subset of the timeseries, not including any known broiler-associated outbreaks, was analysed. The optimal resolution based on the available data and conditions of the present analysis appeared to be weekly or bi-weekly data. There is no simple relationship between broiler prevalence and human cases. Results suggest that broiler prevalence with a two-week lag period can explain part of the human cases but has a smaller explanatory impact during the part of the study period not including the large known outbreaks. Additional factors beyond broiler prevalence need to be evaluated to understand the transmission routes and epidemiology of campylobacteriosis.

The programme covers more than 99% of the broilers slaughtered in Sweden. Since 2006, sampling is performed by collecting intact caeca from 10 birds per sampled slaughter batch at the major abattoirs. In 2022, eight abattoirs delivered samples. During 2022, when the flock was slaughtered at more than one time point and the time interval between the slaughter batches was longer than one day, samples were taken from both batches, otherwise only from one of the batches. From April to October 2022, the samples were transported chilled to the laboratory.

The caeca are pooled into one composite sample per batch and analysed for detection of *Campylobacter* spp. according to EN ISO 10272-1. During 2022, four colonies were picked from each sample with suspected *Campylobacter*, to be able to detect if several *Campylobacter* species were present in the sample.

In 2022 all *Campylobacter* isolates collected during a period of 2.5 weeks, (weeks 31, 32 and half of week 33) were subjected to whole genome sequencing (WGS).

Food

There is no official surveillance programme for *Campylobacter* spp. in food. National and local authorities may perform sampling as a part of extended official controls or targeted projects.

Since 1 January 2018, abattoirs are obliged to sample neck skins from poultry carcasses for *Campylobacter* analyses using a culture-based method (ISO 10272-2 or alternative methods validated against the standard method), according to regulation (EC) No 2073/2005. A limit of 1000 CFU/g applies to a set of 50 pooled samples derived from 10 consecutive sampling sessions. Since 2020, the regulation has allowed up to 30% of the samples to exceed the limit.

Humans

The surveillance in humans is based on identification of the disease by a physician and/or by laboratory diagnosis (i.e., passive surveillance). Physicians and laboratories are obliged to report to the regional and national level to enable further analyses and adequate intervention measures.

During 2017–2021, the Public Health Agency of Sweden requested isolates from all domestic cases reported during selected periods of weeks (in March and in August) for WGS analysis as part of the microbiological surveillance programme. As a conventional nomenclature tool, the Multi Locus Sequence Typing (MLST) type, i.e., ST type, is defined by WGS. Single nucleotide polymorphism (SNP) analysis is used to compare human isolates to identify clusters

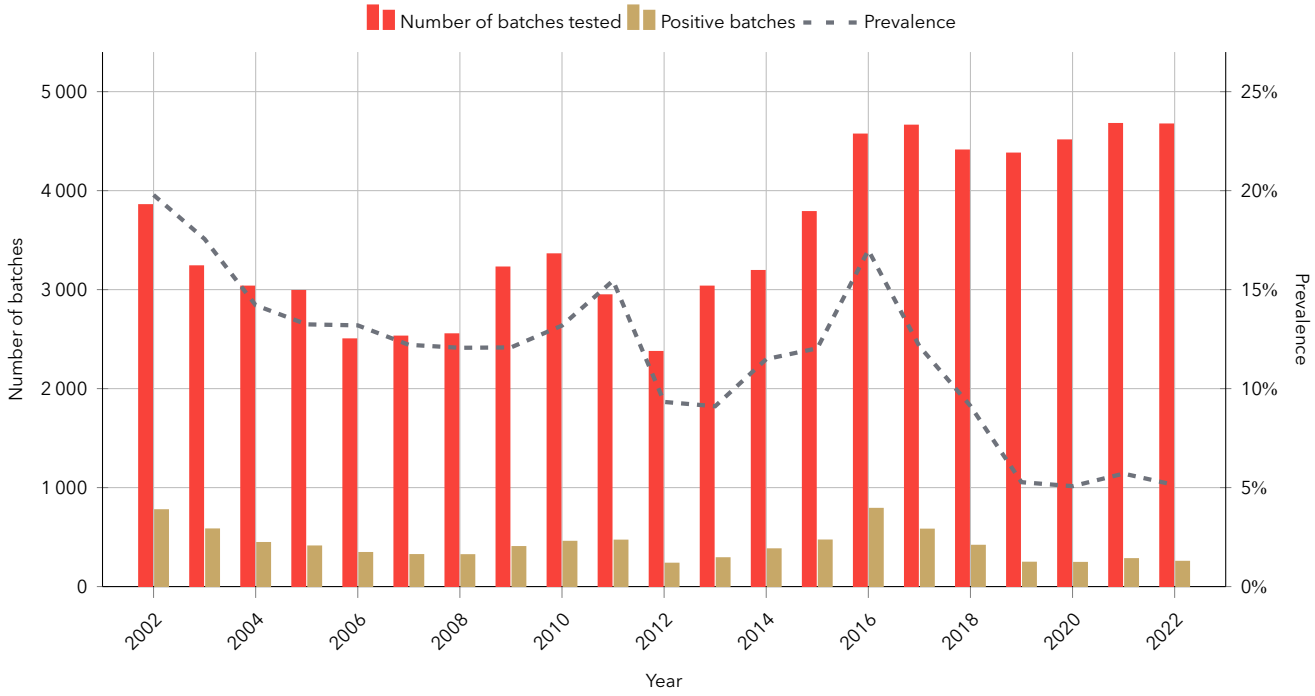

Figure 13: Prevalence of *Campylobacter* in slaughter batches of broiler chicken in 2002–2022.

and can also be used for outbreak investigations. The aims of the typing are to assess the diversity of domestic strains and identify clusters. The long-term goal is to use the data to evaluate efforts to lower the level of domestic incidence of campylobacteriosis attributed to food borne sources. In 2022 an evaluation of the microbiological programme of 2017–2021 was initiated and only samples from a suspected outbreak were collected and analysed.

RESULTS

Animals

In 2022, thermophilic *Campylobacter* spp. were detected in 239 (5.1%) of the 4657 broiler chicken batches tested at slaughter (Figure 13), which is at the same level as the last two years. The monthly prevalence of *Campylobacter* in chicken slaughter batches varied between 0.3% (April and December) and 16.9% with the highest prevalence in August (Figure 14). The prevalence of *Campylobacter* in incoming batches varied between abattoirs. Among the slaughter batches at the four largest abattoirs, which cover 97.5% of the slaughtered chicken, *Campylobacter* spp., was detected in 4.6%, with prevalences varying from 2.5% to 12.6%. The monthly number of chickens from *Campylobacter* positive slaughter batches varied as well.

Food

In 2022, national and local authorities took 64 samples from different types of food. *Campylobacter* was not found in any of these samples.

Food business operators at seven abattoirs collected 1046 pooled neck skin samples according to regulation (EC) No 2073/2005. Test results at all abattoirs were satisfactory according to the legislation, and only 18 (2%) of the 1046 samples exceeded the limit of 1000 CFU/g.

Humans

A total of 5165 cases of campylobacteriosis were reported in 2022. Of the reported cases, 57% (2945 cases) were domestic. The incidence of domestic cases was 20 per 100 000 inhabitants, a similar level as in 2021 (20.9). The incidence of travel-related cases was increased by 66% compared to 2021 but still on a lower level than before 2020 and the COVID-19 pandemic (Figure 12). The reported domestic cases followed the typical yearly pattern with more cases during the summer months, peaked in July-September when 51% (n=1511) of all domestic cases were reported.

For the domestic cases in 2022, the median age was 51 years with a range of 0–101 years. More men (54%) than women were reported with campylobacteriosis.

Isolates for typing were only collected during week 47–49 from selected regions due to an unexpected rise of domestic cases. A new sequence type for human samples, ST227, was found in 11 of 17 domestic cases which clustered based on WGS (whole genome sequencing). This sequence type also clustered with an isolate from a batch of chickens.

Human campylobacteriosis cases versus positive chicken slaughter batches

The number of human domestic cases and the number of animals from *Campylobacter* positive chicken slaughter batches were compared during 2022. The comparison shows a clear covariation over the year with the highest numbers in the summer and autumn and the lowest in winter and spring (Figure 14).

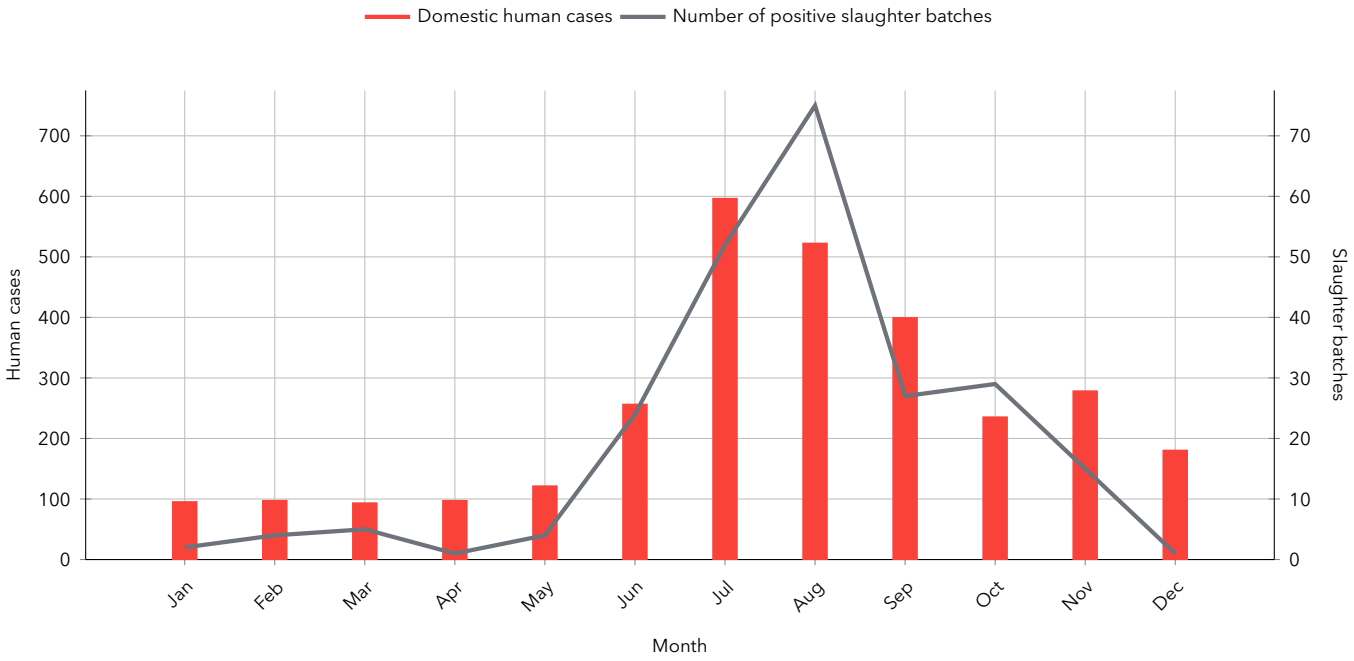

Figure 14: Number of notified domestic cases of human campylobacteriosis, along with the number of broiler batches positive for *Campylobacter*, broken down per month in 2022.

DISCUSSION

The domestic incidence of campylobacteriosis was lower in 2022 compared to the period 2009–2019, but similar to 2021. Most campylobacteriosis cases have been considered sporadic, but cluster analysis of isolates typed in recent years with WGS indicates that several cases have been part of outbreaks. Many of these outbreaks appear genetically linked to isolates from retail poultry meat.

In 2022, the annual prevalence of *Campylobacter* in chicken slaughter batches was at the same level as in 2021 but lower than in previous years (Figure 13). The correlation between human cases of campylobacteriosis and *Campylobacter*-positive broiler batches underscores the need for further preventive measures. *Campylobacter* prevalence varies considerably between abattoirs, with only a few findings at some and a higher prevalence at others. During the last ten-year period, the Swedish chicken production has increased by approximately 30% and the share of fresh chicken meat has increased compared to frozen meat. This has led to a higher amount of potentially contaminated chicken meat on the market, because *Campylobacter* are sensitive to freezing and therefore more common in fresh than in frozen meat.

Sampling of the neck skin for analysis of *Campylobacter* according to regulation (EC) No 2073/2005 functioned well in most of the abattoirs concerned. The results show that no abattoir in Sweden had any difficulties in meeting the process hygiene criterion in the regulation, which is set at a level that reflects the much higher prevalence of *Campylobacter* in broilers in many other EU member states.

Reducing *Campylobacter* prevalence at the farm level as well as the measures taken at slaughter decrease the risk of human infection. Over the years, applying strict biosecurity measures has decreased the number of *Campylobacter*-positive broiler slaughter batches in Sweden. The outbreaks of recent years have demonstrated that failures in the production chain may lead to an increase in human illnesses and illustrated the importance of biosecurity measures, not only at the farm level but in the whole production chain.

Broiler carcasses are easily contaminated at slaughter, which necessitates that consumers apply good hygiene practices. Strict hygiene in the kitchen is essential to avoid cross-contamination between contaminated raw meat and food that is ready to eat.

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