SURVEILLANCE OF INFECTIOUS DISEASES IN ANIMALS AND HUMANS IN SWEDEN 2020

Chapter excerpt -
Campylobacteriosis

SVA NATIONAL VETERINARY INSTITUTE
Jordbruks verket Swedish Board of Agriculture
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Cover: Juvenile mink in hand. Photo: Elina Kähkönen

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, produced by authors, 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 using pandoc and R to the LaTeX typesetting language. Most figures and maps are produced using the R software for statistical computing and the LaTeX library pgfplots. Development for 2020 has further improved the importing of content from Excel files to automatically build figures in the pgfplots LaTeX library. The tool is available as an R-package on GitHub (https://github.com/SVA-SE/mill/). The report generation R-package and process was designed by Thomas Rosendal, Wiktor Gustafsson and Stefan Widgren. In 2020, final typsetting was done primarily by Wiktor Gustafsson with contributions from the report authors.

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Campylobacteriosis

Consumption and handling of chicken meat are the most important sources of campylobacteriosis in humans. Therefore, measures to decrease the prevalence in chicken and chicken meat are pivotal. Photo: Bengt Ekberg/SVA.

BACKGROUND

Thermophilic *Campylobacter* species (spp.) are the most common causes of human bacterial gastroenteritis in many countries. A majority of 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.

Since 1997, the incidence of human campylobacteriosis in Sweden has varied between 65 and 110 cases per 100 000 inhabitants (Figure 5). 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 and a record high proportion of domestic infections in relation to infections retrieved abroad in 2020.

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.

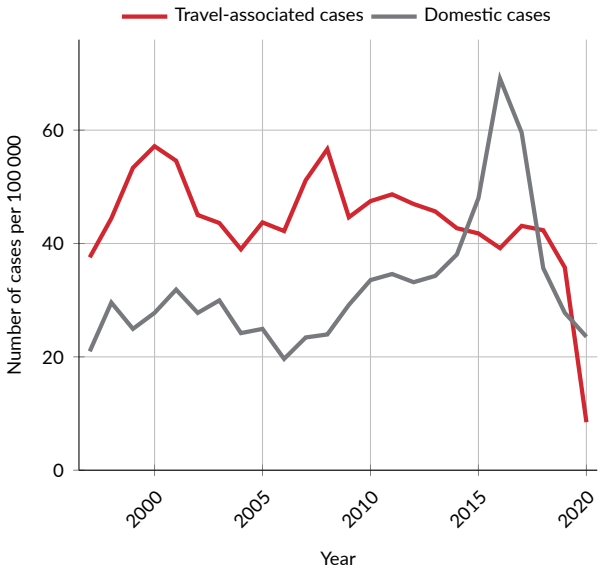

Figure 5: Incidence (per 100 000 inhabitants) of notified human cases of campylobacteriosis in Sweden, 1997–2020. Travel-associated cases are those where the patient has reported travel to another country during the incubation period prior to clinical presentation. Domestic cases are patients that have not recently travelled outside Sweden.

LEGISLATION

Animals

Findings of thermophilic *Campylobacter* spp. in meat-producing poultry are notifiable in Sweden, according to SJVFS 2012:24. 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 slaughterhouses 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 be 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 2013:634). 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 2017, the guidelines for the programme were reviewed.

The programme covers more than 97% 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 slaughterhouses. In 2020, seven slaughterhouses delivered samples. When the flock is slaughtered at more than one time point and the time interval between the slaughter batches is longer than four days, samples are taken from both batches, otherwise only from one of the batches. The caeca are pooled into one composite sample per batch and analysed according to ISO-10272 part 1.

Since 2017, all *Campylobacter* isolates collected during two periods of 2.5 weeks, starting week 8 and week 31, have been subjected to whole genome sequencing (WGS). Those periods have been selected to precede the collection of human domestic isolates.

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, slaughterhouses 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. In 2020, the regulation 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.

Since 2017, the Public Health Agency of Sweden requests isolates from all domestic cases reported during selected periods in March (low season) and August (high season) for whole genome sequencing analysis (WGS). 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 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.

RESULTS

Animals

In 2020, thermophilic *Campylobacter* spp. were detected in 228 (5.1%) of the 4496 broiler chicken batches tested at slaughter (Figure 6), which is at the same level as in 2019 and less than in years prior to 2019. Among the slaughter batches

at the four largest slaughterhouses, which cover 97.2% of the slaughtered chicken, *Campylobacter* spp, was detected in 4.5% of them. The monthly prevalence of *Campylobacter* in chicken slaughter batches varied between 0.0% (April) and 12.9% with the highest prevalence in August. The prevalence of *Campylobacter* in incoming batches varied between slaughterhouses. The monthly number of chickens from *Campylobacter* positive slaughter batches varied as well. Between July and October approximately 4.5 million chicken originated from *Campylobacter* positive slaughter batches (Figure 7).

In March 2020, only three isolates of *Campylobacter* were retrieved for sequencing. Typing of isolates from August to October confirmed that *Campylobacter* had been spread between chicken farms, most probably during thinning (see Outbreaks).

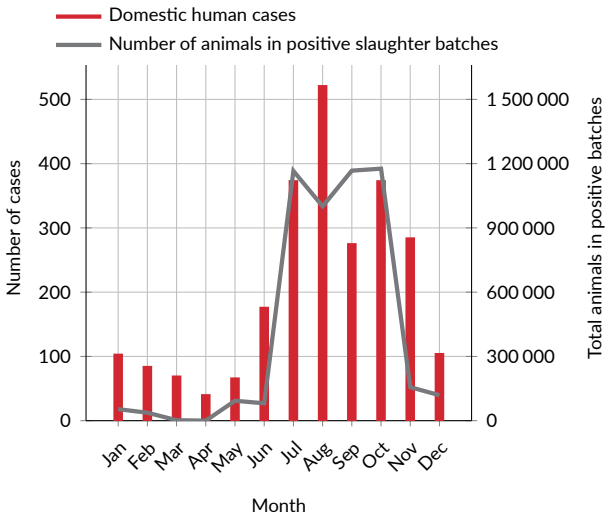

Figure 7: Number of notified domestic cases of human campylobacteriosis, along with the proportion of *Campylobacter*-positive broiler batches, broken down per month in 2020.

IN FOCUS: Occupational risk of Campylobacter infection

In Sweden, four abattoirs, located in four counties, dominate the chicken slaughter. These abattoirs account for over 97% of the domestic chicken meat production. As for data on human cases of campylobacteriosis, the clinical notifications always include information on the county of residence and allows for reporting details about the route of transmission and occupation, although this information is often missing. A closer examination of the clinical reports from notified cases between 2007 and 2020 from these four counties shows 168 reports of cases with an occupational connection to an abattoir. In 64% of the reports (n=108), only "work at abattoir" or other unspecific descriptions of the profession were given. In 14% of the reports (n=24), one of several occupational tasks related to the production at the abattoir was stated. However, the single most reported task was "transport of chicken" (n=20) including loading/unloading, transport and cleaning related to both live animals and of chicken meat products.

Other professions with a suspicion of the source of the infection being an abattoir were mainly related to occupations in construction and/or maintenance (n=15). For most of the cases within these occupational categories, the infection was suspected to have occurred during a temporary work at the abattoirs.

There are regulations that describe the responsibility of the employer to minimize the risk of infection. Regular risk assessments and education of employees about risks and protection are examples of tools to minimize the risk of infection at the workplace. The clinical reports show that a high awareness of the occupational risk of campylobacteriosis for different occupations all through the production chain is pivotal.

The strong association between the prevalence of *Campylobacter* in broiler flocks and infections among humans makes monitoring in broiler flocks an important tool for early warning. In addition, information on occupational infections can provide early information, considering the "time gained" between production and consumption of poultry meat. In two recent Swedish outbreaks, such information has been useful. In 2018, a regional medical officer reported that several employees at an abattoir had fallen ill, which was the prelude to an extensive outbreak caused by contamination at a large hatchery. Similarly, several illnesses among abattoir employees were noticed in summer 2020 (see "Outbreaks") which could thus support suspicions of an outbreak on the rise despite comparatively few reports of campylobacteriosis during 2020 and especially since the start of the COVID-19 pandemic.

Food

In 2020, national and local authorities took 58 samples from different types of food. *Campylobacter* was detected in three samples taken at retail within the framework of a control project. Two of these samples were from broiler meat and one from minced bovine meat. The sample of bovine meat and one of the samples of broiler meat were taken at a store which prepared both bovine and broiler meat, indicating a possibility for cross- contamination at retail level.

Food business operators at seven slaughterhouses collected 907 pooled neck skin samples according to regulation (EC) No. 2073/2005. Test results at all slaughterhouses were satisfactory according to the legislation, and only seven (0.8%) of the 907 samples exceeded the limit of 1000 CFU/g.

Humans

A total of 3434 cases of campylobacteriosis were reported in 2020. Of the reported cases, 71% (2444 cases) were domestic. The incidence of domestic cases decreased by 15% from the year before to 23.5 per 100,000 inhabitants. Hence, the domestic incidence was like the levels seen over a decade ago. The incidence of travel-related cases was a record low 8.5 cases per 100 000 inhabitants, a decrease of 76% from 2019, which also makes the overall incidence the lowest (33.1) since the current reporting system was introduced in 1997 (Figure 5). As many as 82% of travel-related cases in 2020 were reported during January-March, before travel restrictions were introduced due to the COVID-19 pandemic. The domestic cases were fewer for most of the year but an outbreak that lasted from the end of the summer and throughout the autumn led to a relative increase in the number of cases that during October and November were more than usually.

For the domestic cases in 2020, the median age was 47 years with a range from 0 to 96 years. The incidence was highest in the age group 1–4 years, followed by people aged 50–69 years, both of which are age groups that historically tend to have comparatively high proportions of cases. More men (58%) than women were reported with campylobacteriosis.

In the microbial surveillance programme at the Public Health Agency of Sweden, isolates from domestic cases were collected during weeks 11 and 12 and in weeks 32–35. In March, 55 isolates were characterised of which only two clustered, which indicates that most cases were sporadic. In August, 335 isolates were characterised, and 36 percent (n = 119) clustered with two or more isolates. The largest cluster belonged to ST-19 (n = 55) which was the dominant clone during an outbreak in the autumn (see the text on Outbreaks). The second largest cluster (ST-45, n = 21) was also linked to the outbreak. During the collection in August, isolates were received from people with reported occupational infections within the chicken production. These individuals carried isolates from identified outbreak clones.

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 2020. 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 7).

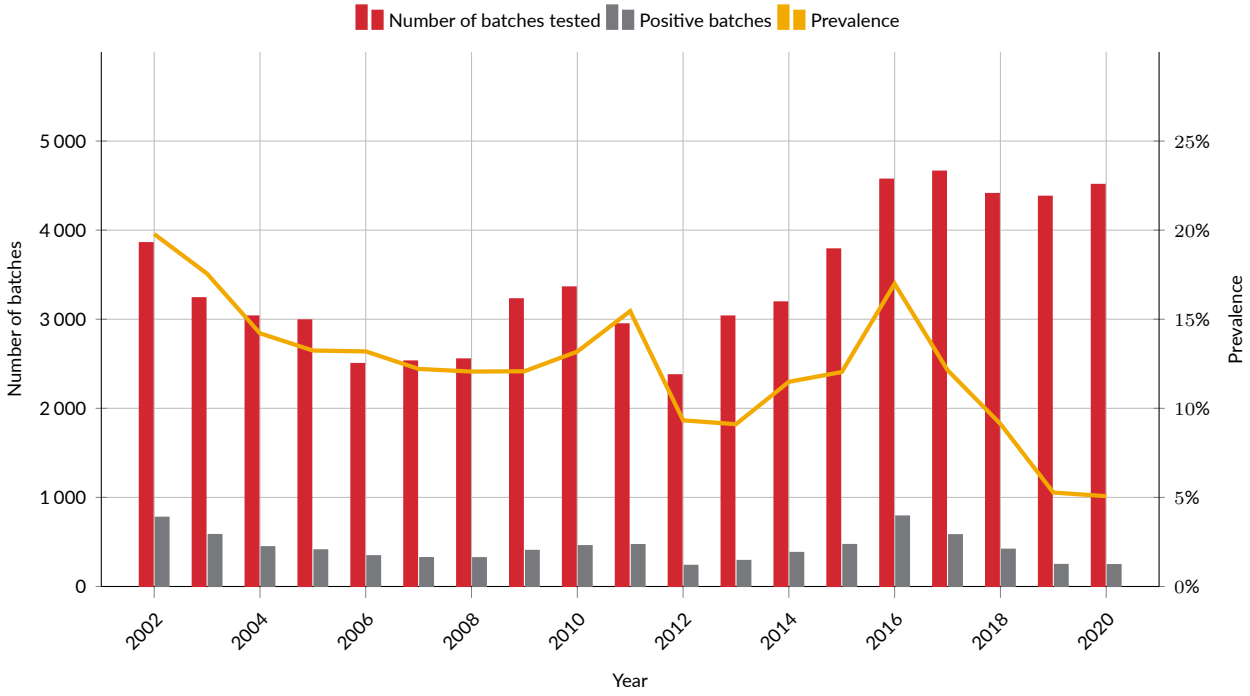

Figure 6: Prevalence of *Campylobacter* in slaughter batches of broiler chicken in 2002–2019.

OUTBREAKS

From having been at very low levels from the beginning of the year and especially since the start of the COVID-19 pandemic, an unexpectedly large increase in the number of people infected with campylobacter was noticed in early August. In parallel to this increase, several cases of infection were observed among abattoir employees at one of the large slaughterhouses. It also turned out that there had been an increase in the proportion of *Campylobacter*-positive slaughter batches of chicken from the second half of July, and this mainly among flocks delivered for slaughter to this very same slaughterhouse. The number of positive slaughter batches remained high until October and a decrease in the number of human cases occurred in mid-November. One reason for the spread of *Campylobacter* among poultry flocks was dirty transport cages that carried the bacteria between chicken farms. One factor that may have made it easier for the bacteria to gain foothold at the farms is the practice of thinning.

The signal of increased human cases in August coincided with the collection of isolates within the national microbial surveillance program, which, therefore, was extended from two to four weeks. The same sequence types (ST-19, ST-45) dominated among isolates from human cases and chicken which confirmed the source of the outbreak.

DISCUSSION

The domestic incidence of campylobacteriosis was lower in 2020 compared with previous years. Most campylobacteriosis cases have been considered sporadic, but cluster analysis of isolates typed in recent years with WGS indicates that a large part of the cases could indeed be part of outbreaks. Many of these outbreaks appear genetically linked to isolates from retail poultry meat.

In 2020, the annual prevalence of *Campylobacter* in chicken slaughter batches was at the same level as in 2019 but lower than in previous years (Figure 6). The correlation between human cases of campylobacteriosis and *Campylobacter*-positive broiler batches further underscores the need for preventive measures. *Campylobacter* prevalence varies considerably between slaughterhouses, 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 at 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 slaughterhouses concerned. The results show that no slaughterhouse in Sweden had any difficulties in meeting the 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 decreases the risk of human infection as well as the measures taken at slaughter. 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 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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