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5. A One Health status on surveillance, outbreak investigation and action plans for *Campylobacter* in Denmark

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5.1 *Campylobacter* surveillance in humans

In Denmark, between 3,740 and 5,389 human *Campylobacter* cases have been registered yearly in the past five years (See Table A1). In 2022, the number of registered *Campylobacter* cases was 5,142, 28% of which were travel-related. Since 2019, a subset of human samples (around 10-15%) have been sent routinely to Statens Serum Institut for subtyping by whole genome sequencing in order to detect clusters and outbreaks. Figure 5.1 shows the number of domestic cases from 2018 to 2022, the proportion of cases in clusters, and clusters with a food match.

In 2022, the threshold for investigation of clusters was changed to examine genetic clusters of human cases down

to five cases. This was done to gain further knowledge of their aetiology. Since this surveillance setup only captures the tip of the iceberg, it is estimated that whenever a cluster of five cases is detected, this covers an outbreak of a least 40-50 cases.

From 2018 to 2022, 62 genetic clusters were detected with five *C. jejuni* cases or more constituting 32% (849 / 2,683) of the sequenced human isolates. Twenty-six clusters comprised ten or more cases constituting 23% (618 / 2,683) of the sequenced human isolates. The largest cluster contained 124 cases (spanning 2018-2022) and was described in Anonymous 2020 [1].

Figure 5.1. Registered human cases with *Campylobacter* infections (with no history of travel, pink), Denmark (2018-2022). Sequenced human isolates (*C. jejuni* and *C. coli*, orange), human isolates in clusters (≥ 2 human isolate, light blue), human isolates in clusters with a detected food match (dark blue)

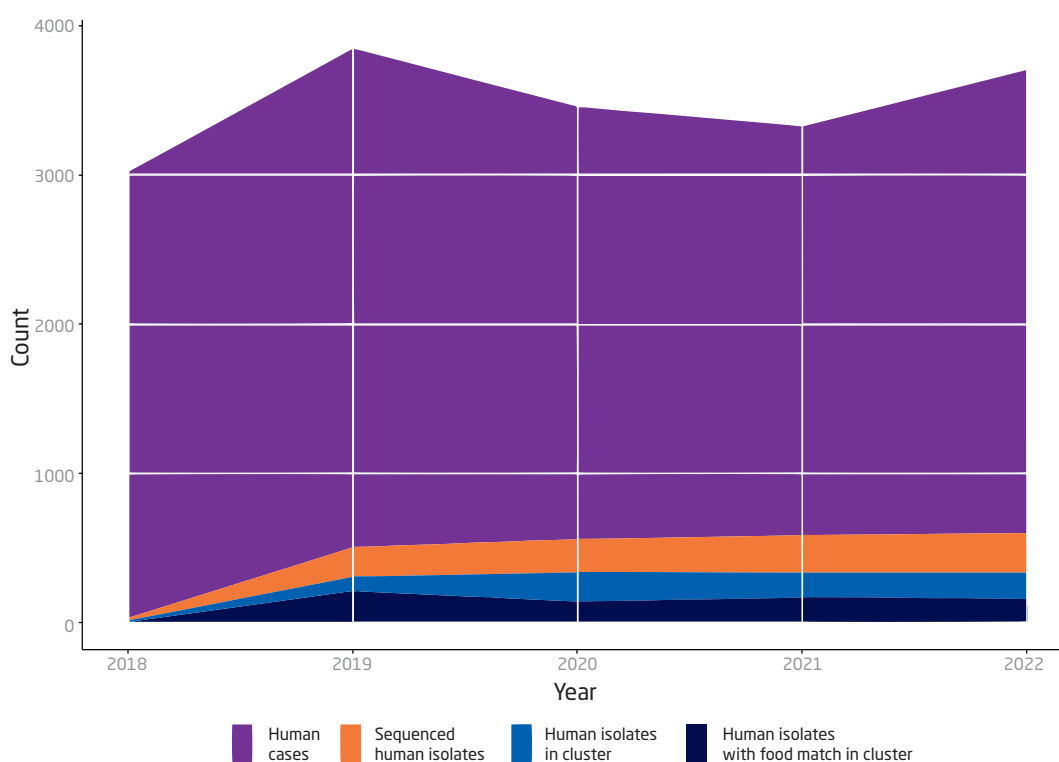
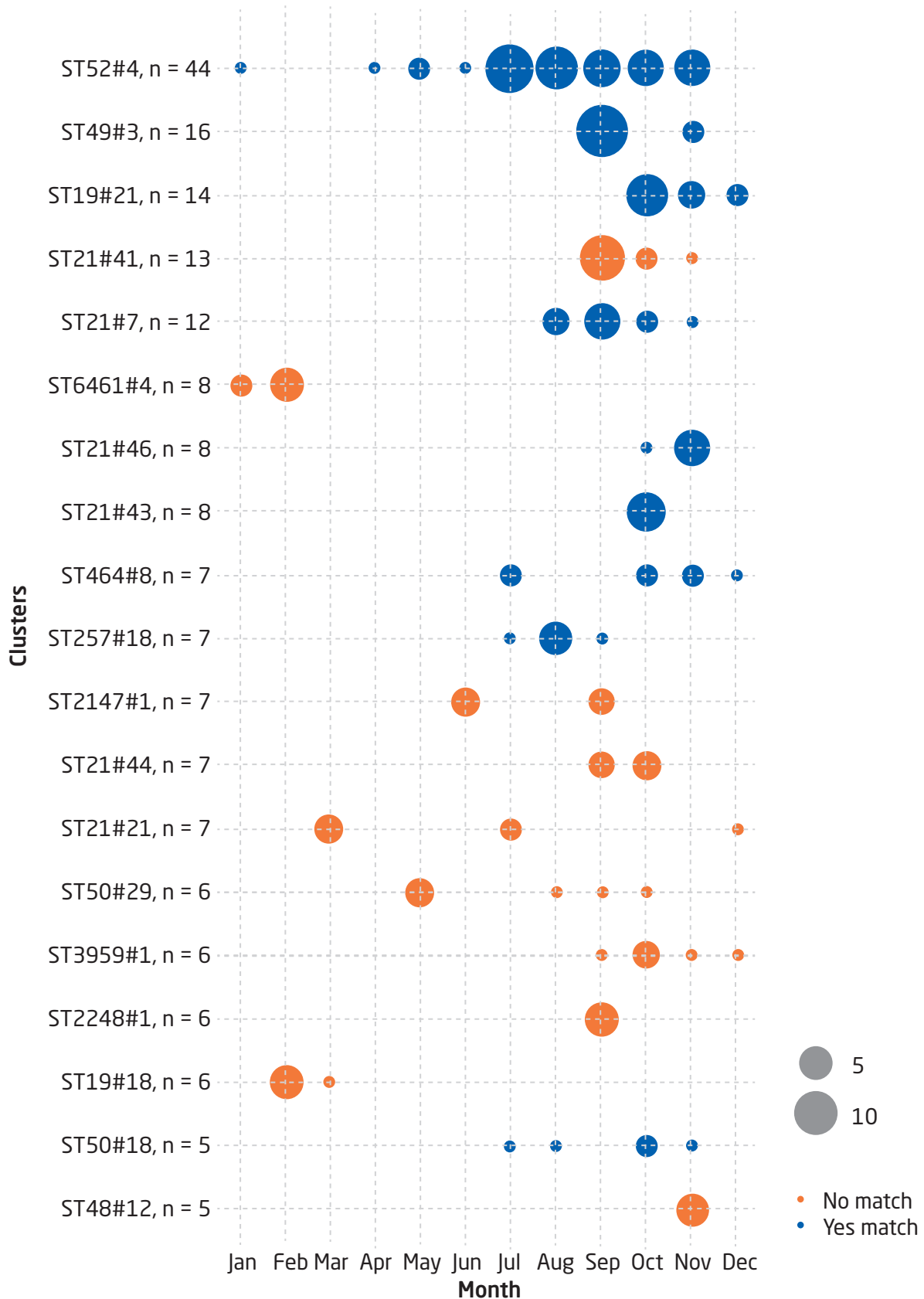


Figure 5.2. Persistence over time (2022) of the *C. jejuni* genetic clusters. Only clusters with 5 or more human cases in 2022 are illustrated (regardless of travel history). Clusters matching food isolates are blue. The size of bubbles indicates the number of cases per year



In 2022, nineteen genetic clusters with five or more cases were detected (Figure 5.2) comprising 26% (192 / 737) of the sequenced cases. For nine of these clusters a food match was detected within the same or the previous year. Food matches were linked to Danish produced chicken meat, except from one that was linked to imported chicken meat. In total, 25% (184 / 737) of the sequenced human isolates in 2022, was matched to a source.

Since chicken meat is consumed by the majority of the Danish population, and it is hard to remember brand or type of meat, the interviews of cases in the genetic clusters do not add much to the aetiology. The exception is point source outbreaks with a specific source e.g. the suspected milk outbreak in Bornholm in 2021 [2].

5.2 Surveillance of *Campylobacter* in broiler flocks

Campylobacter status of broiler flocks is monitored through cloacal swab samples obtained at the slaughterhouses where all flocks are sampled. In 2022, 18.6% of broiler flocks tested positive for *Campylobacter* (Appendix Table A9). Since 2014, a decrease in the prevalence of flocks testing positive on cloacal swabs has been observed which might be a result of the measures taken at farms to prevent introduction of *Campylobacter*. As usual, the surveillance of *Campylobacter* in broiler flocks shows

a higher proportion of positive flocks in the late summer months (Figure 5.3), and a much higher prevalence of *Campylobacter* in outdoor-raised flocks than in indoor-raised flocks (data not shown).

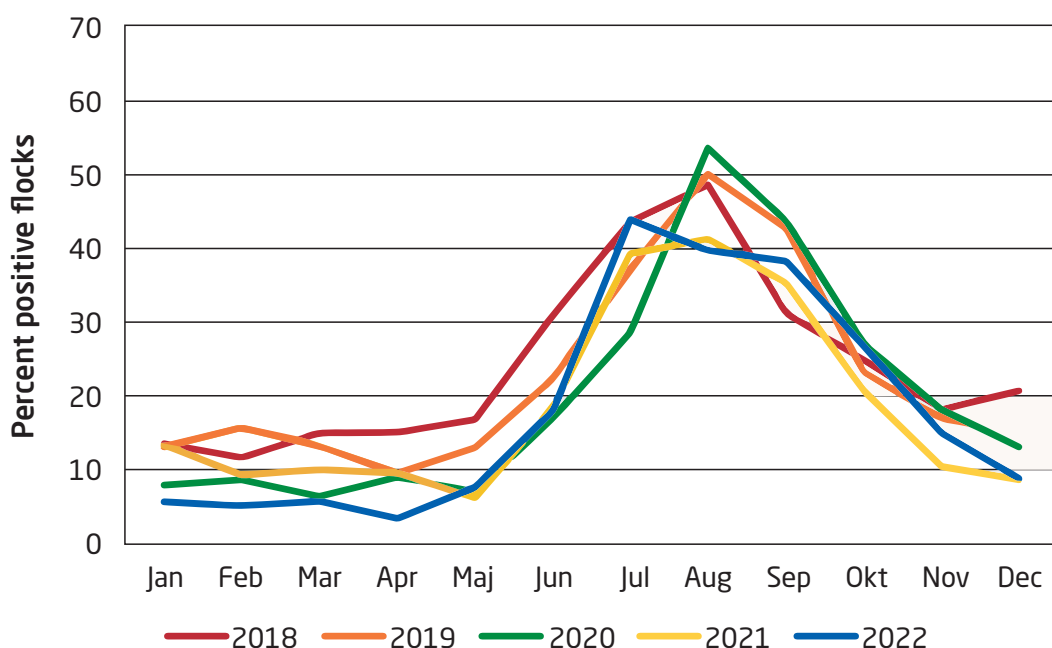
5.3 Surveillance of *Campylobacter* in fresh broiler meat at the slaughterhouses

More than 85% of the conventional Danish broilers are slaughtered at the two largest slaughterhouses in Denmark, where the Danish Food and Veterinary Administration (DVFA) has carried out surveillance of *Campylobacter* in fresh meat for more than a decade. In 2013, the surveillance sample type was changed to include leg skin samples collected from chilled carcasses ready for human consumption. Similar to the observations of *Campylobacter* in broiler flocks, the prevalence of *Campylobacter* in Danish broiler meat is higher in the late summer months (Figure 5.4) and in the meat samples from outdoor-raised chicken flocks compared to conventional meat samples (data not shown).

5.4 Action plans against *Campylobacter*

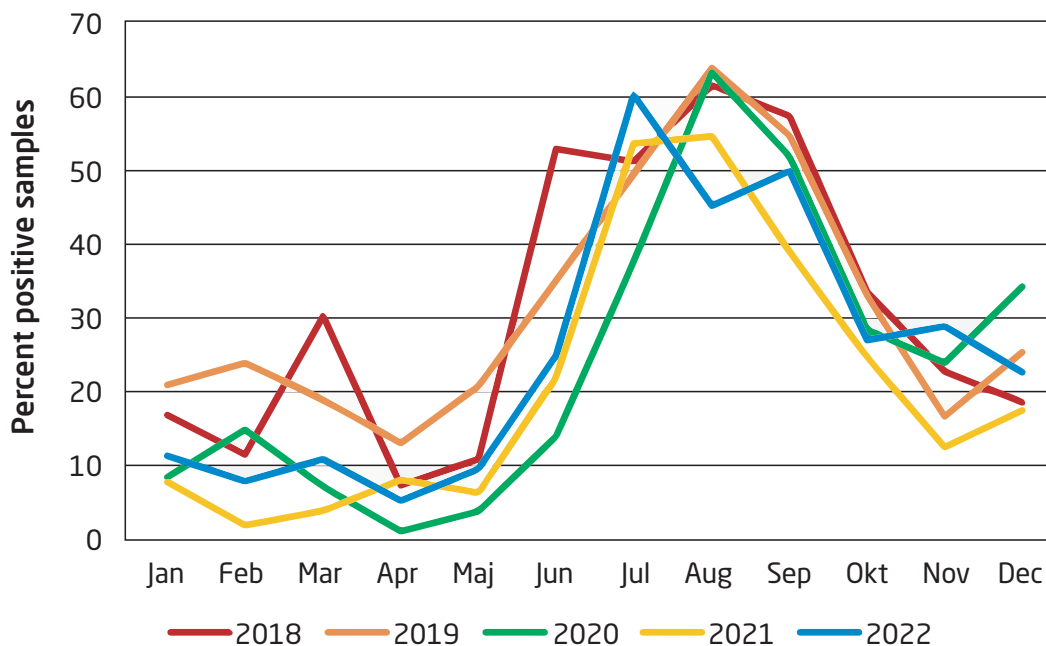
Denmark has had National Action Plans against *Campylobacter* since 2008. The first Action Plan focused solely on broilers and broiler meat, but the focus has broadened in the later Action Plans.

Figure 5.3. Percentage of broiler flocks positive for *Campylobacter* per month, 2018-2022



Source: Danish Agricultural & Food Council

Figure 5.4. Prevalence of *Campylobacter* in the surveillance of leg skin samples from conventionally produced broilers, 2018-2022



Source: Danish Veterinary and Food Administration

5.5 Action plans against *Campylobacter*, 2018-2021

The third Action Plan was adopted in 2018 and is described by Anonymous (2018) [3].

The main goal of the Action Plan was to obtain a 5% reduction in registered human cases each year. This was the first time a specific target on the reduction of human cases was included in the Action Plan. The goal however, was not reached in 2018 or 2019. In the same period, the number of clinical microbiological laboratories using PCR based methods increased (see chapter 3). These methods are more sensitive, resulting in a higher number of registered cases. Moreover, in 2019, a large outbreak of human campylobacteriosis occurred. In 2020, the goal was reached, however this was primarily due to the Covid-19 pandemic, which resulted in a marked decrease of travel related human cases, as described in Anonymous (2021) [4]. In 2021, the number of human cases remained at the level of 2020.

In broiler flocks, the target was to maintain the low prevalence obtained in 2017 (17.6%). This target was not reached. In 2018 the prevalence increased to 24.6% positive flocks, but decreased again to 22.7% in 2019, 20.4% in 2020 and in 2021 the prevalence was 19.1% [4].

In broiler meat, the target was to reduce the risk of illness from *Campylobacter* to 50% by 2021 relative to the risk in 2013 - applying the Relative Risk Model (RRM) made by Nauta et al. (2012) [5]. By the end of 2021, the risk of getting *Campylobacter* from broiler meat was 53% of the risk in 2013, nearly reaching the target of the Action Plan. Close to half of the reduction of risk was reached in 2021.

5.6 Action plans against *Campylobacter*, 2022-2026

The initiatives in the new Action Plan from 2022-2026 are based on the experiences, results and knowledge obtained from the previous Action Plans. The Action Plan was prepared by DVFA in collaboration with Danish Agriculture and Food Council, Confederation of Danish Industry, Danish Butchers Association FoodDenmark and DTU Food. The Action Plan is available on the DVFA website (fvst.dk).

The main target of the Action Plan is to reduce the number of human cases, a specific target on the reduction was not set this time. However, it was decided to set separate targets for the different production systems (conventional and organic/free range) and to set individual targets for each of the medium/major slaughterhouses (slaughterhouses slaughtering above 1 million broilers pr. year).

For conventional broiler flocks, the goal is to maintain the low prevalence of positive flocks at approximately 15% and for organic/free ranges broiler flocks the target is, to keep it at, or below 65% positive flocks. Moreover, the aim is to further reduce the number of positive broiler flocks over a 5-year period. At the slaughterhouse-level (broiler meat), it was the plan that individual targets should be set, when the updated baseline of the RRM was obtained. In 2022 it was decided not to use the RRM for setting the new targets. Instead, targets for reduction and maximum levels of prevalence and concentration (number of positive samples above 1000 cfu/g) were set using the 3-year average (2019-2021) for each of the slaughterhouses as a baseline. Furthermore, it was decided to set different goals for the maximum level of concentration of *Campylobacter* in the meat, for the summer- and winter period, considering the seasonal differences in the prevalence of *Campylobacter* positive broiler flocks.

Most efforts and measures from the previous Action Plan are continued, such as surveillance of broiler flocks at slaughterhouses and in retail. Screening of other possible sources such as cattle and imported meat is also carried out. Whole genome sequencing of isolates is performed in order to compare with the sequences of isolates from the surveillance of human cases (Figure 5.1 & Figure 5.2). Consumer information is issued regularly to raise awareness on the importance of kitchen hygiene. Further research on sources and on mitigation measures is also a part of the plan.

The Action Plan is dynamic, meaning that targets and measures will be followed and adjusted according to the development in the production of broilers as well as contribution to infection from other sources.

5.7 Conclusion

The One Health surveillance of *Campylobacter* in Denmark consists of different monitoring and research as well as control activities. Routine comparison of human and food isolates is crucial to enhance outbreak management and gain more knowledge on the etiology of *Campylobacter*. The monitoring of flocks with cloacal swabs as well as monitoring of fresh meat at the slaughterhouse level continues to be done in the Action Plan 2022-2026. Likewise, is the comparison of isolates from the human monitoring of *Campylobacter* and from broiler meat to identify human outbreaks also continued in the new plan. Screening of the potential other sources (and comparison to human isolates) such as cattle and imported broiler meat, as well as research projects on sources, transmission and on mitigation measures are also included in the Action Plan. Consumer information is issued regularly to raise awareness e.g. on the importance of kitchen hygiene, hygiene when barbecuing, and recommendations when travelling abroad.

5.8 References

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