Annual Report on Zoonoses in Denmark 2007

DTU Food
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Annual Report on Zoonoses in Denmark 2007

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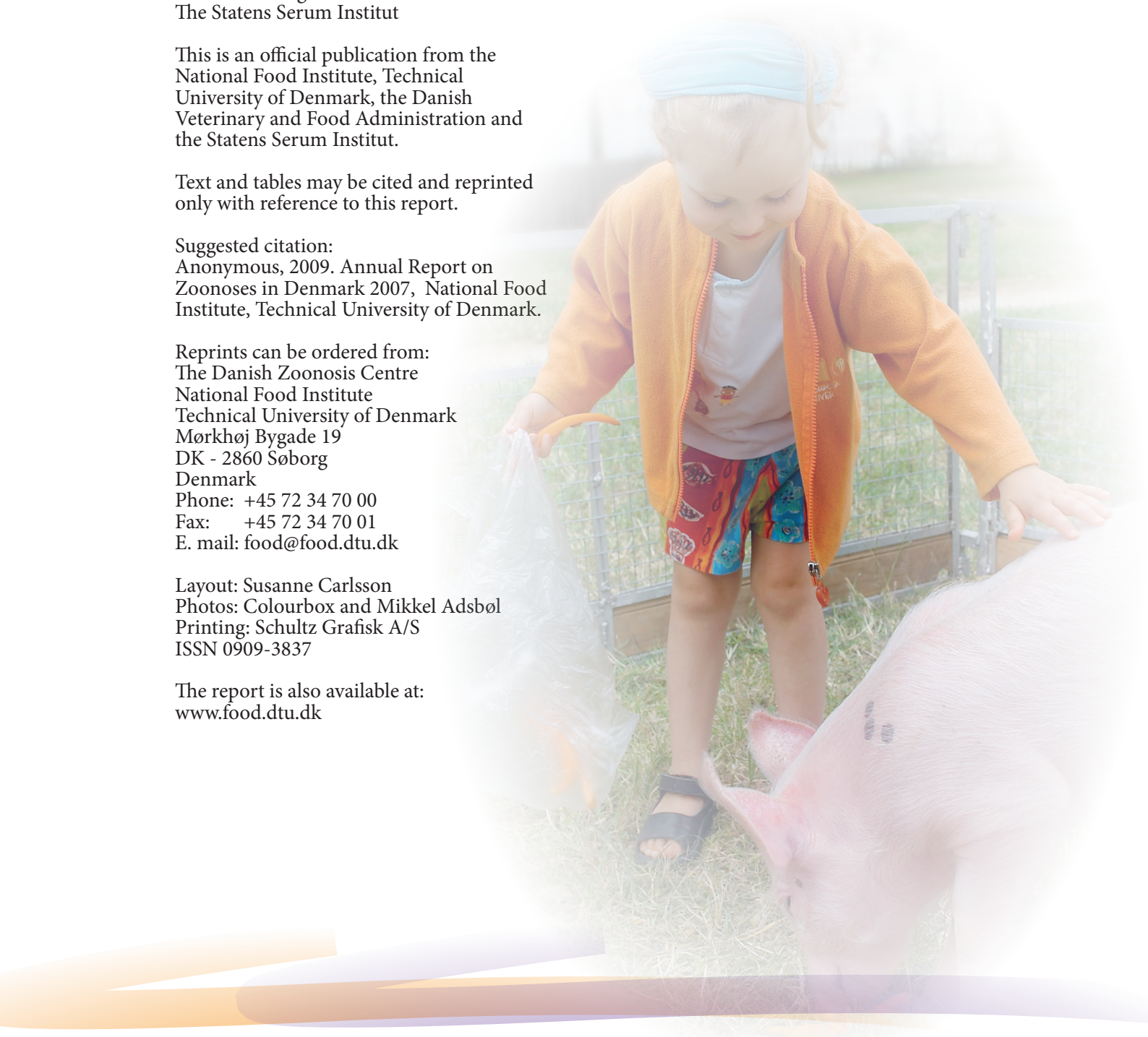

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Introduction

The annual Report on Zoonoses presents a summary of the trends and sources of zoonotic infections in humans and animals, as well as the occurrence of zoonotic agents in food and feeding stuffs in Denmark in 2007. Greenland and the Faeroe Islands are not represented. The report is based on data collected according to the Zoonoses Directive 2003/99/EC, supplemented by data obtained from national surveillance and control programmes as well as data from relevant research projects. The report is also available at www.food.dtu.dk.

The previous Annual Reports on Zoonoses in Denmark have through the last decade been focusing on describing the annual occurrence of zoonotic diseases as detected through the Danish surveillance programmes in place. This year we introduce some editorial changes to give room for chapters with a more in depth analyses of trends as well as presentations of topics of special interest e.g. research projects relevant for the national surveillance of zoonosis, reviews of action plans carried out within a specific area. Additionally, a chapter containing information on topics related to the European Union is introduced.

The general descriptions of the surveillance and monitoring of zoonosis is still an important part of the report, but only selected results are presented in a narrative form. Like in previous years, all surveillance data are presented in the appendix tables.

Occasionally corrections to the data may occur after publication resulting in minor changes in the presentation of historical data in the following years reports.

Profile of the year

In 2007, a substantial improvement in the collection of travel information for human cases was initiated and the outcome showed that approximately 50% of the human cases of salmonellosis was estimated to be related to traveling abroad, which represents an increase of 100% compared to the previous years. The estimation of sources due to human salmonellosis has been calculated for 11 years and an overview of the trends are presented.

Campylobacter has been the leading cause of bacterial gastrointestinal disease in Denmark since 1999. In 2007, new travel information indicated that approximately 20% of the human cases of campylobacteriosis in 2007 were estimated to be related to travel abroad. An overview of the status, new surveillance activities and the content of a 5-year action plan are included in the report.

Waterborne outbreaks are rare in Denmark, but in 2007 a waterborne outbreak due to semi-purified sewage accidentally being led into the drinking water system took place. Close to 6,000 inhabitants and a number companies were prohibited from using the tap water for several weeks; 453 inhabitants were known to be affected and 77 cases tested positive with mostly norovirus or *Campylobacter*, but a number of other pathogens were also detected.

In 2007, Denmark was assigned the status as a region where the risk of *Trichinella* in domestic pig is recognised as negligible.

1. Trends and sources in human salmonellosis

By Sara Monteiro Pires (smpi@food.dtu.dk) and Tine Hald

During the last decades, fluctuations in the incidence of human salmonellosis have been observed in Denmark. These fluctuations were accompanied by changes in the incidence of infections caused by different *Salmonella* sero- and phage types, suggesting that the sources of human salmonellosis change over time. To get a better understanding of the most important sources of human *Salmonella* infections, the Danish Zoonosis Centre has described and routinely applied a method that estimates the proportion of human cases of salmonellosis associated with specific food-animal sources (1). This so-called *Salmonella* Source Account was initiated in 1996 and has been applied to available *Salmonella* surveillance data dating back to 1988 (Figure 1.1). The method has proved to be a useful tool to support the Danish risk managers in their decision for implementing new intervention strategies, and for the evaluation of existing control programmes.

The principle of the method is to compare the number of human cases caused by different *Salmonella* subtypes with the distribution of the same subtypes in the various sources. In brief, types that occur almost exclusively in a specific animal reservoir (unique types) are used as "anchor points" for the distribution of types found in several sources. It is assumed that all human cases caused by the unique types are associated only with that specific food or animal reservoir, except for travel-related cases. Cases caused by types isolated from various sources are distributed relatively to the occurrence of the unique types.

The originally developed method took a deterministic approach to estimate the number of cases attributed to each source and associated to travelling abroad, but did not include uncertainty of the estimated parameters. The method included a number of assumptions, including equal pathogenicity, survivability and ability to cause disease of all *Salmonella* subtypes. The model was later modified, and in 2000 it evolved from being purely deterministic to becoming a stochastic model built under a Bayesian framework (4). This approach allows for the inclusion of uncertainty of the estimated parameters, and assesses the presumable differences in the ability of different *Salmonella* subtypes and of different animal-food sources to cause infection.

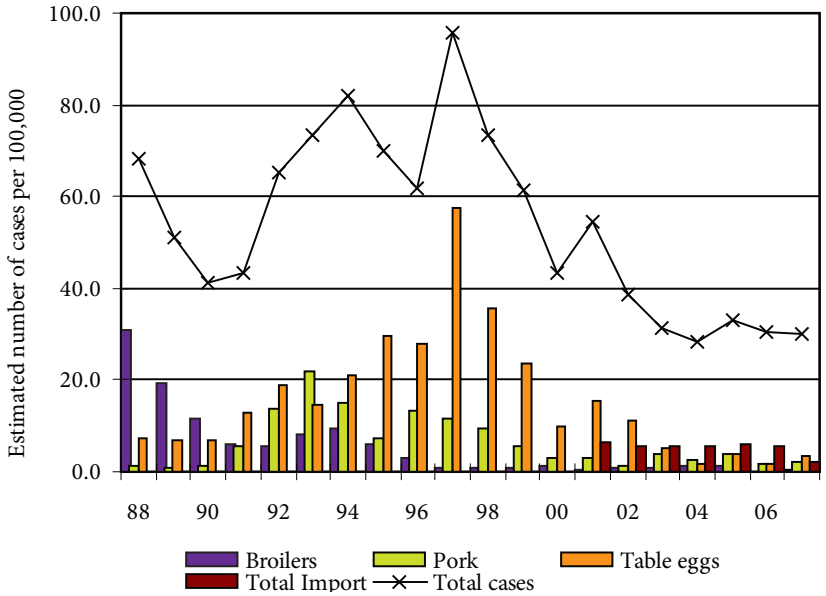

Figure 1.1. Trends and sources of human salmonellosis in Denmark, 1988 to 2007
Source: Danish Zoonosis Centre, National Food Institute, Technical University of Denmark

1.1 *Salmonella* source account 2007

In 2007, the incidence of salmonellosis was 30.1 per 100,000 inhabitants (10.4 for *S.* Enteritidis and 6.3 for *S.* Typhimurium) (appendix B, Table A2). The estimated incidence of salmonellosis attributed to the various animal-food sources was: table eggs: 3.3; pork: 2.0; beef: 0.2; broilers: 0.2; imported pork: 0.4; imported beef: 0.4; imported chicken: 1.1; imported turkey: 0.2; travel related cases: 13.9; unknown source: 7.0; outbreak related cases with unknown source: 1.3 (appendix A, Table A1).

Around 46% of the human cases of salmonellosis were estimated to be related to travelling abroad, which represents an increase of almost 100% compared to the previous years (Figure 1.2). This increase is explained by a substantial improvement in the collection of travel information for human cases in 2007, where the Statens Serum Institut has retrospectively interviewed a significant part of the patients with no travel information reported by their General Practitioners. The patients were asked if they had been travelling abroad in the seven-day period before disease onset. Travel information was available for a total of 44% of the reported cases. Still, some uncertainty concerning the travel-related estimated cases remained, as not all cases had travel information and because the number of people interviewed differed between counties and year quarters. In 2007, 762 cases were estimated to be travel associated. Of these, 298 had reported to be travelling before onset of symptoms.

Domestically produced animal foods were estimated to be responsible for around 19% of the total number of reported cases. The proportion of human cases attributable to table eggs increased from 2006 to 2007, representing 11.0% of the reported cases in 2007, but was at the same level as in 2005. No cases were attributed to the consumption of domestic ducks this year, as the commercial production of duck meat has been discontinued in Denmark.

A reduction from 18.0% in 2006 to 6.9% in 2007 in the proportion of human cases of salmonellosis attributed to imported products was observed (appendix A, Table A1). Particularly, the number of cases attributed to imported chicken decreased when compared to the previous year, representing 3.7% (95% CI: 2.1, 5.3%) of the total number of reported sporadic cases of salmonellosis in 2007. Due to the improved information about travelling, substantial number cases were attributed to travel compared to previous years. A part of these new travel related cases came from the group of cases related to imported foods, because there is a considerable overlap between *Salmonella* subtypes isolated in imported foods and in patients that have been travelling, However, the decrease in human cases associated with imported foods is also believed to be caused by the intensified surveillance of imported and Danish food (i.e. the case-by-case control, see chapter 4).

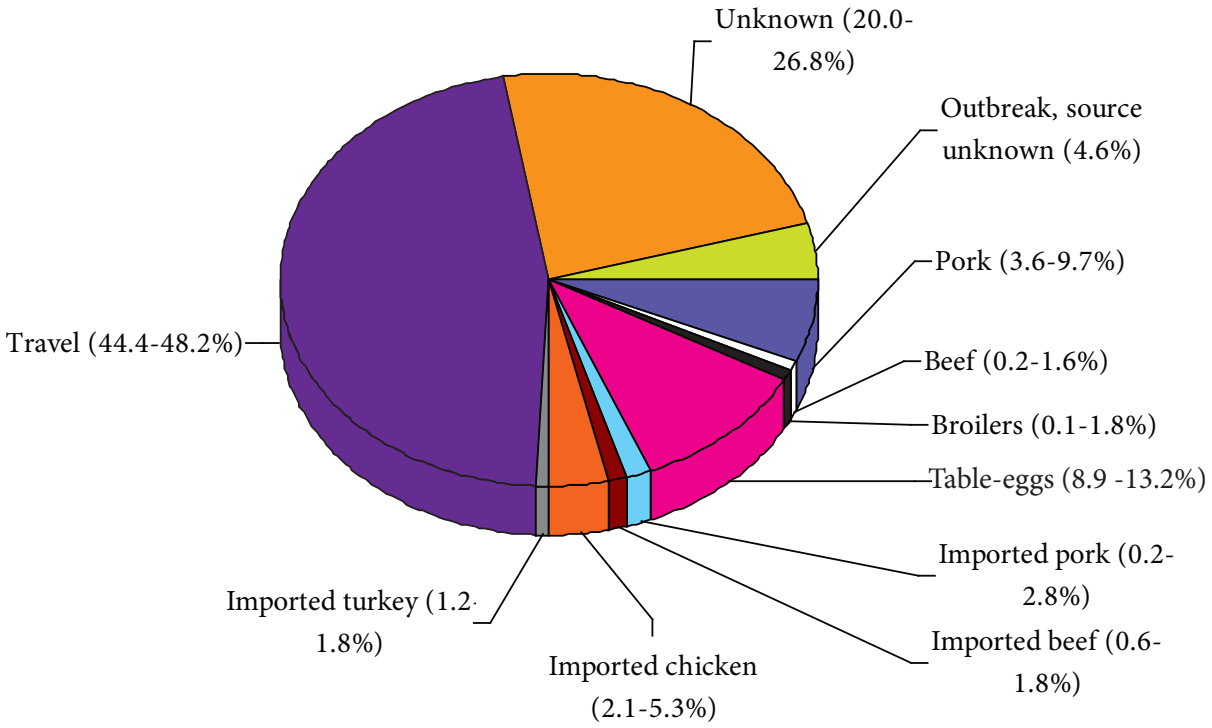

Figure 1.2. Estimated sources of 1,647 cases of human salmonellosis in Denmark, 2007 (See also Appendix A, Table A1)

Source: Danish Zoonosis Centre, National Food Institute, Technical University of Denmark

The proportion of human cases attributed to an unknown source decreased from 36.5% in 2006 to 23.4 in 2007. Probably also as a consequence of the improved travel estimates. These cases include human infections that could not be attributed to any of the sources included in the national monitoring. Other sources may include pet animals or food sources (imported or domestically produced fruit and vegetables).

Of the 343 reported cases caused by *S.* Typhimurium, 116 were estimated to be travel related and 21 were associated to an outbreak. Of the remaining 206 domestically acquired sporadic cases, 52% was attributed to domestic animal-food sources, 8% was estimated to be associated to the consumption of imported foods and 40% of the cases had unknown origin. Around 13% of the *S.* Typhimurium infections attributed to domestic food-animal sources were caused by multi-resistant types (resistant to four or more antimicrobials), 31% was caused by resistant types (resistant to less than four antimicrobials), and 56% was caused by susceptible types; no infections acquired from domestic sources were quinolone-resistant (Figure 1.3). In cases associated with imported foods, 670% was multi-resistant, around 13% was quinolone-resistant, 15% was resistant, and 4% was caused by susceptible types. In total, 52% of the multi- and/or quinolone-resistant cases was associated with domestic products, while the remaining 48% was attributed to the consumption of imported foods.

Among the travel related cases caused by *S.* Typhimurium types, 35% was caused by multi-resistant types, 6% was quinolone-resistant, 35% was resistant and the remaining 24% was caused by susceptible types (Figure 1.3).

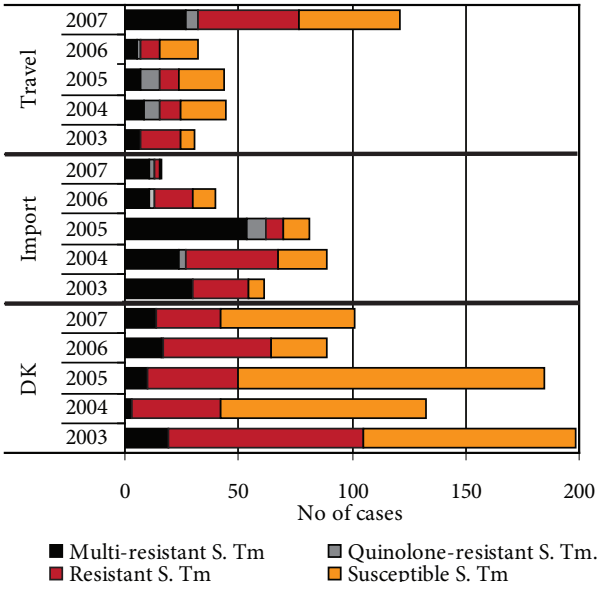

Figure 1.3. Sources of antimicrobial resistant S. *Typhimurium infections in humans, 2003-2007*
Source: Danish Zoonosis Centre, National Food Institute, Technical University of Denmark

1.2 *Salmonella* Source Account in Denmark, an 11 years overview

The overall incidence of human salmonellosis has decreased substantially since the mid 90's, from 62.7 human cases per 100,000 inhabitants in 1996 to 30.1 human cases per 100,000 inhabitants in 2007. Denmark has experienced three waves of human salmonellosis where the majority of cases has been caused by three distinct sources: broilers in the late 80's, pork in the mid 90's and eggs in the mid/late 90's. At each peak, a new control programme was implemented resulting in a decline in the number of human cases attributed to that particular source.

Applied on a yearly basis, the approach has been a useful tool to investigate trends of the most important sources of human salmonellosis in Denmark over time and to assess the effectiveness of the implemented surveillance and control programs in the different animal species.

Most frequent serotypes and phage types causing human disease

Since 1994, the *Salmonella* serotype most frequently causing human disease in Denmark is *S.* Enteritidis followed by *S.* Typhimurium. In 1997, the number of human cases caused by S. Enteritidis was three times higher that the number of infections caused by S. Typhimurium (Figure 1.4). However, starting in 2003, the relative importance of the latter in the overall burden of human salmonellosis increased. In 2007, *S.* Typhimurium caused 22% of the cases, whereas *S.* Enteritidis was responsible for 30% of the cases. The remaining cases were caused by a variety of other *Salmonella* serotypes. Until 2000, the most commonly encountered serotypes were *S.* Virchow, *S.* Hadar, *S.* Infantis and *S.* Agona. From 2000 and onwards, *S.* Dublin, *S.* Newport, *S.* Infantis and *S.* Stanley have also frequently caused human disease, with variable importance in different years.

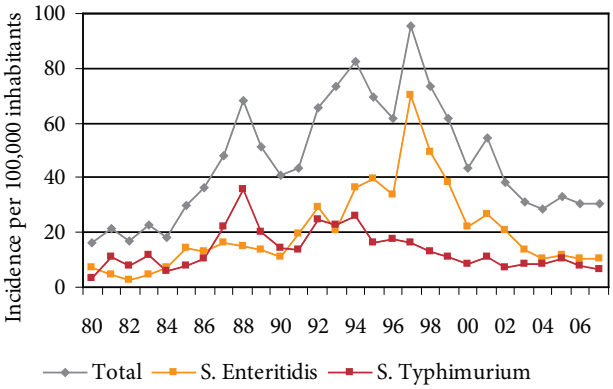

Figure 1.4. Incidence of human infections by Salmonella *(all serotypes),* S. *Enteritidis and* S. *Typhimurium in Denmark, 1980 to 2007*
Source: Statens Serum Institut

The number of different phage types of *S.* Typhimurium and *S.* Enteritidis isolated from humans has been relatively constant across the years. The most frequent *S.* Typhimurium phage types include DT12, DT120, DT104, DT66, U288, DT135 and DT193, and the most frequent *S.* Enteritidis phage types were PT8, PT6, PT4, PT1, PT21, PT6a and PT29.

An analysis of the distribution of the *S.* Typhimurium phage types shows that fluctuations of the relative importance of each phage type in the major animal reservoirs were accompanied by similar changes in the distribution of the phage types responsible for human disease (Figures 1.5 to 1.7).

In pigs, the most significant change over time in the *S.* Typhimurium phage type distribution was observed for *S.* Typhimurium DT12. In 1997, DT12 was the most common phage type, accounting for 55.1% of all *S.* Typhimurium isolates in Danish pigs. In 2007, the occurrence had declined to 13% (Figure 1.5). In the same period, the number of human cases caused by DT12 declined proportionally, indicating that pork was an important source of DT12 infections in humans. In contrast, the occurrence of *S.* Typhimurium DT120 and DT104 started to increase in both humans and pork in 2002. From 1997 through 2007, 81-85% of all DT12, DT17 and DT66 isolates from pigs remained fully susceptible to the nine antimicrobial agents included in the Danish resistance monitoring programme DANMAP despite the increase in the antimicrobial consumption in pigs. However, during the same period, DT120, DT170 and DT104 emerged and only 21-34% of the isolates was fully susceptible to all drugs. In DT104, the presence of a multi-drug resistant profile is well described. In DT120, the dominant resistant profile (Ampicillin-Streptomycin-Sulfonamide-Tetracycline) occurred in 50% of the pig isolates. Studies have shown that antimicrobial susceptible serovars and *S.* Typhimurium phage types only slowly become resistant regardless of increased antimicrobial consumption (2). The observed emergence of resistance is therefore caused by a change in clones, i.e. susceptible clones (e.g. DT12) are replaced by resistant clones (e.g. DT120) (2). In other words, the use of antimicrobial agents might select for resistant and multi-resistant clones, and this could be the driver for changes in observed clone pattern(2), e.g. the increased occurrence of DT120 and DT104 is most likely explained by an increased use of antimicrobials, particularly tetracycline, in the pig production (3).

The dominant animal reservoir for *S.* Enteritidis in Denmark is table egg layers, where PT8 and PT6 have been the most frequently occurring phage types followed by PT21 and PT4 (Figure 1.8). The number of infected flocks has decreased significantly over the years, and

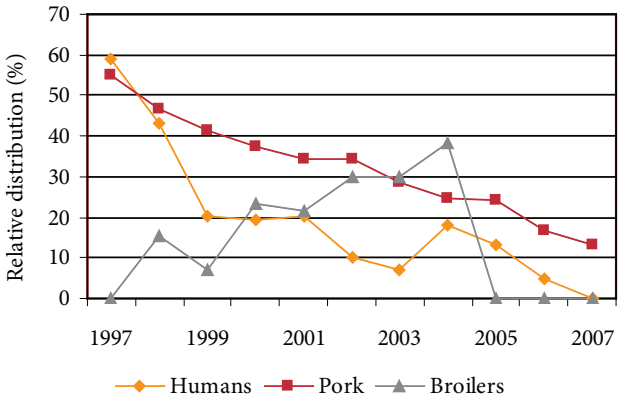

Figure 1.5. S. Typhimurium DT12 distribution in humans, pork and broilers
Source: National Food Institute, Technical University of Denmark

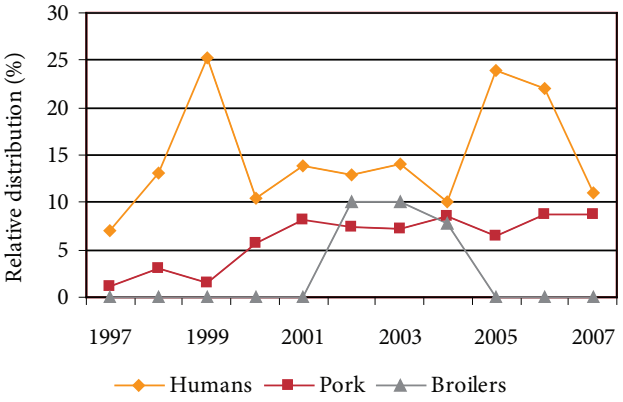

Figure 1.6. S. Typhimurium DT104 distribution in humans, pork and broilers
Source: National Food Institute, Technical University of Denmark

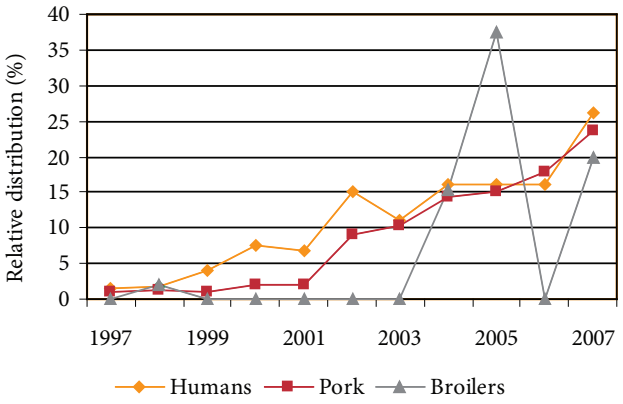

Figure 1.7. S. Typhimurium DT120 distribution in humans, pork and broilers
Source: National Food Institute, Technical University of Denmark

has been accompanied by a decrease in the number of human infections caused by *S.* Enteritidis phage types (Figure 1.9).

Most important sources of human salmonellosis

Table eggs

The number of cases attributable to the main food-animal sources oscillated over the years (Figure 1.1). A substantial proportion of human cases was attributed to table eggs from 1996 to 1998 (40-50%), with a peak observed in 1997. The incidence of human *S.* Enteritidis infections increased by 107% in 1997 compared with the previous year. Surveillance in layers, typing of bacterial isolates from different sources and evidence from outbreak investigations suggested that this increase was due to increased levels of infected layers and shell eggs (1). A programme to control *Salmonella* in layers was implemented in December 1996, with further adjustments added in the following years. The continuous monitoring of all flocks and the destruction of infected breeder and rearing flocks resulted in a decrease in the prevalence of *Salmonella* in the table egg producing flocks already in 1998. Furthermore, the plan ascertained that eggs from production flocks found serological or bacteriological positive for *Salmonella* were referred to heat-treatment. The implemented intervention strategies resulted in a considerable reduction of the risk to consumers associated with the consumption of table eggs. The incidence of human *Salmonella* infections attributable to table eggs was 23.7 cases per 100,000 inhabitants in 1999. A further reduction in the table egg related cases was observed in subsequent years, with the exception of an increase in 2001 (Figure 1.1). In 2007, 3.3 salmonellosis cases per 100,000 inhabitants were attributed to the consumption of Danish produced table eggs which correspond to 11.0% of the registered human cases of salmonellosis (appendix A, Table A1).

Pigs

The proportion of human cases attributed to pigs and the consumption of domestic pork reached a peak of 22.0 cases per 100,000 inhabitants in 1993 (Figure 1.1). A gradual and variable decrease has been observed since then. The national *Salmonella* control programme in pigs is based on routine testing and classification of slaughter pig herds and subsequent slaughter of pigs according to the inherent risk. Pigs from breeding and multiplying herds are tested monthly by serology (See appendix D, Table A33). Slaughter pig herds are monitored continuously by serological testing of meat juice samples. Pig herds with unacceptable high levels of *Salmonella* antibodies are slaughtered under intensified hygienic precautions. Slaughterhouses that exceed a certain predetermined level of *Salmonella* in the routine monitoring of carcasses are obliged to investigate and reduce the contamination to an acceptable level. The prevalence of pig herds with unacceptable high levels of *Salmonella* antibodies has been steadily reduced since the program began. Bacteriological testing results show that the herd infection level was reduced from 14.7% to 7.2% in small herds and 22.2% to 10.4% in large herds from 1993 to 1998. In 2007, the prevalence of *Salmonella* in Danish slaughter pigs was 8% according to the European Food Safety Authority (EFSA)'s baseline study based on bacteriological testing of lymph nodes (See section 5.2). During the period 1993 to 2007, the level of *Salmonella* contamination in pork products determined by the routine monitoring was reduced from 3% to 1.1% or less.

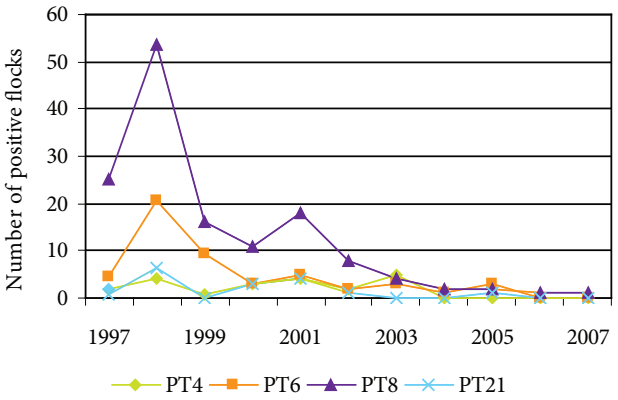

Figure 1.8. S. Enteritidis Phage type distribution in layer flocks

Source: National Food Institute, Technical University of Denmark

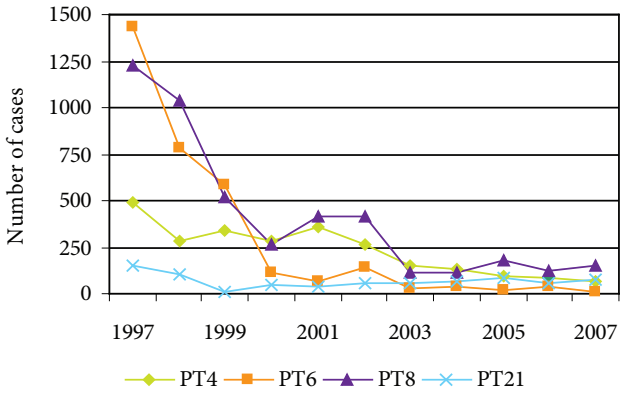

Figure 1.9. S. Enteritidis Phage type distribution in humans

Source: National Food Institute, Technical University of Denmark

The estimated number of cases per 100,000 inhabitants attributable to pork has never reached the peak in 1993, but fluctuations have been observed during the years (Figure 1.1). An increase in the proportion of attributed cases was observed in 2003 with a subsequent reduction in the proportion of attributed cases in the following year. In 2007, 2.0 human cases of salmonellosis per 100,000 inhabitants were assoicated with pork. This corresponds to 6.5% of all registered human cases of salmonellosis in 2007 (appendix A, Table A1).

Broilers

The number of human cases associated with the consumption of poultry and broiler meat in Denmark reached a peak in the late 80's, where 50% of the cases was estimated to be due to consumption of broiler meat. A control programme was initiated and in the following years the number of cases attributable to broilers was reduced from 2-7% in 1996 to 0.8% in 2007. The control programme in broiler flocks is based on the principle of top-down eradication in order to achieve freedom from *Salmonella* from the top of the broiler-breeding pyramid and down. The original programme has been revised over the years; the testing program has been improved and adjusted to higher food safety objectives. As progress stalled, more intensive serological and bacteriological testing methods were developed and applied. The goal is to achieve complete freedom from *Salmonella* in the broiler production. The proportion of *Salmonella* positive broiler flocks has been significantly reduced since the initiation of the control program. More than 65% of broiler flocks tested positive for *Salmonella* during the first year of the program compared to 2% in 2000 and onwards. This decrease in *Salmonella* positive flocks has led to a concomitant reduction in the proportion of infected broiler carcasses after slaughter and at retail, and subsequently a reduction of the human health burden of salmonellosis attributable to the consumption of broiler meat.

Imported products

Attribution of sporadic cases of salmonellosis to imported foods was first accounted for in 1998 with the estimation of the proportion of cases attributable to imported poultry products. Imported pork and beef products were considered for the first time in the source account model in 2000; these sources represented 4-6% and 2-4% of the cases, respectively. Antimicrobial susceptibility testing of *S.* Typhimurium isolates was introduced in 2003. In this year, it was estimated that the majority of the infections caused by multi-resistant *S.* Typhimurium was acquired from foods produced outside of Denmark, whereas a higher proportion of infections caused by susceptible or resistant types was associated with the consumption of domestically produced foods. Additionally, quinolone resistance has been more frequently linked with imported foods. This trend was observed in subsequent years, however from 2006 a shift was observed and the proportion of multi-resistant cases attributed to domestic foods has been higher in the last two years. This change may be explained by the intensified surveillance of imported and Danish food (see chapter 4).

Travel related cases

The quality of the travel information for the reported human cases of salmonellosis varied considerably over the years. Before 2003, the number of travel-related cases among patients with unknown travel history was estimated on the basis of the data from cases with known

travel history. However, from 2003 and until 2006, this approach proved extremely difficult, since the majority (between 70 to 80% of the cases) of patients had no travel information. During these years, estimates of the total number of travel-associated cases were highly uncertain and should be interpreted with care. In 2007, there was a substantial improvement in the collection of travel information for human cases, as described earlier.

The proportion of estimated travel associated cases varied substantially over the last 11 years. In the mid and late 90's, 15% of the *Salmonella* infections was attributed to travelling abroad. The estimated proportion of travel related cases increased in 2002 to 26% of the total number of reported cases. Similar levels were estimated in the following years. In 2007, the estimated proportion of travel associated cases increased to 46% of all cases (Figure 1.2).

Unknown source

Each year, a proportion of the human cases cannot be attributed to any known source. These cases include infections caused by *Salmonella* subtypes that are not found in any of the sources covered by the surveillance, and infections caused by strains that were not/could not be subtyped. Contaminated vegetables and fruit, other food sources and pets are not routinely monitored in Denmark, but undoubtedly cause human *Salmonella* infections. Some of these cases are probably allocated to the unknown category. The proportion of cases attributed to an unknown source fluctuated from the initial years to 2005, from between 15% to 28% of the cases. In 2006, the proportion of human cases with unknown source increased to 35%. In this year, it was only possible to make inferences about the attribution of cases to specific food sources for around 20% of the *S.* Typhimurium cases, due to many untypable strains or unavailable data. This may explain some of the observed increase. In 2007, the number of unknown cases was reduced to 23.4% of the total number of reported cases of salmonellosis.

Conclusion

The *Salmonella* source account has proved to be a useful tool for the prioritization of intervention strategies, and for the evaluation of the implemented control programmes. Overall, it can be concluded that the national *Salmonella* control programmes have been effective in reducing the levels of *Salmonella* in the main animal reservoirs, subsequently resulting in a reduction of the human health burden of salmonellosis attributed to these sources. The presented results also highlight the importance of monitoring the changes in the main *Salmonella* subtypes isolated from the animal reservoirs as it has been observed that the more frequent types fluctuate over the years. The intervention strategies should not focus on single types without further assessment of their development over time.

References

(1) Anonymous (1999). Annual Report on Zoonoses in Denmark 1998. Copenhagen, Denmark: Ministry of Food, Agriculture and Fisheries.

(2) Emborg HD, Baggesen DL, Aarestrup FM (2008). Ten years of antimicrobial susceptibility testing of *Salmonella* from Danish pig farms. J Antimicrob Chemother; 62: 360-363.

(3) Emborg HD, Vigre H, Jensen VF, Vieira AR, Baggesen DL, Aarestrup FM (2007). Tetracycline consumption and occurrence of tetracycline resistance in *Salmonella* Typhimurium phage types from Danish pigs. Microb Drug Resist; 13: 289-294.

(4) Hald T, Vose D, Wegener HC, Koupeev T (2004). A Bayesian Approach to Quantify the Contribution of Animal-Food Sources to Human Salmonellosis. Risk Anal; 24: 251-65.


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2. *Campylobacter*
- status and new surveillance activities

By Hanne Rosenquist (haro@food.dtu.dk), Steen Ethelberg, Louise Boysen and Birgitte Helwigh

Campylobacter has been the leading cause of bacterial gastrointestinal disease in Denmark since 1999. Therefore, special emphasis is put on this organism with regard to nationwide monitoring and surveillance as well as management strategies. Since 1979, campylobacteriosis has been notifiable in humans. In 2007, *Campylobacter* was a part of the monitoring programme including production animals and food, in particular broilers and broiler meat. Additionally, Denmark hosted an Expert Consultation concerning intervention strategies to control *Campylobacter* in the broiler production in 2007 and a 5-year action plan for *Campylobacter* was drafted. The results of the national monitoring and surveillance, the main conclusions of the Expert Consultation and the initiatives listed in the *Campylobacter* action plan are included below.

2.1 Humans

In 2007, there were 3,868 reported human cases of Campylobacteriosis, corresponding to an incidence of 71 cases per 100,000 inhabitants (appendix B, table A2). A random sample of 164 human isolates were speciated of which 149 (91%) were found to be *C. jejuni* and 15 (9%) *C. coli*. The incidence of human campylobacteriosis by county is shown in appendix B, Figure A3.

Campylobacter infections in humans surpassed *Salmonella* in 1999 (Figure 2.1). The number of *Campylobacter* infections rose dramatically (by a factor of four) from 1991 to 2001 after which a decreasing trend was observed. However, the number of infections in 2007 constituted an increase of 19% compared to the number of infections in 2006 and was the highest recorded in 5 years.

The epidemiology of *Campylobacter* is not understood in the same detail as for *Salmonella*. As in other Western countries, consumption and handling of poultry and poultry products is believed to be the primary source of human campylobacteriosis in Denmark, though several other sources also exist. A case-control study of sporadic infections performed in 2000-01 found the main risk factor for infection to be consumption of non-frozen chicken (1). A research project (2008-2010), funded by The Danish Food Industy Agency, will seek to identify sources of human infections by developing a source attribution account for *Campylobacter* based on multi locus sequence typing of isolates collected from the food chain and the environment.

Data on travel history are not routinely collected via the Danish laboratory surveillance system, but for 2007 an estimate became available for the first time where the Statens Serum Institut retrospectively interviewed 140 patients and found that 20% of the patients had been travelling abroad in the seven day period before onset of the disease.

General outbreaks of human campylobacteriosis are rare; a few small outbreaks were recorded in 2007 (see Chapter 3). *Campylobacter* was the main bacterial agent in a large waterborne community outbreak that occurred in the beginning of the year (2). In 2005-2006, the three largest reported outbreaks caused by *Campylobacter* were related to eating in workplace canteens; the source was contamination in the kitchens from raw chicken to ready-to-eat foods in all three instances (3; 4).

2.2 Animals

The occurrence of *Campylobacter* in production animals is seen in appendix C, Table A11a (broilers) and Table A17 (pigs and cattle). All broiler flocks are tested for *Campylobacter* at slaughter, and pigs and cattle herds were tested for *Campylobacter* as part of the DANMAP programme. No flocks of hens, ducks or turkeys were tested for *Campylobacter* in 2007. Pets, zoo animals and

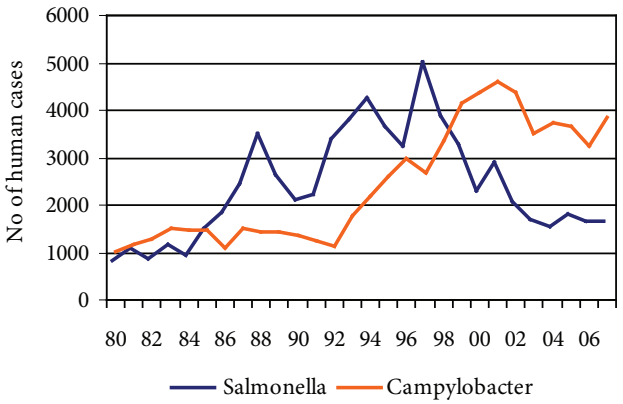


Figure 2.1. Number of human cases of salmonellosis and campylobacteriosis 1980-2007
Source: Statens Serum Institut

wildlife are not routinely monitored for *Campylobacter*, but only tested on clinical indications (appendix C, table A22).

In Denmark, broilers are believed to be the major risk factor for human campylobacteriosis and only the broiler production has been subject to risk assessment (5; 6) and interventions (described in the Annual Report 2003), therefore broiler flocks are more extensively monitored than other production animals. Only results of broilers are presented in the following.

Broilers

All broiler flocks are sampled for *Campylobacter* at the slaughterhouse prior to slaughter. Ten cloacal swabs are collected from each broiler flock, and analysed as one pooled sample per flock using a PCR detection method.

In 2007, there were 26.8% *Campylobacter* positive broiler flocks which is similar to previous years (Figure 2.2 and appendix C, Table A11a). However, it is a significant decrease compared to the years prior to implementation of the voluntary intervention strategy in 2003 where the prevalence was higher than 38%. The prevalence in broilers has a distinct seasonal variation with a summer peak in July/August. This is similar to what is observed in humans (Figure 2.3). In 2007, the prevalence of positive broiler flocks per month ranged from 8.8% positive flocks in April to 55.6% in August. The significant reduction in prevalence, compared to the years prior to the implementation of the strategy, is considered to be attributable to the enforcement of intervention strategies at the farms.

The PCR method used in surveillance of *Campylobacter* in broilers does not differentiate between species of *Campylobacter*. However, as part of the monitoring programme for the occurrence of antimicrobial resistance in zoonotic bacteria (DANMAP) approximately one positive sample per positive flock from each broiler holding was speciated by conventional microbiological methods. Of the 380 samples investigated, 29.2% was positive for *Campylobacter*. The species identified were *C. jejuni* (91.9%), *C. coli* (0.9%) and *C. upsaliensis* (5.4%), which is a similar distribution as observed in previous years (appendix C, Table A12).

2.3 Food

As in the preceding years, to evaluate the contribution of different products to human exposure, the occurrence of *Campylobacter* in broiler and turkey meat was monitored in 2007. Samples were collected at wholesale or retail level and included Danish produced as well as imported meat (appendix C, Table A11b). In addition, to evaluate the effect of the implemented intervention strategy (described in Annual Report 2003), samples of fresh chilled broiler meat were collected in the two larger Danish broiler-processing plants (appendix C, Table A11a). No other food categories were sampled in 2007.

Broiler meat

The occurrence of *Campylobacter* in chilled and frozen domestic produced and imported broiler meat is shown in Figure 2.4 and appendix C, Table A11b. In 2007, prevalence estimation was changed compared to previous years to account for uneven sampling during individual years. Uneven sampling will lead to either too high or too low annual mean prevalence due to a distinct seasonality in the occurrence of *Campylobacter*. The proportion of *Campylobacter* positive samples is now calculated as the mean of quarterly prevalences based on the sum of data from the year in question and the previous year. Data from a two year period is merged to calculate reliable quarterly prevalence estimates. Furthermore, monitoring data from the period 2004-

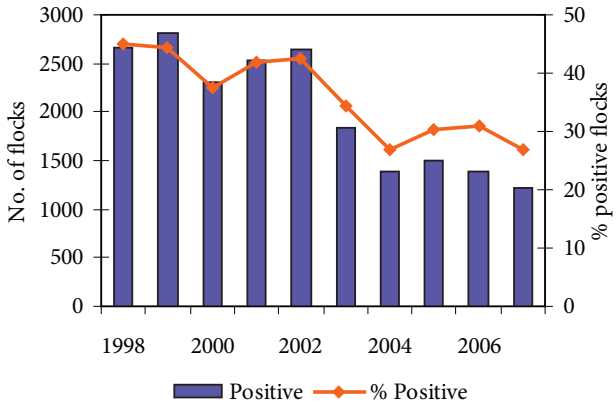


Figure 2.2. Broiler flocks positive for Campylobacter, *1998-2007*

Source: National Veterinary Institute, Technical University of Denmark

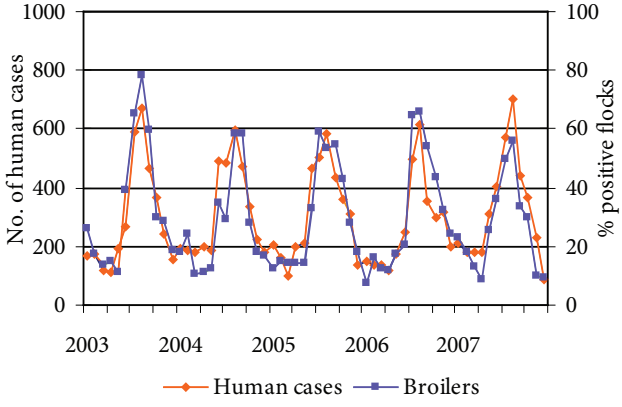


Figure 2.3. Montly percent Campylobacter *positive broiler flocks and number of human campylobacteriosis cases, 2003-2007*

Source: Statens Serum Institut and National Veterinary Institute, Technical University of Denmark

2006 has been updated retrospectively, as additional information became available.

The proportion of *Campylobacter* positive samples in domestic produced chilled broiler meat sampled at retail decreased from 40% subsequent to the voluntary strategy implemented in 2003 to 30% in the following years (Figure 2.4 and appendix C, Table A11b). This is equivalent to the results reported for the Danish broiler flocks (Figure 2.2 and appendix C, Table A11a).

The monitoring of domestic produced fresh, chilled broiler meat sampled at two larger broiler-processing plants showed a decline in the *Campylobacter* prevalence from 2004 to 2006 (appendix C, Table A11a.). This decline is also believed to reflect the effect of the intervention strategy implemented in 2003. The occurrence of *Campylobacter* in 2007 was at the same level as in 2006. These products are sampled regularly during individual years. The data from this monitoring programme are not directly comparable with the retail data presented in Figure 2.4 due to different methods of analysis.

For domestic produced frozen broiler meat, the proportion of *Campylobacter* positive samples decreased from 18.3% in 2002-2003 to 10.9% in 2003-2004 (Figure 2.4 and appendix C, Table A11b). This observed reduction is similar to the observations in domestic produced chilled broiler meat. However, since 2003-2004, the proportion of *Campylobacter* positive frozen broiler meat samples has increased slightly and in 2006-2007 the proportion of positive samples was higher than in the years before the voluntary strategy was implemented.

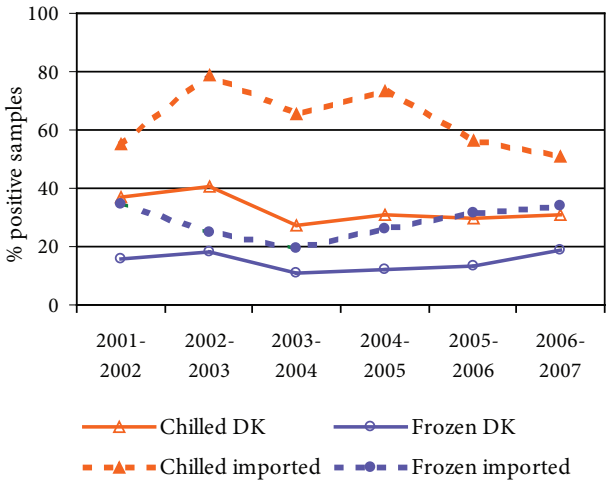


Figure 2.4. Percent Campylobacter *positive samples from chilled and frozen Danish and imported broiler meat at retail, 2001-2007. Percent positive samples are calculated as the mean of quarterly prevalences based on the sum of data from the two years specified*

Source: National Food Institute, Technical University of Denmark

In imported broiler meat, the proportion of *Campylobacter* positive chilled meat has dropped markedly since 2004-2005. This can partly be explained by a shift in countries exporting broiler meat to Denmark. The proportion of *Campylobacter* positive imported frozen broiler meat has increased since 2003-2004, which is similar to the reported results from domestic produced frozen broiler meat (Figure 2.4 and appendix C, Table A11b).

Turkey meat

The proportion of *Campylobacter* positive samples of chilled, imported turkey meat increased from 30% in 2005 and 2006 to 44% in 2007. This change is not readily explained. No domestic processed turkeys were sampled in 2007 as only very few turkey flocks are slaughtered in Denmark.

Intensified control of *Campylobacter* in fresh poultry meat – a case by case based surveillance

Since November 2006, a case-by-case based surveillance programme has estimated the occurrence of *Campylobacter* and *Salmonella* in batches of Danish and imported fresh poultry meat or poultry meat marinated in a salt solution (See chapter 4). In 2007, 245 batches of Danish poultry meat and 574 batches of imported poultry meat were tested. *Campylobacter* was detected in 15.1% of the Danish batches and in 27.7% of the imported batches (appendix C, Table A18).

For each positive batch, the Regional Veterinary and Food Control Authorities request the National Food Institute, Technical University of Denmark to conduct a risk assessment, where the estimated prevalence and relative human risk is compared to the general level in 2005. The estimated relative human risk includes the quantitative test results and is based on a mathematical model developed for a risk assessment of *Campylobacter* in chicken products published in 2001 (7; 8).

Based on the risk assessment, the Regional Veterinary and Food Control Authorities decide if the specific batch of fresh meat must be considered a hazard to human health according to article 14 in the EU food law (Regulation (EC) 178/2002). If so, the food producing establishments are not allowed to market the batch and already marketed batches must be withdrawn. In 2007, two Danish batches and 26 imported batches of fresh poultry meat were considered unsafe following a risk assessment (appendix C, Table A18).

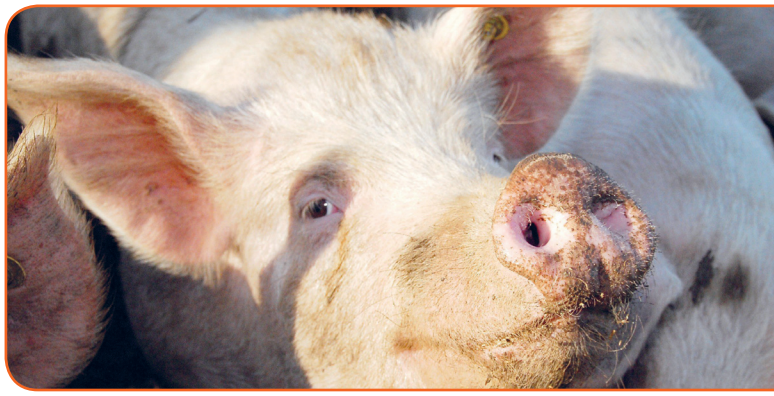
2.4 New action plan

In Denmark, actions to combat *Campylobacter* in the broiler production were initiated in the mid 90's. Priority was given to hygienic measures at farm level. Later, initiatives during processing were included, e.g. freezing of positive flocks when possible. Nonetheless, the effect on the number of human cases has been limited. Denmark has experienced a decrease in human cases, but *Campylobacter* is still the leading cause of bacterial gastrointestinal disease (Figure 2.1 and appendix C, Table A2). There might be numerous explanations for lack of effect on the human incidence and new initiatives are needed to further reduce the incidence of campylobacteriosis. This was one of the conclusions in the report "Danish special guaranties and new initiatives concerning *Salmonella* and *Campylobacter* in Danish and imported meat and eggs" from the Danish Veterinary and Food Administration in 2006. This report recommended an action plan for *Campylobacter* in broilers and broiler meat.

To facilitate and guide the decision-making for the action plan, the National Food Institute, Technical University of Denmark hosted an expert consultation in 2007 aiming at providing information and recommendations on the most useful interventions in the Danish broiler production in terms of effect, cost, applicability and consumer acceptability (5). A total of 25 invited experts from eight countries participated and the consultation concluded the following:

- Biosecurity in and around the broiler houses, in particular insect control (fly screens) was given top priority
- The allocation of positive flocks for decontamination was given high priority. In this context, freezing was considered the most efficient method of decontamination. However, because freezing limits the quantity of chilled fresh meat during periods with high *Campylobacter* prevalence, other methods of decontamination or combinations of several methods were preferred. Examples of such methods are steam-ultrasound, crust-freezing and forced-air-chilling
- Allocation of meat for products that would be safe for the consumer to handle, for example oven-ready products in foil trays, whole chickens in roasting-bags or heat-treated, ready-to-eat products were also considered important
- Interventions aimed at reducing faecal contamination were also given high priority
- Consumer education, specifically education of children, was considered important.

A current research project (2005-2009), funded by The Danish Food Industry Agency, also aims at providing information on cost-effective interventions for *Campylobacter* control in the Danish broiler production. The project will recommend best-interventions in consideration of ability to reduce numbers of *Campylobacter*, technical feasibility, costs, public perceptions of risk and reduction strategies, consumer's willingness to pay for low-risk products, and saved socio-economic costs due to an expected lower number of human infections. Several activities were running in 2007, but no conclusions were drawn yet.



Ultimo 2007, a 5-year action plan was drafted by the Danish Veterinary and Food Administration, the National Food Institute, Technical University of Denmark, the National Veterinary Institute, Technical University of Denmark, the Danish Meat Association, the Danish Poultry Council and the Organic Denmark (6). The action plan aimed at:

- Reducing the *Campylobacter* prevalence in the Danish broiler flocks
- Reducing the occurrence of *Campylobacter* in Danish broiler meat
- Reducing the risk from imported broiler meat.

Imported meat was included in the plan, as imported broiler meat had been estimated to contribute more to human infections than Danish broiler meat. The calculation was carried out by National Food Institute, Technical University of Denmark using the Danish risk assessment model (7; 8), incorporating data from the national monitoring programme on prevalence and numbers of *Campylobacter* in Danish and imported broiler meat.

The key initiatives of the action plan directed against the imported broiler meat included:

- A continued case-by-case based surveillance
- A request to retailers and wholesalers to enforce stricter requirements for food safety for their suppliers.

Concerning the Danish broiler production, initiatives included:

- Development and implementation of an industry code of practice for the lay out of new buildings and production hygiene
- Further development of fly screens for broiler houses, which have proven very effective in preventing introduction of *Campylobacter* in the broiler houses under Danish conditions (9)
- Improvement of the detection and allocation of *Campylobacter* positive flocks
- Investigation of the effectiveness of decontamination techniques
- Research elucidating the occurrence of *Campylobacter* in free-range and organic broilers and broiler meat to be able to decide management options for this branch of production
- Education of consumers in kitchen hygiene, part of the plan was to launch consumer information campaigns and produce educational material for school children.

References

(1) Wingstrand A, Neimann J, Engberg J, Nielsen EM, Gerner-Smidt P, Wegener HC, et al. (2006). Fresh chicken as main risk factor for campylobacteriosis, Denmark. Emerg Infect Dis Feb. 12(2):280-5.

(2) Vestergaard LS, Olsen KE, Stensvold R, Bottiger BE, Adelhardt M, Lisby M, et al. (2007). Outbreak of severe gastroenteritis with multiple aetiologies caused by contaminated drinking water in Denmark, January 2007. Euro Surveill 2007 Mar;12(3):E070329.

(3) Mazick A, Ethelberg S, Moller NE, Molbak K, Lisby M (2006). An outbreak of *Campylobacter* jejuni associated with consumption of chicken, Copenhagen, 2005. Euro Surveill 2006 May 20;11(5).

(4) Statens Serum Institut. *Campylobacter* outbreaks. Epi-News 2007;(20/21). Available from: http://www.ssi.dk.

(5) Rosenquist H, Boysen L, Borck B (2008). Interventions to control *Campylobacter* in the broiler production. Report of an International Expert Consultation, Copenhagen, Denmark, 26–27 November 2007, National Food Institute, Technical University of Denmark. Available from: http://www.food.dtu.dk.

(6) Fødevarestyrelsen. Handlingsplan for *Campylobacter* i slagtekyllinger (2008). Available from: http://www.foedevarestyrelsen.dk.

(7) Rosenquist H, Nielsen NL, Sommer H, Nørrung B, Christensen B (2003). Quantitative risk assessment of human campylobacteriosis associated with thermophilic *Campylobacter* species in chickens. Int J Food Microbiol; 83, 87-103.

(8) Christensen B, Sommer H, Rosenquist H, Nielsen N (2001). Risk assessment on *Campylobacter jejuni* in chicken products. First Edition, Division of Microbiological Safety, Institute of Food Safety and Toxicology, the Danish Veterinary and Food Administration, 140 p.

(9) Hald B, Sommer HM, Skovgård H (2007). Use of fly screens to reduce *Campylobacter* spp. introduction in broiler houses. Emerg Infect Dis; 13(12):1951-3.

3. Outbreaks of special interest

By Steen Ethelberg (set@ssi.dk)

In Denmark, local foodborne outbreaks are typically investigated by the Regional Veterinary and Food Control Authority in collaboration with the medical officer; often with the participation of the regional clinical microbiology laboratory. Larger outbreaks involving more than one region are typically investigated by the Statens Serum Institut, the National Food Institute, and the Danish Veterinary and Food Administration.

Outbreaks are reported in the Food- and waterborne Outbreaks Database (FUD) and all verified outbreaks in 2007 are presented in appendix B, Table A4. Some of the more notable outbreaks are outlined below. Household outbreaks and outbreaks that were reported but not investigated to the extent of providing reliable detailed information are not included in the table. The relative distribution of the outbreaks due to the different pathogens is presented in Figure 3.1. The reporting and outbreak investigation systems are described in further detail in Chapter 6.2.

In Denmark, large waterborne outbreaks are very rare, but in the middle of January 2007 semi-purified sewage from a sewage treatment facility was accidentally led into the drinking water system in part of a town south of Copenhagen resulting in a waterborne outbreak (FUD no. 686). Close to 6,000 persons living in the area and a number of companies were prohibited from using the tap water for several weeks while investigations took place; following these, the water systems were chlorinated in the middle of February. The contamination event was then known to have affected the addresses of 453 individuals. In a questionnare study, two thirds of those responding reported gastrointestinal illness. Stool samples of 139 individuals living in the town were analysed and 77 patients tested positive. Norovirus were found in 29 patients and *Campylobacter* (*jejuni, coli* and *lari*) in 23, but a number of other infectious agents were also detected including different types of diarreagenic *E. coli*, different *Salmonella* serotypes, *Giardia* and *Blastocystis hominis* (1).

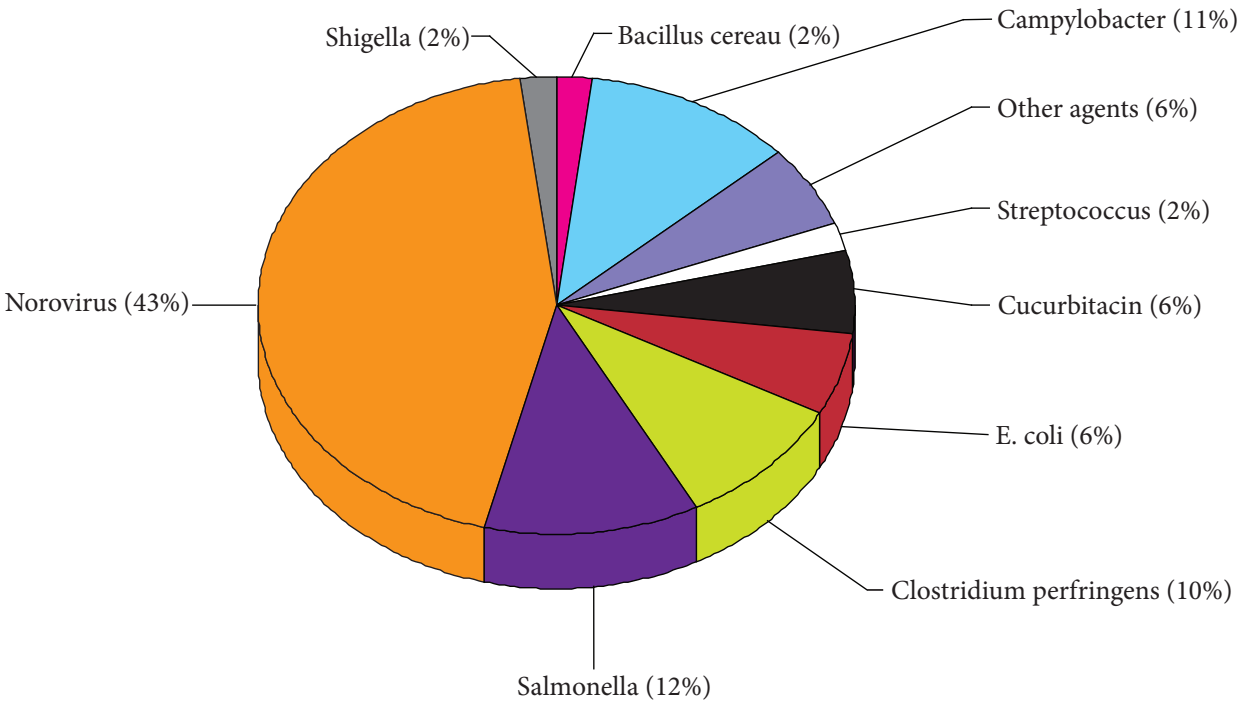


Figure 3.1. Aetiology of foodborne disease outbreaks reported with a causative agent in the Food- and waterborne Outbreak Database (FUD), 2007. Percentage of total outbreaks indicated in brackets
Source: Statens Serum Institut

In February and March, an outbreak with Verocytotoxin-producing *E. coli* O26:H11 occurred (FUD no. 688). There were 20 laboratory confirmed cases, 19 of which were small children, but the outbreak was believed to have affected many more persons. The outbreak strain was positive for vtx1 and eae, but negative for vtx2 and symptoms of cases were generally quite mild. Through the use of a case-control study and of a comparative study of shopping lists of affected families obtained from supermarket computer systems using credit card information, the source of the outbreak was found to be a particular organic cured beef sausage. The batch of 19,000 sausages was recalled, but was sold out at the time. The presence of the outbreak strain in the sausages was later confirmed microbiologically (2).

In August, a large outbreak with *Shigella sonnei* took place (FUD no. 726). Though *Shigella* is not a zoonosis, this foodborne outbreak was unusually large by Danish standards and deserves mention here. A total of 172 laboratory confirmed cases were part of the outbreak. A large number of the cases were infected via the salad buffets in their workplace canteens, which were served by the same catering company. A cohort study performed among employees in one of those companies, along with other epidemiological evidence, showed that the source of the outbreak was baby corn imported fresh from Thailand. An investigation was also launched by the Thai authorities; contaminated baby corn had also been exported to Australia where cases also appeared (3).

Norovirus accounted for the majority of registered outbreaks in 2007, as was the case in the previous two years where the outbreak database was also in use. Predominantly, these outbreaks were a result of contamination events associated with workplace lunch buffets, restaurants and private parties. Several of these outbreaks followed gastrointestinal symptoms in persons handling the food.

The proportion of outbreaks caused by *Salmonella* was smaller than in previous years which were mostly due to fewer reported outbreaks caused by *S.* Enteritidis and *S.* Typhimurium. The number of outbreaks and investigated clusters of disease caused by other *Salmonella* serotypes was higher than before. One outbreak caused by *S.* Weltevreden (FUD no. 743) took place in the autumn of 2007. It comprised 19 laboratory confirmed cases. This outbreak was traced to the consumption of alfalfa sprouts grown from contaminated imported seeds. Part of the batch of seeds was exported to Norway where cases also appeared. Further, cases were reported in Finland. The seeds were withdrawn from the market and notified via the Rapid Alert System for Food and Feed (4).

References

(1) Vestergaard LS, Olsen KE, Stensvold R, Bottiger BE, Adelhardt M, Lisby M, et al. (2007). Outbreak of severe gastroenteritis with multiple aetiologies caused by contaminated drinking water in Denmark, January 2007. Euro Surveill 2007 Mar;12(3):E070329.

(2) Ethelberg S, Smith B, Torpdahl M, Lisby M, Boel J, Jensen T, et al. (2007). An outbreak of Verocytotoxin-producing *Escherichia* coli O26:H11 caused by beef sausage, Denmark 2007. Euro Surveill 2007 May;12(5):E070531.

(3) Lewis HC, Ethelberg S, Olsen KEP, Nielsen EM, Lisby M, Madsen SB, et al. (2009). Outbreaks of *Shigella sonnei* infections in Denmark and Australia linked to consumption of imported raw baby corn. Epidemiology & Infection 137:326-324.

(4) Emberland KE, Ethelberg S, Kuusi M, Vold L, Jensvoll L, Lindstedt BA, et al. (2007). Outbreak of *Salmonella* Weltevreden infections in Norway, Denmark and Finland associated with alfalfa sprouts, July-October 2007. Euro Surveill 2007 Nov;12(11):E071129.

4. Intensified control of *Salmonella* and *Campylobacter* in fresh meat – case-by-case based risk assessment

By Helle Korsgaard (hkor@food.dtu.dk)

During 2007, the control of *Salmonella* and *Campylobacter* in Danish and imported fresh meat has been based on a case-by-case surveillance. Regional Veterinary and Food Control Authorities request the National Food Institute to conduct a risk assessment on positive batches, where the estimated prevalence and relative human risk is compared to the general level in 2005. For *Salmonella*, the relative human risk estimate is based on a Human Illness Attribution Model from 2005 (2) and the occurrence of critical types of antimicrobial resistance. For *Campylobacter*, the estimated relative human risk is based on a mathematical model on the risk assessment on *Campylobacter* in chicken products (3).

Based on the risk assessment, the Regional Veterinary and Food Control Authorities decide if the specific batch of fresh meat should be considered injurious according to article 14 in the EU food law (Regulation (EC) 178/2002). If so, the food producing establishments cannot market the batch and already marketed batches must be withdrawn. A Rapid Alert notification is also issued to the EU commission if the incriminated batch has been traded across borders.

During 2007, 902 batches of imported meat and 707 batches of Danish meat were tested (appendix C, Table A18). Sanctions due to an unacceptable human risk were imposed for 14 Danish (2.0%) and 66 imported (7.3%) batches.

Overall, 15.1% of the Danish batches of fresh poultry meat tested *Campylobacter* positive compared to 27.7% of the imported batches.

Salmonella was detected in 1.6% of the Danish batches of fresh poultry meat and 14.5% of the imported batches of fresh poultry meat. In Danish and imported fresh pork, the proportion of *Salmonella* positive batches were at similar levels, 11.3% and 13.1% respectively. The proportion of *Salmonella* positive batches of fresh beef were found positive at similar levels in Danish and imported batches as well, 2.9% and 3.6% respectively (Figure 4.1 and appendix C, Table A18).

Generally, the occurrence of *Salmonella* isolates with critical types of antimicrobial resistance is relatively lower in fresh meat of Danish origin compared to imported meat. In the imported beef, broiler and turkey batches, 30% to 50% of the positive batches were contaminated with *Salmonella* strains resistant towards ceftiofur and/or ciprofloxacin (Figure 4.2), which are drugs WHO consider very important in the treatment of human disease. Eight *Salmonella* isolates carrying transferrable qnr genes were isolated from three batches of fresh turkey meat. Transferrable qnr genes are plasmid borne genes coding for quinolone resistance. Two *S.* Saintpaul isolates from these batches of fresh turkey meat carried qnrS1, whereas two *S.* Newport isolates and four *S.* Hadar isolates harboured qnrB5 (1). The findings indicate that turkey meat might be a possible source of *Salmonella* harbouring transferable quinolone resistance determinants. The emergence of qnr genes in isolates from meat products is a concern, although the clinical implications of transferable quinolone resistance are still unknown.

References:

(1) Cavaco1 LM, Korsgaard H, Sørensen G, Aarestrup FM (2008). Plasmid-mediated quinolone resistance due to qnrB5 and qnrS1 genes in *Salmonella* enterica serovars Newport, Hadar and Saintpaul isolated from turkey meat in Denmark. JAC May.

(2) Hald T, Vose D, Wegener HC, Koupeev T (2004). A Bayesian approach to quantify the contribution of animal-food sources to human salmonellosis. Risk Anal Feb; 24(1):255-69.

(3) Rosenquist H, Nielsen NL, Sommer HM, Nørrung B, Christensen BB (2003). Quantitative risk assessment of human campylobacteriosis associated with thermophilic *Campylobacter* species in chicken. Int J of Food Microbiol; 83:87-103.

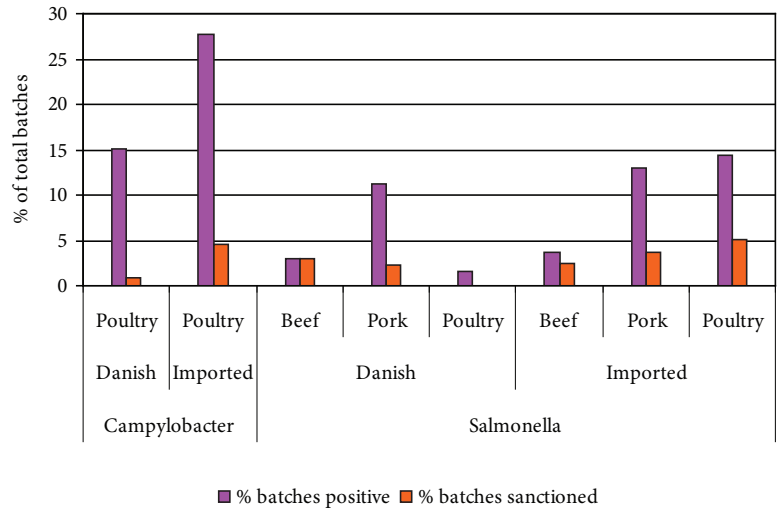


Figure 4.1. Proportion (%) of tested batches of fresh meat positive for Salmonella *or* Campylobacter *and sanctioned due to unacceptable human risk, 2007*

Source: National Food Institute, Technical University of Denmark

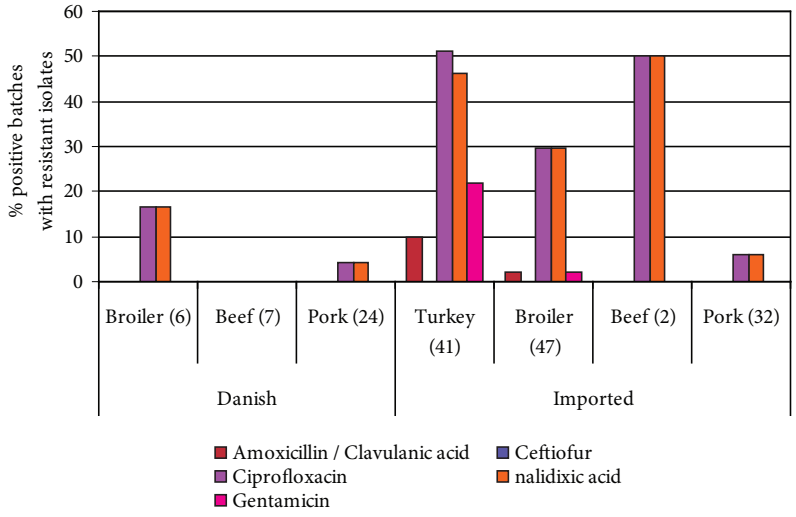


Figure 4.2. Proportion (%) positive batches of Danish and imported fresh meat with Salmonella *isolates resistant towards critical antimicrobials, 2007. (Number of batches in bracket)*

Source: National Food Institute, Technical University of Denmark

5. EU related topics

5.1 *Trichinella* special status

In July 2007, the European Commission and the other member states assigned Denmark status as a region where the risk of *Trichinella* in domestic swine is officially recognised as negligible (EU Regulation (EC) No 2075/2005).

As a result of this status the future monitoring programme for *Trichinella* can be risk based meaning that slaughter pigs reared under controlled housing conditions in integrated production systems do not have to be tested for *Trichinella*. All other categories of pigs and other species (domestic or game) that can become infected with *Trichinella* will be examined in accordance with the methods laid down in Regulation (EC) No 2075/2005. Further, pork exported to third market countries will be tested for *Trichinella* unless the importing country accepts the new monitoring programme.

In addition, a monitoring programme for *Trichinella* in wildlife will be initiated from 2008; and 300 foxes and 50 other carnivores will be examined annually.

5.2 EU studies initiated due to European Commission decisions

EU Baseline studies

Based in the Zoonosis Directive 2009/99/EC and Regulation (EC) 2160/2003 the Commission has initiated EU-studies – the Baseline studies - of the *Salmonella* prevalence in laying hens, broilers, broiler carcasses, breeding pigs, slaughter pigs and turkeys, of the *Campylobacter* prevalence in broilers and broiler carcasses and of MRSA in breeding pigs. The objectives of the studies are to generate comparable prevalence data from all member states with the purpose of setting common EU targets for the reduction of the pathogen in question.

The Danish results from the baseline study on *Salmonella* in laying hens and broilers were presented in Annual Reports 2005 and 2006, respectively.

Baseline study on the prevalence of *Salmonella* in slaughter pigs

From October 2006 to October 2007 a harmonised investigation on the *Salmonella* prevalence in slaughter pigs was conducted in all member states. Slaughter pigs were randomly selected from slaughterhouses that together accounted for 80% of pigs slaughtered in each member state. All member states collected lymph nodes and on a voluntary base some member states (including Denmark) collected swab samples from some of the carcasses. Denmark also collected meat juice samples from all carcasses. The analysis of lymph nodes detect *Salmonella* infection of slaughter pigs at primary production level, whereas presence of *Salmonella* on carcass swabs detects the surface contamination of the carcass at the end of the slaughtering procces.

In Denmark, the regional veterinary officers from the Regional Veterinary and Food Control Authorities performed the sampling. Bacteriological testing was performed on lymph nodes and on swab samples. Serological testing was performed on meat juice samples from all carcasses.

Samples positive for *Salmonella* were serotyped and tested for antimicrobial susceptibility. Samples positive with *S.* Typhimurium and *S.* Enteritidis were also phage typed. All samples were analysed at the national reference laboratory for *Salmonella* (The National Food Institute).

A total of 1,010 lymph nodes, 346 carcass swabs and 991 meat juice samples were analysed.

Lymph nodes

In total, 80 lymph nodes were positive with *Salmonella* (7.9%). *S.* Typhimurium was isolated in 57.5% of the positive samples followed by *S.* Derby (17.5%) and *S.* Infantis (11.3%). The most common phage types in the *S.* Typhimurium isolates were DT12 (19.6%), DT120 (17.4%), DT17 (10.9%) and DT193 (10.9%).

Carcass swabs

In total, 10 carcass swabs were positive with *Salmonella* (2.9%). *S.* Typhimurium was isolated in 50.0% of the positive samples followed by *S.* Derby (20.0%), Infantis (20.0%) and *S.* Livingstone (10.0%). None of the *S.* Typhimurium strains isolated from carcasses showed antimicrobial resistance.

Meat juice samples

In total, 71 meat juice samples were positive with *Salmonella* (7.2%).

EU Baseline study on the prevalence of *Salmonella* in turkeys

From October 2006 to September 2007 harmonised investigations of the *Salmonella* prevalence in breeding and production flocks of turkeys were carried out in all member states. All breeder holdings with more than 250 animals and all production holdings with more than 500 animals were to be tested. There is no breeder flocks in Denmark, hence only production flocks were included in the study.

A total of 27 holdings with a flock size of more than 500 animals were registered with a reported capacity of 90 flocks. In holdings with a capacity of less than five flocks all houses should be sampled. In holdings with a capacity of five or more flocks four houses should be sampled. However, due to different technical and communication problems all houses available had to be sampled. From each flock, five sock samples were collected and the holding was considered positive if one sample tested positive. A total of 64 flocks was tested for *Salmonella* and one flock (1.6%) was positive with the serotype 4,12:b:-.

Survey on prion protein genotypes in sheep

Denmark has a population of approximately 200,000 sheep and lambs. In the sheep population, some animals have a genotype that is resistant to classical scrapie. Although less conclusive, evidence also suggests that the same genotype is resistant to BSE. The pathogenic prion load in these resistant sheep is much lower than in non-resistant sheep. Therefore, the resistant sheep will pose a much lower public health risk, compared to that of non-resistant sheep. In 2007, like previous years, a study was conducted to determine the prion protein genotypes from a sample of ovine animals according to EU Regulation (EC) No 999/2001 (as amended). The study included 100 randomly selected animals. Results showed that 16% of sheep had the resistant prion protein genotype ARR/ARR (Appendix C, Table A25).

Survey for chronic wasting disease in deer

Chronic wasting disease (CWD) is a deadly degenerative disease affecting the brain of deer; especially red deer and white tailed deer. The disease was discovered in 1967 in Canada and in 1978 recognised as a TSE infection like BSE in cattle, scrapie in sheep and goats, and Creutzfeldt Jacobs in humans. The disease has newer been reported in Europe. CWD is not documented to be a risk for humans.

In 2007, an EU survey was carried out according to Commission Decision 2007/182/EC. Member states with large numbers of susceptible animals were to test hunted deer and slaughter animals over 18 month of age during the hunting season. All Member States were to test clinically ill animals, fallen stock animals and road-injured animals through out the year.

A total of 169 animals were tested in Denmark and none were positive.

6. Surveillance and monitoring

6.1 Surveillance of human disease

Presented in this report is the occurrence of zoonotic enteric pathogens in Denmark:

- Notifiable through the laboratory surveillance system: *Salmonella, Campylobacter, Yersinia,* Verocytotoxin-producing *E. coli* and *Listeria*
- Individually notifiable zoonotic pathogens: *Chlamydia psittacci* (ornithosis), *Leptospira, Mycobacterium*, BSE prions (var. Creutzfeldt-Jakob Disease), Verocyto-toxin-producing *E. coli* and *Lyssavirus* (rabies)
- Non-notifiable zoonotic pathogens: *Brucella, Coxiella burnetii* (Q-fever), *Cryptosporidium, Echinococcus, Toxoplasma* and *Trichinella.*

An overview of these notifiable and non-notifiable human diseases with reference to the relevant legislation is provided in appendix D, Table A29.

In Denmark, the physicians report individually notifiable zoonotic diseases to the medical officers and the Department of Epidemiology at the Statens Serum Institut (Figure 6.1). Positive cases diagnosed by a clinical microbiological laboratory are reported through the laboratory surveillance system to the Unit of Gastrointestinal Infections at the Statens Serum Institut. Physicians send specimens from suspect cases to one of 15 clinical microbiology laboratories depending on county of residence of the requesting physician. The laboratories must report positive results to the Statens Serum Institut

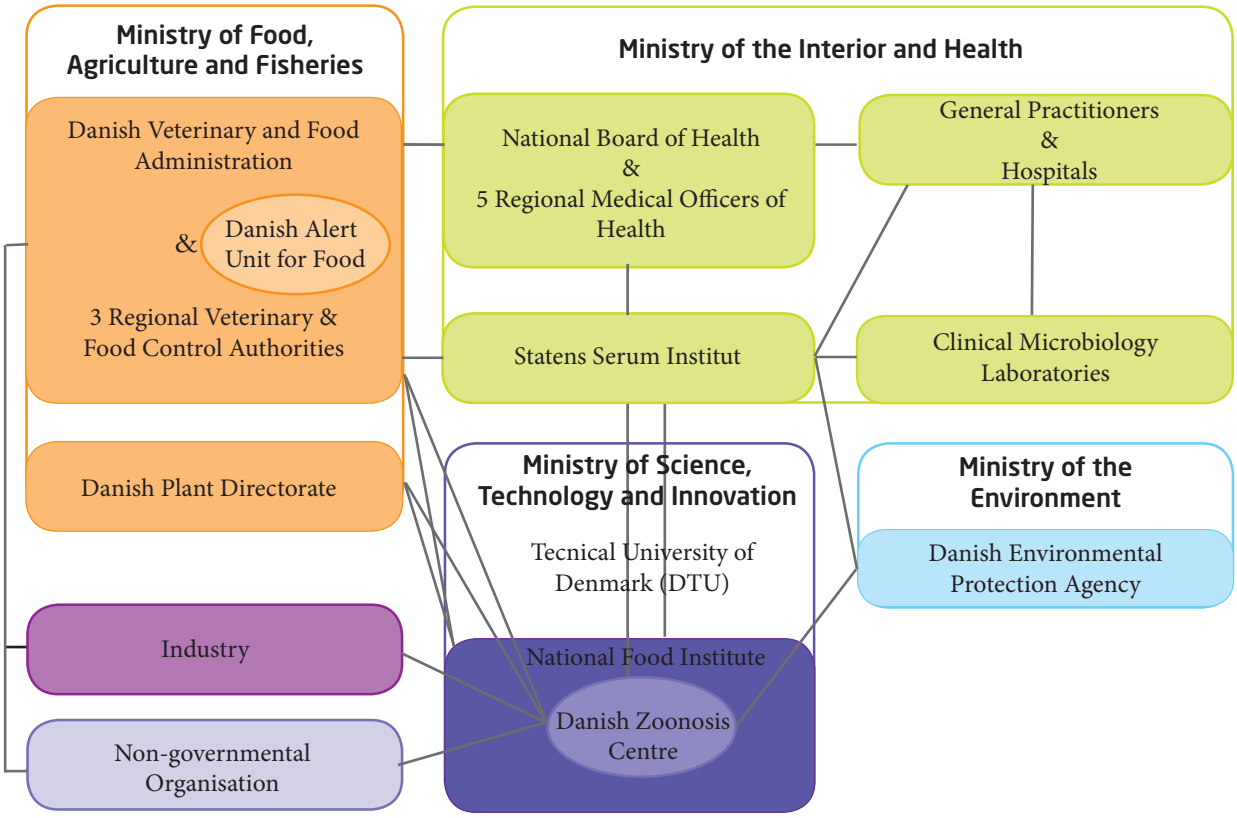


Figure 6.1. Overview of the monitoring and outbreak investigation network for reporting infectious pathogens in humans, animals, foodstuffs and feedstuffs in Denmark

Note: In the begining of 2007, The Danish Veterinary and Food Administration and the Regional Authorities were under the Ministry of Family and Consumer Affairs.

Source: Danish Zoonosis Centre, National Food Institute, Technical University of Denmark

within one week. Furthermore, all *Salmonella* and VTEC isolates are sent to the reference laboratory at the Statens Serum Institut for further sero- and genotyping. The *Salmonella* positive isolates are mailed to National Food Institute, Technical University of Denmark for phage typing. The results are recorded in the Register of Enteric Pathogens maintained by the Statens Serum Institut. Positive cases are reported as episodes, i.e. each person-infectious agent combination is only recorded once in any six-month period. Overviews of results from the Register of Enteric Pathogens are presented as follows:

- All human cases are presented in appendix B, Table A2
- Regional distribution of human cases of salmonellosis is presented in appendix B, Figures A1-A2
- Regional distribution of human cases of campylobacteriosis is presented in appendix B, Figure A3
- Regional distribution of human cases of yersiniosis is presented in appendix B, Figure A4
- Regional distribution of human cases due to VTEC is presented in appendix B, Figure A5.

Further, additional information on human infections are presented as follows:

- The *Salmonella* sero- and phage type distributions are presented in appendix C, Tables A5-A7
- VTEC O-group distribution in humans is presented in appendix B, Table A3.

6.2 Outbreaks of zoonotic gastrointestinal infections

In Denmark, local foodborne outbreaks are typically investigated by the Regional Veterinary and Food Control Authority in collaboration with the medical officer; often with the participation of the regional clinical microbiology laboratory. Larger outbreaks involving more than one region are typically investigated by the Statens Serum Institut, the National Food Institute and the Danish Veterinary and Food Administration. These institutions may also aid in the investigation of local outbreaks. In 2007, the Danish Alert Unit for Food co-ordinated the day-to-day collaboration between the Statens Serum Institut, the National Food Institute and the Danish Veterinary and Food Administration. Representatives from these institutions meet regularly to discuss surveillance results, compare the reported occurrence of zoonotic agents in animals, food and feedstuffs with that in humans, and review major outbreaks. The formal responsibility of investigating food- or waterborne out- breaks is currently divided between three ministries based on the outbreak source: the Ministry for the Interior and Health for infectious diseases; the Ministry of Food, Agriculture and Fisheries for food and animal related diseases; and the Ministry of the Environment (along with the municipalities) for water related diseases.

Outbreaks may be detected in various ways. Individuals who experience illness related to food intake in settings such as restaurants or work place cantinas may report these incidents directly to the Regional Veterinary and Food Control Authorities. Physicians are obligated to report all suspect water- and foodborne infections to the regional medical officer and to the Statens Serum Institut. Clusters of cases may be noted in the laboratory or identified at the Statens Serum Institut through the laboratory surveillance system of gastrointestinal bacterial infections or through subtyping of bacterial isolates from patients.

A list of verified outbreaks (not including household outbreaks) reported to the Food- and waterborne Outbreaks Database (FUD) are presented in Appendix B, Table A4 and some of the more notable outbreaks are outlined in chapter 3.

6.3 Surveillance and monitoring of animals and animal products

Surveillance and monitoring programmes for poultry, pigs and cattle are presented in appendix D, Tables A30-A34. Sample analysis is performed at authorised private laboratories, the Regional Veterinary and Food Control Authorities or the National Food Institute. Isolates positive with *Salmonella* are forwarded to the National Food Institute for subtyping (sero-, phage- and genotyping as well as antimicrobial susceptibility testing).

Overviews of results from surveillance of *Salmonella* are presented as follows:

- Results from the table egg production are presented in appendix C, Tables A5-A9
- Results from the broiler production are presented in appendix C, Tables A5-A7 and A10
- Results from the pig production are presented in appendix C, Tables A5-A7, A13 and Figures A6-A8
- Results from the cattle production are presented in appendix C, Tables A5, A7, A14-A15 and Figure A9
- Results from the feeding stuff production are presented in appendix C, Tables A19-20
- Results from the rendering plants are presented in appendix C, Table A21
- Results from pets, zoo animals and wild life are presented in appendix C, Table A22.

Salmonella sero-and phage type distribution in cattle and pig herds investigated due to clinical disease (not necessarily salmonellosis) and found positive for *Salmonella* are presented in appendix C, Table A16. Cattle herds with confirmed infections of multiresistant *S.* Typhimurium DT104 (MRDT104) or herds that have been in contact with herds infected with MRDT104 are placed under official veterinary supervision. Cattle herds

with confirmed infection of *S.* Dublin are subject to hygienic slaughter.

Overviews of results from monitoring of *Campylobacter* are presented as follows:

- Results from the poultry production are presented in appendix C, Tables A11a, 11b and A12
- Results from pig and cattle herds are presented in appendix C, Tables A17
- Results from pets, zoo animals and wild life are presented in appendix C, Table A22.

Pig and cattle carcasses are screened for *Mycobacterium* and *Echinococcus* during meat inspection at the slaughterhouse. All slaughter pigs slaughtered at export approved slaughterhouses, all horses slaughtered for human consumption and all wild boars are examined for *Trichinella*. In addition, boars and bulls are tested for *Brucella* and bulls are tested for *Mycobacterium* at semen collection centres. All positive results for notifiable infectious diseases are reported to the Danish Veterinary and Food Administration. Results are presented in appendix C, Table A13-A14.

Results from the surveillance for Bovine Spongiform Encephalopathy (BSE) in cattle, Transmissible Spongiform Encephalopathy (TSE) in sheep/goats and Chronic wasting disease (CWD) in deer are presented in appendix C, Tables A23-A26.

Appendix D, Table A29 gives an overview of notifiable and non-notifiable zoonoses presented in this report along with the relevant legislation.

6.4 Official testing of zoonotic pathogens in foodstuffs

In Denmark, control of pathogens in foodstuffs is coordinated both at the regional and at the central level of administration. Each Regional Veterinary and Food Control Authorities is responsible for the control carried out within its own region, and the Danish Veterinary and Food Administration is responsible for the regulation, control strategy and the surveillance at the national level.

The main purpose of the regional microbiological control system is to verify that the own-check programmes implemented at food establishments are functioning effectively and to verify the compliance with the microbiological criteria laid down in the legislation.

Regional microbiological control is carried out as follows:

- Targeted survey sampling primarily at the retail level. These surveys are focused on collecting samples from high risk products, specific types of production processes or specific types of food establishments
- Other types of sampling at the food whole sale and retail level include:
  - Sampling based on suspicion to support findings from inspection of food establishments
  - Sampling at the wholesale level to verify compliance with microbiological criteria in the legislation
  - Sampling in relation to the investigation of foodborne outbreaks
  - Sampling in response to consumer complaints.

Centrally co-ordinated control is carried out as national projects or surveys. The purposes of these projects are to:

- Verify compliance with microbiological criteria laid down in the legislation
- Discover emerging problems with microbiological contaminants
- Generate data for the preparation of risk profiles and risk assessments to support microbial risk management
- Monitor the effect of established risk management procedures in order to evaluate if these provide the desired results or if they need to be reconsidered.

Appendix C, Table A27 provides information on the centrally co-ordinated projects conducted in 2007. Information on the following projects is presented:

- The intensified control of *Salmonella* and *Campylobacter* in Danish and imported meat are presented in appendix C, Table A18
- The findings of *Campylobacter* in non-heat treated meat cuts from broilers are presented in appendix C, Tables A11a and A11b
- Findings of *Listeria monocytogenes* in ready-to-eat products are presented in appendix C, Table A28.

For further information consult Danish Veterinary and Food Administration's webpage www.fvst.dk (in Danish).

Antimicrobial Resistance

For information on antimicrobial resistance in zoonotic bacteria please refer to the annual report "DANMAP – Consumption of antimicrobial agents and occurrence of antimicrobial resistance in bacteria from food animals, food and humans in Denmark". The 2007 DANMAP report is available from **www.danmap.org** or may be ordered from the Danish Zoonosis Centre (vibb@food.dtu.dk).

Appendix A

Trends and sources in human salmonellosis

Table A1. Estimated no. of reported human cases and percentage of cases per major food source, travel or outbreaks, 2005-2007

	2007		2006		2005	
Source	Estimated no. of reported cases (95% credibility interval)	Percentage of reported cases	Estimated no. of reported cases (95% credibility interval)	Percentage of reported cases	Estimated no. of reported cases (95% credibility interval)	Percentage of reported cases
Pork	107 (59-159)	6.5	101 (77-129)	6.1	215 (159-278)	12.1
Beef	12 (2-27)	0.8	23 (12-33)	1.4	26 (17-38)	1.5
Table eggs	181 (147-217)	11.0	103 (81-124)	6.2	214 (182-249)	12.1
Broilers	12 (2-30)	0.8	8 (3-16)	0.5	72 (45-101)	4.1
Ducks	-	-	12 (3-23)	0.7	13 (6-25)	0.7
Imported pork	21 (4-46)	1.3	26 (12-43)	1.6	45 (15-89)	2.5
Imported beef	20 (10-29)	1.2	22 (12-34)	1.3	66 (34-99)	3.7
Imported chicken	61 (34-87)	3.7	152 (123-184)	9.2	194 (152-238)	10.9
Imported turkey	12 (2-29)	0.7	87(67-108)	5.2	18 (0-62)	1.0
Imported duck	-		11 (5-20)	0.7	7 (0-25)	0.4
Travels[1]	762 (731-794)	46.3	410	24.7	426	24.0
Unknown	386 (329-441)	23.4	605 (556-653)	36.5	451 (392-511)	25.4
Outbreaks, unknown source	73	4.4	98	5.9	28	1.6
TOTAL	1,647		1,658		1,775	

1) In 2005-2006, the estimate of travel related cases should be interpreted carefully, since availability of travel history data was incomplete.

Source: Danish Zoonosis Centre, National Food Institute, Technical University of Denmark

Appendix B

Human disease and outbreak data

Table A2. Zoonoses in humans, number of laboratory-confirmed cases over a ten year period

	Incidence per 100,000	Reported no. of cases					
Zoonotic pathogen	2007	2007	2006	2005	2004	2003	1998
Bacteria							
Brucella abortus/melitensis [a,c,d]	-	20	9	15	4	14	-
Campylobacter coli/jejuni [b]	70.9	3,868	3,242	3,671	3,724	3,536	3,372
Chlamydia psittaci [b]	1.2	11	7	22	8	14	-
Coxiella burnetii [a]	-	28	47	-	-	-	-
Leptospira spp. [b]	0.2	10	15	24	33	13	12
Listeria monocytogenes [b]	1.1	58	56	46	41	29	41
Mycobacterium bovis [b]	0.0	1	3	0	2	1	8
Salmonella [b]	30.1	1,647	1,658	1,775	1,538	1,712	3,880
S. Enteritidis[b]	10.4	566	562	642	546	735	2,607
S. Typhimurium[b]	6.3	343	411	565	467	449	678
Other serotypes[b]	13.6	740	687	568	525	528	595
VTEC total[b]	3.0	161	146	154	168	128	34
O157	0.5	25	19	25	47	27	12
other or non-typeable	2.5	136	127	129	121	101	22
Yersinia enterocolitica [b]	4.9	270	215	241	228	243	464
Parasites							
Cryptosporidium spp. [a,c]	-	49	-	-	-	-	-
E. multilocularis [a,e]	-	3	-	-	-	-	-
E. granulosus [a,e]	-	9	-	-	-	-	-
Toxoplasma gondii [a,f]	-	-	14	9	8	13	-
Trichinella spp. [a,c,e]	-	1	-	-	-	-	-
Viruses							
Lyssavirus [b]	-	0	0	0	0	0	0

a) Not notifiable hence the incidence cannot be calculated.
b) Notifiable.
c) Data presented are from one laboratory (Statens Serum Institut) only, representing a proportion of the Danish population (approximately 1/3 in 2007). The proportion of the population represented varies from year to year, thus results from different years are not comparable. Testing for these pathogens is carried out only if specifically requested on the submission form.
d) In 2007, based on serology 13 cases were positive for *B. abortus* and seven cases were positive for both *B. abortus* and *B. melitensis*. Three cases were imported. One case was positive for *Yersinia O9*, known to cross-react with *Brucella* spp.
e) The cases were imported.
f) The nation-wide neonatal screening for congenital toxoplasmosis stopped in 2007.
Source: Statens Serum Institut

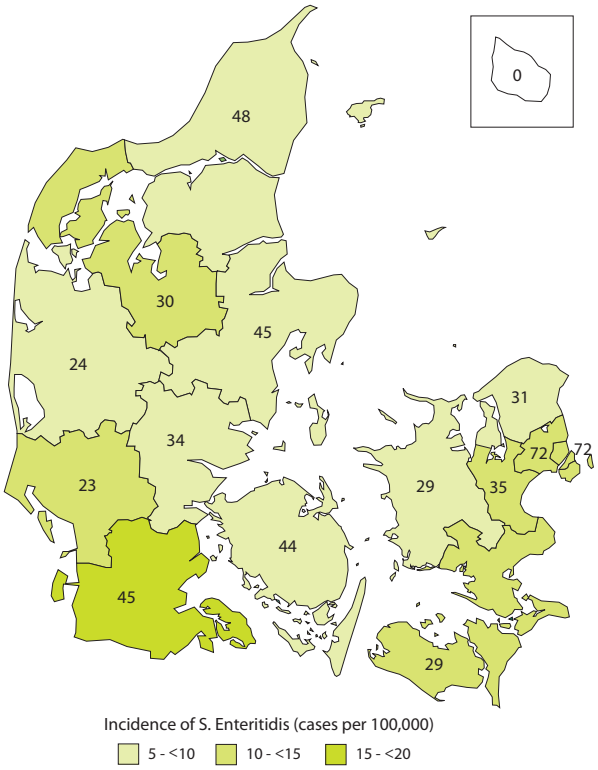


Figure A1. Geographical distribution of human cases per county and incidence of human infections with S. Enteritidis, 2007
Source: Statens Serum Institut

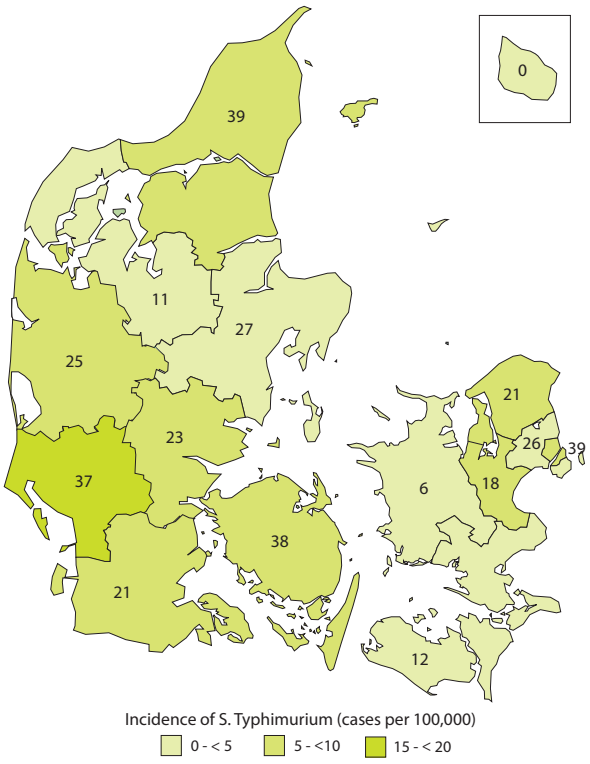


Figure A2. Geographical distribution of human cases per county and incidence of human infections with S. Typhimurium, 2007
Source: Statens Serum Institut

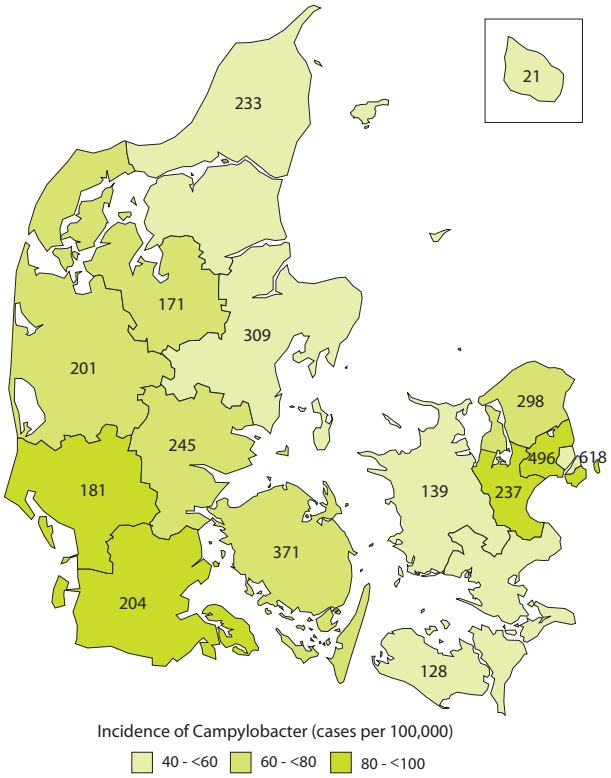


Figure A3. Geographical distribution of human cases per county and incidence of human infections with Campylobacter, *2007*
Source: Statens Serum Institut

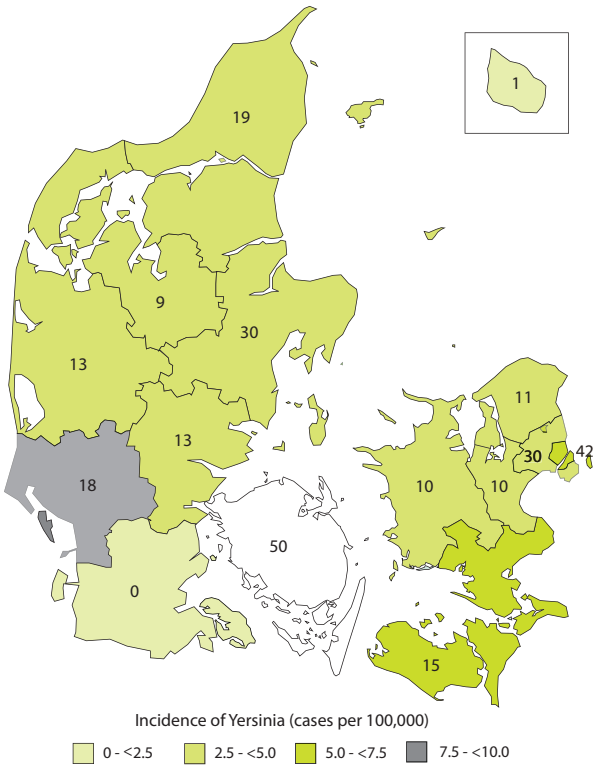


Figure A4. Geographical distribution of human cases per county and incidence of human infections with Yersinia, *2007*
Source: Statens Serum Institut

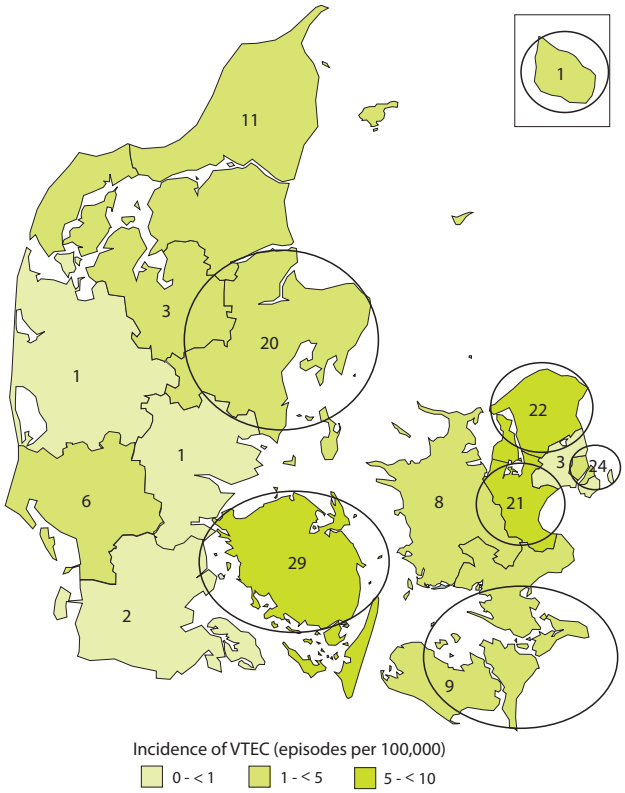


Figure A5. Geographical distribution of human cases per county and incidence of human infections with VTEC, *2007. The circled counties offer testing by molecular detection*
Source: Statens Serum Institut

Table A3. VTEC *O-group distribution in humans, 2007*

O-group[a]	Number of episodes
O26	27
O157	25
O103	16
O91	9
O146	8
O117	6
O145	5
O113	5
O- rough	7
Other O-groups or not-typed	53
TOTAL	161

a) All O-groups that resulted in five or more episodes are listed.
Source: Statens Serum Institut

Table A4. Foodborne disease outbreaks reported in the Foodborne Outbreak Database (FUD), 2007

Pathogen	No. of patients	Patients laboratory confirmed	Setting	Suspected source	FUD no.
Lectins (beans)	6	1	Restaurant/catering	Fresh vegetables	772
Cucurbitacin (squash)	6	.	Restaurant/catering	Fresh vegetables	763
Cucurbitacin (squash)	2	.	Private party	Fresh vegetables	762
Cucurbitacin (squash)	3	.	Private home	Fresh vegetables	761
Histamin	4	.	Private home	Fish	749
Histamin	4	.	Canteen	Fish	698
Norovirus	40	1	Private party	Unknown	750
Norovirus	39	.	Canteen	Buffet meals	718
Norovirus	10	0	Canteen	Buffet meals	681
Norovirus	31	2	Restaurant/catering	Unknown	706
Norovirus	100	.	School	Buffet meals	771
Norovirus	27	.	Unknown	Unknown	735
Norovirus	18	.	Hotel	Unknown	679
Norovirus	19	1	Private party	Buffet meals	757
Norovirus	42	3	Institution	Composite meal	756
Norovirus	18	2	Restaurant/catering	Buffet meals	755
Norovirus	19	1	Restaurant/catering	Buffet meals	754
Norovirus	25	1	Private party	Buffet meals	753
Norovirus	78	.	Canteen	Buffet meals	752
Norovirus	36	.	Hotel	Buffet meals	739
Norovirus	14	.	Restaurant/catering	Fresh vegetables	734
Norovirus	18	.	Canteen	Buffet meals	691
Norovirus	59	.	Canteen	Buffet meals	682
Norovirus	8	.	Private home	Composite meal	720
Norovirus	9	0	Private party	Fresh fruit	708
Norovirus	145	30	Other	Drinking water	686
Norovirus	45	.	Hotel	Unknown	782
Norovirus	39	2	Restaurant/catering	Molluscs, shellfish, etc	775
Norovirus	25	.	Restaurant/catering	Unknown	774
Virus	32	1	Private party	Unknown	770
Virus	18	.	Other	Unknown	719
Staphylococcus aureus	6	.	Restaurant/catering	Cheese	766
Shigella sonnei	200	172	Canteen	Fresh vegetables	726
S. Heidelberg	13	13	Private party	Unknown	697
S. Weltevreden	.	19	Unknown	Fresh vegetables	743
S. Senftenberg	.	3	Unknown	Herbs and spices	703
S. Typhimurium	41	27	Private party	Pork	729
S. Enteritidis	9	1	Canteen	Chicken	767
S. Enteritidis	11	8	Private home	Eggs	740
VTEC, other than 0157	20	20	Unknown	Beef	688
ETEC	8	1	Canteen	Unknown	716
Escherichia coli	45	0	Food producer	Fresh vegetables	732
Clostridium perfringens	11	.	Private party	Composite meal	765
Clostridium perfringens	29	.	Restaurant/catering	Composite meal	746
Clostridium perfringens	26	.	Canteen	Composite meal	721
Clostridium perfringens	65	0	Hotel	Composite meal	707
Clostridium perfringens	35	.	Canteen	Composite meal	728
Campylobacter	6	1	Farm	Milk, milk products	727
Campylobacter	2	1	Restaurant/catering	Chicken	768
Campylobacter	3	1	Private home	Chicken	722
Campylobacter	5	1	Private party	Turkey	712
Campylobacter	.	2	Canteen	Buffet meals	709
Campylobacter	11	3	Canteen	Chicken	680
Bacillus cereus	3	.	Restaurant/catering	Composite meal	715
Unknown	20	.	Canteen	Unknown	741
Total	1,508	318			

Appendix C

Monitoring and surveillance data

Table A5. Serotype distribution (%) of Salmonella *from humans, animals, carcasses at slaughterhouse and imported meat, 2007*

		Pig		Cattle		Layer	Broiler	Imported meat[f]			
	Human	herds[a]	Pork[b]	herds[c]	Beef[b]	flocks[d]	flocks[e]	Pork	Beef	Chicken	Turkey
Serotype	N=1,647	N=901	N=196	N=44	N=16	N=5	N=103	N=39	N=3	N=69	N=79
Enteritidis	34.4	0.4	1.0	0	0	20.0	6.8	2.6	0	8.7	0
Typhimurium	20.8	64.6	24.5	38.6	12.5	60.0	6.8	64.1	0	4.3	24.1
Agona	3.2	0.2	0	0	0	0	0	0	0	14.5	3.8
Virchow	2.6	0.1	0	0	0	0	0	0	0	1.4	0
Dublin	1.6	0	0.5	52.3	81.3	0	0	0	66.7	0	0
Newport	1.5	0	0	0	0	20.0	0	0	0	0	5.1
Infantis	1.4	4.2	7.7	0	0	0	8.7	7.7	0	4.3	0
Heidelberg	1.3	0.2	0	0	0	0	0	0	0	1.4	0
Saintpaul	1.0	0	0	0	0	0	3.9	0	0	0	8.9
Senftenberg	0.9	0	0	0	0	0	1.0	0	0	1.4	1.3
Thompson	0.8	0	0	0	0	0	0	0	0	1.4	0
Kentucky	0.7	0	0	0	0	0	2.9	0	0	0	0
Braenderup	0.6	0	0	0	0	0	1.0	0	0	1.4	0
Mbandaka	0.4	0	0	0	0	0	0	0	0	2.9	0
Panama	0.4	0.1	4.6	0	0	0	0	0	0	0	0
Derby	0.4	24.6	29.1	0	6.3	0	2.9	7.7	0	0	1.3
Poona	0.4	0	0	0	0	0	1.0	0	0	0	0
Hadar	0.3	0	0	0	0	0	0	2.6	0	1.4	7.6
Reading	0.2	0	0	0	0	0	0	2.6	0	0	0
Blockley	0.2	0	0	0	0	0	0	0	0	0	3.8
Give	0.2	0.1	0	0	0	0	0	0	0	2.9	0
Livingstone	0.2	1.6	2.6	0	0	0	0	0	0	2.9	0
Tennessee	0.2	0	0	0	0	0	11.7	0	0	0	0
Indiana	0.1	0	0	0	0	0	24.3	0	0	26.1	0
Others	26.4	3.8	30.1	9.1	0	0	29.1	12.8	33.3	24.6	44.3
TOTAL	100	100	100	100	100	100	100	100	100	100	100

a) Isolates obtained from sampling of herds placed in level 2 and 3 (See Table A33 for detailes on the surveillance programme).
b) Swab samples of pork and beef carcasses from the surveillance programme at slaughterhouses.
c) Cattle herds examined based on clinical indication. The data are not representative for the Danish cattle population.
d) Represenative samples from the surveillance programme in prodution flocks.
e) Representative faecal or sock samples from the mandatory AM inspection prior to slaughter.
f) Case-by-case monitoring of imported meat and meat products.
Source: Danish Veterinary and Food Administration, Statens Serum Institut and National Food Institute, Technical University of Denmark

Table A6. Phage type distribution (%) of S. Enteritidis *from humans, animals and imported meat, 2007*

	Human	Pig herds[a]	Pork[b]	Layer flocks[d]	Broiler flocks[e]	Imported meat[f]	
						Pork	Chicken
	n=566	n=4	n=2	n=1	n=7	n=1	n=6
PT 8	31.7	75.0	0	100	14.3	0	16.7
PT 4	13.9	25.0	50.0	0	14.3	100	0
PT 6	2.4	0	0	0	14.3	0	33.3
PT 11	1.1	0	50.0	0	14.3	0	0
PT 5	0.2	0	0	0	0	0	16.7
Others	50.7	0	0	0	42.8	0	33.3
Total	100	100	100	100	100	100	100

Footnotes: See Table A5.

Source: Danish Veterinary and Food Administration, Statens Serum Institut and National Food Institute, Technical University of Denmark

Table A7. Phage type distribution (%) of S. Typhimurium *from humans, animals and imported meat, 2007*

	Human	Pig herds[a]	Pork[b]	Cattle herds[c]	Beef[b]	Layers flocks[d]	Broiler flocks[e]	Imported meat[f]		
								Pork	Chicken	Turkey
Phagetype	n=343	n=582	n=48	n=17	n=2	n=3	n=7	n=25	n=3	n=4
DT 104	11.1	7.7	6.3	11.8	0	0	0	24.0	0	15.8
DT 120	26.2	25.3	22.9	41.2	50.0	33.3	20.0	8.0	0	5.3
DT 170	1.5	9.8	4.2	0	0	0	40.0	0	0	0
DT 193	5.0	6.4	10.4	5.9	0	0	0	24.0	66.7	21.1
NT	28.0	3.1	10.4	23.5	50.0	33.3	20.0	24.0	0	31.6
Others	28.3	47.8	45.8	17.6	0.0	33.3	20.0	20.0	33.3	26.3
Total	100	100	100	100	100	100	100	100	100	100

Footnotes: See Table A5.

Source: Danish Veterinary and Food Administration, Statens Serum Institut and National Food Institute, Technical University of Denmark

Table A8. Occurrence of Salmonella *in the table egg production[a], 1996-2007*

	Central rearing		Adult breeders		(Pullet) rearing		Layers	
	N	Positive	N	Positive	N	Positive	N	Positive
1996	-	-	-	-	-	-	442	13
1997	15	2	33	5	96	26	431	60
1998	21	0	42	0	375	11	700	97
1999	14	0	26	1	422	10	718	37
2000	15	0	29	0	374	8	688	32
2001	14	0	22	0	339	4	607	35
2002	15	0	22	0	330	9	619	15
2003	24	0	15	0	367	4	611	10
2004	9	2[b]	9	0	368	1	641	5
2005	16	0	9	0	255	6	655	7
2006	17	0	11	0	289	2	565	2
2007	11	0	12	0	326	0	510	5[c]

a) See Table A33 for description of the surveillance programme.

b) Two positive flocks in the same holding; the second flock was registered approx. six weeks after the first flocks.

c) One flock positive with *S.* Enteritidis PT8, one positive with *S.* Typhimurium DT120, one positive with *S.* Typhimurium DT41, one positive with *S.* Newport and one flock positive with *S.* Typhimurium ftrdnc.

Source: Danish Veterinary and Food Administration

Table A9. Occurrence of Salmonella *in the table egg layer flocks according to type of production, 2000-2007*

	Deep litter		Free range		Organic		Battery	
	N	Positive	N	Positive	N	Positive	N	Positive
2000	48	0	86	5	111	9	79	16
2001	46	2	122	16	137	3	129	14
2002	49	1	123	4	130	4	127	7
2003	71	2	191	2	173	1	167	9
2004	72	2	214	0	175	1	177	2
2005	70	0	217	3	178	0	175	4
2006	62	0	185	0	164	2	148	0
2007	56	2[a]	155	0	146	2[b]	146	1[c]

a) One flock positive with *S.* Typhimurium DT120 and one positive with *S.* Newport.
b) One flock positive with *S.* Typhimurium DT41 and one flock positive with *S.* Typhimurium ftrdnc.
c) One flock positive with *S.* Enteritidis PT8.
Source: Danish Veterinary and Food Administration

Table A10. Occurrence of Salmonella *in the broiler production, 1996-2007*

	Rearing breeders Flocks		Adult breeders Flocks		Broilers Flocks		Slaughterhouse Flocks/Batches	
	N	Positive	N	Positive	N	Positive	N	Positive
1996	-	-	-	-	3,963	331	-	-
1997	-	-	408	8	4,139	534	4,378	749
1998	-	-	344	2	4,166	271	4,985	553
1999	-	-	361	2	4,716	165	5,117	338
2000	222	3	345	3	4,567	87	4,543	131
2001	243	0	325	7	4,504	68	1,695[a]	69
2002	241	2	330	2	4,378	65	1,667	92
2003	265	2	182[c]	4	4,385	74	1,552	77
2004	275	1	155[c]	6	4,313	64	1,472	24
2005	214	0	185[c]	0	4,083	85	1,174	27
2006	190	0	282	5	3,640	80	775[b]	17
2007	152	0	258	3[d]	3,486	55	828	10

a) PM sampling at the slaughterhouse were changed from pooled neck skin samples of flocks to chicken cuts sampling of batches.
b) From 2006, data cover only samples taken following the *Salmonella* programme set up in the legislation (Table A32). Verification samples taken once a week by producers of poultry meat approved to market *Salmonella*-free poultry meat are not included, this sampling started in middle of 2005.
c) In 2003-2005, only one flock pr house was registered per year although there may have been more than one flock in the house, however all flocks were sampled according to the surveillance programme.
d) One flock positive with *S.* Typhimurium, one positive with *S.* Typhimurium DT41 and one positive with *S.*Typhimurium DT104b.
Source: Danish Meat Association and Danish Veterinary and Food Administration

Table A11a. Occurrence of Campylobacter *in broiler flocks and in fresh meat at slaughter, 1998-2007*

	Broilers (flocks)[a]		Chilled broiler meat (samples)[b]	
Year	N	% pos	N	% pos
1998	5,931	44.9	-	-
1999	6,305	44.5	-	-
2000	6,146	37.6	-	-
2001	6,054	41.8	-	-
2002	6,208	42.6	-	-
2003	5,373	34.2	-	-
2004	5,157	27.0	1,603	17.8
2005	4,952	30.4	1,689	12.3
2006	4,522	30.8	959	7.9
2007	4,527	26.8	439	8.2

a) Flocks investigated by cloacal swabs collected at slaughter, 10 samples/flock pooled and analysed as 1 sample using PCR.
b) Centrally co-ordinated studies, slaughterhouse samples (see section 6.4 for description). Detection limit <10 cfu/g.
Source: Danish Veterinary and Food Administration, Danish Meat Association and National Veterinary Institute, Technical University of Denmark

Table A11b. Occurrence of Campylobacter *in non-heat treated broiler meat at retail[a,b], 2001-2007*

	Samples of chilled meat				**Samples of frozen meat**			
	Denmark		Import		Denmark		Import	
Year	N	% pos (adjusted)	N	% pos (adjusted)	N	% pos (adjusted)	N	% pos (adjusted)
2001-2002	762	36.7	190	55.0	485	15.6	215	34.5
2002-2003	403	40.8	139	78.5	324	18.3	167	24.9
2003-2004	334	27.2	170	65.7	566	10.9	272	19.6
2004-2005	517	31.1	299	73.2	937	12.2	391	25.9
2005-2006	401	29.8	854	56.3	1087	13.5	698	31.3
2006-2007	363	31.0	1128	51.1	897	19.0	812	33.9

a) Centrally co-ordinated studies, retail samples (see section 6.4 for description). 2000-2002: detection limit <0.4 cfu/g; 2003-2007: detection limit <0.1 cfu/g.
b) The prevalence is calculated as a mean of quarterly prevalences based on the sum of data from the two years specified.
Source: National Food Institute, Technical University of Denmark

Table A12. Distribution of Campylobacter *species (%) in broilers before slaughter[a], 2007*

Year		*C. jejuni*	*C. upsaliensis*	*C. coli*	Non-typeable/other
	N	% pos	% pos	% pos	% pos
2002	178	93.3	0	6.7	0
2003	113	92.9	0	6.2	0.9[b]
2004	101	94.1	0	5.9	0
2005	109	90.8	2.8	0	6.4
2006	113	92.0	0.9	7.1	0
2007	111	91.9	5.4	0.9	1.8

a) Positive isolates collected as part of the DANMAP programme was examined using conventional microbiological methods.
b) *C. lari.*
Source: National Veterinary Institute, Technical University of Denmark

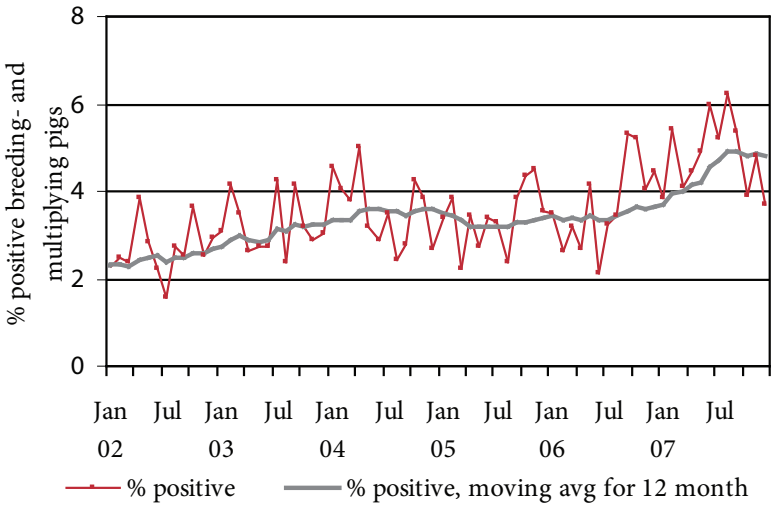


Figure A6. Serological surveillance of Salmonella *in breeding and multiplying pigs based on monthly testing of blood samples, 2002-2007. For more information about the surveillance programme, see table A33*

Source: Danish Meat Association

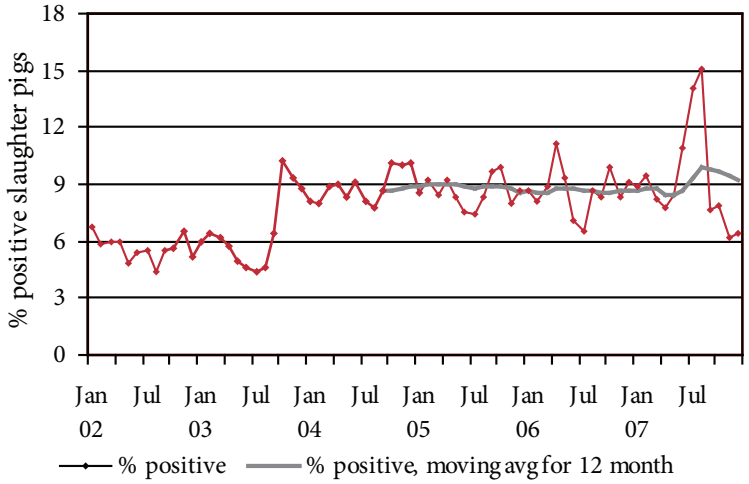


Figure A7. Serological surveillance of Salmonella *in slaughterpigs. Percentage of seropositive meat juice samples (first sample per herd per month), 2002-2007. The abrupt increase in 2003 was attributed, in part, to analytical-technical adjustments. The peak in late summer 2007 was due to technical problems in the laboratory. For more information about the surveillance programme, see table A33*

Source: Danish Veterinary and Food Administration

Table A13. Occurrence of zoonotic pathogens in pigs and pork in Denmark, 2007

	Primary production			Slaughterhouse (slaughtering >50 pigs pr month)		Slaughterhouse (slaughtering 50 or less pigs pr month)	
	Herds	Herds/ Animals	Animals/ samples	Samples		Samples	
Zoonotic pathogen	N	Positive	N	N	% pos	N	% pos
Salmonella [a]	10,327[b]	266[b]	-	25,275[c]	1,1[d]	258[c]	0.8[d]
Brucella abortus [e]		0	24,617	-	-	-	-
Mycobacterium bovis [f]	-	0	21,391,000	-	-	-	-
Echinococcus granulosis/multilocularis [f]	-	0	21,391,000	-	-	-	-
Leptospira [g]	44	0	124	-	-	-	-
Trichinella spp.[h]	-	0	21,391,000	-	-	-	-

a) See Table A33 for describtion of the surveillance programme.
b) Data are from December, 2007. Herds monitored using serological testing. Herds belonging to level 2 and 3 were defined as *Salmonella* positive.
c) Swabs from three areas of the half-carcass were collected at the slaughterhouse after min. 12 h chilling. Sample size is 3x100 cm^2. Samples from 5 animals were pooled, except at slaughterhouses where 50 pigs or less were slaughtered per month, in which case samples were analysed induvidually.
d) When estimating the prevalence of *Salmonella*, both the loss of sensitivity and the probability of more than one sample being positive in each pool are taken into consideration. A conversion factor has been determined on the basis of comparative studies, as described in Annual Report 2001.
e) Including samples from boars (examined at pre-entry, every 18 month, and prior to release from semen collection centres) (17,032 samples), samples collected in connection with export (7,157 samples), import (197 samples) or fertility problems (231 samples). 5-8 ml blood samples were analysed using either the SAT, RBT, CFT or ELISA methods.
f) Slaughtered pigs were examined by slaughterhouse meat inspectors.
g) Sampling is based on suspicion of leptosporosis due to increased abortions or other reproductive problems in a herd. Samples are investigated using immunoflourescence techniques.
h) Samples from pigs slaughtered at export approved slaughterhouses were examined using the method described in Directive 2075/2005/EEC.
Source: Danish Veterinary and Food Administration, National Veterinary Institute, Technical University of Denmark and National Food Institute, Technical University of Denmark

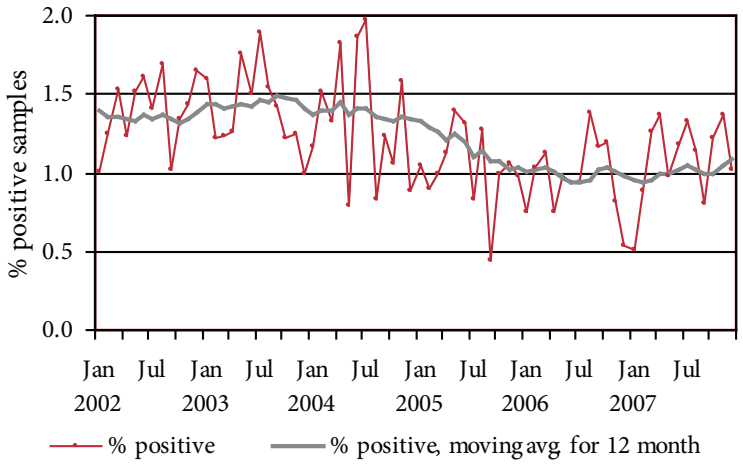


Figure A8. Salmonella *in pork, monitored at slaughterhouses, 2002-2007. Swab samples from three designated areas of chilled half carcasses*
Source: Danish Veterinary and Food Administration

Table A14. Occurrence of zoonotic pathogens in cattle and beef in Denmark, 2007

	Primary production			Slaughterhouse (slaughtering >50 cattle pr month)		Slaughterhouse (slaughtering 50 or less cattle pr month)	
	Herds	Herds/ Animals	Animals/ Samples	Samples		Samples	
Zoonotic pathogen	N	Positive	N	N	% pos	N	% pos
Salmonella [a,b]	-	-	-	7,350	0.5	174	0
Brucella abortus [c,d]	-	0	5,218	-	-	-	-
Mycobacterium bovis [e,f]	-	0	511,600	-	-	-	-
VTEC 0157[g,h]		14	186	-	-	-	-
Echinococcusus granulosis/multilocularis [f]	-	0	511,600	-	-	-	-
Coxiella brunetii	58	16/80	514[i]	-	-	-	-
	754	428	798[j]	-	-	-	-

a) Swabs from three areas of the half-carcass were collected at the slaughterhouse after min. 12 h chilling. Sample size is 3x100 cm^2. Samples from 5 animals were pooled, except at slaughterhouses where 50 pigs or less were slaughtered per month, in which case samples were analysed induvidually. See Table A34 for description of the surveillance programme.
b) When estimating the prevalence of *Salmonella*, both the loss of sensitivity and the probability of more than one sample being positive in each pool are taken into consideration. A conversion factor has been determined on the basis of comparative studies, as described in Annual Report 2001.
c) Denmark has been declared officially brucelosis free since 1979. The last outbreak was recorded in 1962.
d) Including samples from boars (examined at pre-entry, every 18 month, and prior to release from semen collection centres) (2,721 samples), samples collected in connection with export (2,293 samples) or fertility problems (204 samples). 5-8 ml blood samples were analysed using either the SAT, RBT, CFT or ELISA methods.
e) Denmark has been declared officially tuberculosis free since 1980. The last case of TB in cattle was diagnosed in 1988.
f) Slaughtered cattle were examined by the slaughterhouse meat inspectors.
g) Caecal content are tested from one animal per herd, collected at slaughter (DANMAP programme).
h) A 25g faecal sample from one slaughter calf per herd are examined using overnight enrichment, immonomagnetic separation method and plating on CT-SMAC plates for O157.
i) Serum samples taken for diagnostic testing and analysed using an ELISA method. An additional 43 samples from placenta was analysed using the FISH method, all samples were negative.
j) 2007 was the first year where tank milk samples were used for diagnostic testing. In the first part of the year, the samples were mainly taken as a supplement to the serum samples, however later on many farmers decided to use the tank milk as the primary sampling. samples were analysed using an ELISA method.
Source: Danish Veterinary and Food Administration, National Veterinary Institute, Technical University of Denmark and National Food Institute, Technical University of Denmark

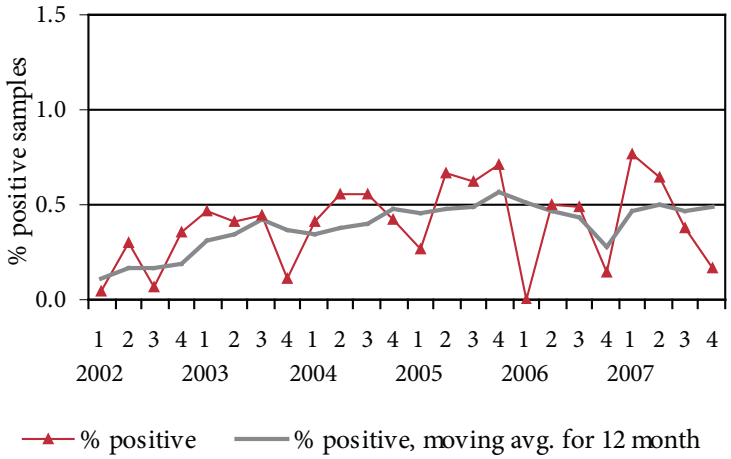


Figure A9. Salmonella *in beef, monitored at slaughterhouses, 2002-2007. Swab samples taken from three designated areas of chilled half-carcasses*
Source: Danish Veterinary and Food Administration

Table A15. Cattle herds assigned to level 1-3 according to the S. *Dublin surveillance programme[a], January 2008*

Salmonella Dublin level		Non-milk producing herds		Milk producing herds	
		N	% pos	N	% pos
Level 1					
1a	On the basis of milk samples	1,019	5.7	3,889	82.3
1b	On the basis of blood samples	13,654	76.0	56	1.2
Total	Probably *Salmonella* Dublin free	14,673	81.7	3,945	83.7
Level 2					
2	Titer high in blood- or milk samples	613	3.4	671	14.2
2	Contact with herds in level 2 or 3	1,080	6.0	88	1.9
2	'Non-Level 1' due to too few blood samples	11	0.1	11	0.2
Total	Non *Salmonella* Dublin free	1,704	9.5	770	16.3
Level 3					
Total	Salmonellosis, official supervision		<0.1	3	0.1
Unknown	Too few blood samples	1,574	8.8		0.0
TOTAL		17,951		4,715	

a) See Table A34 for description of the surveillance programme.
Source: Danish Veterinary and Food Administration

Table A16. Isolation of Salmonella *from outbreaks of clinical disease in pig and cattle herds, 2007*

Serotype and phage type	Pigs herds	Cattle herds
S. 4,12:-		1
S. 9,12:-:-		1
S. Dublin		23
S. Typhimurium		3
S. Typhimurium DT		1
S. Typhimurium DT104	6	2
S. Typhimurium DT12		3
S. Typhimurium DT120		7
S. Typhimurium DT193		1
S. Typhimurium U288	2	
Salmonella	1	2
TOTAL	8	42

Source: Danish Veterinary and Food Administration

Table A17. Distribution of Campylobacter *(%) in pig and cattle herds[a], 1998-2007*

	Pigs				Cattle			
	N	% pos			N	% pos		
		C. coli	*C. jejuni*	other/unknown		*C. coli*	*C. jejuni*	other/unknown
1998	318	63.2	4.1	1.3	85	42.4	3.5	1.2
1999	312	49.0	3.8	0.6	84	0	48.8	1.2
2000	310	59.4	4.2	0.6	90	1.1	56.7	3.3
2001	238	68.5	2.9	5.5	76	6.6	53.9	11.8
2002	240	78.8	1.7	0.0	87	0	63.2	2.3
2003	259	-	-	93.4	88	-	-	63.6
2004	191	78.0	1.0	0.5	67	1.5	62.7	0
2005	185	83.2	2.2	0	73	0	42.5	0
2006	295	50.8	1.4	0	224	6.7	37.5	0
2007	261	76.6	1.9	0	132	3.0	67.4	0

a) Samples were collected as part of the DANMAP programme. Caecal content was tested from one animal per herd.
Source: National Food Institute, Technical University of Denmark

Table A18. Results from the intensified control of Salmonella *and* Campylobacter *in fresh meat based on a case-by-case risk assessment, 2007*

		No. of batches tested	No. of batches positive	No. of batches sanctioned	Mean prevalence in positive batches[a,b]	Mean relative human risk in positive batches[a]
Campylobacter						
Danish	Poultry	245	37	2	35.9%	2.8
Imported	Poultry	574	159	26	44.0%	4.6
Salmonella						
Danish	Beef	241	7	7	8.3%	0.5
	Pork	221	25	5	44.0%	4.8
	Poultry	245	4	0	42.5%	4.4
Imported	Beef	83	3	2	4.8%	56.7
	Pork	245	32	9	15.4%	6.7
	Poultry	574	83	29	1.7%	0.3

a) Include positive batches where a risk assesment has been performed. Risk assesments of positive batches of marinated meat is not required, but conducted in most cases.
b) The *Salmonella* prevalence in each batch is based on the proportion of positive pooled samples (12 pools pr batch) and number of subsamples pr pool.
Source: Danish Veterinary and Food Administration and National Food Institute, Technical University of Denmark

Table A19. Control of Salmonella *in compound feeds, feed processing and feed material in 2003-2007*

	2007 Samples		2006 Samples		2005 Samples		2004 Samples		2003 Samples	
	N	Positive	N	Positive	N	Positive	N	Positive	N	Positive
Feed processing plants (process control)[a]:										
Ordinary inspections	976	17[d]	1,589	31	1,885	29	2,008	30	2,409	34
Additional inspections	-	-	174	13	175	15	156	21	241	46
Feed materials, farm animals[b]	71	3[e]	336	16	1,119	72	1,127	49	144	2
Transport vehicles, hygiene samples[c]	95	0	191	2	254	3	317	3	-	-

a) The presence of *Salmonella* in compound feed is indirectly monitored by the environmental samples collected during feed processing. Companies are sampled 1 to 4 times per year.
b) Sampling of feed materials used without further heat treatment (predominantly soy bean meal and rapeseed cake).
c) Samples from transport vehicles (hygiene samples) prior to loading of feed compounds.
d) *S.* Agona, *S.* Havana (2), *S.* Infantis (5), *S.* Jerusalem, *S.* Liverpool, *S.* Mbandaka, *S.* Meleagridis (2), *S.* Rissen, *S.* Senftenberg (3).
e) *S.* Havana, *S.* Ohio, *S.* Typhimurium DT 3.
Source: Danish Plant Directorate

Table A20. Feed business operators own sampling of Salmonella *in compound feeds, feed processing and feed material, 2007*

	Samples	
	N	Positive
Feed processing plants (process control)[a]:		
Ordinary inspections	6,865	9[d]
Compound feed, farm animals	424	6[e]
Feed materials, farm animals[b]	1,408	35[f]
Transport vehicles, hygiene samples[c]	949	2[g]

a) The presence of *Salmonella* in compound feed is indirectly monitored by the environmental samples collected during feed processing.
b) Sampling of feed materials used without further heattreatment (predominantly soy bean meal and rapeseed cake).
c) Samples from transport vehicles (hygiene samples) prior to loading of feed compounds.
d) *S.* Infantis, *S.* Livingstone, *S.* Mbandaka, *S.* Senftenberg, *S.* Tennessee
e) *S.* Tennessee.
f) *S.* Agona, *S.* Cubana, *S.* Kentucky, *S.* Lexington, *S.* Livingstone, *S.* Orion var 15, *S.* Rissen, *S.* Senftenberg, *S.* Tennessee.
g) *S.* Kentucky, *S.* Tennessee.
Source: Danish Plant Directorate / Feed business operators

Table A21. Three categories of meat and bone meal by products not intended for human consumption[1], 2007

Category of processing plant		Own-check samples		Product samples	
		N	Pos	N	Pos
1	By-products of this material cannot be used for feeding purposes[2]	67	3	67	3
2	By-product of this material may be used for feed for fur animals[2]	176	6	176	6
3	By-products from healthy animals slaughtered in a slaughterhouse. Products of these may be used for petfood and for feed for fur animals	3,981	48	3,244	28
	TOTAL	4,224	57	3,487	37

1) Regulation No. 1774 of 03/10/2002.
2) Own-check samples and product samples are identical.
Source: Danish Veterinary and Food Administration

Table A22. Occurrence of zoonotic pathogens in pets, zoo animals and wild life in Denmark[a], 2007

	Pet animals						Zoo animals				Wildlife			
	Dogs		Cats		Others		Mammal & reptiles		Birds		Mammal		Birds	
Zoonotic pathogen	N	pos	N	pos	N	pos	N	pos	N	pos	N	pos	N	pos
Salmonella	31	0	14	5[b]	2	0	20	2[c]	25	0	92	20[d]	43	18[e]
Campylobacter spp.	3	0	1	0	0	-	2	0	0	0	6	1[f]	0	0
Brucella canis/abortus[k]	43	0	-	-	-	-	47[g]	0	-	-	105[h]	0	-	-
Chlamydia psittaci	0	-	4	0	34[i]	8	0	-	22	0	0	-	0	-
Cryptosporidium spp.	51	7	29	3	2	1	42	3	0	-	5	5	0	0
Echinococcus spp.	0	-	0	-	0	-	0	-	0	-	0	-	0	-
European Bat *Lyssavirus*	-	-	-	-	-	-	-	-	-	-	25[j]	2	-	-

a) All samples are analysed based on suspision of disease and does not reflect the country prevalence.
b) *S.* Typhimurium.
c) Boa constrictor, *S.* arizonae and bearded dragon, S.11:2yZ23-5.IV.
d) *S.* Enteritidis.
e) Serotypes other than *S.* Typhimurium and *S.* Enteritidis.
f) Hedgehog, *C. jejuni*.
g) 8 alpaca, 4 antilope, 25 buffalo, 2 giraffe, 4 deer, 1 camel, 1 okapi, 1 ram, 1 unknown.
h) Red deer and fallow deer.
i) Birds.
j) 2 samples out of 22 samples from bats were positive, 3 samples from foxes were negative.
k) Samples from pets are examined for B. canis, samples from zoo animals and wildlife are examined for B.abortus.
Source: National Veterinary Institute, Technical University of Denmark

Table A23. The Bovine Spongiform Encephalopathy (B*SE) surveillance programme for cattle, 2007*

Type of surveillance	N	Positive
Active surveillance		
Healthy slaughtered animals (>30 month)[a,c]	191,349	0
Risk categories[b,c]:		
Emergency slaugthers (>24 month)	1,577	0
Slaughterhouse ante-mortem inspection revealed suspicion or signs of disease (>24 month)	4	0
Fallen stock (>24 month)	39,689	0
Animals imported from the UK	0	0
Animals from herds under restriction	3	0
Passive surveillance		
Animals suspected of having clinical BSE	6	0
TOTAL	232,628	0

a) Samples (brain stem material) are tested using a IDEXX technique or Enfer Test (ELISA).
b) Samples (brain stem material) are tested using the IDEXX or western blot technique.
c) Confirmatory testing is carried out using histopathology or immunohistochemistry. Further confirmation is performed at the Community TSE reference laboratory.
Source: Danish Veterinary and Food Administration

Table A24. The Transmissible Spongiform Encephalopathy (*TSE) surveillance programme for sheep and goats, 2007*

Type of Surveillance	N[a,b]	Positive
Active surveillance		
Fallen stock (>18 mo.)	7,668	0
Healthy slaughtered animals (>18 mo.)	91	0
Animals from herds under restriction[c]	168	0
Passive surveillance		
Animals suspected of having clinical TSE	1	0
TOTAL	7,928	0

a) Samples (brain stem material) are tested using a IDEXX technique or a western blotting tecnique.
b) Confirmatory testing is carried out using histopathology or immunohistochemistry. Further confirmation is performed at the Community TSE reference laboratory. The high number is due to cases of atypical scrapie in 2006.
c) A higher number of herds is under restriction in 2007 than seen in previous years due to atypical scrabie found in 3 animals in 2006.
Source: Danish Veterinary and Food Administration

Table A25. Distribution[a] (%) of prion protein genotype of sheep randomly selected, 2007

	Genotype	Sheep n=102
NSP 1	ARR/ARR	15.7
NSP 2	ARR/AHQ	2.0
	ARR/ARH	0
	ARR/ARQ	22.5
	ARR/ARH/Q	2.0
NSP 3 (ARQ/ARQ)	ARQ/ARQ	34.3
NSP 3 (Other)	AHQ/AHQ	1.0
	AHQ/ARH	1.0
	AHQ/ARQ	1.0
	ARH/ARQ	0
	ARH/ARH	0
	ARQ/ARH	1.0
	ARQ/AHQ	5.9
NSP4	ARR/VRQ	2.0
NSP5	ARH/VRQ	1.0
	ARQ/VRQ	8.8
	VRQ/VRQ	1.0
	AHQ/VRQ	1.0
Total		100.0

a) The genotypes were grouped in using the NSP classification system according to their different susceptibility:
NSP 1: Genetically most resistant.
NSP 2: Genetically resistant.
NSP 3: Genetically little resistance.
NSP 4: Genetically susceptible.
NSP 5: Genetically highly susceptible.
Source: National Veterinary Institute, Technical University of Denmark

Table A26. The Cronic wasting disease (CWD) surveillance programme for deer, 2007

Type of Surveillance	N[a,b]	Positive
Active surveillance		
Wild deer - road injured/hunted (>18 mo.)	84	0
Farmed deer - culled (>18 mo.)	85	0
TOTAL	169	0

a) Samples (brain stem material) are tested using a IDEXX technique.
b) Confirmatory testing is carried out using histopathology or immunohistochemistry. Further confirmation is performed at the Community TSE reference laboratory.
Source: Danish Veterinary and Food Administration

Table A27. Centrally coordinated studies conducted in 2007

Title of project	No. of samples	Agents analysis per sample (regional laboratories)	Further information
Microbiological classification of the production areas for bivalve molluscs	100	*E. coli, Salmonella,* vira	Results were not available
Antimicrobial resistance in Danish and imported meat (beef and pork)	640	*Campylobacter, Salmonella, E. coli, Enterococcus*	Results were not available
Campylobacter in fresh, chilled Danish chicken meat	440	*Campylobacter*	Chapter 2
Campylobacter and antimicrobial resistance in fresh chilled and frozen Danish and imported chicken meat	1,700	*Campylobacter, Salmonella, E. coli, Enterococcus*	Chapter 2
Campylobacter and antimicrobial resistance in fresh chilled imported turkey meat	480	*Campylobacter, Salmonella, E. coli, Enterococcus*	Chapter 2
Intensified control for *Salmonella* and *Campylobacter* in fresh Danish meat	675[a]	*Salmonella, Campylobacter* (quantitative)	Chapter 3
Intensified control for *Salmonella* and *Campylobacter* in fresh imported meat	1,125[a]	*Salmonella, Campylobacter* (quantitative)	Chapter 3
Salmonella in Danish and imported meat preparation	500	*Salmonella*	Results were not available
Hygiene quality and shelf life of sliced meat production	200	*Salmonella, Campylobacter* (quantitative)	Results were not available
Salmonella Dublin in Danish dairy herd	1,600	*Salmonella* Dublin	Appendix C, Table A15

a) Batches.
Source: Danish Veterinary and Food Administration and National Food Institute, Technical University of Denmark

Table A28. Listeria monocytogenes in ready-to-eat foods[a], 2007

	Samples analysed by a qualitative method		Samples analysed by a quantitative method			
Food category	N	Positive[b]	N	Samples with < 10 cfu[c]/g	Samples between 10 and 100 cfu/g	Samples with >100 cfu/g
Meat products	68	2	735	730	3	2
Milk and dairy products	187	0	39	39	0	0
Eggs and egg product	0	0	1	1	0	0
Fruit and vegetables	10	0	60	60	0	0
Fishery products	24	2	153	152	1	0
Other products[d]	278	0	22	18	4	0
TOTAL	567	4	1,010	1,000	8	2

a) Samples are collected by the Regional Veterinary and Food Control Authorities
b) Listeria monocytogenes present in a 25 g sample of the the product.
c) cfu: The number of colony forming units.
d) Predominantly ready-to-eat dishes.
Source: Danish Veterinary and Food Administration

Appendix D

Monitoring and surveillance programmes

Table A29. Overview of human and animal notifiable and non-notifiable diseases (reported herein) in Denmark, 2007, with reference to the relevant legislation

	Notifiable in humans	Notification route	Notifiable in animals	EU legislation	Danish legislation
Bacteria					
Brucella spp.	no	-	1920[i] OBF in 1979[f], no cases since 1962.	Cattle - Decision 2004/320/EEC	Order no 305 of 3/5 2000
			Never detected, ObmF in 1995[g]	Sheep and goats - 2004/320/EEC	Order no. 739 of 21/8 2001
			-	Pigs - Directive 2003/99/EEC	Order no. 215 of 18/3 1997
Campylobacter spp.	1979[a]	Lab[b]	no	-	
Chlamydophila psittaci (Ornithosis)	1980[a]	Physician[c]	yes	-	Poultry - order no. 78 of 30/1 1997
Listeria monocytogenes	1993[a]	Physician	no	-	-
Leptospira spp.	1980[a]	Physician	yes	-	Act no. 432 of 09/06/2004
Mycobacterium bovis/ tuberculosis	1905[a]	Physician (and lab[d])	1920[i] OTF since 1980[h]	Cattle - Decision 2004/320/EEC	Cattle - Order no. 306 of 3/5 2000
Coxiella burnetii	no		2005	-	Act no. 432 of 09/06/2004
Salmonella	1979[a]	Lab	1993[e]	-	Cattle/swine - Order no. 112 of 24/02/2005 Poultry - Order no. 1010 of 24/10/2005
VTEC	2000[a]	Physician and Lab	no	-	-
Yersinia enterocolitica	1979[a]	Lab	no	-	-
Parasites					
Cryptosporidium spp.	no	-	no	-	-
Echinococcus multilocularis	no		2004	-	-
Echinococcus granulosus	no	-	1993	-	Act no. 432 of 09/06/2004
Toxoplasma gondii	no	-	no	-	-
Trichinella spp.	no	-	1920[i]	Regulation 2075/2005	Circular no. 9466 of 12/07/2006
Viruses					
Lyssa virus (Rabies)	1964[a]	Telephone and physician	1920		Order no. 14 of 11/01/1999 and Order no. 914 of 15/12/1987
Prions					
TSE	-	-	yes	Sheep & goats - Regulation 999/2001 (as amended)	Order no. 930 ot 07/09/2006
BSE	-	-	yes	Cattle - Regulation 999/2001 (as amended)	Order no. 800 of 13/07/2006
BSE/Creutzfeld Jacob	1997[a]	Physician	-	-	-

a) Danish order no. 277 of 14/04/2000. Cases must be notified to the Statens Serum Institut.
b) The regional microbiological laboratories report confirmed cases.
c) The physician report individually notifiable infections.
d) The laboratories voluntarily report confirmed cases.
e) Only clinical cases notifiable.
f) OBF according to Council Directive 64/432/EEC as amended by Council Directive 97/12/EC and Commision Decisions 93/52/EEC, 2003/467/EC and 2004/320/EC.
g) ObmF according to Council Directive 91/68/EEC and Commision Decisions 93/52/EEC, 94/877/EEC, 2003/467/EC and 2004/320/EC.
h) OTF according to Council Directive 64/432/EEC as amended by Council Directive 97/12/EC and regulation (EC) 1226/2002, and Commission Decision 2003/467/EEC.
i) Clinical cases, observations during the meat inspection at the slaughterhouse, positive blood sampes or finding of agens are notifiable.

Source: Statens Serum Institut and Danish Veterinary and Food Administration

Table A30. Salmonella *surveillance programme for the rearing breeding flocks and adult breeding flocks of the grandparent and parent generation of the broiler and table-egg production, 2007*

Rearing breeding flocks		*Grandparent generation*	*Parent generation*
Time	Sample taking	Material	Material
Day-old[a,b]	Per delivery	5 transport crates from one delivery: crate liners (>1m^2 in total) or swab samples (>1m^2 in total). Analysed as one pool.	5 transport crates from one delivery: crate liners (>1m^2 in total) or swab samples (>1m^2 in total). Analysed as one pool.
1st & 2nd week[b]	Per unit[c]	-	2 pairs of sock samples / boot swabs. Analysed as one pooled sample. Cage birds: 60 samples of fresh droppings (1g). Analysed as one pool.
4th [a] & 8th week[b]	Per unit	2 pairs of sock samples / boot swabs. Analysed as one pooled samples. Cage birds: 60 samples of fresh droppings (1g). Analysed as one pool.	2 pairs of sock samples / boot swabs. Analysed as one pooled sample. Cage birds: 60 samples of fresh droppings (1g). Analysed as one pool.
2 weeks prior to moving[a,d]	Per unit	2 pairs of sock samples / boot swabs. Analysed as one pooled samples. Cage birds: 60 samples of fresh droppings (1g). Analysed as one pool.	2 pairs of sock samples / boot swabs. Analysed as one pooled sample. Cage birds: 60 samples of fresh droppings (1g). Analysed as one pool.
Adult breeding flocks		*Grandparent generation*	*Parent generation*
Time	Sample taking	Material	Material
Every two weeks[b] (Every 16th week[d])[e]	Per flock	Hatcher basket liners from 5 baskets (>1m^2 in total) or 10g of broken eggshells from each of 25 hatcher baskets (reduced to 25g sub-sample). Analysed as one pool.	Hatcher basket liners from 5 baskets (>1m^2 in total) or 10g of broken eggshells from each of 25 hatcher baskets (reduced to 25g sub-sample). Analysed as one pool.
After each hatch[b]	Per hatch	Wet dust samples. Up to 4 hatchers of the same flock can be pooled.	Wet dust samples. Up to 4 hatchers of the same flock can be pooled.
Every week	Per unit	-	2 pairs of sock samples / boot swabs. Analysed as one pool.
0-4 weeks after moving, 8-0 weeks before slaughter[d]	Per unit	5 pairs of sock samples / boot swabs. Analysed as two pooled samples. Cage birds: 3x60 samples of fresh droppings (1g). Analysed as three pools.	5 pairs of sock samples / boot swabs. Analysed as two pooled samples. Cage birds: 3x60 samples of fresh droppings (1g). Analysed as three pools.
After positive findings at hatchery[d]	Per unit	5 pairs of sock samples / boot swabs. Analysed as two pooled samples. Cage birds: 3x60 samples of fresh droppings (1g). Analysed as three pools.	5 pairs of sock samples / boot swabs. Analysed as two pooled samples. Cage birds: 3x60 samples of fresh droppings (1g). Analysed as three pools.

a) Sampling requirements set out by Regulation (EC) 2160/2003.
b) Samples collected by the food business operator.
d) Samples collected by the Regional Veterinary and Food Control Authorities.
c) A unit (house) may harbor part of a flock or more than one flock, depending on the size of the unit.
e) When eggs from a flock exceed the capacity of one incubator, each incubator should be sampled as described.
Source: Danish Veterinary and Food Administration

Table A31. Salmonella *surveillance programme for the broiler flocks, 2007*

Broiler production		
Time	Samples taken	Material
1-3 weeks before slaughter Ante mortem (AM)	Per flock	5 pairs of sock samples / boot swabs. Analysed individually.
After slaughter Post mortem (PM)	Per batch	AM-negative batches: 4 pooled samples of 10 chicken cuts of 5g[a] AM-positive batches: 12 pooled samples of 5 chicken cuts of 5g[a]

a)Requirements of the Commission Regulation (EC) 92/1538
Source: Danish Veterinary and Food Administration

Table A32. Salmonella *surveillance programme for the pullet-rearing, layer and barnyard/hobby flocks in the table-egg production, 2007*

Pullet-rearing flocks		
Time	Sample taking	Material
Day-old	Per delivery	10 samples of crate material and 20 dead chicks
3 weeks old	Per flock	5 pairs of sock samples / boot swabs.Analysed as two pooled samples. Cage birds: 5x60 samples of fresh droppings (1g). Analysed as three pooled samples.
12 weeks old, no later than 2 weeks before moving[a]	Per flock	Flocks of 500 or more birds: 60 blood samples (serology) and 5 pairs of sock samples or 300 faecal samples if sock samples cannot be collected Flocks of 200-499 birds: 55 blood samples (serology) and 5 pairs of sock sample Flocks of less than 200 birds: Blood samples[b] (serology) and 2 pairs of sock samples or 60 faecal samples
Layers (Production for certified packing stations)		
Time	Sample taking	Material
Every 9 weeks	Per flock	2 pairs of sock samples / boot swabs. Analysed as one pooled sample. Cage birds: 60 samples of fresh drop-pings (1g). Analysed as one pool. 60 eggs[b] (serology)
Barnyard and hobby flocks		
Time	Sample taking	Material
3 times a year[b]	Per flock	Egg samples

a) Samples collected by the Regional Veterinary and Food Control Authorities.
b) According to Table 1 in Governmental Order No. 44, Jan 23rd 2003.
Source: Danish Veterinary and Food Administration

Table A33. Salmonella *surveillance programme for the pig production, 2007*

Breeding- and multiplier herds		
Time	Sample taken	Purpose
Every month	10 blood samples per epidemiological unit	Calculation of *Salmonella* -index based on the mean from the last three months with most weight to the result from the more recent months (1:3:6)
Max. twice per year	Herds with *Salmonella* -index 5 or above: Pen-faecal samples[a]	Clarify distribution and type of infection in the herd
Sow-herds		
Time	Sample taken	Purpose
When purchaser of piglets is assigned to level 2 or 3, max. twice per year	Pen-faecal samples	Clarify distribution and type of infection in the herd, and clarify possible transmission from sow herds to slaughter-pig herds
Slaughter-pig herds		
Time	Sample taken	Purpose
At slaughter	Meat juice, 60-100 samples per herd per year. Herds in RBOV[a]: one meat juice sample per month	Calculation of slaughter-pig index based on the mean from the last three months with most weight to the result from the most recent month (1:1:3). Assigning herds to level 1-3 and assigning herds to risk-based surveillance (RBOV)[b]
Herds assigned to level 2 or 3, max. twice per year	Pen-faecal samples[c]	Clarify distribution and type of infection in the herd
Pork carcasses at the slaughterhouse		
No. of samples	Sample taken	Time and no. of animals slaughtered
5 samples daily pooled into one analysis	Swab samples from 3 designated areas (3x100 cm2) after min. 12 h chilling	> 200 pigs slaughter/day
5 samples pr 200 slaughtered pig, pooled into one analysis	Swab samples from 3 designated areas (3x100 cm2) after min. 12 h chilling	> 200 pigs pr. months, < = 200 pigs pr. day
5 samples every 3rd month, pooled into one analysis	Swab samples from 3 designated areas (3x100 cm2) after min. 12 h chilling	> 50 pigs pr. month, < 200 pigs pr. month
1 sample every 3rd month	Swab samples from 3 designated areas (3x100 cm2) after min. 12 h chilling	< 50 pigs pr. month

a) The herd owner must inform buyers of breeding animals about the infection level and type of *Salmonella.*
b) RBOV: risk-based surveillance where the sample size in herds with a SP-index of zero (no positive samples in the previous 3 months) are reduced to one sample per month.
c) Producers are paid a reduced price per animal. Pigs from herds in Level 3 must be slaughtered under special hygienic precautions.
Source: Danish Veterinary and Food Administration

Table A34. Salmonella *Dublin surveillance programme for the cattle production, 2007*

Milk producing herds		
No. of tests	Sample taken	Herd level
4 samples distributed over 13 months	Tank milk	1a
8 samples	Blood samples	1b
Non-milk producing herds		
No. of tests	Sample taken	Herd level
1 sample[a]	Blood samples	1b
If the owner wants a herd moved from level 2 to 1b[b]	Blood samples	2 ->1b
Beef carcasses at the slaughterhouse		
No. of samples	Sample taken	Sampling time and no. of animals slaughtered
5 samples daily pooled into one analysis	Swab samples from 3 designated areas after 12 hours chilling (3-100m^2)	> 200 cattle's slaughtered pr. day
5 samples pr 200 slaughtered cattle pooled into one analysis	Swab samples from 3 designated areas after 12 hours chilling (3-100m^2)	> 200 cattle's slaughtered pr. months, < = 200 cattle's slaughtered pr. day
5 samples every 3rd month pooled into one analysis	Swab samples from 3 designated areas after 12 hours chilling (3-100m^2)	> 50 cattle's slaughtered pr. month, < 200 cattle's slaughtered pr. month
1 sample every 3rd month	Swab samples from 3 designated areas after 12 hours chilling (3-100m^2)	< 50 cattle's slaughtered pr. month

a) If the herd has been tested for S.Dublin within the last 120 days or 8 samples have been tested within the last 12 months no samples are taken.
b) Number of samples equals total number of animals in the herd minus 2 (max. 8 animals, min. 4 animals).
Source: Danish Veterinary and Food Administration

Appendix E

Population and slaughter data

Human population, 2007

Age group (years)	males	females	Total
0-4	166,580	159,026	325,606
5-14	350,693	333,618	684,311
15-24	326,145	311,915	638,060
25-44	758,646	744,561	1,503,207
45-64	738,401	733,165	1,471,566
> 65	372,201	480,840	853,041
Total	2,712,666	2,763,125	5,475,791

Source: The statistical Yearbook 2007, Danmarks Statistik

Number of herds, livestock and animals slaughtered, 2007

	Herds/flocks	Livestock (capacity)	Number slaughtered
Pigs	12,342	13,900,000	21,391,000
Cattle	24,883	1,545,000	511,600
Parent breeding flocks	154	1,300,000	-[a]
Broilers	570	14,239,000	103,236,000
Laying hen flocks (excl. barnyard)	336	2,900,000	-[a]
Turkeys	46	454,471	-[a,b]
Sheep & lambs	9,818	180,641	87,600
Goats	3,217	20,022	1,959
Horses	-	-	2,500

a) Animals are slaughtered abroad.

b) In 2007, 1 mill turkeys were exported.

Source: The Central Husbandry Register, The statistical Yearbook 2007, Danmarks Statistik and Danish Veterinary and Food Administration

Number of farms in the broiler production, 2007.

	No. of holdings	No. of flocks	Livestock (capacity)
Parent breeding - rearing	17	98	14,000
Parent breeding - production	46	152	720,000
Hatcheries	2		
Broilers	232	570	n.a.

Source: Danish meat assosiation and Danish Veterinary and Food Administration

Number of farms in the table-egg production, 2007.

	No. of holdings	No. of flocks	Livestock (capacity)
Parent breeding - rearing	5	6	20,000
Parent breeding - production	7	12	30,000
Hatcheries	4		
Rearing	103	166	1,500,000
Laying hen flocks (excl. Barnyard)	245	336	3,110,000

Source: Danish meat assosiation and Danish Veterinary and Food Administration

Appendix F

List of Figures

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