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Infectious Diseases in Finland 2017

REPORT

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Report 14/2018

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Infectious Diseases in Finland 2017

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Contents

Introduction

Infectious Diseases in Finland, an annual report edited by the Health Security Department of the National Institute for Health and Welfare, deals with the situation of infectious diseases, the most important epidemics and the prevalence of diseases in 2017. The report compares the latest data with earlier years, making it possible to highlight long-term changes in the incidence of infectious diseases, and brings up regional differences. The publication contains information about respiratory and gastrointestinal infections, hepatitis, sexually transmitted diseases, antimicrobial resistance, vaccine-preventable diseases and travel-related infections. The data for the report are compiled from the National Infectious Diseases Register maintained by the National Institute for Health and Welfare.

Helsinki 29 June 2018

The editors

Respiratory infections

- The epidemic season of winter 2017 peaked at the turn of the year 2016–2017. A(H3N2) subtype viruses, whose incidence did not decline until the end of May, emerged as the epidemic dominant viruses. Influenza B infections were only diagnosed sporadically during the epidemic season.
- The epidemic season 2017–2018 exceptionally began with influenza B in November and December 2017.
- The number of whooping cough cases was more or less the same as in the previous year, and the incidence of the disease was the highest in age group 10 to 14.
- More cases of legionellosis were found than in recent years. Of these patients, 16 had contracted the infection while travelling abroad, and 11 in Finland.

ADENOVIRUS

In 2017, 994 adenovirus infections were confirmed (2016: 914). While the largest number of cases was reported in the under 5 age group (more than 500), a moderate number was also diagnosed in the 5 to 9 age group. In October–December 2017, slightly more adenovirus infections were reported than in the other months (94–127 cases per month). At other times of the year, the monthly numbers of adenovirus infections varied between 49 and 89 cases per month.

In late 2017, an exceptionally large number of serious cases of conjunctivitis caused by adenoviruses were diagnosed in the Helsinki and Uusimaa Hospital District. As their cause was established type 3 and 4 adenoviruses.

More than 60 types of adenoviruses are known. Some cause respiratory infections, while others cause gastrointestinal, eye or other infections. While adenoviruses are common pathogens in infants and young children, they also infect adults. Laboratories use various test methods for detecting adenoviruses in clinical samples. Antigen detection, virus cultures and PCR are highly sensitive and reliable methods used in specialised virus laboratories.

INFLUENZA

The epidemic season of winter 2017 peaked at the turn of the year 2016–2017. A(H3N2) subtype viruses, the case numbers of which did not decrease until the end of May, emerged as the dominant viruses of the epidemic. Influenza B infections were only diagnosed in individual cases during the epidemic season 2016–2017. In November and December 2017, the epidemic season 2017–2018 exceptionally began with influenza B, and Yamagata viruses emerged as the epidemic dominant virus.

Influenza A

In 2017, 10,153 cases of influenza A were reported to the National Infectious Diseases Register, which is one half of the previous year's number (2016: 20,889). The smaller number of influenza A infections compared to the year before is explained by the fact that the epidemic season 2016–2017 already peaked in late 2016. In the first six months of 2017, between January and June, 8,975 influenza A infections were reported to the National Infectious Diseases Register, while this figure for July–December was 1,189.

The figures of the National Infectious Diseases Register and the national influenza surveillance of the National Institute for Health and Welfare indicate that in 2016–2017, influenza A peaked in weeks 49/2016–2/2017, in which period 1,000–3,000 findings of this infection were reported each week. After the peak period, the case numbers gradually declined, and only sporadic cases of influenza A infections were diagnosed after May. In early December, a slight increase was again observed in influenza A case numbers. A few epidemics caused by influenza A(H3N2) viruses were already recorded in autumn 2017 at long-term care institutions around Finland.

Influenza A infections occurred in all age groups in 2017. In the period between January and June, ten times more influenza A infections were reported in almost all age groups than in July–December. The greatest number of influenza A infections was reported in the over 75 age group (3,667, compared to 266 to 666 in the other age groups). The reasons for the greater morbidity in this age group may include the high incidence of influenza A(H3N2) viruses in early 2017 and the antigenic differences between these viruses and the vaccine virus which, especially in older persons, has reduced the effectiveness of the vaccine. During influenza A(H3N2) seasons, serious infections are known to occur in older persons more often than in the other age groups.

The national vaccination programme offers a free vaccine against seasonal influenza to children aged 6 to 35 months, those aged over 65, social and health care and medical care staff, pregnant women, those in medical risk groups as well as men in military service and women in voluntary military service. The vaccination coverage has been monitored based on administered doses reported to the national vaccination register since 2010. Due to shortcomings of information systems, both regional and systematic gaps are known to exist in the vaccination coverages, and information on influenza vaccinations administered in the private sector is also not communicated to the vaccination register at the moment. Based on register data, the lowest vaccination coverage rate for young children (6 to 35 months) of approx. 13% was recorded in epidemic season 2012–2013, following which the rate has increased in each subsequent season. The vaccination coverage was 32% in 2016–2017 and increased to 34% in 2017–2018.

In those aged 65 and over, the vaccination coverage was 47% both in 2016–2017 and in 2017–2018.

Influenza B

As in previous years, a relatively high number of influenza B infections was reported to the National Infectious Diseases Register in 2017 (2017: 3,064 compared to 2016: 4,729 and 2015: 5,462).
The epidemic of winter 2017 (epidemic season 2016–2017) was mild for the part of influenza B infections, and only low numbers of these infections were diagnosed steadily throughout the season. 752 influenza B diagnoses were reported to the National Infectious Diseases Register in January–June and 2,316 in July–December. In November, influenza B infections started increasing more than influenza A infections, and as an exception to previous seasons, emerged as the dominant virus of the epidemic season 2017–2018.

Influenza B infections occurred in all age groups in 2017. The greatest numbers of infections were reported in aged groups 5 to 9, 10 to 14 and over 75.

Two influenza B virus lineages are circulating in the world simultaneously, the Yamagata lineage and the Victoria lineage. Only sporadic cases of Yamagata and Victoria lineage viruses were diagnosed in winter 2017. In late 2017, the epidemic influenza B viruses that circulated in the epidemic season 2017–2018 represented almost exclusively the Yamagata lineage and differed from the tri-component vaccine virus (B/Brisbane/60/2008).

Effectiveness of vaccines in epidemic seasons 2016–2017 and 2017–2018

The effectiveness of a vaccine can be assessed by combining data collected in the National Infectious Diseases Register, the Register of Primary Health Care Visits and the vaccination register during the season. The effectiveness for those over 65 and young children in the previous season of 2016–2017 have been published as part of the monitoring report, see below. Real-time data indicating initial effectiveness in season 2017–2018 can be accessed at www.influenssa.fi.

Vaccine for the epidemic season 2018–2019

In February 2018, WHO issued a new vaccine recommendation for the epidemic season 2018–2019 in the Northern hemisphere. This recommendation was based on the data on the epidemic situation collected by early February and an assessment of the type of influenza viruses that were likely to circulate in the forthcoming epidemic season. WHO recommended the replacement of two virus components. The recommendation proposed that the influenza A(H3N2) virus component be replaced by an A/Singapore/INFIMH-16-0019/2016 type virus that is a better antigenic match for the A(H3N2) viruses circulating as epidemics. The recommendation proposed that the influenza A(H1N1)pdm09 virus component, or the A/Michigan/45/2015 virus, should not be replaced. WHO recommended that the influenza B virus be replaced by the B/Colorado/06/2017 virus, which provides a better match for the mutated B/Victoria lineage viruses of the new type. In addition to these, B/Phuket/3073/2013, another influenza B virus of the Yamagata lineage, was recommended for quadrivalent vaccines.

Monitoring report for epidemic season 2016–2017: Influenza Season in Finland, weeks 40/2016−20/2017 (in finnish)

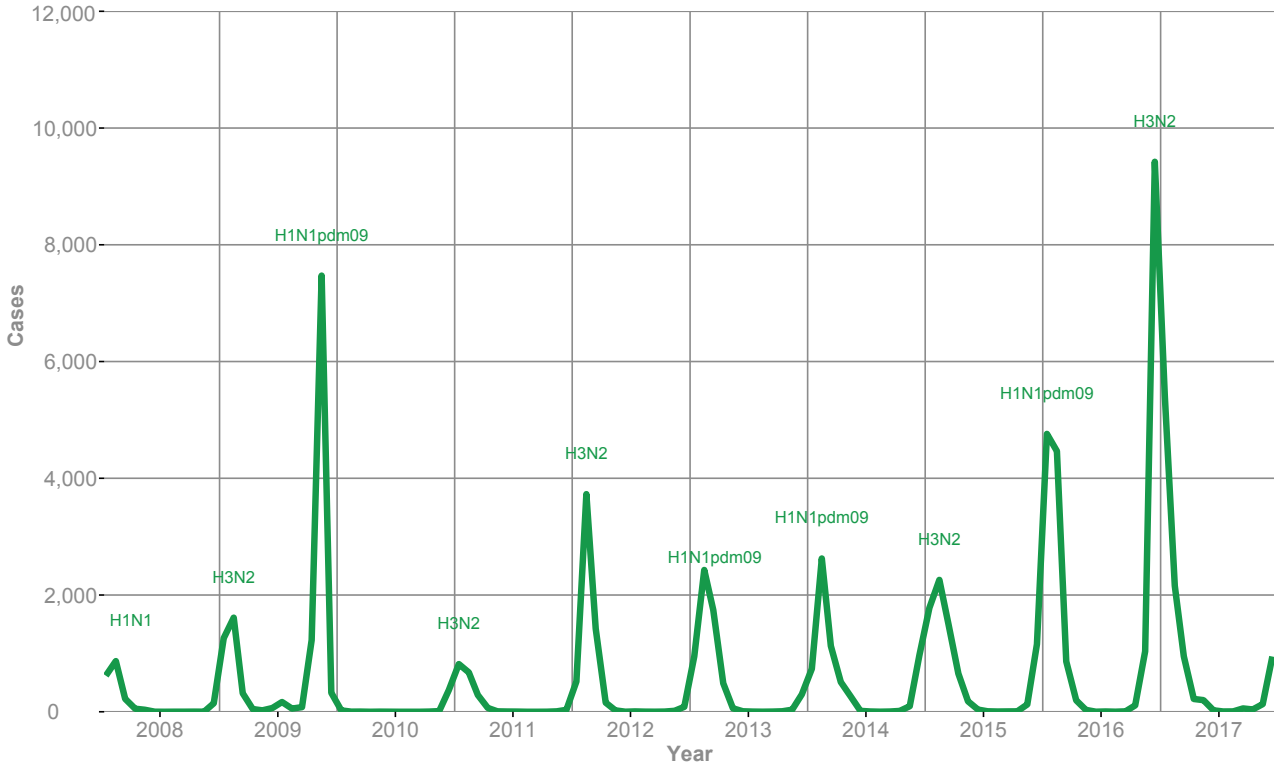

Figure 1. Cases of influenza A by month and epidemic virus serotypes, 2008–2017 (no. of cases).

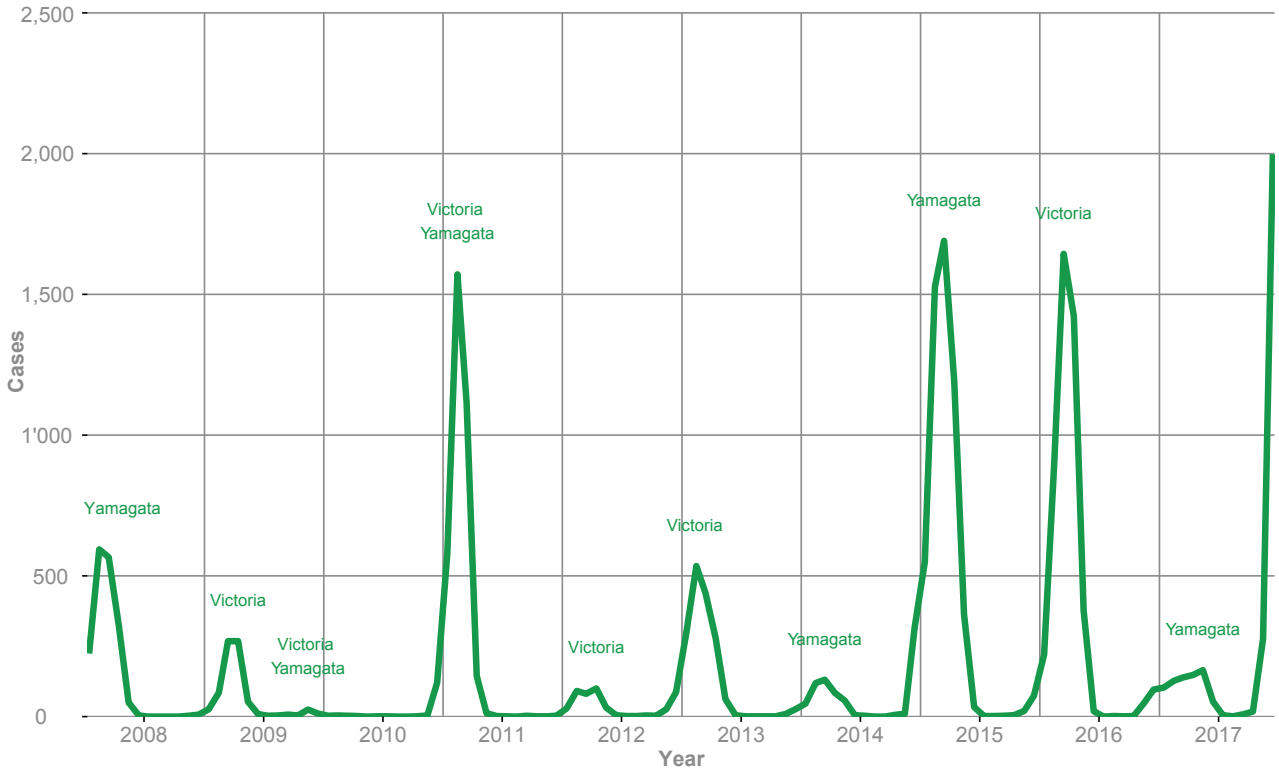

Figure 2. Cases of influenza B by month and epidemic virus serotypes, 2008–2017 (no. of cases).

PARAINFLUENZA

Parainfluenza viruses are grouped under a single heading in the National Infectious Diseases Register, even though laboratories usually differentiate between parainfluenza viruses 1, 2, 3 and 4. In 2017, 791 parainfluenza infections were confirmed (2016: 605), most of these in the 0 to 4 age group (343 cases). A moderate number of cases was also reported in those aged over 65 (102). Parainfluenza infections are diagnosed at all times of the year, but based on the case numbers, a single clear peak could be observed in March–May 2017. During the peak season, monthly case numbers varied between 127 and 156. The case numbers started again increasingly slightly in December.

Parainfluenza virus infections are found in all age groups. The first parainfluenza infections in children can lead to a severe condition that may require hospitalisation. In an older child or an adult, the symptoms of a parainfluenza infection are typically much milder. They often present as an ordinary upper respiratory tract infection and do not necessarily require laboratory diagnostics. In special groups, however, such as immune deficiency patients, parainfluenza viruses may cause severe symptoms.

RHINOVIRUS

In 2017, 1,775 confirmed rhinovirus infections were recorded (2016: 1,146). The numbers were highest in May–December (105 to 276 per month), peaking in September. At other times, rhinovirus infections occurred at a steady rate every month (55 to 86 per month). More than 60% of these infections were diagnosed in children under the age of 4. A typical feature of rhinoviruses is higher case numbers in spring and autumn. Last year, a relatively high number of infections was also reported over the summer months.

Over 150 types of rhinoviruses are known. They are the most common cause of mild respiratory infections. While rhinovirus infections are the most common in young children, they are present in all age groups. Since August 2013, rhinoviruses have been included in the surveillance of respiratory virus infections conducted by the National Institute for Health and Welfare, which may partly contribute to the increase in the number of cases from 2013 to 2017. Laboratories use a PCR test to detect rhinoviruses in clinical samples. This test is highly sensitive and reliable. Specialised virus laboratories are also able to culture rhinoviruses.

RSV

In 2017, 3,834 cases of RSV confirmed by laboratory tests were reported to the National Infectious Disease Register (2016: 4,946). As part of long-term surveillance, a major RSV epidemic is observed in Finland every other winter, often starting in November–December. In addition, minor epidemics occur between the major ones. As expected, the major winter epidemic of 2016 was followed by a minor epidemic that began in December 2016 and continued until May 2017. The highest numbers of RSV infections during the epidemic were reported in February–April (more than 400 to 500 cases/month). While the RSV epidemic partly coincided with the influenza epidemic, it peaked towards the end of the influenza season. Individual cases of RSV infection were diagnosed during the summer. In November–December, the number of RSV cases again began to increase, indicating the start of another RSV epidemic.

The majority of RSV cases (over 60%) were found in children aged 0 to 4. Slightly more cases of RSV were reported in patients aged over 75 than in other age groups. Although RSV infections are present in all age groups, cases requiring hospitalisation and confirmed by laboratory tests mainly affect infants and young children, and to some extent also older people.

Reliable quick tests for RSV diagnostics have been developed for use at health centres, outpatient clinics and hospitals. In a hospital environment, RSV is easily transmitted between patients. Quick tests make it easier to identify RSV infections and therefore to prevent further transmission. Specialised virus laboratories increasingly use genetic replication methods for diagnosing RSV.

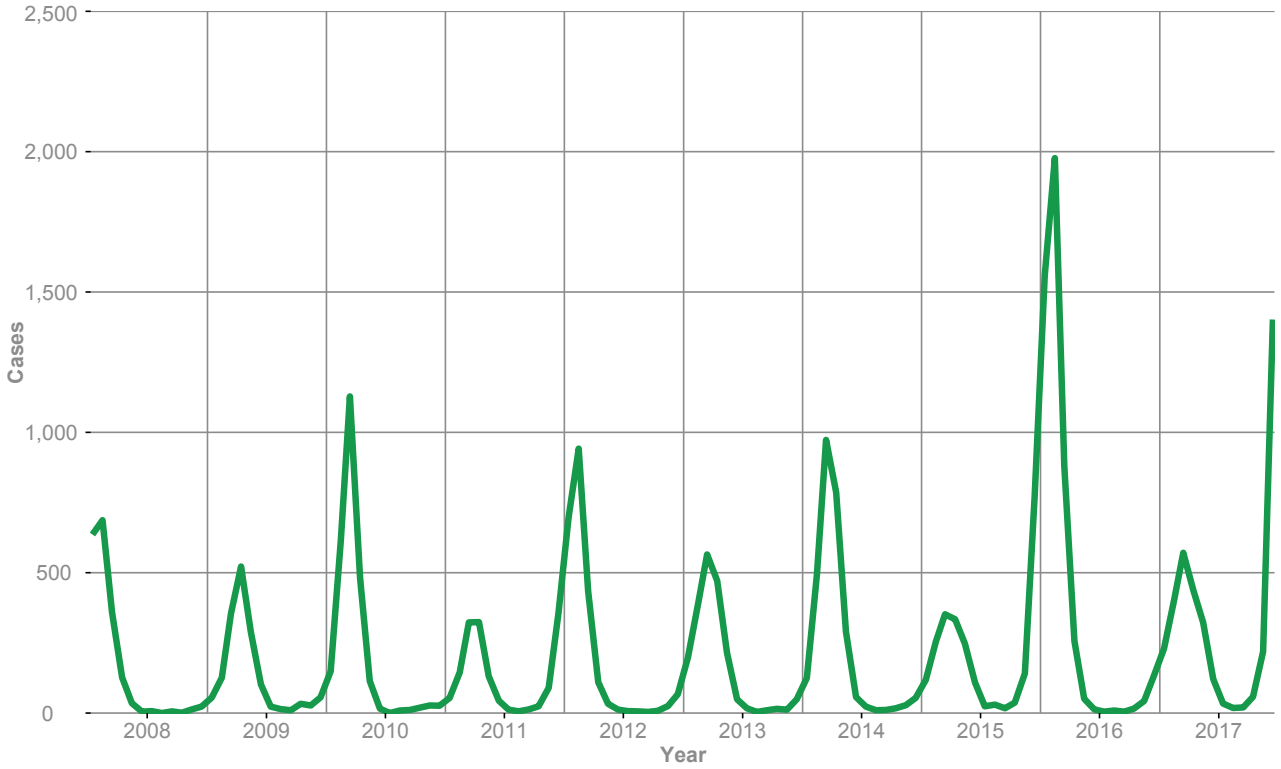

Figure 3. Cases of RSV by month, 2008–2017 (no. of cases).

ENTEROVIRUS

In 2017, 283 cases of enterovirus infection were reported to the National Infectious Diseases Register, which is less than in 2016 (336) but more than in 2015 (119). Most cases were found in the autumn, which is typical of enteroviruses. The epidemic peaked in September, in which month were reported one fifth of the year's cases. One half of all cases were diagnosed in September–November. The majority of those infected were children: 162 (57%) were aged under 5, and 39 (14%) were aged 5 to 14. More infections were found in men than in women (56% compared to 44%). The largest numbers of cases were found in the hospital districts of North Ostrobothnia (87), Southwest Finland (45) and North Savo (28). In other hospital districts, the number of enterovirus infections diagnosed remained below 20.

In addition to upper respiratory tract infections, enteroviruses cause meningitis, myocarditis, hand, foot and mouth disease and other types of dermatological diseases, among other things. Enterovirus types D68 and A71 have circulated in Europe in recent years, and also caused severe neurological symptoms in children. No severe infections were reported to the National Institute for Health and Welfare in 2017.

WHOOPING COUGH

In 2017, 399 cases of whooping cough were reported to the National Infectious Diseases Register (7.3/100,000). This is close to the previous year's figure (432); in 2016, twice as many cases were diagnosed compared to 2015, or more than ever in the previous 20 years. As before, the cases were most common in the 0 to 14 age group, with a particularly high incidence in the age group 10 to 14 (30.6/100,000). 12 of the cases were diagnosed in patients under 12 months of age, and 4 of them were less than 3 months, thus too young to have been vaccinated. The diagnosis of patients aged under 12 months was based on a PCR test in seven cases and a bacterial culture in five cases. For patients in other age groups, the diagnoses were based on antibody testing.

Of the children in the age group 3 to 23 months who contracted whooping cough and whose vaccination data was available (n=15), one was too young to have had the first vaccine, four had refused the vaccine, three had received only one dose as indicated by their age, and in seven, the three vaccinations administered to them failed to protect them from the disease. Four of the children contracted the infection while aged under 3 months.

In 2017, nine of the 18 *Bordetella pertussis* strains isolated did not produce pertactin. This is a considerable increase from previous years (2016: 3 out of 26 strains did not produce pertactin).

As previously, the incidence of whooping cough varied considerably by hospital district (0 to 35.8/100,000). The highest incidence was reported in the Vaasa Hospital District (35.8) and Åland (13.7). No cases were diagnosed in the Lapland Hospital District.

Choosing an optimum vaccination strategy for whooping cough is challenging, as the acellular vaccines widely used in the Western countries are inadequate in terms of their efficiency and duration; the protection lasts for approximately five years. A booster for six-year-olds was added to the national vaccination programme in Finland in 2003. In 2005, the whole-cell vaccine was replaced with an acellular combination vaccine containing *Bordetella pertussis* antigens for children in the age groups covered by child care clinics. Until 2007, adolescent vaccinations were given between the ages of 11 and 13. Since 2009, the recommendation has been to vaccinate adolescents at the age of 14 to 15, i.e. from the 8th grade of comprehensive school up. Due to this transition, very few of these vaccinations were administered between 2009 and 2011. This created temporarily a less well protected cohort in adolescent age groups. Infections contracted by infants indicate insufficient herd immunity. Especially in the Vaasa Hospital District, a causal relationship is suspected between lack of herd immunity and the epidemic observed in the second half of 2017. A whooping cough vaccine for conscripts beginning their military service was added to the Finnish Defence Forces' vaccination programme in summer 2012. Consequently, the incidence of whooping cough has decreased considerably among those in the age for participating in military service.

So far, Finland has been spared an extensive whooping cough epidemic of the type that generated more than 40,000 cases in the United States and almost 10,000 cases in the UK in 2012. In that year of a major epidemic, an extensive strain collection in the United States showed that 60% of *B. pertussis* strains did not produce pertactin. Both countries initiated a whooping cough vaccination campaign for pregnant women, resulting in a significant reduction in the number of whooping cough cases in young infants. With respect to Finland's neighbouring countries, the number of whooping cough cases almost tripled in Sweden in 2014 and also remained high in 2015 and 2016 (>600 cases).

A National Institute for Health and Welfare working paper titled "Control and prevention of pertussis in Finland 2017–2021" published in 2017 contains an expert assessment of the epidemiological situation of whooping cough in Finland and certain other countries, as well as proposals for measures to be taken in the event that the incidence of this disease increases essentially in Finland. It is also now recommended in Finland that the districts with the highest incidence consider starting the vaccinations of infants at the earlier age of two months. The National Advisory Committee on Vaccinations intends to review the proposals for a whooping cough vaccination strategy in 2018.

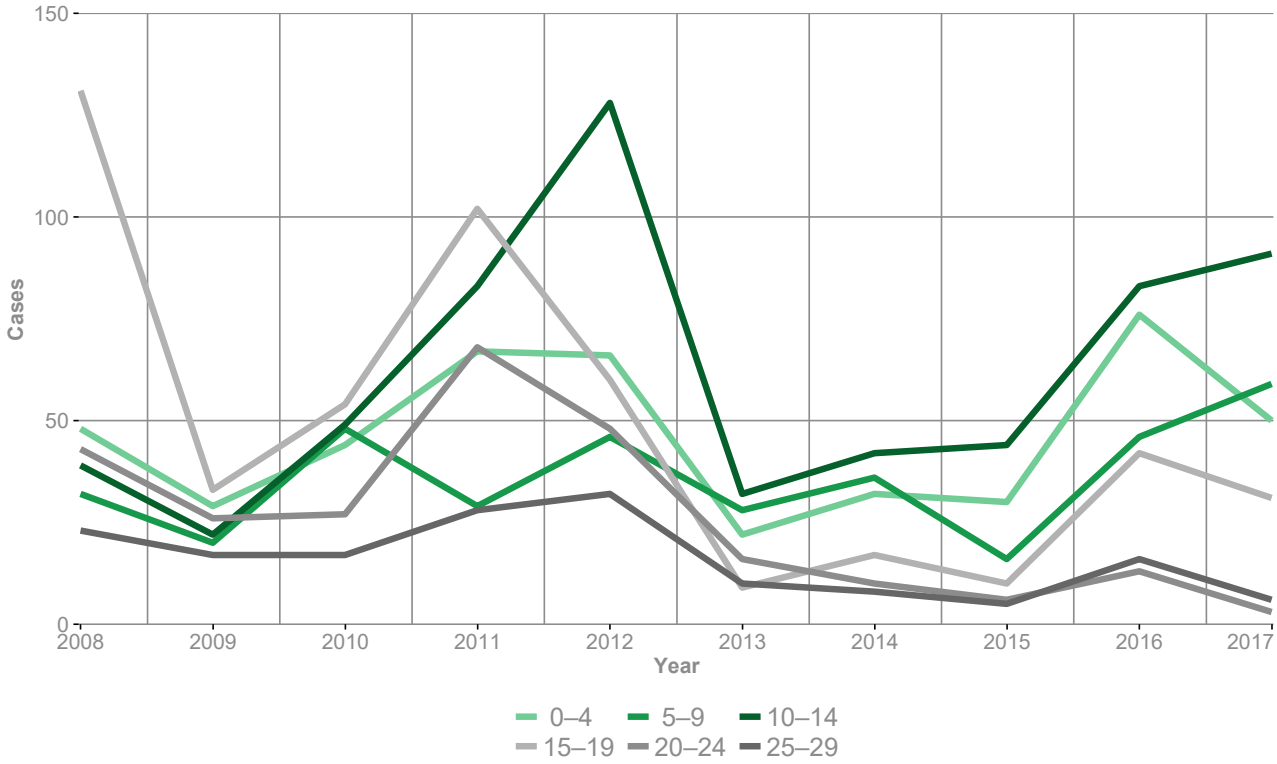

Figure 4. Cases of whooping cough in children's and young adults' age groups, 2008–2017 (no. of cases).

CHLAMYDIA PNEUMONIAE

In 2017, 268 cases of *Chlamydia pneumoniae* were reported, mainly based on antibody testing. This figure has remained relatively stable over the last few years. While the largest number of cases was found in the Helsinki and Uusimaa Hospital District, the incidence was highest in the hospital districts of Satakunta (16/100,000) and Åland (10/100,000).

LEGIONELLA

In 2017, 44 cases of legionellosis were reported to the National Infectious Diseases Register by seven laboratories, of which 21 were based on the detection of the antigen in urine, 7 on cultures, 4 on a PCR test and 18 on serological methods. In four cases, several laboratory tests had been used. The symptoms were consistent with legionellosis in 27 patients, whose chest X-rays revealed changes indicative of pneumonia. More than one half of the patients were aged over 50 (variation 29 to 82), and 23 of them (85%) were men. Sixteen (59%) individuals had contracted the infection while travelling abroad, and eleven (41%) in Finland. Three of the infections were health care associated, and three were work-related. The patients who had contracted the infection abroad had travelled in Latvia (4), India (2), Hungary (2), Estonia (2), Mexico (1), Spain (1), Greece (1), the United Arab Emirates (1) and Qatar (1). Four of the cases proved fatal. All strains cultured from respiratory tract secretions were different serogroups of *L. pneumophila* : sg 1 (4 cases), sg 3 (1), sg 6 (1), and one untyped sg 2-14. *L. longbeachae* was also cultured in a sample of synovial fluid from the wrist; the patient had had a splinter of wood in her skin.

Three clusters of legionellosis were identified. The first one was found by antigen detection in urine in two employees who had carried out annual maintenance at a power plant. They had been exposed to a water aerosol containing legionella, which originated from the scrubber waste water (510 cfu/l of *L. pneumophila* sg 1, 10,000 cfu/l of other legionella bacteria). Another cluster, which was also verified by antigen detection, occurred at a hospital where two patients in different wards were infected (cold and hot water systems, 1,700–5,000 cfu/l of *L. pneumophila* sg 1). The third cluster was associated with domestic travel. A group of seven people came down with a fever immediately after returning home from a trip to Lapland. The party had spent two nights at a hotel, and on one of the days,

they had used the whirlpool of the suite (1,200,000 cfu/l of *L. pneumophila* sg 6). Pneumonia was diagnosed in two of the patients and suspected in one. The symptoms displayed by the four others matched Pontiac fever. An increased level of legionella antibodies was detected in the two pneumonia patients. Urine antigen tests were negative.

In an isolated case, as the source of infection was confirmed a hospital's water supply system, in which a *L. pneumophila* sg 3 strain (95,000 cfu/l in hot water supply to showers) identical with the strain in the patients was isolated. In total, six homes were investigated. While legionella bacteria were found in two of them, only one was confirmed as the source of infection (warm water supply to the shower 500 cfu/l of *L. pneumophila* sg 1).

MYCOPLASMA PNEUMONIAE

In 2017, the total number of *Mycoplasma pneumoniae* cases confirmed in laboratory tests was 2,507. The number of cases changed little from the year before. Following the latest significant epidemic (2010–2012), the case numbers have settled at a level higher than before, and in the winter months of 2017, a great number of *M. pneumoniae* findings were made (similarly to earlier years of epidemics).

While the greatest number of cases was diagnosed in the Helsinki and Uusimaa Hospital District (almost 800 cases), the incidence was highest in the Kymenlaakso Hospital District (>98/100,000). A local *M. pneumoniae* epidemic was thus observed in Kymenlaakso. The incidence of the disease was also high in the hospital districts of East Savo and Central Ostrobothnia. In addition to serological methods, the diagnostics of *M. pneumoniae* may be based on nucleic acid detection tests (PCR), which also make it possible to assess the macrolide resistance of the strains circulating in Finland.

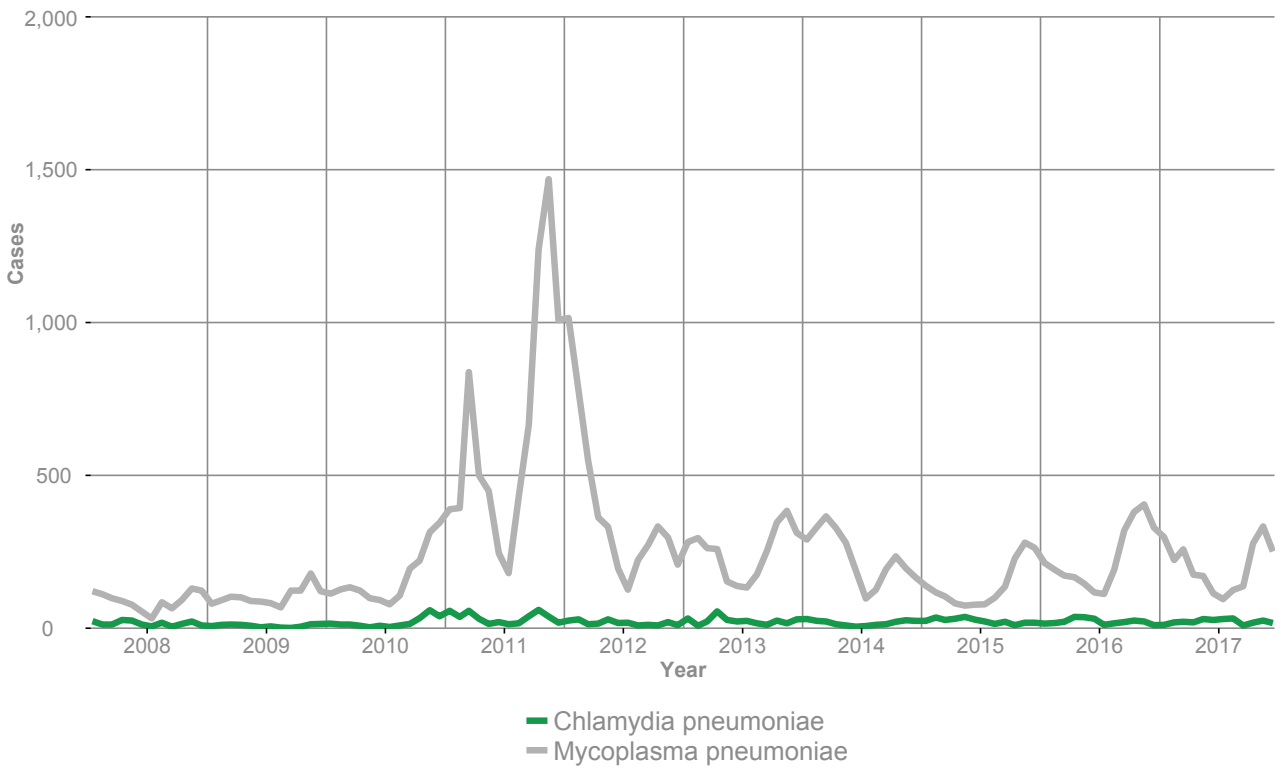

Figure 5. Cases of Mycoplasma pneumoniae and Chlamydia pneumoniae by month, 2008–2017 (no. of cases).

Gastrointestinal infections

- Cases of cryptosporidiosis, EHEC, listeriosis and domestic cambylobacter infections have increased clearly in recent years. This increase may be partly explained by changes in laboratory diagnostics.
- As in previous years, the highest number of norovirus infections was recorded in the January to May period. More than one half of the patients were over 75.
- Four listeriosis clusters were confirmed by means of typing based on whole genome sequencing. Listeria strains similar to these cases were found in frozen sweetcorn as well as cold-smoked and dry-cured fish.
- Two water-borne outbreaks caused by norovirus were detected in 2017.

GASTROINTESTINAL OUTBREAKS

Municipal outbreak investigation working groups report suspected food and water-borne outbreaks to the common register (RYMY) maintained by the National Institute for Health and Welfare and the Finnish Food Safety Authority Evira. In 2017, 59 notifications of suspected cases were entered in the RYMY system (2016: 89). The National Institute for Health and Welfare contacted the municipal outbreak investigation working group with regard to 10 notifications. Several other gastrointestinal infection clusters were confirmed as well.

Four listeriosis clusters with a total of 38 patients were confirmed by means of whole genome sequencing (WGS). The National Institute for Health and Welfare investigated the clusters in cooperation with the local authorities, the Finnish Food Safety Authority Evira and the European Centre for Disease Prevention and Control. To establish the source of the infections, the strains isolated in the patients were compared to listeria strains found in foodstuffs in Finland and other European countries. Listeriosis monitoring was intensified by collecting information on cases and possible exposure agents using a questionnaire, which was modified based on the information obtained. Listeria strains similar to the cases were found in frozen sweetcorn and cold-smoked and dry-cured fish, but only a few patients reported in the interviews having eaten these foods before they became ill.

Several cryptosporidiosis infections were reported to the National Institute for Health and Welfare, the source of which was suspected to be contact with calves. The number of infections was more than ten-fold in 2017 (250 cases) compared to the figures reported in early 2000s (4 to 18 annually). This increase affected the hospital districts in Ostrobothnia, in particular. Funding has been applied for to investigate the cause of this increase.

Two water-borne outbreaks were detected in 2017, one of which originated in a drilled well and the other in the pool water at a spa. Contamination in the water of the drilled well at a private accommodation establishment left almost 60 persons ill in total. A GII genogroup norovirus was found both in the water and in patient samples. A more accurate typing of the patient samples revealed a GII.P17 genotype norovirus as the cause of the outbreak. Other shortcomings were also found in the quality of the well water, as the nitrate and nitrite contents exceeded the requirements of the Domestic water decree (401/2001). It was suspected that the well had been contaminated by the accommodation establishment's sewage system. The contaminated well was taken out of use, the water pipes of the property were treated with intensive chlorination, and a new drilled well was built for the property.

The illness of 34 patients had a potential link to pool water contaminated by faeces. A GII.16 genotype norovirus was found in the patient samples, including EPEC in one sample. While no norovirus was found in the pool water, there were shortcomings in the water quality. *Staphylococcus aureus* and enterococcus bacteria were found in the water, and the urea content exceeded the requirements set for pool water quality. By means of more effective treatment and disinfection of the water, the water quality was improved to a safe standard. While it was suspected that the first infections originated from contaminated pool water, the virus partly also spread through surfaces in the spa hotel's common facilities and guest rooms.

In December 2017, the National Institute for Health and Welfare received two reports of suspected *Yersinia enterocolitica* outbreaks from working groups in the Hospital Districts of North Karelia and North Savo. Bioserotype 4/O:3 cases were also diagnosed in the Helsinki and Uusimaa Hospital District, and a decision was made to limit the investigation to these districts. In November–December, a total of 58 bioserotype 4/O:3 cases was diagnosed. The source of the infection was investigated in cooperation with regional working groups, laboratories, the Finnish Food Safety Authority Evira and the National Institute for Health and Welfare. A request was made to send *Yersinia enterocolitica* strains to the National Institute for Health and Welfare's laboratory for typing. By whole genome sequencing, six different clusters and individual genotypes were identified. No links could be found between the clusters based on patient interviews and investigations of foodstuffs.

In May–June, 32 cases of *Salmonella Enteritidis* phage type 14B (MLVA 2-9-9-5-1 or MLVA 2-9-NA- 5-1) were diagnosed. Sequencing confirmed that thirteen of these were of the same strain. Based on an epidemiological investigation, mung bean sprouts were suspected as the source of the infection.

In June–December, 27 cases of *S. Bareilly* were diagnosed. The genome of a salmonella strain isolated in seven patients was sequenced, and the strains were found to be similar. Some of the patients were linked by having had a meal at the same restaurant, where an identical strain was found in two vegetable dishes served to customers. The strain causing the outbreak was also compared to a *S. Bareilly* strain that occurred in the Czech Republic at the same time, but the two strains were dissimilar.

In July–October, a monophasic strain of *S.* Typhimurium (phage type 193, MLVA 3-13-10-NA/9-0211) was diagnosed in 15 people. Of these, the strains of eight persons were sequenced and found to be similar. A strain with similar phage and MLVA types was found in an imported foodstuff which, however, was confirmed to be different by sequencing. Smaller clusters of salmonella were also detected, as well as a cluster of seven EHEC cases in April, in which no exposure agent linking the patients could be found in the interviews.

CLOSTRIDIUM DIFFICILE

In total, 4,823 *Clostridium difficile* cases were reported, and 97% of these involved a toxin-producing strain or toxin gene findings. The proportion of toxin-positive strains has increased steadily since 2008, in which year it was 79%. Women accounted for 58%, people aged 75 or over for 47%, and under 15-year-olds for 3.9% of the cases; 2.7% were diagnosed in under 4-year-olds. No changes have taken place in the age and gender distributions. The incidence of the infection was 88/100,000 inhabitants, which is slightly less than in the preceding six years (2011–2016: 92 to 101/100,000). Differences in incidence between hospital districts remained significant (46 to 159/100,000). While the hospital districts may be going through different stages of the epidemic, differences may also be found in the use of antimicrobials, the rate of sample-taking, the testing methods used and the actions taken to control infections.

Findings were reported by 21 clinical microbiology laboratories, the four largest once submitting over one half of these reports. The rising trend in the use of nucleic acid detection tests, which started in 2014, continued in the selection of laboratory methods: 78% of the findings had been obtained using these tests in 2017, whereas the use of cultures dropped below 20% for the first time. The change has been rapid: as recently as in 2013, 90% of the findings were based on cultures, and the proportion of nucleic acid tests was 4%. Most laboratories still have capabilities for using cultures, however, which allows the typing of the strains, for example in case of a suspected epidemic in a ward. Similarly to the two previous years, the proportion of antigen findings was approximately 10%.

The National Institute for Health and Welfare types strains related to suspected epidemics and severe individual cases. As cultures are used less, the number of typed strains has also declined significantly.

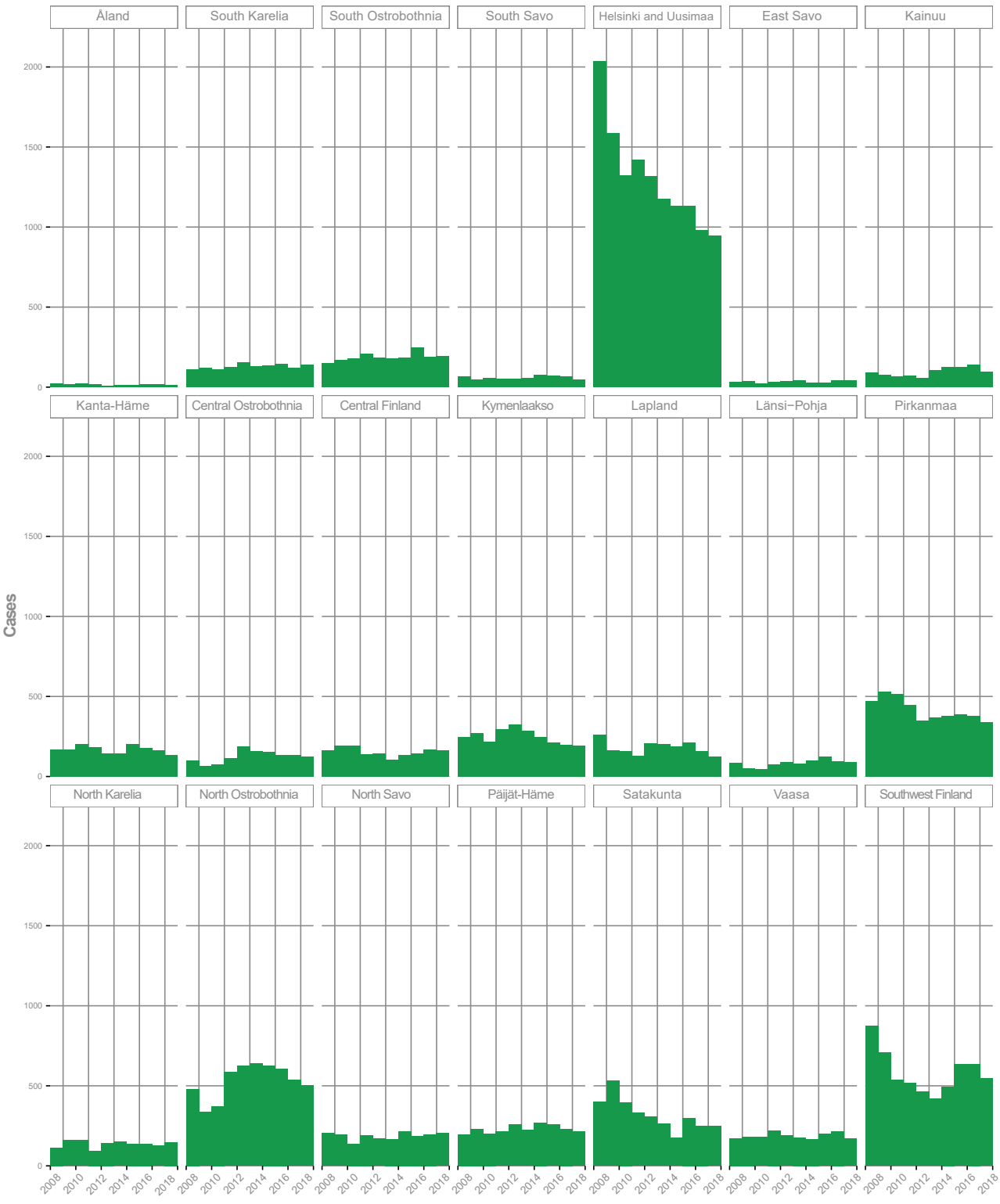

Figure 6. Cases of Clostridium difficile by hospital district and by year, 2008–2017 (no. of cases).

ENTEROHAEMORRHAGIC ESCHERICHIA COLI (EHEC)

A total of 124 cases caused by enterohaemorrhagic *Escherichia coli* (EHEC) were reported to the National Infectious Diseases Register (2016:144). The incidence was 2.6/100,000 inhabitants across the country, and the highest incidence was recorded in the 0 to 4 age group (5.2/100,000). By far the highest number of cases was reported in the Helsinki and Uusimaa Hospital District (71/124).

There has been an increase in the number of EHEC infections since 2013. Changes in the laboratory diagnostics of EHEC explain the higher number of infections: it is likely that the increasing number of PCR tests has also resulted in higher sensitivity in detecting epidemics. The reporting criterion for EHEC findings was changed in 2016. In addition to microbial findings confirmed by cultures, findings based on PCR or other nucleic acid tests (NH) are also reported to the National Infectious Diseases Register.

51% (63) of the infections were classified as being of domestic origin. Since 2014, information on symptoms and exposure relating to EHEC infections of domestic origin has been collected using an electronic interview form completed by municipal officials responsible for infectious disease control. The interview data indicates that two patients were diagnosed with haemolytic uremic syndrome (HUS). Nine EHEC infections had suspected links to contact with a farm, and in three cases, identical EHEC strains were found in the patients and samples taken from the farm.

In compliance with the Communicable Diseases Act, laboratories attach a microbe strain or a sample to their EHEC notifications. The bacterial cultures of 82 (65%) of the 80 EHEC cases were sent to the National Institute for Health and Welfare's laboratory and confirmed using a PCR test. An O157:H7 serotype strain was isolated in the bacterial cultures of 28 cases (35%). All O157:H7 serotype strains were sorbitol-negative. 20 of the strains tested positive for both the stx1 and stx2 gene (the most common stx subtype 1a2c, 18 strains). Eights strains were only positive for the stx2 gene (the most common stx subtype 2c, 7 strains). Three clusters of infections with three to seven cases each caused by the O157 strain were diagnosed by whole genome sequencing.

A non-O157 serogroup strain was isolated in a bacterial culture in 54 cases. In total, 18 serogroups were identified. The most common serogroups were O26 (10 strains), O146 (7 strains), O103 (5 strains), O111 (4 strains) and O121 (4 strains). Five strains could not be serogrouped by the traditional method based on agglutination or WGS. 29 of the strains only tested positive for the stx1 gene (the most common stx subtype 1a, 23 strains), and 17 only for the stx2 gene (the most common stx subtype 2a, 9 strains), while eight had both stx genes (the most common stx subtype 1c2b, 5 strains). Three clusters of infection with two to three cases each caused by the non-O157 strain were diagnosed by WGS: O103:H2, O111:H8, O121:H19 and O181:H16.

The strains of two HUS cases were obtained for grouping. The patients came from the same family and belonged to a family cluster of three O121:H19 cases. The strain was positive for the eae gene and hlyA gene, and represented stx subtype 2a.

Figure 7. EHEC cases by year, 2008–2017 (no. of cases).

CAMPYLOBACTER

Campylobacter is the most common bacterial cause of gastrointestinal infections in Finland. In 2017, 4,289 findings of campylobacter were reported (2016: 4,637). *Campylobacter jejuni* was by far the most common type of campylobacter (3 594), while 395 cases of *C. coli* were reported. The type was not specified in 128 cases.

The incidence in the entire population was 78/100,000. Men accounted for 54% of the cases. The highest number of infections was reported in the 40 to 44 age group (incidence 130/100,000). The highest incidence was recorded in the Helsinki and Uusimaa Hospital District (110/100,000). Seasonal variation was typical for campylobacter infections, as the highest incidences were reported in July–August.

In 44% of the cases, data was lacking on the country of acquisition. Of the infections, 15 % (643) were of domestic origin. The number of domestic infections has increased since 2010. The reason for this is not known. More information on the sources of campylobacter infections would be necessary to target prevention measures. In 2017, the National Institute for Health and Welfare's laboratory did not examine a single campylobacter isolated from patient samples.

LISTERIA

In 2017, a total of 91 systemic infections caused by *Listeria monocytogenes* were diagnosed (2016: 67). Of these patients, more than one half were aged 74 or over, and 53% (48) were men. Listeriosis cases occurred in all hospital districts bar three. While no pregnancy-related cases were reported to the National Infectious Diseases Register, one was diagnosed based on patient interviews.

There has been a clear increase in the number of listeriosis cases since 2009. Listeria infections are foodborne, and high-risk foods include animal and plant based products and ready-made foods that are refrigerated for long periods. Listeria bacteria may occur in food production environments and contaminate a product after the heat treatment that is part of the production process. In Finland, foods with a particularly high risk include dry-cured and cold smoked fish products. In 2010, dry-cured salmon was confirmed as the source of an epidemic, and in 2012, an epidemic was caused by aspic.

The *L. monocytogenes* strain isolated from the blood and/or cerebrospinal fluid of 93 patients arrived for typing at laboratory. Two strains were isolated in newborns or foetuses. Of these strains, 52 (56%, in 2016: 67%, in 2015: 82%) belonged to serogroup IIa, 25 to IVb, 14 to IIc and 2 to IIb. The strains represented 26 MLST types, the most common ones of which were ST9 (14 strains), ST6 (12), ST8 (11) and ST451 (10 strains). Using whole genome sequencing (WGS), six clusters with more than two cases each were found. The most prominent strains in these clusters were IVb, ST 6 (11 cases), serogroup IIc, ST 9 (10 cases) and serogroup IIa, ST451 (10 cases). Strains belonging to these WGS clusters continued to be diagnosed in early 2018. Strains of the ST6 and ST9 clusters also occurred in 2016.

Table 1. The most common listeria strains in 2017, number of cases.

MLST	Cases, number	Similar strains in WGS clusters, number
ST9	14	10
ST6	12	11
ST8	11	3
ST451	10	10
ST1	5	2
ST206	4	4
ST19	3	3

SALMONELLA

In 2017, a total of 1,550 salmonella cases was reported (2016: 1,505), of which 55% were diagnosed in women. The annual incidence in the entire country was 28/100,000. The highest incidence was reported in the Helsinki and Uusimaa Hospital District (39/100,000) and the lowest in the East Savo Hospital District (0.3/100,000). The highest number of infections was reported in the 20 to 24 age group. The *S.* Typhi bacterium, which causes typhoid fever, was identified in nine persons. Two cases of *S.* Paratyphi (Paratyphi A), which causes paratyphoid fever, were found. All patients had been travelling abroad.

Since the beginning of 2017, the National Institute for Health and Welfare has only accepted salmonella strains from domestic and/or invasive infections, or in cases of *S.* Typhi or *S.* Paratyphi. The bacterial strains of a total of 422 salmonella cases were sent to the National Institute for Health and Welfare, of which 306 (71%) were of domestic and 77 (18%) foreign origin. In 49 (11%) cases, data on the country in which the salmonella infection had been acquired was not obtained. In 2016, this data was only missing for 2% of the strains sent to the National Institute for Health and Welfare.

Domestic salmonella infections were caused by 48 different serotypes. The three most common serotypes, including Enteritidis (79 cases), group B (51) and Typhimurium (34), caused 53% of the infections. As in previous years, the majority (72%) continued to be susceptible to all 12 antimicrobials tested; the proportion of multiresistant strains increased slightly from the previous years' level (2017: 22%; 2016: 19%).

The number of domestic cases caused by the Enteritidis serotype was 79 (2016: 83) and they were mostly susceptible to all of the antimicrobials tested (91%, 2016: 45%, 2015: 80%). Enteritidis strains were divided into 18 different phage types, the most common one of which was PT 14B (41%).

The number of domestic group B cases increased considerably from the previous year (51 compared to 22). The majority of group B strains were so-called monophasic *S.* Typhimurium strains (46 cases). Almost all monophasic Typhimurium strains isolated from infections of domestic origin were multiresistant; most commonly to ampicillins, streptomycin, sulfonamide and tetracycline.

This resistance gives us reason to suspect that the monophasic Typhimurium strains are actually of foreign origin, e.g. secondary cases related to someone who travelled abroad or originating in an imported food product. Multiresistant monophasic Typhimurium strains are not known to occur in domestic farm animals. The most common monophasic phage type has varied in previous years (PT7A, PT120, PT195). In 2017, the most common type was FT193 (25/51); this was also true for 2016 (11/20).

Of the domestic Typhimurium strains, 18% were multiresistant (2016: 7%, 2015: 6%). The Typhimurium strains were divided into 8 different phage types. The proportion of the domestic phage type PT1 (38%) was slightly higher than in recent years (2016: 27%, 2015: 29%). All PT1 strains were susceptible to antimicrobials.

Table 2. The most common serotypes of salmonella cases of domestic origin, 2008–2017 (excluding *S.*Typhi and *S.* Paratyphi), no. of cases.

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Source: THL Expert Microbiology										
S.Enteritidis	48	51	44	47	83	46	49	59	83	79
S.group B	5	7	8	40	35	38	32	30	22	51
S.Typhimurium	85	140	132	94	98	94	92	79	55	34
S.Bareilly	0	1	3	2	2	2		2	1	25
S.Infantis	7	2	9	10	36	12	9	10	7	19
S.Agona	15	2	2	11	33	12	8	4	2	15
S.Newport	71	9	8	6	7	11	9	27	5	7
S.Stanley	8	6	7	1	3	1	6	6	6	5
S.Senftenberg	2	0	5	5	1	1	3	1	6	4
Salmonella ssp.IIIb	2	3	1	0	1	3	2	0	2	4
S.Derby	2	1	0	0	0	2	0	0	0	4
S.group D	0	1	1	0	1	0	0	0	0	4

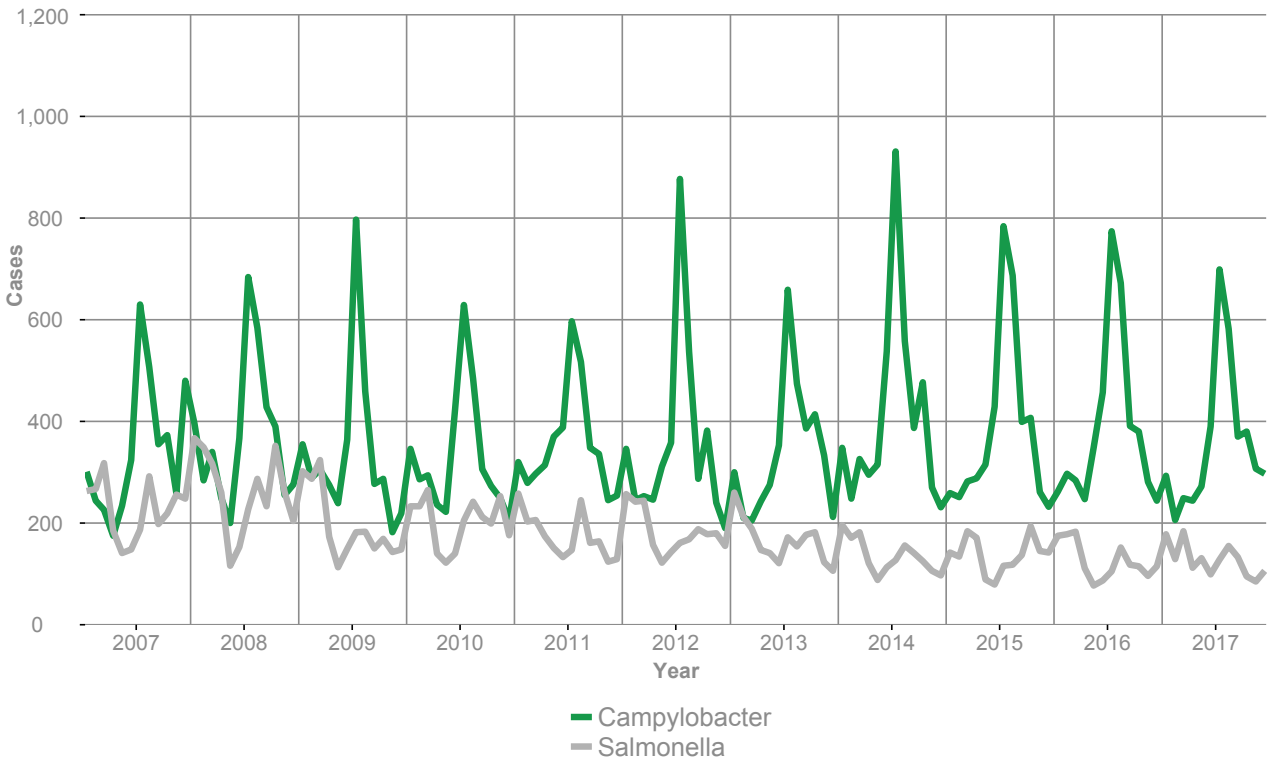

Figure 8. Salmonella and campylobacter cases by month, 2008–2017 (no. of cases).

SHIGELLA

In 2017, the incidence of shigellosis was 1.7/100,000. The total number of cases reported was 91 (2016: 66). Of these, 51% were men, and the median age was 44 years (variation <1 to 72). The majority of the cases (63%) were reported in the Helsinki and Uusimaa Hospital District. The proportion of infections reportedly acquired in Finland has increased in recent years.

The shigella strains of 78 persons were sent to the National Institute for Health and Welfare's laboratory by a total of six laboratories. It was reported that 56 of the infections (72%) had been acquired abroad and 10 (13%) in Finland. The country of acquisition was not reported in 12 cases. The most common countries in which the infections were contracted were India (14), Spain (4) and Morocco (4). A total of 50 strains (64%) were typed, including all infections of domestic origin and a sample of the foreign ones. The prevailing shigella species were *Shigella sonnei* (27) and *Shigella flexneri* (15). The strains were multiresistant (resistant to at least three of the 12 antimicrobials tested), excluding one strain of foreign origin.

YERSINIA

Yersinia findings are reported to the National Infectious Diseases Register under the Communicable Diseases Decree, which does not, however, require that Yersinia strains be sent to the National Institute for Health and Welfare. The institute only types Yersinia strains in special circumstances, including epidemics or serious infections.

Yersinia enterocolitica

In 2017, 518 *Yersinia enterocolitica* cases were reported to the National Infectious Diseases Register (2016: 547). The incidence in the entire country was 9.4/100,000, with the highest incidence recorded in the 20 to 24 age group (17.6/100,000). Regional variation in *Y. enterocolitica* findings was great. The highest incidence was recorded in the hospital districts of Helsinki and Uusimaa (31/100,000), North Ostrobothnia (15/100,000) and Kymenlaakso (14/100,000). Information on the country of acquisition was not provided in 77% of the reports (397/518). In late 2017, an increase in *Yersinia enterocolitica* bioserotype 4/O:3 diagnoses was reported in the hospital districts of North Karelia, North Savo and Helsinki and Uusimaa.

Y. enterocolitica is most commonly identified from a stool culture. In 2017, the number of cases confirmed by culture totalled 479, while 7 cases were identified by nucleic acid detection and 42 by antibody findings in serum. Eleven cases were diagnosed on the basis of both a culture and antibody findings. In 2017, one case of *Y. enterocolitica* was also identified in a cultured blood sample.

Y. enterocolitica findings were reported by 19 laboratories. Of these, ten also reported the biotype and/or serotype, or the results of a virulence plasmid test, at least occasionally. The typing result was given in 51% of the cases: 41% (109/265) were of the biotype BT1A, 46% of the biotype/serotype BT4/O:3, and 3% of the type BT2/O:9. BT 1A is a heterogeneous group of strains that lack the pYV virulence plasmid typical of pathogenic Yersinia strains. However, some BT 1A strains may have other properties affecting their pathogenic capabilities.

Yersinia pseudotuberculosis

In 2017, the number of *Yersinia pseudotuberculosis* cases was 12 (2016: 23). The incidence in the entire country was 0.2/100,000 inhabitants. One half of the cases (6) were verified by culture and the remainder by antibody findings. The numbers were too low to describe regional differences.

NOROVIRUS

In 2017, 3,871 cases of norovirus infection were reported to the National Infectious Diseases Register, which is clearly more than in 2016 (2,395). Reports were submitted by all hospital districts and, as in previous years, the peak period was in January–May (3,406, 88%). While cases occurred in all age groups, more than one half (60%) were diagnosed in persons over 75 years of age. The proportion of women was 56%.

Norovirus is one of the most common causes of food and water-borne epidemics. In 2017, 13/58 (22%) epidemics in which the suspected pathogen was a norovirus were reported to RYMY, the national information system of the National Institute for Health and Welfare and the Finnish Food Safety Authority Evira. Norovirus samples from eight epidemics were typed: GII.Pe was identified in four epidemics, in addition to which the findings included GII.P4, GII.P17, GII.P16 and GII.P16-GII.4.

In addition, norovirus samples collected in connection with nine other epidemics, as well as individual samples were typed. Also in these the most common norovirus type was GII.Pe. Other norovirus types diagnosed in 2017 included GII.P4, GII.P16, GI.P1, GI.P2, GI.P3, and GI.P4 as well as the recombinant strains GI.Pf-GI.3 and GI.Pb-GI.6.

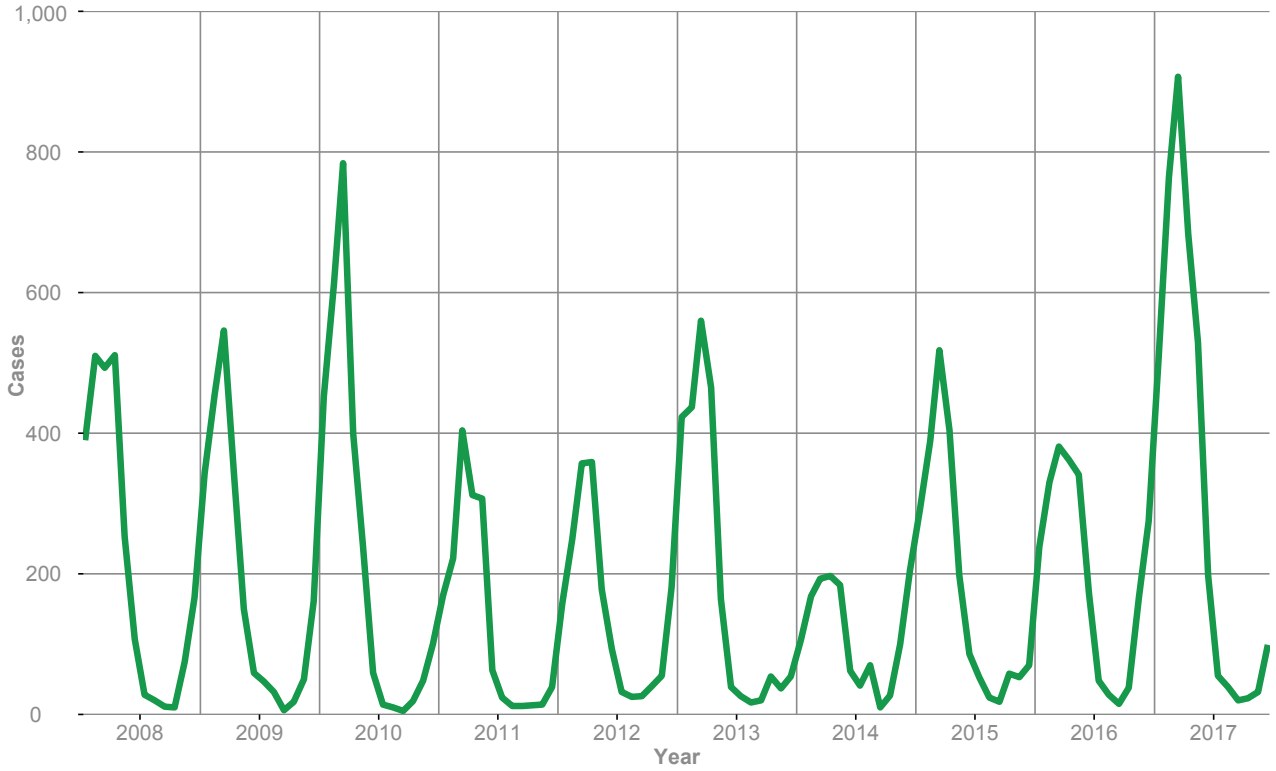

Figure 9. Cases of norovirus infection by month, 2008–2017 (no. of cases).

ROTAVIRUS

In 2017, 243 cases of rotavirus were reported to the National Infectious Diseases Register. The number of cases has remained below 500 since the rotavirus vaccine was introduced to the national vaccination programme in 2009. Comprehensive rotavirus vaccinations for young children have clearly lowered the incidence of rotavirus infections in under 5-year-olds (2017: 39.4/100,000) in comparison with the average incidence (460/100,000) in this age group prior to the vaccination programme. A continuously increasing percentage of cases occur in patients aged 5 and older (2017: 53.5%), whereas the percentage of such cases before the vaccinations was approximately 10%. More than one half of rotavirus cases in children under 5 occurred in unvaccinated individuals.

In 2017, the most common rotavirus genotypes in Finland were G12P[8] and G9P[4]. Their proportion in the infections has increased steadily. The next most common genotypes were G3P[8], G9P[8], G2P[4], G1P[8] and G4P[8]. In five cases, the patients presented with dual infections. The dual infections were caused by the virus pairs G9+G3 P[4]+P[8]; G3+G12P[8]; G3+G12P[8]; G2+G12P[4]; and G4+G9P[8]. No zoonotic rotaviruses, or those originating in animals, were diagnosed in the samples tested in 2017.

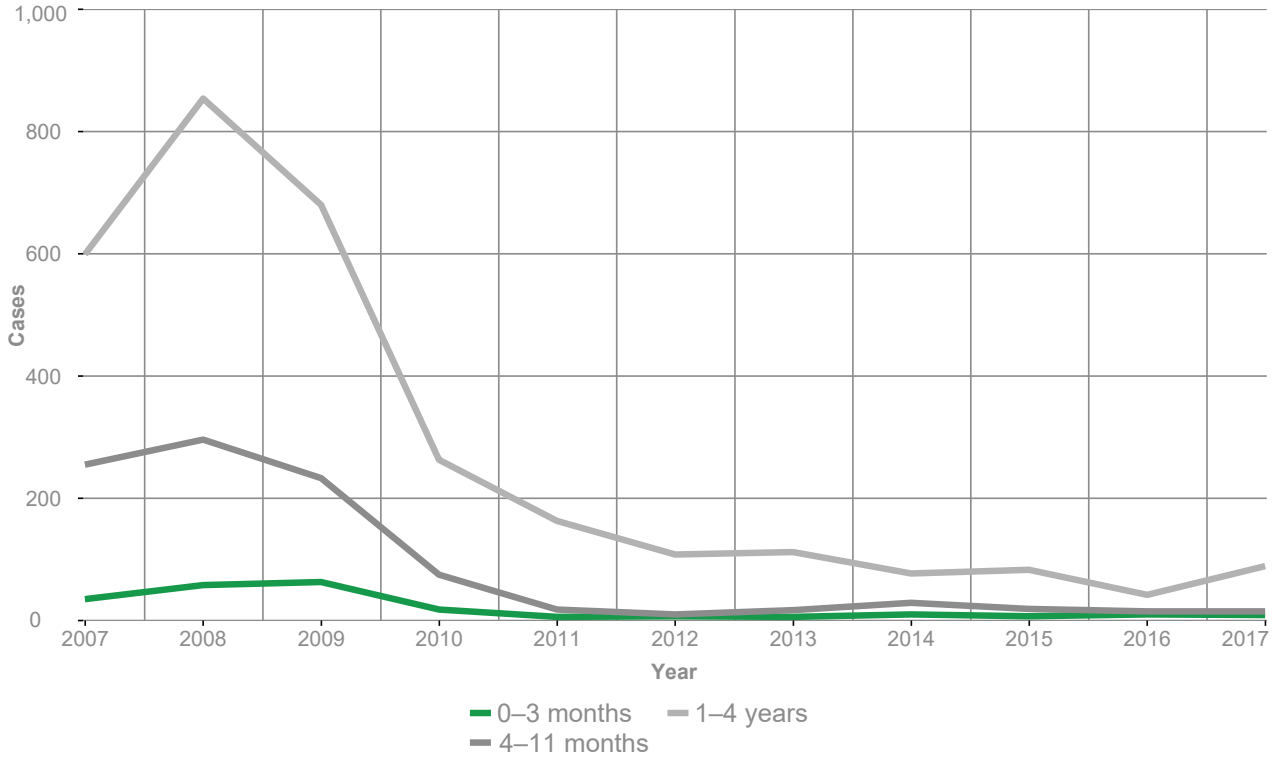

Figure 10. Rotavirus cases by age group in children aged 0 to 4, 2008–2017 (no. of cases).

Hepatitis

- One third of the hepatitis A-infections were linked to three different clusters that originated in Europe in summer 2016. Most had been acquired in sexual contact between men.
- Less than ten acute hepatitis B infections were diagnosed, and the number of chronic infections is also going down.
- There was no change in the number of hepatitis C cases.

HEPATITIS A

In 2017, 29 hepatitis A cases were reported (0.6/100,000) (in 2013–2016: 6–41). The majority of those who contracted the infection were men (22/29) in the age group 30 to 60. The age range of infected patients was 4 to 80. Starting in summer 2016, hepatitis A clusters caused by three different IA subtypes were reported in different parts of Europe. Most of the infections in Europe were diagnosed in men who have sex with other men. The clusters were first observed in the United Kingdom, Germany and the Netherlands. By the end of September 2017, infections associated with these clusters had been diagnosed in 20 European countries, including Finland. The number of confirmed cases linked to these clusters in Europe has been almost 3,000. Of hepatitis A cases in Finland, at least 11 were linked to these clusters, and five of the patients had travelled abroad before acquiring the infection. In 2017, travel abroad before contracting the infection was associated with at least one half of all cases. Men who have sex with other men were added to the target groups of the hepatitis A vaccinations in the national vaccination programme in November 2017.

HEPATITIS B

Acute hepatitis B

In 2017, six acute cases (0.11/100,000) of hepatitis B, i.e. ones that tested positive for IgM antibodies, were reported to the National Infectious Diseases Register. Two of these were diagnosed in men. Two of the people who had contracted the infection were of a foreign origin.

Over the previous ten years, on average 20 acute hepatitis B infections a year have been reported to the National Infectious Diseases Register. Consequently, the figure for 2017 is slightly smaller than in previous years. The number of cases has also decreased over the long term: in the peak year of 1998, almost 180 acute hepatitis B infections were reported. This decrease is mainly due to better vaccination coverage. Vaccinations of risk groups began in Finland in the 1990s. The vaccination coverage has also been improved by individuals who get the vaccination at their own cost, which has been especially popular among travellers. Moreover, needle and syringe exchange has probably prevented infections among intravenous drug users.

Chronic hepatitis B

In 2017, 258 chronic hepatitis B infections were reported (4.69/100,000), which is 77 cases less than the year before. Of these infections, 59% (152/258) were diagnosed in men. 79% of the persons who contracted the infection (204/258) were of a foreign origin, and one out of five (55/258) did not have a Finnish personal identity code. The category of the country in which the infection had been acquired was reported in 60% of the cases (154/258); of these patients, 90% (139/154) had been infected abroad. The mode of transmission was reported in 17% of the cases (43/258). The most common modes were sexual contact (16 cases) and perinatal infection (13 cases).

The year-on-year decrease in the number of cases can to a great extent be explained by the reduced influx of asylum seekers in Finland. In 2016, almost one half of chronic hepatitis B cases were reported in persons who did not have a Finnish personal identity code. A similar reduction in case numbers has not taken place in infections contracted by Finnish citizens.

HEPATITIS C

In 2017, 1,170 (20/100,000) new cases of hepatitis C were reported to the National Infectious Diseases Register, on a par with previous years. The highest number of infections (34%) was reported in the Helsinki and Uusimaa Hospital District (23/100,000) but, as in the previous year, the highest incidences were recorded in the hospital districts of North Savo (33/100,000), Kainuu (31/100,000) and Länsi-Pohja (26/100,000) and the lowest in Åland (3/100,000) and the hospital districts of South Ostrobothnia (10/100,000) and Central Ostrobothnia (10/100,000).

65% of the infections were found in men. The cases were the most frequent in the age group 20 to 39, which accounted for 69% of all cases. The highest incidence (65/100,000) was reported in the age group 20 to 24. The majority of cases (84%) were diagnosed in individuals of Finnish origin. The country of acquisition was known in 67% of the cases. The majority of these (78%) were infections contracted in Finland.

The most common mode of transmission was intravenous drug use (47%). In 8% of the cases, sexual contact was reported as the mode of transmission: in 51%, the infection was diagnosed in women, and seven infections acquired through sex between men were reported. Information on the mode of transmission was lacking in 41% of the cases.

The majority of hepatitis C infections was reported without a personal identity code in 1995–1997. The high figures for hepatitis C in 1996–2000 (1,800 cases on average per year) may have been partially due to cases without personal identity codes being registered several times, and the probable registration in those years of most cases initially diagnosed before the surveillance began. Since 2003, the annual number of cases has been 1,200 on average.

In all, some 31,000 cases of hepatitis C have been reported to the National Infectious Diseases Register in 1994–2017. The total number of those infected and carriers is unknown as the prevalence of hepatitis C has not been studied at population level in Finland. The number of carriers is growing, as the number of new infections is clearly higher than the number of cases treated every year.

The majority of infected patients in Finland are intravenous drug users. A very high percentage, around 75%, of intravenous drug users have been found to have hepatitis C antibodies. Because of this, reducing the number of infections in this group further by means of the current needle and syringe exchange programmes alone is difficult.

In 2016, the Ministry of Social Affairs and Health published the first Finnish hepatitis C strategy. The long-term objective of the strategy is treating all hepatitis C carriers and decreasing the incidence of hepatitis C and the number of patients with a chronic infection. The National Institute for Health and Welfare has appointed a national expert group for 2017−2019 to discuss issues related to the prevention, treatment and monitoring of both HIV and hepatitis infections. The tasks of the working group include monitoring the hepatitis C strategy, investigating the changes proposed in the strategy, and providing instructions for carrying out the changes. The expert group is preparing a national recommendation on hepatitis C diagnostics and care pathways for infected patients.

Table 3. All cases of hepatitis C according to physicians' reports, by mode of transmission, 2008–2017 (no. of cases).

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Injecting drugs	589	533	642	630	665	655	709	621	631	553
Sex	82	76	83	91	70	92	90	79	81	89
Perinatal	10	10	11	12	8	5	4	3	2	6
Blood products	20	5	14	8	7	11	13	14	6	7
Other	43	47	51	40	32	42	36	39	28	34
Unknown	431	415	378	405	405	380	391	427	417	481
Total	1,175	1,086	1,179	1,186	1,187	1,185	1,243	1,183	1,165	1,170

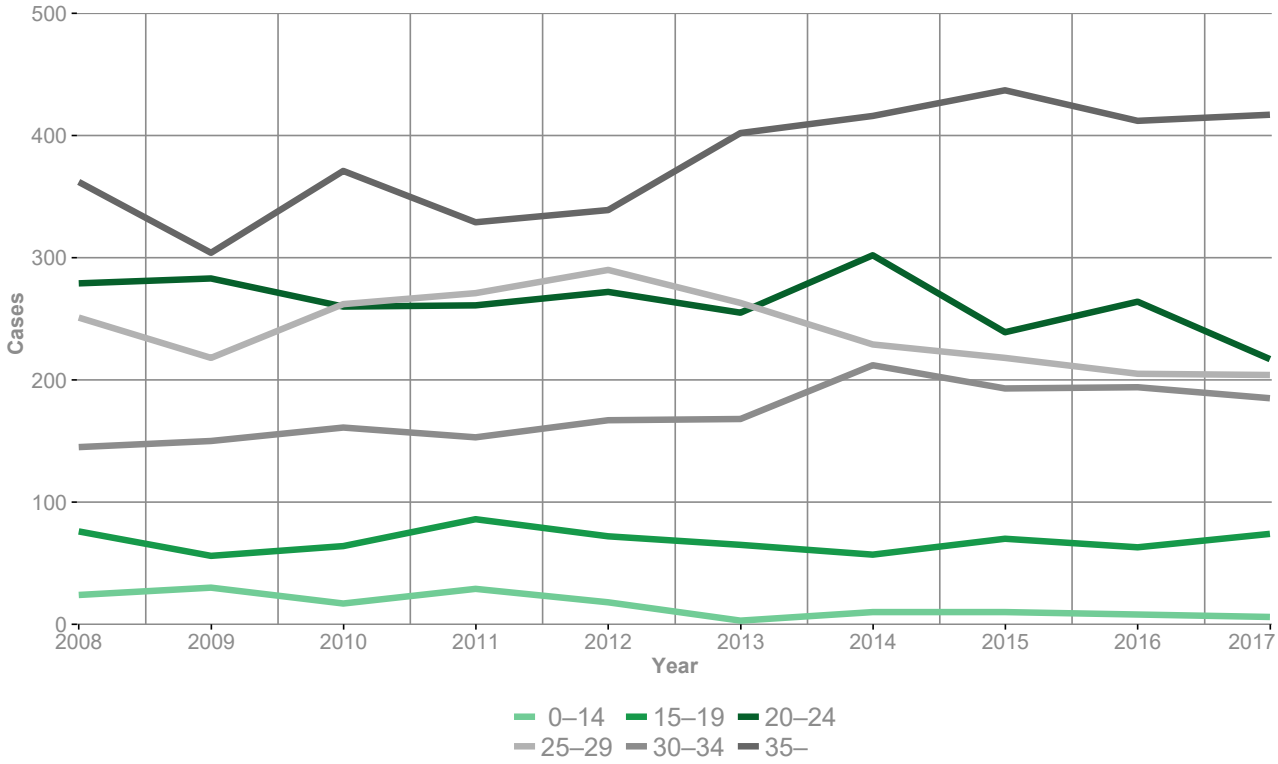

Figure 11. Hepatitis C by age group, 2008–2017 (no. of cases).

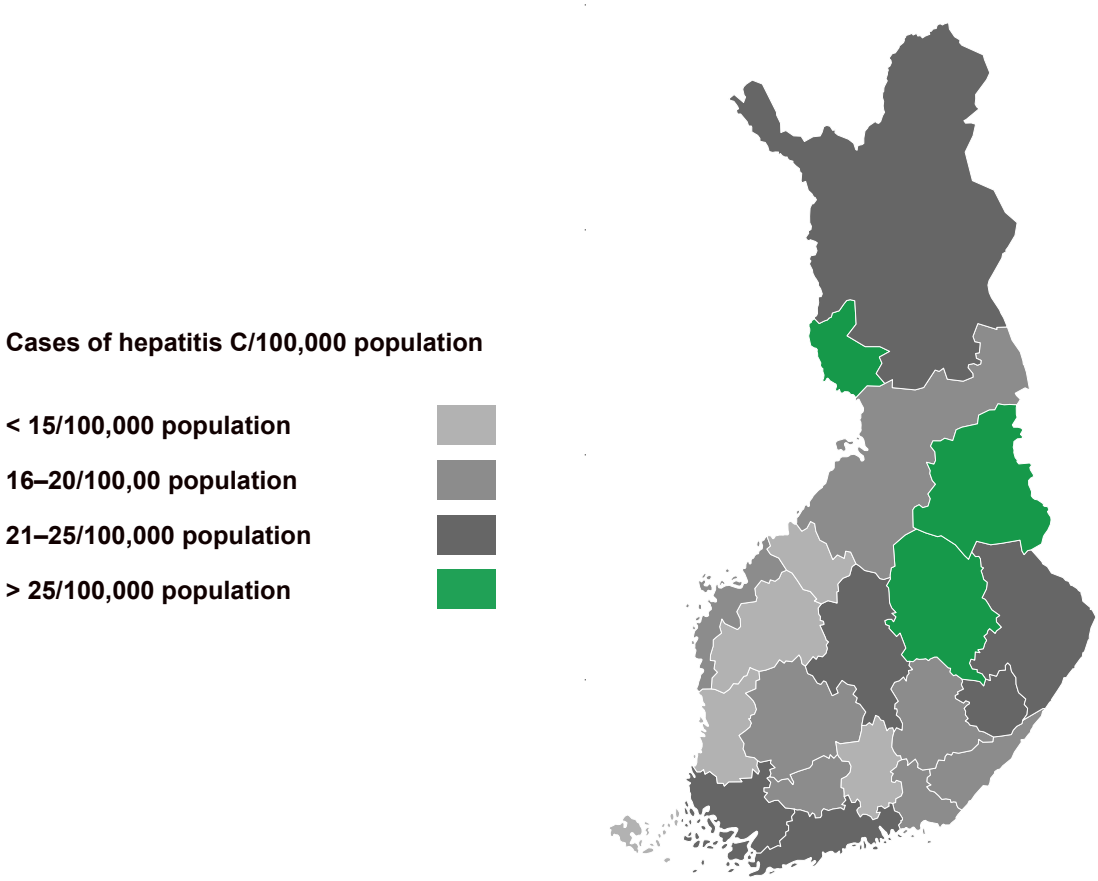

Figure 12. Incidence of hepatitis C (cases/100,000 population) by hospital district, 2017.

Sexually transmitted diseases

- The increase in chlamydia infections appears to have slowed down.
- A record number of gonorrhoea cases was diagnosed, over 70% of them in men.
- The majority of syphilis and gonorrhoea infections had been acquired in Finland.
- A significant proportion of HIV, syphilis and gonorrhoea infections had been contracted in sexual contact between men.

CHLAMYDIA (CHLAMYDIA TRACHOMATIS)

In 2017, 14,461 chlamydia infections were diagnosed (263/100,000). The increase in the number of chlamydia infections observed earlier appears to have slowed down. The highest number of cases (34%) was reported in the Helsinki and Uusimaa Hospital District but, as in the previous year, the highest incidence was reported in the Southwest Finland Hospital District (329/100,000). In addition to the prevalence of the disease, its incidence is also likely to be influenced by the testing rate.

Typically for chlamydia, most cases were diagnosed in women, young adults and persons of Finnish origin: 59% were women, 79% aged 15 to 29 and 91% Finnish. The highest incidence (1,719/100,000) was recorded in the age group 20 to 24. The incidence of chlamydia was significantly greater in women than in men in the age group 15 to 24, in the same range for both genders in the age group 25 to 29, and greater in men than in women in those aged over 29. Over the longer term, the number of infections diagnosed in the age group 15 to 19 has decreased; this figure is down by almost one quarter when comparing years 2017 and 2008. In the older age groups, on the other hand, the infections have become more widespread.

Physicians do not report chlamydia cases to the National Infectious Diseases Register, and no data are thus available on the modes of transmission and countries of acquisition.

LGV (LYMPHOGRANULOMA VENEREUM)

In 2017, five LGV cases caused by *Chlamydia trachomatis* were reported, four in men and one in a woman. Three of the infected patients were of Finnish and two of foreign origin. Three infections had been contracted abroad and one in Finland, and in one case the origin of the infection was not known. All infections diagnosed in men had been acquired through sexual contact between men.

The reporting of LVG cases began in 2011. By the end of 2017, a total of 32 infections had been reported, all bar one in men, 25 in Finnish citizens and seven in foreigners. 14 infections had been contracted abroad, 12 in Finland, and in 6 cases the origin of the infection was not known. In men's infections, the gender of the sexual contact had been reported excluding one case, and all these concerned sexual contact with a man.

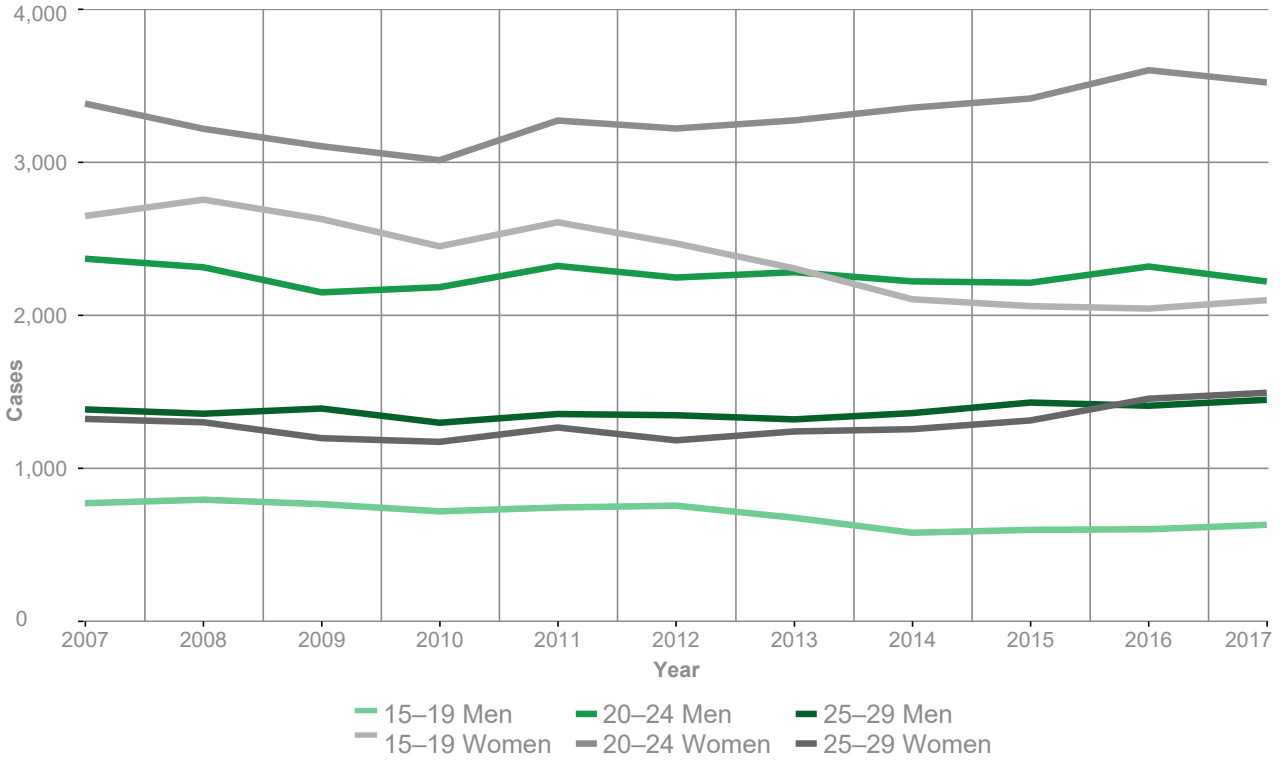

Figure 13. Chlamydia cases in the young adult age groups, 2008–2017 (no. of cases).

GONORRHOEAE (NEISSERIA GONORRHOEA)

The number of gonorrhoea infections continued to increase strongly in 2017. A total of 597 cases of gonorrhoea were reported (10.9/100,000), which exceeds the previous year's number by 181 and is the largest annual figure reported to the National Infectious Diseases Register so far. The highest number of infections, accounting for 64% of all cases, was reported in the Helsinki and Uusimaa Hospital District, where the highest incidence was also found (23.2/100,000).

73% of the infections were reported in men. However, the number of women's infections has increased more strongly than men's compared to 2016 (66% and 37%). The incidence (40.8/100,000) was highest in the age group 25 to 29, with an incremental decrease towards each older age group. 76% of the infections were diagnosed in individuals of Finnish origin.

The origin of the infection was reported in 86% of the cases. Of the infections in both Finnish and foreign patients where the origin of the infection was known, the majority had been acquired in Finland (71% and 55%).

The gender of the sexual contact was reported in 77% of the cases in men. Of these infections, 66% had been acquired in sexual contact between men. 72% of the infections contracted in sexual contact between men (excluding cases where the origin was not known) had been acquired in Finland, and 76% of the cases were reported in the Helsinki and Uusimaa Hospital District.

Gonorrhoea is in most cases diagnosed by means of PCR. The antimicrobial susceptibility of gonorrhoea is monitored by means of cultures – in 2016, as few as slightly over one half of the strains had been cultured. No Gonococcus strains resistant to ceftriaxon had been reported in Finland by the end of 2016.

SYPHILIS (TREPONEMA PALLIDUM)

In 2017, 182 syphilis infections were diagnosed (3.3/100,000). The figure includes both reported active infections and old serological scars. The number of infections decreased by 49 from the year before. In particular, fewer infections were diagnosed in foreigners. This is probably explained by the fact that the statistics for 2016 were affected by screenings for infectious diseases associated with the refugee crisis of 2014−2015. Slightly over one half of the cases were reported in the Helsinki and Uusimaa Hospital District. As in the year before, the highest incidence was reported in the South Karelia Hospital District (6.1/100,000).

74% of the infections were reported in men. The highest incidence (11,2/100,000) was recorded in the age group 35 to 39. One half of the infections were diagnosed in persons of a foreign background. It is likely that some of them had an old serological scar.

The country of acquisition was reported in 73% of all cases. Finnish citizens had predominantly contracted the infection at home (58%). The majority of foreign patients (83%), on the other hand, had acquired the disease abroad.

For 64% of the infections in men, the gender of the sexual contact was known. Of these cases, 74% had acquired the infection in sexual contact between men. 56% of the infections related to sexual contact between men where the country of acquisition was known had been contracted in Finland.

HIV AND AIDS

In 2017, 158 new HIV infections were diagnosed (2.9/100,000), or 22 less than the year before. As in previous years, the highest number of cases (45%) was reported in the Helsinki and Uusimaa Hospital District, even if the figure for this district dropped by almost two thirds compared to 2016. The highest incidence was reported in the South Karelia Hospital District (6.1/100,000).

56% of the HIV infections were diagnosed in foreigners, and 64% in men. The proportion of Finnish men was higher than that of foreign men (81% and 50%). The highest incidence (8.4/100,000) was reported in the age groups 30 to 34 and 35 to 39. At the time of diagnosis, the average age of Finnish patients was higher than that of foreigners (49 compared to 36 years).

The share of heterosexual contact in the infections was 43%, sexual contact between men 20%, injecting drugs 6% and blood products 1%. In 29% of the cases, the mode of transmission was not known. In almost one half of these, there was no physician's report.

The number of reported infections contracted in heterosexual contact was 68, of which foreigners accounted for 52%. The country of acquisition was known in all cases except four. 77% of the infections had been contracted abroad. As in previous years, a high proportion of infections in Finnish people were contracted by men in Thailand.

The number of infections acquired through sexual encounters between men was 32. Of these, individuals of Finnish origin accounted for 63%. The country of acquisition was known in all cases except two. 67% of the infections had been acquired abroad.

Ten infections associated with injecting drugs were diagnosed, all in foreigners and contracted abroad. Since the epidemic at the turn of the millennium, efficient prevention methods have helped to keep the number of infections contracted by Finnish people at a low level.

A blood transfusion carried out abroad was reported as the source of infection in two foreigners. Since HIV testing of donated blood began in Finland in 1985, no cases of infection through blood products have been reported in Finland.

The CD4 value was reported in 78% of the cases. In 48%, it was below 350 at the time of diagnosis. A total of 18 new AIDS cases was reported, 11 in foreigners and 7 in Finnish people. The principal reason for AIDS cases was a late diagnosis – in all cases except one, AIDS was diagnosed within three months of the HIV diagnosis. The challenge thus lies in detecting HIV infections earlier. Early diagnosis can help prevent morbidity, mortality and the spread of infection.

By the end of 2017, the total number of HIV infections diagnosed in Finland was 3,898. The reported number of HIV positive patients who died is 498, with 26 deaths in 2017. Because of efficient HIV medication, the majority of deaths in the 2000s were due to reasons other than HIV.

An updated HIV strategy for 2018–2020 (http://urn.fi/URN:ISBN:978-952-302-983-5, in finninsh) was published in December 2017. Its main objective is to reduce the number of new HIV infections and the morbidity and mortality caused by infections as well as to minimise the effects of HIV for those who are infected, the people close to them, and on the level of society as a whole. A precondition for achieving these objectives is targeting prevention at population groups with a high HIV risk and providing tailored services for them. Versatile combinations of different social, behavioural and medical methods as well as strong collaboration between different actors will also be needed.

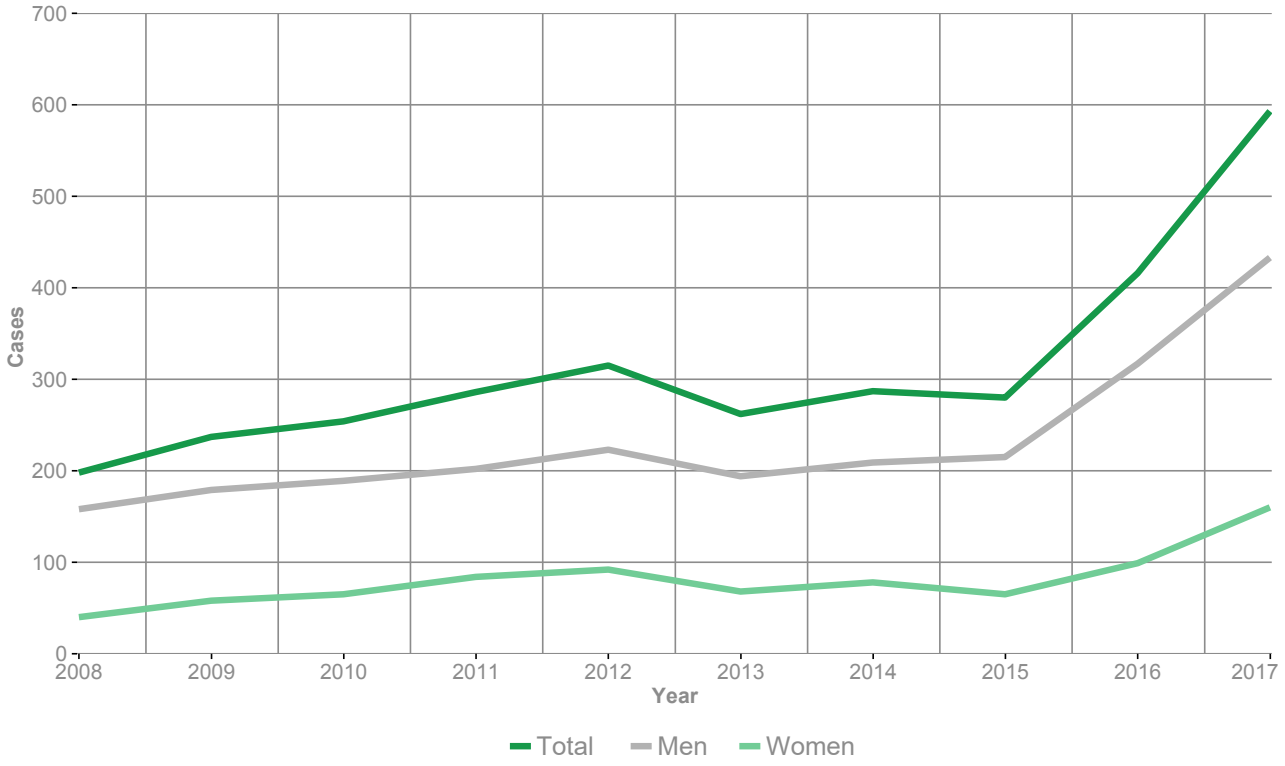

Figure 14. No. of gonorrhoea cases by gender, 2008–2017.

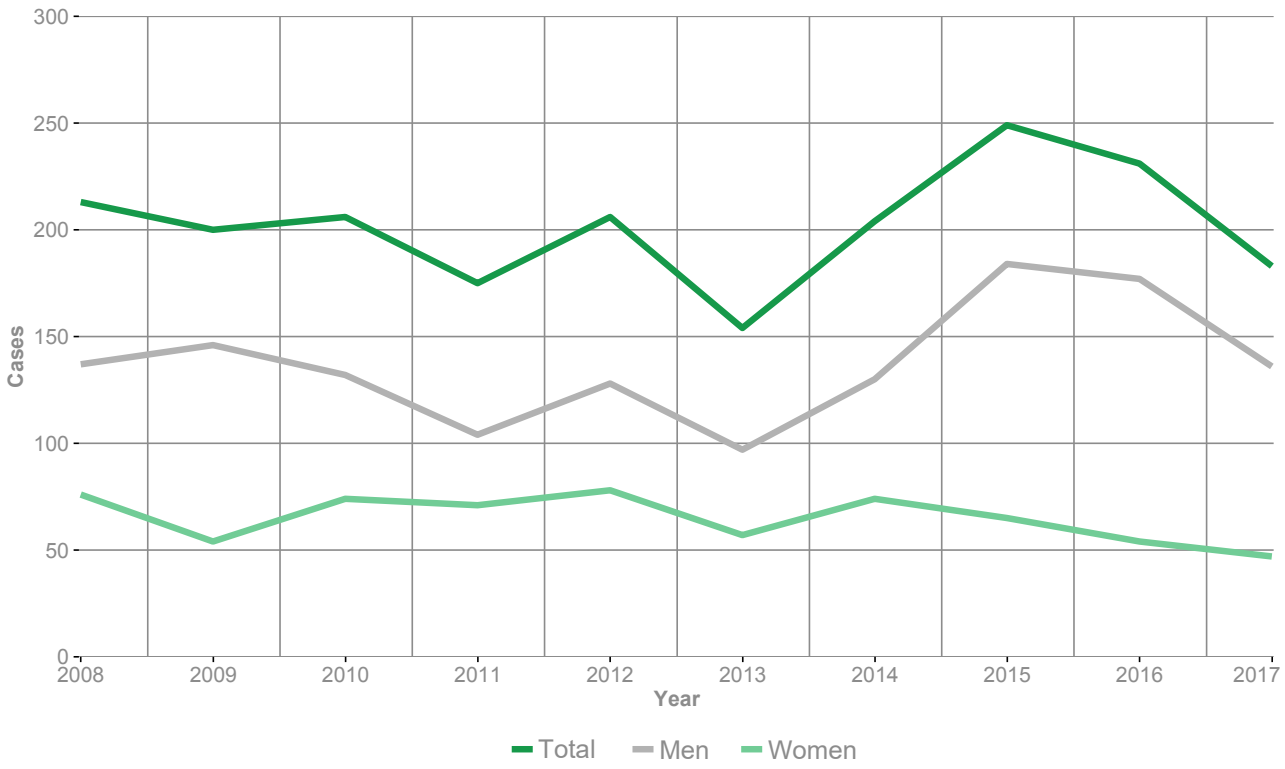

Figure 15. No. of syphilis cases by gender, 2008–2017.

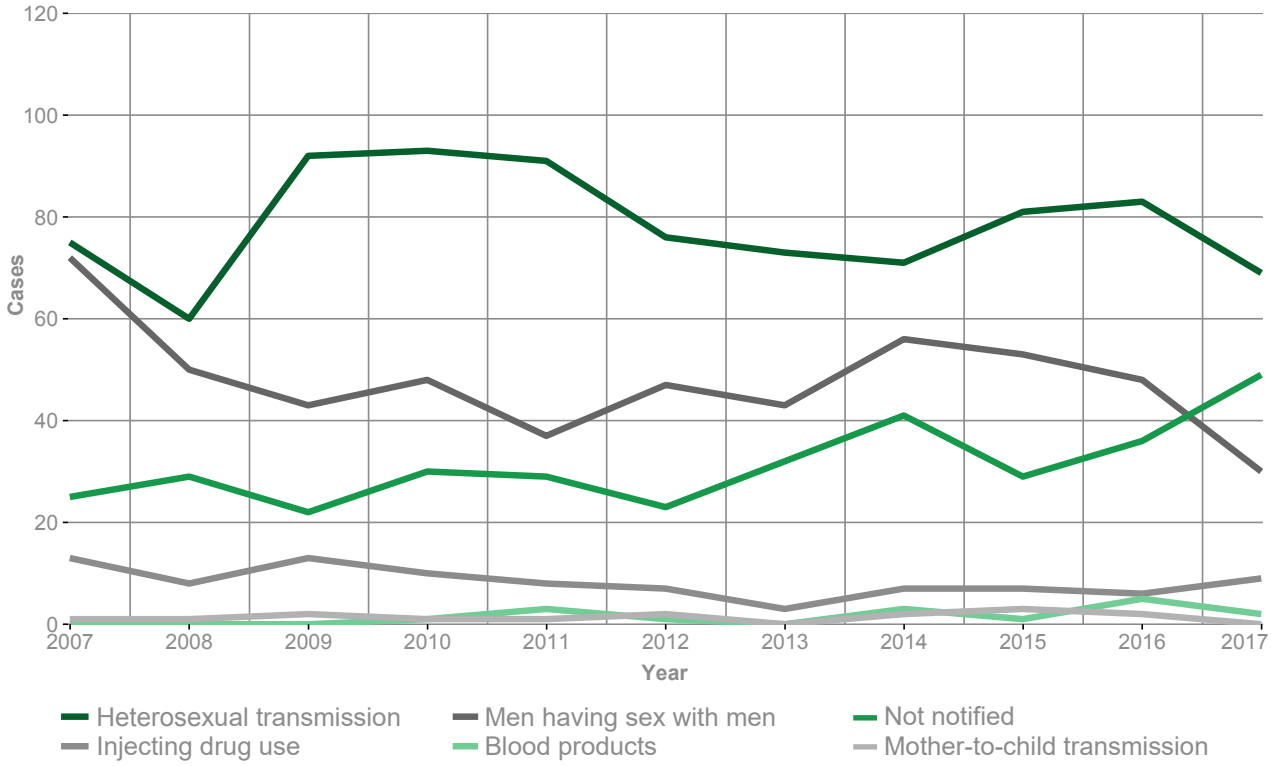

Figure 16. HIV cases by mode of transmission, 2008–2017 (no. of cases).

Antimicrobial resistance

- While the number of MRSA infections was lower than the year before, the number of MRSA findings in blood cultures changed little. MRSA infections in children continued to increase.
- The number of VRE cases was in the same range as the year before, but the number of findings in blood cultures was higher.
- The number *E. coli* ESBL findings was slightly smaller than the year before, while findings in blood cultures increased.
- CPE cases remain relatively rare but show a continuous increase. More than one half of the CPE infections had probably been acquired abroad.

MRSA

In 2017, 1,435 new cases of MRSA (methicillin resistant *Staphylococcus aureus*) were reported, which is less than in the year before (2016: 1,700). The number of MRSA cases diagnosed on the basis of blood cultures was similar, however (2017: 44, 2016: 49). Of the MRSA blood culture findings, 13 were made in the Helsinki and Uusimaa Hospital District (0.8/100,000), six in Pirkanmaa (1.0/100,000) and five in Southwest Finland (1.0/100,000), while the other hospital districts reported zero to four cases, totalling 20. Most invasive cases occurred in men (31/44), and more than a half in the 60 and over age group (24/44), while four were found in children. The highest total number of cases was reported in the hospital districts of Helsinki and Uusimaa (506) and Pirkanmaa (242), and the incidence was highest in Pirkanmaa (46/100,000) and Päijät-Häme (42/100,000). Similarly to the year before, approximately one out of four was diagnosed in the age group 20 to 34 (2017: 24%, 2016: 26%), while a smaller proportion than before was diagnosed in those aged 65 and over (2017: 28%, 2016: 34%). The increase of MRSA cases in children continued (2017: 212, 2016: 194).

Patients arriving at hospital are screened for MRSA if they have been in a refugee camp or hospitalised abroad in the last 12 months. In 2017, 154 patients who did not have a Finnish personal identity code were diagnosed as MRSA carriers (2016: 371 findings). This group is highly likely to include not only tourists but also a significant number of asylum seekers.

The MRSA strain was typed in 1,563 individuals. There were 274 different spa types among the MRSA strains (2016: 262; 2015: 247). While the most common spa types are the same as the year before, t304 has replaced t067 as one of the three most common spa types. The three most common spa types were: t008 9% (2016: 12%, 2015: 8%), t172 7% (2016: 10%, 2015: 16%) and t304 7% (2016: 7%, 2015: 4%). The next most common spa types were: t067 6%, t223 6%, t127 4% and t044 3%.

t008 occurred in 15 hospital districts. It was the most common spa type in the hospital districts of Helsinki and Uusimaa, Kymenlaakso and Länsi-Pohja. t172 occurred in 13 different hospital districts, and it was the most common spa type in the South Savo Hospital District. t304 was the most common spa type in the hospital districts of Southwest Finland, South Karelia and Päijät-Häme. In proportion, the greatest number of spa type t067 cases was diagnosed in the South Ostrobothnia Hospital District, where the strain caused a cluster. However, the greatest number of t067 strains was typed in the Pirkanmaa Hospital District.

The two most common spa types in patients aged 75 and over were t067 18% (2016: 17%), t172 13% (2016: 13%) and t008 10% (2016: 19%). The most common spa types among children under the age of 16 were t223 13% (2016: 12%), t304 13% (2016: 13%), t127 6% (2016: 4%) t008 5% (2016: 7%) and t172 4% (2016: 4%).

An invasive strain was typed in 46 individuals. The most common spa types were : t008 (2017: 10 and 2016: 9), t067 (2017: 5 and 2016: 6), t172 (2017: 4 and 2016: 4), t304 (2017: 4 and 2016: 2), t032 (2017: 2 and 2016: 0) and t767 (2017:2 and 2016: 0). The remaining 20/46 isolates each represented different spa types.

In 2017, five MRSA strains with the *mecC* gene were isolated from clinical samples (2016: 5). Of these, one represented spa type t10471 and the other four spa type t843.

Spa types of the MRSA CC398 complex related to production animals were found in the samples of 49 individuals. In 2017, it accounted for 3.4% of new MRSA cases (2016: 2.9%, 2015: 3.2%, 2014: 1.3%). Spa type t034 remains clearly the most common strain of the CC398 complex in Finland (2017): 33/49; 2016: 37/49; 2015: 33/41). No MRSA CC398 findings were made in blood samples in 2017. In total, five such findings have been made in Finland (2016: 2, 2015: 2 and 2013: 1). Other spa types of the CC398 complex found in Finland include t011, t108, t571, t899, t1250, t1255, t2582, t2741, t1259 and t16760.

Table 4. MRSA findings and their percentage of *S. aureus* blood culture findings, 1995–2017 (no. of cases and %).

Year	MRSA findings	S.aureus blood culture findings	MRSA blood culture findings and S.aureus methicillin resistance (%)
1995	89	627	2 (0.3)
1996	110	667	0 (0.0)
1997	121	747	4 (0.5)
1998	190	719	5 (0.7)
1999	212	813	8 (1.0)
2000	266	850	4 (0.5)
2001	340	887	4 (0.5)
2002	600	989	9 (0.9)
2003	859	981	7 (0.7)
2004	1,479	1,059	30 (2.8)
2005	1,374	1,013	27 (2.7)
2006	1,331	1,240	37 (3.0)
2007	1,254	1,179	33 (2.8)
2008	1,728	1,260	40 (3.2)
2009	1,266	1,289	30 (2.3)
2010	1,267	1,374	26 (1.9)
2011	1,328	1,484	43 (2.9)
2012	1,287	1,492	30 (2.0)
2013	1,282	1,590	29 (1.8)
2014	1,342	1,925	46 (2.4)
2015	1,274	2,051	40 (2.0)
2016	1,700	2,209	49 (2.2)
2017	1,435	2,270	44 (1.9)

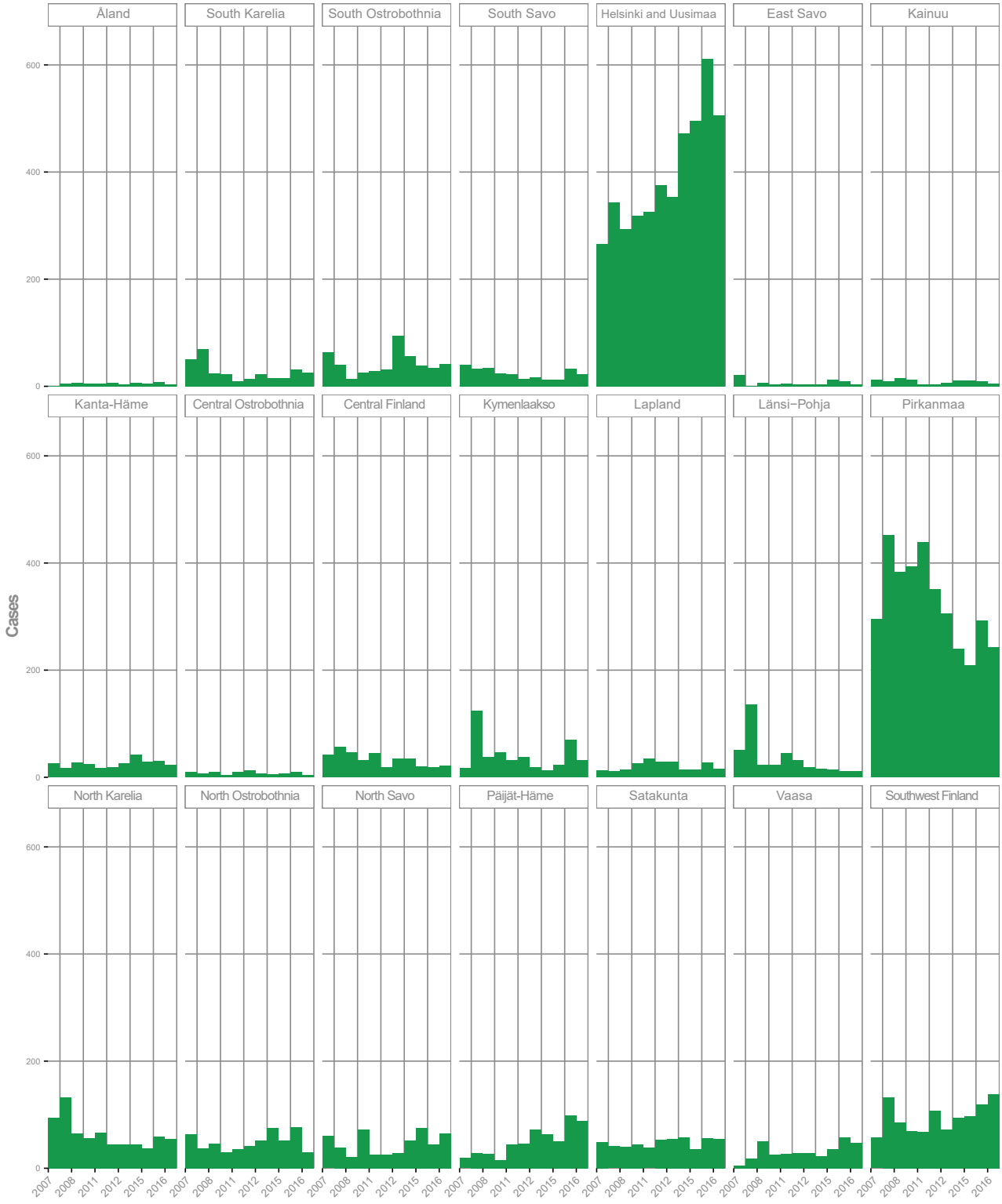

Figure 17. MRSA cases by hospital district and by year, 2008–2017 (no. of cases).

VRE

In 2017, the number of new VRE (vancomycin resistant enterococcus) cases was similar to the year before (2017: 66, 2016: 71). The highest numbers of findings were in the hospital districts of North Savo (22), Helsinki and Uusimaa (10) and North Ostrobothnia (8). In the other hospital districts, the number of findings varied from zero to six. Four of the findings were based on a blood sample, while in general, VRE has been found in blood less often (2013-2016: 0-1).

In total, 65 VRE findings were sent to the microbial strain collection. 64 of them were of the species *Enterococcus faecium* (17 *vanA*, 47 *vanB*) and one *E. faecalis* (*vanB*). A cluster of 28 cases caused by *vanB* positive *E. faecium* (ST117) was found in the North Karelia Hospital District. In the North Ostrobothnia Hospital District, on the other hand, five *vanB* positive *E. faecium* (ST780) isolates were typed, which were part of the cluster already identified in 2016. In addition, two small local clusters of two patients and one cluster of three patients were found. The remainder of the typed strains (25/65) were isolated findings. As in 2016, all VRE strains were typed using whole genome sequencing (WGS).

ESBL

Since the beginning of 2008, third-generation *Escherichia coli* and *Klebsiella pneumoniae* exhibiting reduced susceptibility or resistance to cephalosporin (I for intermediate and R for resistant, respectively) have been reported to the National Infectious Diseases Register. An estimated 90 percent of these bacteria are extended-spectrum beta-lactamase-producing cephalosporins and so-called ESBL strains producing enzymes that break down all penicillins.

In 2017, the majority of the findings were *E. coli* (4,648; in 2016: 4,690), and a small minority were *K. pneumoniae* strains (492; in 2016: 407). *E. coli* ESBL findings were made in all age groups, 75% in women and one half in patients aged 65 or over. More than one half of the findings (55%) were based on urine cultures. While the largest number of cases was found in the Helsinki and Uusimaa Hospital District (1,364, 83/100,000), the highest incidence was recorded in the hospital districts of South Karelia (136/100,000) and Kymenlaakso (136/100,000). The number of blood culture findings exceeded the figures for 2016 (316 compared to 286) (the proportion of ESBL in *E. coli* blood cultures: 316/5,232, 6.0% compared to 2016: 5.8%). Of these findings, 30% were made in the Helsinki and Uusimaa Hospital District (6/100,000). However, the incidence of blood sample findings was the highest in the hospital districts of North Karelia, South Karelia, South Savo, Lapland and East Savo (10–14/100,000).

More than 60% of ESBL findings involving *K. pneumoniae* were diagnosed in patients aged 65 and over but, at 57%, the proportion of women was smaller than in *E. coli* ESBL findings. Almost one half of the diagnoses (48%) were based on urine. The largest numbers of cases were recorded in the hospital districts of Helsinki and Uusimaa (138) and Southwest Finland (66), while the highest incidences were reported in the hospital districts of Lapland (24/100,000) and Kymenlaakso (21/100 000). 24 of the findings (2016: 27) were based on blood (the ESBL proportion in *K. pneumoniae* blood cultures: 2017: 24/741, 3.2% compared to 2016: 3.5%).

The resistance of third-generation *E. coli* to cephalosporin continues to increase in Finland, albeit at a clearly slower rate than before. The increase appears to have started slowing down since 2013 and concerns colonisation. It remains to be seen if the increase will stall completely and if resistance to cephalosporin of the *E. coli* stabilises at its current level. The cephalosporin resistance of *K. pneumoniae* is low but continues to increase steadily.

Table 5. E. coli findings with reduced susceptibility to third-generation cephalosporins (possible ESBL, extended-spectrum β-lactamase) and ESBL percentage, 2008–2017 (no. of cases and %).

	ESBL findings	E. coli blood culture findings	ESBL E. coli blood culture findings and percentage of ESBL E. coli (%)
2008	1,674	2,814	43 (1.5)
2009	2,177	2,989	77 (2.6)
2010	2,559	3,226	111 (3.4)
2011	3,138	3,475	149 (4.3)
2012	3,686	3,463	203 (5.9)
2013	4,464	3,876	233 (6.0)
2014	4,190	4,366	232 (5.3)
2015	4,175	4,532	232 (5.1)
2016	4,690	4,966	286 (5.8)
2017	4,648	5,232	316 (6.0)

Table 6. K. pneumoniae findings with reduced susceptibility to third generation cephalosporins (possible ESBL, extended-spectrum β-lactamase) and ESBL percentage, 2008–2017, (no. of cases and %).

	ESBL findings	K. pneumoniae blood culture findings	ESBL K. pneumoniae blood culture findings and percentage of ESBL K. pneumoniae (%)
2008	116	418	3 (0.7)
2009	156	480	6 (1.3)
2010	190	508	16 (3.1)
2011	242	453	10 (2.2)
2012	242	583	10 (1.7)
2013	238	570	12 (2.1)
2014	307	634	20 (3.2)
2015	288	670	15 (2.3)
2016	407	770	27 (3.5)
2017	492	741	24 (3.2)

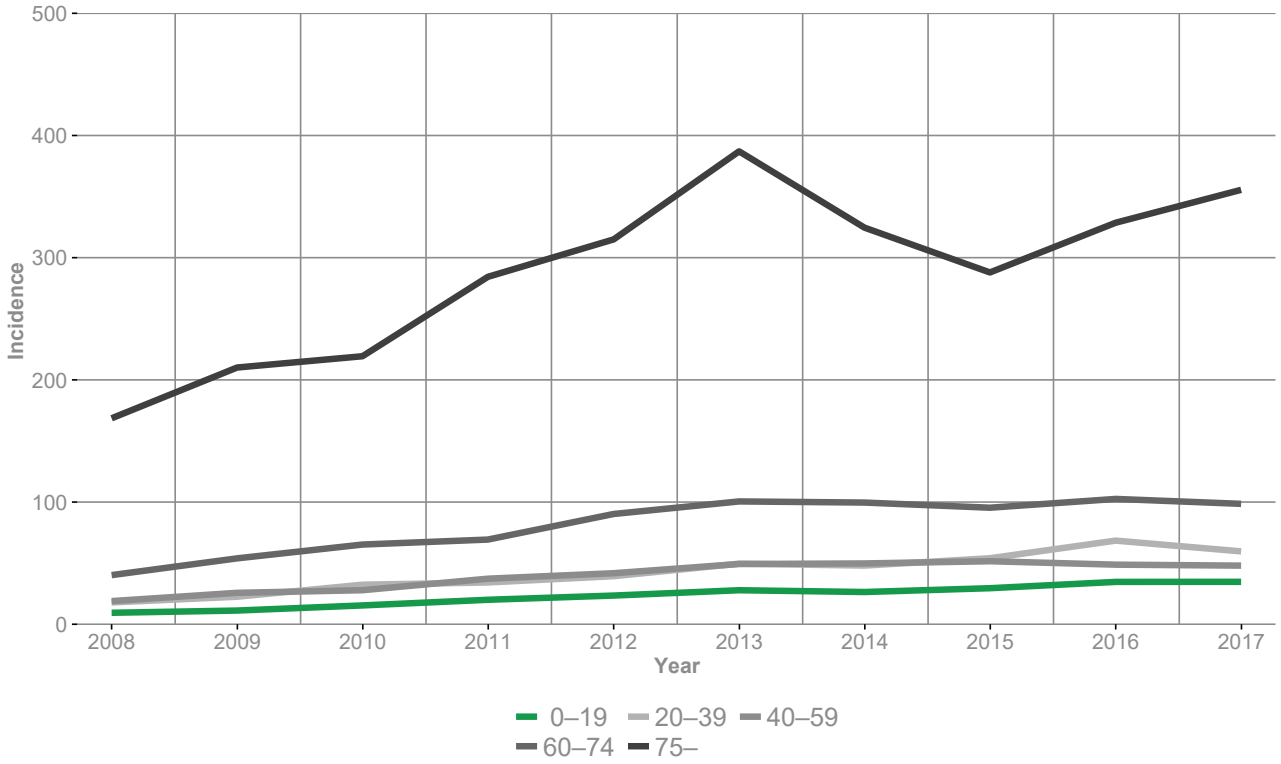

Figure 18. Incidence of E. coli findings (cases/100,000 population) with reduced susceptibility and resistance to third-generation cephalosporins (possible ESBL, extended-spectrum β-lactamase) by age group 2008–2017.

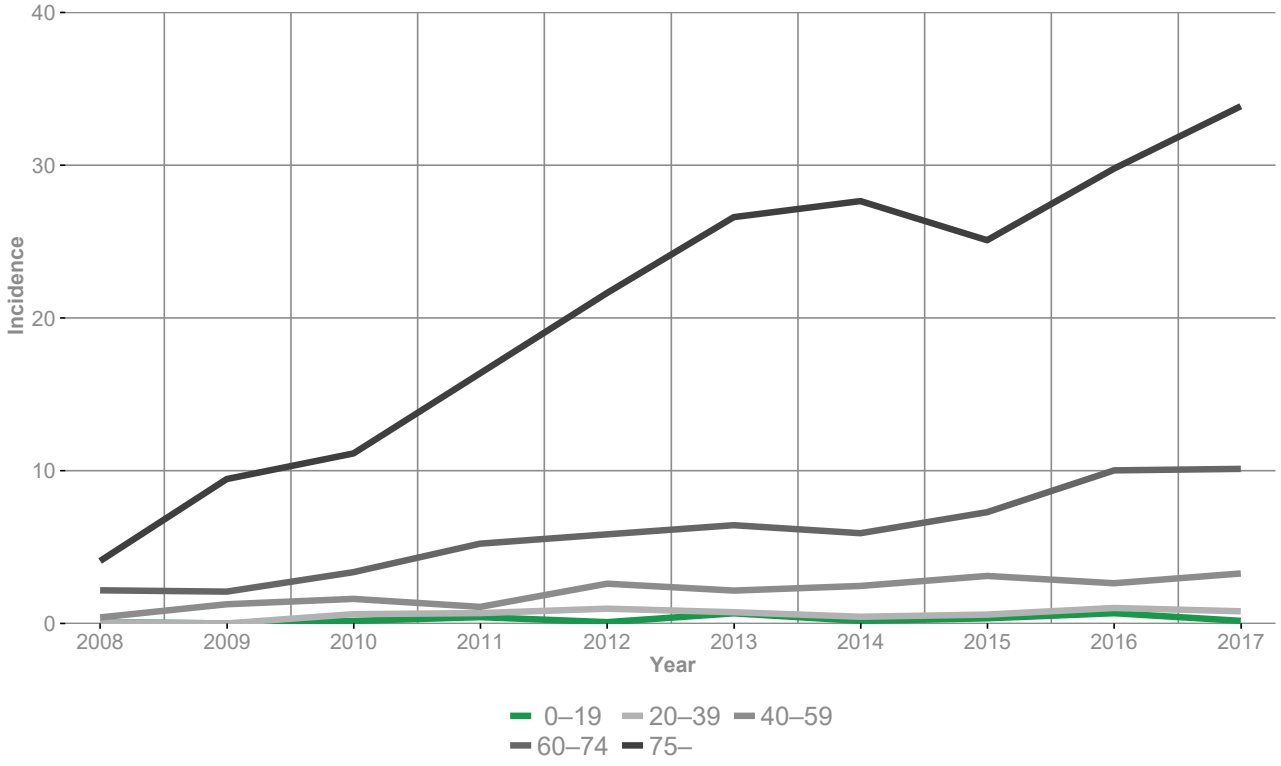

Figure 19. Incidence of E. coli findings (blood and cerebrospinal fluid findings /100,000 population) with reduced susceptibility and resistance to third-generation cephalosporins (possible ESBL, extededspectrum β-lactamase) by age group 2008–2017.

CPE

In 2017, 65 findings were reported to the National Infectious Diseases Register showing enterobacteria with reduced susceptibility (intermediate, I) or resistance (resistant, R) to carbapenemase, i.e. the bacterial strain was possibly CPE. Of these findings, 37 were *Escherichia coli*, 20 *Klebsiella pneumoniae* and 8 *Enterobacter cloacae*.

A total of 134 suspected CPE samples were sent to the National Institute for Health and Welfare, of which 48 were confirmed as carbapenemase-producing, or considerably more than in the year before (2016: 36). Most findings involved *E. coli* strains (25), while *K. pneumoniae* strains were also common (17). In addition, individual other enterobacter species with the carbapenemase gene were isolated, including *Enterobacter cloacae*, *Enterobacter kobei*, *Citrobacter freundii* and *Morganella morganii*. The most common carbapenemases were NDM-5, OXA-181, OXA-48, KPC-3 and NDM-1. The majority of CPE strains were found in colonisation samples. The median age of the patients was 60.

More than one half of the CPE infections had probably been acquired abroad. In 2013–2017, three clusters of infections caused by KPC-3 positive *K. pneumoniae* (ST512) in care institutions have been found in Finland.

In 2008–2017, the most common CPE finding has been *K. pneumoniae* (approx. 49%). Findings to be reported to the National Infectious Diseases Register (*K. pneumoniae*, *E. coli* and *E. cloacae*) account for 92% of all CPE findings. While the number of CPE cases in Finland remains relatively small, it has grown continuously. In particular, an increase has been observed in carbapenemase-producing strains NDM and OXA. In most cases, these involve *E. coli*.

Table 7. Carbapenemase-producing enterobacteria (CPE), 2009–2017, (no. of cases).

	CPE findings	
Year	Number of bacterial strains	Number of patients
2009	5	5
2010	8	8
2011	12	11
2012	9	8
2013	21	20
2014	17	14
2015	29	29
2016	36	34
2017	48	46

Table 8. Carbapenemase-producing enterobacteria (CPE) in 2017, (no. of cases).

Carbapenemase	C. freundii	E. cloacae	E. coli	E. kobei	*K. pneumoniae	M. morganii
KPC-2	1		1			
KPC-3					7	
NDM-1		1	3		2	1
NDM-5		1	10		2	
OXA-181			6		2	
OXA-244			2		2	
OXA-48		1	3	1	3	

* One K. pneumoniae strain had both NDM-5 and OXA-48

Tuberculosis

- The number of tuberculosis cases remained stable. Foreigners accounted for 40% of the patients, which is less than the year before.
- Five children, four of whom had a foreign background, contracted tuberculosis.
- The number of tuberculosis drug-resistant *Mycobacterium tuberculosis* strains has increased slightly in recent years. Five MDR cases were diagnosed in 2017, one of which was a tuberculosis with extremely broad antimicrobial resistance.

TUBERCULOSIS

The number of tuberculosis cases was 232 (4.2/100,000), one more than in 2016 (231; 4.2/100,000). Of these, 165 (71%) were cases of pulmonary tuberculosis, 58 (35%) of which produced a positive sputum stain test. There were 194 cases of tuberculosis confirmed by culture (84%), 10 more than in 2016 (184).

The increase in the number of tuberculosis cases in Finland in 2007 and 2008 compared to 2006 can be explained by the introduction of the broader EU definition of tuberculosis cases in 2007. The annual numbers of cases confirmed by culture are comparable throughout the monitoring period.

The distribution of cases by age group was as follows: 5 (2%) in the age group under 15, 56 (24%) in the age group 15 to 29, 32 (14%) in the age group 30 to 44, 23 (10%) in the age group 45 to 59, 44 (19%) in the age group 60 to 74, and 72 (31%) in patients aged over 75. The reducing size in the population of those age groups in whose youth the incidence of tuberculosis in Finland was high and the increasing number of young immigrants have led to a notable decrease in the average age of tuberculosis patients between 2000 and 2017, from 64 to 54 years. In 2017, tuberculosis was diagnosed in five children, four of whom were of foreign origin.

The patient was reported to be foreign in 93 of all cases (40%), i.e. born abroad and assumed to have other than Finnish citizenship unless the data indicate otherwise. This was 13 less than the year before. Of these cases, 61 (66%) had pulmonary tuberculosis, and 31 (33%) other forms of tuberculosis. Information on the patient's country of birth or citizenship was missing in 11 cases (5%). 17 cases (7%) were diagnosed in individuals who did not have a Finnish personal identity code. The majority of these are asylum seekers.

In two (1%) of the tuberculosis cases reported in 2017, the patient also had an HIV infection. Both HIV infections were reported as new cases in 2017. The patients were of a foreign origin.

Tuberculosis strain susceptibility to medication in 2017

Although susceptibility to medication is still fairly good, the number of *Mycobacterium tuberculosis* strains resistant to tuberculosis medication has grown. Of all cultured strains, 87% had full susceptibility and, in 25 cases, resistance to one or several drugs was diagnosed. Of the five MDR cases diagnosed during the year, one case was an extended-drug resistant (XDR) tuberculosis. All cases with MDR had been born abroad: two patients originated in Estonia, two in Russia and one in Iraq. One MDR case was diagnosed in an asylum seeker.

Tuberculosis genotyping findings in 2017

M. tuberculosis strains were analysed using the internationally standardised spoligotyping and MIRU-VNTR methods, and whole genome sequencing was also used in investigations of epidemics.

In 2017, the most common spoligotypes were SIT53 (21 strains) and SIT 50 (10 strains). Only 9 patients were diagnosed with Beijing type SIT1. Of the strains identified in 2017, 118 (59%) belonged to one of the clusters with the same spoligotype and MIRU-VNTR type detected either last year or in preceding years. Each cluster consisted of at most four strains isolated in 2017, and major clusters were thus not observed.

Tuberculosis outcome surveillance in 2012–2016

Table 10 shows the distribution of treatment outcomes between 2012 and 2016. An outcome evaluation is performed 12 months after the case is registered. A significant number (117) of outcome evaluation reports for 2016 were missing when the annual report was written, but the treatment outcome was good in 78% of the cases in 2016 (54 cases). This falls clearly short of the international target set by the WHO at 85%, but is on a par with the average for most EU Member States.

Other mycobacteria

A total of 732 non-tuberculotic, environmental mycobacteria were identified (incidence 13.3/100,000). The most common of these found in patient samples were *Mycobacterium avium* (182), *Mycobacterium gordonae* (177) and *Mycobacterium intracellulare* (92). Nine of them were diagnosed in children under the age of 5.

Table 9. Incidence of tuberculosis (cases/100,000 population) and percentage of culture-confirmed cases in Finland, 1995–2017 (no. of cases and %).

	Pulmonary tuberculosis				Other tuberculosis		All cases				Foreigners	
	Cases	Incidence	Cases with positive sputum smear	Incidence	Cases	Incidence	Cases	Incidence	Culture confirmed	Culture conf. %	Cases	%
1995	436	8.6	243	4.8	223	4.4	659	12.9	472	71.6	30	4.6
1996	451	8.8	243	4.7	206	4.0	657	12.8	511	77.8	36	5.5
1997	359	7.1	188	3.7	214	4.3	573	11.4	440	76.8	43	7.5
1998	399	7.8	207	4.0	213	4.1	612	11.9	493	80.6	50	8.2
1999	399	7.7	183	3.5	193	3.7	592	11.5	506	85.5	41	6.9
2000	372	7.2	225	4.4	170	3.3	542	10.5	455	83.9	42	7.7
2001	316	6.1	155	3.0	182	3.5	498	9.6	416	83.5	58	11.6
2002	297	5.7	136	2.6	178	3.4	475	9.1	394	82.9	44	9.3
2003	293	5.6	147	2.8	122	2.3	415	8.0	351	84.6	39	9.4
2004	233	4.5	127	2.4	102	2.0	335	6.4	291	86.9	33	9.9
2005	269	5.1	137	2.6	103	2.0	372	7.1	324	87.1	41	11.0
2006	206	3.9	99	1.9	90	1.7	296	5.6	271	91.6	47	15.9
2007	229	4.4	93	1.8	118	2.2	347	6.6	251	72.3	67	19.3
2008	213	4.0	105	2.0	127	2.4	340	6.4	246	72.4	46	13.5
2009	289	5.5	94	1.8	124	2.4	413	7.9	303	73.4	116	28.1
2010	225	4.2	85	1.6	92	1.7	317	5.9	250	78.9	101	31.9
2011	232	4.3	84	1.6	92	1.7	324	6.0	252	77.8	80	24.7
2012	194	3.6	83	1.5	82	1.5	276	5.1	223	80.8	81	29.3
2013	213	3.9	92	1.7	58	1.1	271	5.0	204	75.3	87	32.1
2014	196	3.6	80	1.5	64	1.2	260	4.8	213	81.9	86	33.1
2015	195	3.6	62	1.1	76	1.4	271	5.0	215	61.6	105	38.7
2016	170	3.1	54	1.0	61	1.1	231	4.2	184	79.7	106	45.9
2017	165	3.0	58	1.2	67	1.1	232	4.2	194	83.6	93	40.1

Table 10. Results of outcome evaluation for treatment of microbiologically confirmed pulmonary tuberculosis, 2012–2016 (no. of cases and %).

	2012	2013	2014	2015	2016
Favourable	123 (74 %)	142 (78 %)	135 (76 %)	107 (77 %)	42 (78 %)
Cured	64	82	67	58	20
Treatment completed	59	60	68	49	22
Non-favourable	26 (16 %)	33 (18 %)	33 (19 %)	15 (11 %)	4 (7 %)
Deceased	26	32	28	13	0
Interrupted treatment	0	0	5	2	4
Treatment failure	0	1	0	0	0
Unknown	17 (10 %)	8 (4 %)	9 (5 %)	17 (12 %)	8 (15 %)
Treatment continues at 12 months	8	4	5	5	5
Unknown	9	4	4	12	3
Total	166	183	177	139	54

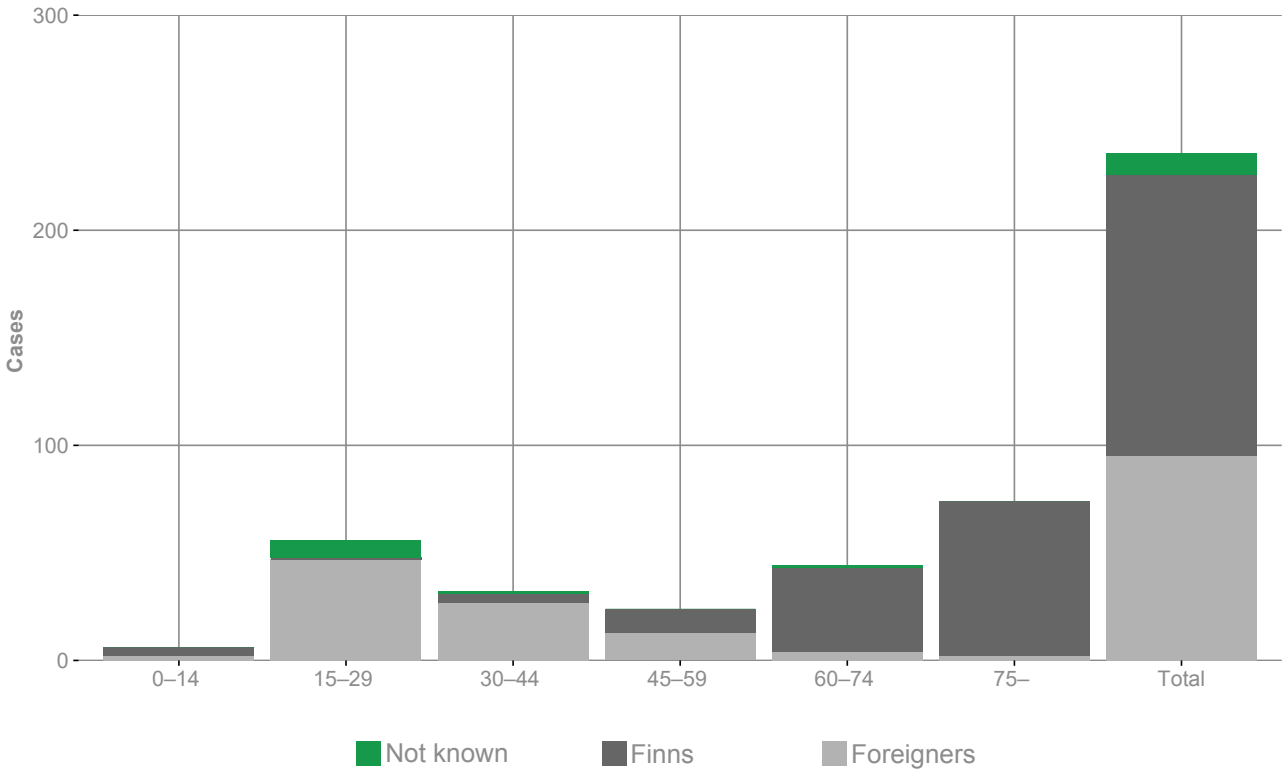

Figure 20. Tuberculosis cases by age group and origin in 2017, (no. of cases).

Other infections

- A similar number of severe pneumococcal infections was diagnosed as in the year before. The incidence of these infections increased slightly in the age group over 65 as a result of the wider spread of a non-vaccine serotype.
- Since the vaccination programme was introduced, severe pneumococcal infections caused by PCV10 vaccine serotypes have been almost totally eliminated in young children, and also reduced significantly in other age groups.
- A total of 16 meningococcal infections was reported, which is the lowest number in the history of the National Infectious Diseases Register.
- Eleven measles infections were diagnosed. One cluster of six cases originated with an unvaccinated tourist who had contracted the infection in Italy, and in the other, four adults acquired the infection in the same location while travelling in Italy.
- A significantly higher number of Borrelia findings was reported than in 2016.
- More cases of tick-borne encephalitis (TBE) were diagnosed than before. In mainland Finland, most TBE infections were contracted in known risk areas.
- The highest number of rabies exposures had taken place in Thailand. More than one half of the cases of exposure abroad were related to a dog bite, and almost one out of five to a monkey bite.
- All cases of malaria, barring one, originated in Africa. More than one half of the patients were immigrants coming from a malarious area who had travelled in their former home region.
- Two zika virus infections were diagnosed in tourists. The infections had been contracted in known risk areas.
- The number of cultured blood samples from children has remained unchanged, and slightly more than one half of the findings were made in infants aged under 12 months.
- The number of early-onset GBS cases in newborns was record-breakingly low (0.2 cases per 1,000 live births). This is probably due to improved preventive practices.
- More than 17,000 bacterial findings were detected in cultured blood samples from adults. These findings have constantly increased, particularly in patients aged 65 or over. *Escherichia coli* was the most common finding in both the working age population and in patients aged 65 and over. Other common findings included *Staphylococcus aureus*, a significant percentage of which is known to be treatment-related infections and thus preventable.
- The number of invasive group A streptococcus infections increased significantly in 2017 compared to previous years. As the predominant emm type emerged emm1, which is known to be associated with severe clinical symptoms.

INVASIVE PNEUMOCOCCAL DISEASE (STREPTOCOCCUS PNEUMONIAE)

The number of invasive, severe cases of pneumococcal disease, in which the pathogen was identified in a blood or cerebrospinal fluid culture, was 822 (15/100,000). This equals the figure from 2016 (817; 15/100,000). 4% of the patients were aged under 5, and slightly over half (53%) over 65 (Table 11).

The incidence of pneumococcal disease remained unchanged compared to 2016. As before, the incidence was higher in men than in women (16 compared to 14/100,000). In some hospital districts, the incidence was three times that of others (10–30/100,000). This may be associated with regional differences in how actively blood cultures are taken, the coverage of pneumococcus vaccinations or the epidemic situation. The disease peaked in January, in which month 112 infections were reported to the National Infectious Diseases Register (14% of the entire year's cases). It coincided with a high number of influenza A cases.

The serotypes of 812 (99%) cases of pneumococcal disease confirmed by culture were identified. 41 serotypes or groups were found. Serotypes 19A and 3 caused approximately one fifth each (serotype 19A, 186; 23% and type 3, 161; 20%) of all cases, while serotype 22F caused less than one out of ten (76; 9%) and serotype 6C 7% (57) of all infections (Figure 21). In all, serotypes 19A, 3, 22F and 6C caused 58% of all cases (2016: 58%). The most common serotype in children aged under 5 was 19A, which caused almost one out of three (9/30) of the infections in this age group (2016: 15/33, 46%).

The 10-valent pneumococcal conjugate vaccine (PCV10) has been included in the national vaccination programme for children since September 2010. Severe pneumococcal diseases caused by serotypes in the PCV10 vaccine (1, 4, 5, 6B, 7F, 9V, 14, 18C, 19F, 23F) have been almost totally eliminated in young children and reduced significantly in age groups 65 and over since the vaccination programme was launched. The vaccine serotypes continued to decrease slightly in adults in 2017 (Table 12). This is the consequence of herd immunity created by the children's vaccination programme. The only case caused by PCV10 serotypes in a child under 2 was diagnosed in an unvaccinated child.

The incidence of serotypes not included in the PCV10 vaccine has increased since the vaccination programme was launched in all age groups, excluding the youngest children, because of the serotype replacement phenomenon. In 2017, the incidence of non-vaccine serotypes remained unchanged or decreased slightly in all age groups except the oldest one, or those aged 65 and over, in which it increased slightly compared to the year before. For more detailed statistics by age and serotype, please see the National Institute for Health and Welfare's website.

Since 2016, the National Institute for Health and Welfare has no longer tested pneumococcus strains sent to the strain collection for antimicrobial susceptibility. As before, national statistics on antimicrobial sensitivity collected from clinical microbiology laboratories are published in the annual Finres report.

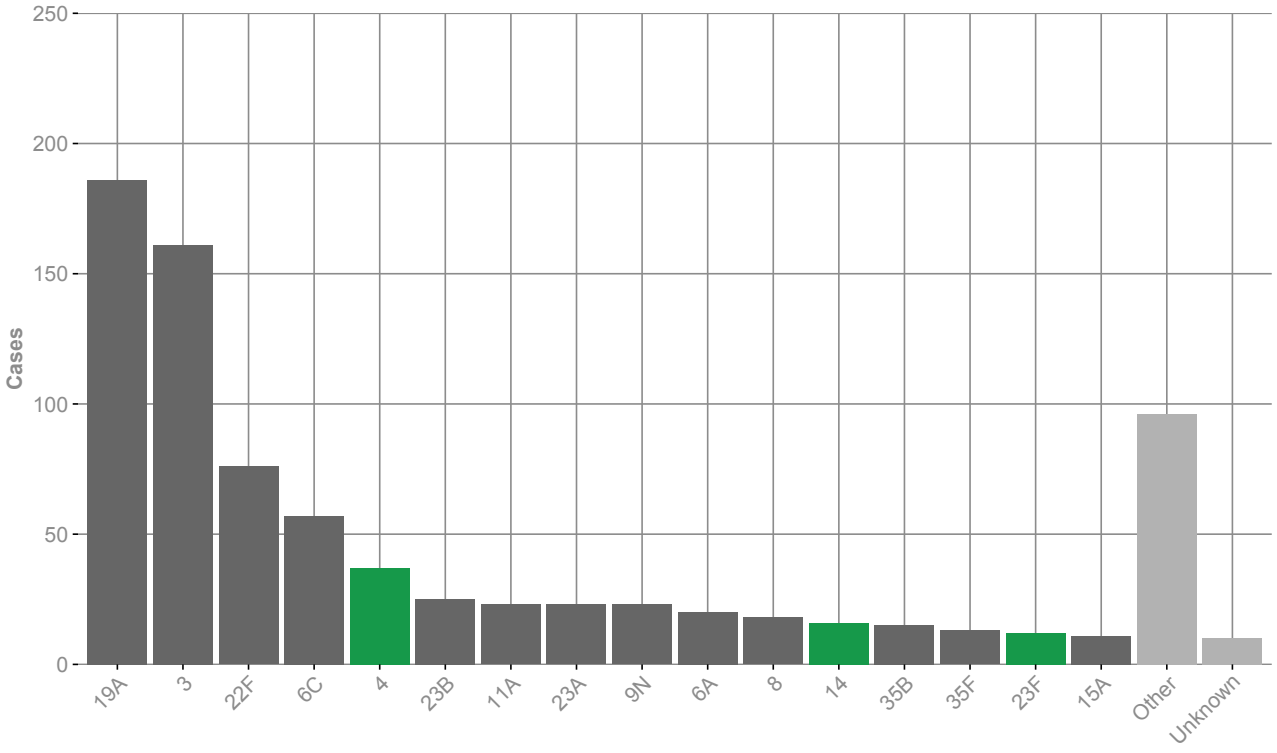

Figure 21. Serotypes of Pneumococcus findings in blood and cerebrospinal fluid 2017 (no. of cases). The column "Other" includes serotypes that caused fewer than 10 cases and the column "Unknown" includes cases whose strains the National Institute for Health and Welfare did not receive. PCV10 serotypes, green columns.

Table 11. Pneumococci isolated in blood and cerebrospinal fluid by age groups 2006–2017, no. of cases and incidence (cases/100,000 population).

	0–1		2–4		5–17		18–64		65–		Total	
Year	Cases	I	Cases	I	Cases	I	Cases	I	Cases	I	Cases	I
2006	82	71.3	31	18.4	19	2.3	345	10.5	271	32.3	748	14.2
2007	78	67.4	45	26.5	20	2.5	351	10.7	291	33.9	785	14.9
2008	65	55.1	32	18.4	23	2.9	479	14.4	328	37.5	927	17.5
2009	62	52.2	31	17.6	32	4.2	434	13.0	295	33.1	854	16.3
2010	61	50.6	41	23.8	17	2.2	410	12.2	304	33.4	833	15.6
2011	45	37.0	27	15.7	21	2.7	386	11.6	297	31.7	776	14.5
2012	15	12.3	17	9.4	15	1.9	361	10.8	342	34.9	750	13.9
2013	19	15.8	14	7.6	14	1.8	358	10.8	319	31.3	724	13.3
2014	13	11.0	14	7.6	18	2.3	303	9.1	355	33.6	703	12.9
2015	11	9.5	12	6.5	14	1.8	351	10.6	427	39.2	815	14.9
2016	16	14.2	17	9.5	16	2.1	353	10.8	415	37.1	817	15.0
2017	15	13.8	15	8.4	16	2.0	337	10.3	439	38.2	822	14.9

Table 12. Pneumococci isolated in blood and cerebrospinal fluid by age and vaccine serotypes in 2006–2017, no. of cases and incidence (cases/100,000 population).

	PCV10 vaccine serotypes												Non-vaccine serotypes												Unknown	
	0–1		2–4		5–17		18–64		65–		Total		0–1		2–4		5–17		18–64		65–		Total		All age groups	
Year	Cases	I	Cases	I	Cases	I	Cases	I	Cases	I	Cases	I	Cases	I	Cases	I	Cases	I	Cases	I	Cases	I	Cases	I	Cases	I
2006	67	58.3	26	15.4	15	1.8	227	6.9	161	19.2	496	9.4	14	12.2	5	3.0	3	0.4	105	3.2	101	12.5	228	4.3	24	0.5
2007	63	54.5	38	22.4	12	1.5	226	6.9	176	20.5	515	9.8	15	13.0	5	3.0	6	0.8	116	3.5	111	12.9	253	4.8	17	0.3
2008	49	41.5	26	15.0	18	2.2	288	8.7	198	22.6	579	10.9	14	11.9	6	3.5	4	0.5	174	5.2	119	13.6	317	6.0	31	0.6
2009	47	39.6	26	14.8	23	2.9	277	8.3	165	18.5	538	10.3	12	10.1	4	2.3	8	1.0	141	4.2	118	13.2	283	5.4	33	0.6
2010	51	42.3	35	19.7	10	1.3	244	7.3	168	18.5	508	9.5	8	6.6	5	2.8	5	0.6	148	4.4	122	13.4	288	5.4	37	0.7
2011	34	28.0	16	8.9	15	1.9	217	6.5	149	15.9	431	8.0	11	9.5	11	6.1	6	0.8	166	5.0	145	15.5	339	6.3	6	0.1
2012	8	6.6	16	8.8	7	0.9	190	5.7	150	15.3	371	6.9	7	5.8	1	0.6	8	1.3	169	5.6	187	19.9	372	6.9	7	0.1
2013	6	5.0	3	1.6	9	1.2	163	4.9	113	11.1	294	5.4	13	10.8	11	6.0	5	0.7	191	5.7	206	20.2	426	7.9	4	0.1
2014	2	1.7	3	1.6	8	1.3	99	3.0	93	8.8	205	3.8	11	9.3	11	6.0	10	1.3	202	6.9	258	24.4	492	9.0	6	0.1
2015	1	0.9	3	1.6	4	0.5	81	2.5	75	6.9	164	3.0	10	8.6	9	4.9	10	1.3	268	8.1	349	32.0	646	11.8	5	0.1
2016	2	1.8	0	0.0	0	0.0	59	1.8	56	5.0	117	2.1	14	12.5	17	9.4	16	2.1	291	8.9	358	32.0	696	12.7	4	0.1
2017	1	0.9	0	0.0	2	0.3	57	1.7	45	3.9	105	1.9	12	11.1	13	7.3	14	1.8	280	8.5	388	33.7	707	12.9	10	0.2

HAEMOPHILUS (HAEMOPHILUS INFLUENZAE)

The total of 73 (1.33/100,000) infections caused by the *Haemophilus influenzae* bacterium diagnosed in blood or cerebrospinal fluid is in the same range as the year before (2016; 69). More than a third (27/73, 37%) were diagnosed in patients aged 75 years and over, and more than a quarter in the age group 60 to 74 (20/73, 27%). Three cases were diagnosed in children under 5.

All cases were diagnosed through culture findings, mainly based on blood cultures (71/73, 97%). As in earlier years, the majority (59/73, 81%) were caused by unencapsulated strains of *Haemophilus influenzae* (NTHi). Two infections caused by serotype b were found. One of the patients was an unvaccinated child aged under 3 months, while the other was an adult in whose childhood the Hib vaccine was not yet included in the national vaccination programme. Serotype f caused an infection in eight people (11%), of whom one was a child aged 5 and the others in the age group 50 to 79. Three infections caused by serotype e were diagnosed in the age group 58 to 68. In one case, the National Institute for Welfare and Health did not obtain the strain, and its serotype remains unknown.

Children born in 1985 or later have been given a Hib vaccine that protects them against serotype b at the child care clinics. While the vaccination programme has succeeded in effectively reducing the number of serious infections caused by this serotype and the circulation of the bacteria within the population, cases may still occur in children with incomplete vaccination coverage.

Table 13. Cases of Haemophilus influenzae by serotype in 2008–2017, (no. of cases).

	Unencapsulated	a	b	e	f	Unknown	All cases
2008	33	0	3	0	8	1	45
2009	30	0	6	2	7	2	47
2010	30	0	5	2	3	1	41
2011	57	0	4	2	2	1	66
2012	73	0	4	0	4	0	81
2013	40	1	1	1	5	0	48
2014	48	0	5	0	6	0	59
2015	40	0	1	2	9	0	52
2016	58	0	1	2	8	0	69
2017	59	0	2	3	8	1	73

MENINGOCOCCUS (NEISSERIA MENINGITIDIS)

The number of reported meningococcus infections detected in blood or cerebrospinal fluid totalled 16 (0.29/100,000), which is the smallest number in the history of the National Infectious Diseases Register. One half of the findings (8/16) were in women. One of the patients was aged 4 months, one was aged 6, four were aged 15 to 19, and ten (63%) were aged between 47 and 93.

All cases were diagnosed through bacterial cultures, mainly based on blood cultures (13/16). The bacterial strains were serogrouped and analysed by means of full genome sequencing. Nine (56%) belonged to serogroup Y, four (25%) to serogroup C and three (19%) to serogroup B. Unlike in three previous years, no infections caused by serogroup W were diagnosed. Serogroup Y caused infections in patients ranging from young adults to older people (15 to 86 years). Of the infections caused by serogroup C, two were found in older persons, one in a middle-aged adult and one in a child approaching school age. One of the infections caused by the B group was diagnosed in a child aged under 12 months, one in a young person aged around 20, and one in an older adult. The young person had recently started in military service and received the ACWY meningococcus vaccine offered by the Defence Forces which, however, does not give protection against group B disease.

Group Y bacteria come in four different types which, typically for this serogroup, belong to the cc23 clone. Two types of serogroup C bacteria were identified. One of these (C:P1.5,2:F3- 3:ST-11(cc11)) caused three cases in Southern Finland and the other (C: P1.5,2: F5-8: ST-9768 (cc865) an individual case in North Ostrobothnia; the first-mentioned hypervirulent strain also caused three cases in Southern Finland the year before. All three group B strains had different antigen structures.

The number of serious infections caused by serogroup B reported to the National Infectious Diseases Register has declined steadily over the last 20 years, whereas the other serogroups have changed little or increased slightly. As a result, the serogroup B disease has become less significant compared to other serogroups in all age groups. In late 1990s, the number of cases caused by group B was 35 to 60 annually, whereas in the last five years, it has remained at 3 to 10.

In sporadic cases of meningococcus infection, all persons in close contact with the patient – except for health care personnel – should be given a vaccination in addition to prophylactic medication, if infection with the strain in question can be prevented by conjugated polysaccharide meningococcus vaccination. Vaccines against the meningococcus serotype groups A, C, W and Y are available in Finland. Since the 1970s, the Defence Forces have vaccinated all conscripts with a quadrivalent unconjugated polysaccharide vaccine, which was replaced by a conjugate vaccine in 2017. In addition to the vaccination of conscripts, conjugated meningococcus vaccines are mainly used in connection with epidemics and travel. Two new recombinant protein vaccines that give protection against serogroup B meningococci, one of which is sold at pharmacies in Finland, have also entered the EU market.

Table 14. Meningococcal infections by serogroup, 2007–2016 (no. of cases).

	A	B	C	W	Y	Unknown	Total
2007	0	29	8	0	5	0	42
2008	0	18	8	0	1	1	28
2009	0	24	3	0	5	1	33
2010	0	14	4	1	13	2	34
2011	0	19	6	1	7	1	34
2012	0	17	3	1	8	4	33
2013	0	10	2	0	8	0	20
2014	0	7	5	1	5	3	21
2015	0	8	5	4	3	2	22
2016	0	6	4	3	5	1	19
2017	0	3	4	0	9	0	16

MMR DISEASES (MEASLES, MUMPS, RUBELLA)

Eleven cases of measles were diagnosed (2016: 4), of which 10 had been confirmed by laboratory testing and one had an epidemiological link to a confirmed measles case.

A cluster of six measles cases occurred in East Savo in June. It originated with an unvaccinated tourist from Italy who had contracted the infection in their home country. Of the five patients who acquired the infection in Finland, one had received the two MPR vaccinations of the vaccination programme over 20 years ago. The other four were unvaccinated young people and adults.

Another cluster of measles was diagnosed in Pirkanmaa in August with four adults falling ill with the disease. All patients had contracted the infection in the same location in Italy following strong and prolonged exposure. All four had received the two MPR vaccines of the vaccination programme in their childhood over 20 years ago. The infections did not spread from the original patients. An isolated case was diagnosed in a foreign tourist who had received one dose of the vaccine as a child.

Ten cases of mumps were diagnosed (2016: 6). Five of these were found in the same family, whose members had acquired the infection abroad. The infection also spread within the family. None of the family members was protected with vaccination. The other five cases were individual infections contracted abroad. One of the patients had received two MPR vaccinations abroad as child, whereas the vaccination history of the other four remained unclear.

No cases of rubella were diagnosed in 2017 (in 2016: 0).

VARICELLA VIRUS

The number of varicella findings reported to the National Infectious Diseases Register was 466 in 2017, which corresponds to the previous years' levels (2014: 478; 2015: 505; 2016: 519). Virus findings were reported among all age groups, the youngest being three days and the oldest 97 years old. Of these findings, 37% were diagnosed by antigen detection, 37% by nucleic acid detection, and 23 % by serological diagnostics. Reports based on diagnostic examination of cerebrospinal fluid numbered 71 (14%), and the majority of these (87%) had been confirmed by nucleic acid detection.

Childhood varicella or chicken pox is a very common disease, which children usually contract when aged under 5. It is usually diagnosed on the basis of symptoms and does not result in a laboratory sample being taken. In contrast herpes zoster, or shingles, caused by the varicella virus being reactivated, is common, particularly in the elderly and requires the use of health care services, which can be seen in the age distribution of the virus findings: the proportion of patients aged 65 or over in the reported cases was 37%, while the percentage of those aged under 5 was as low as 8%.

A varicella vaccination was included in the national vaccination programme in autumn 2017; children are now vaccinated at the ages of 18 months and 6 years. Initially, the varicella vaccine will also be administered to all children aged 1.5 to 11 who have never had chickenpox. As the vaccination coverage increases, the circulation of the virus in the population will be reduced, and the morbidity in children is expected to decline considerably in the next few years.

BORRELIA (LYME DISEASE)

The laboratories reported a total of 2,318 Borrelia findings in 2017, which is considerably more than in 2016 (1,933). The majority (98%) of the reports were based on serological testing, while for the remainder, nucleic acid testing was used. Cases were reported in all parts of the country. While the average incidence was 42/100,000, regional variation was considerable. As in previous years, the highest incidence was recorded in Åland (2,250/100,000). In this district, 657 cases were diagnosed, or less than one third of all Borrelia cases in Finland. As before, the frequency of Borrelia was highest in the autumn from August to October. The majority of cases (76%) were diagnosed in patients aged 45 and over. There were no differences between the genders.

The Borrelia findings in the National Infectious Diseases Register do not give an up-to-date picture of the borreliosis epidemiology, and the cases mainly represent late-stage borreliosis. In the early stage, the disease is diagnosed in outpatient care based on clinical symptoms, and these cases are reported to the outpatient care register of the public health services.

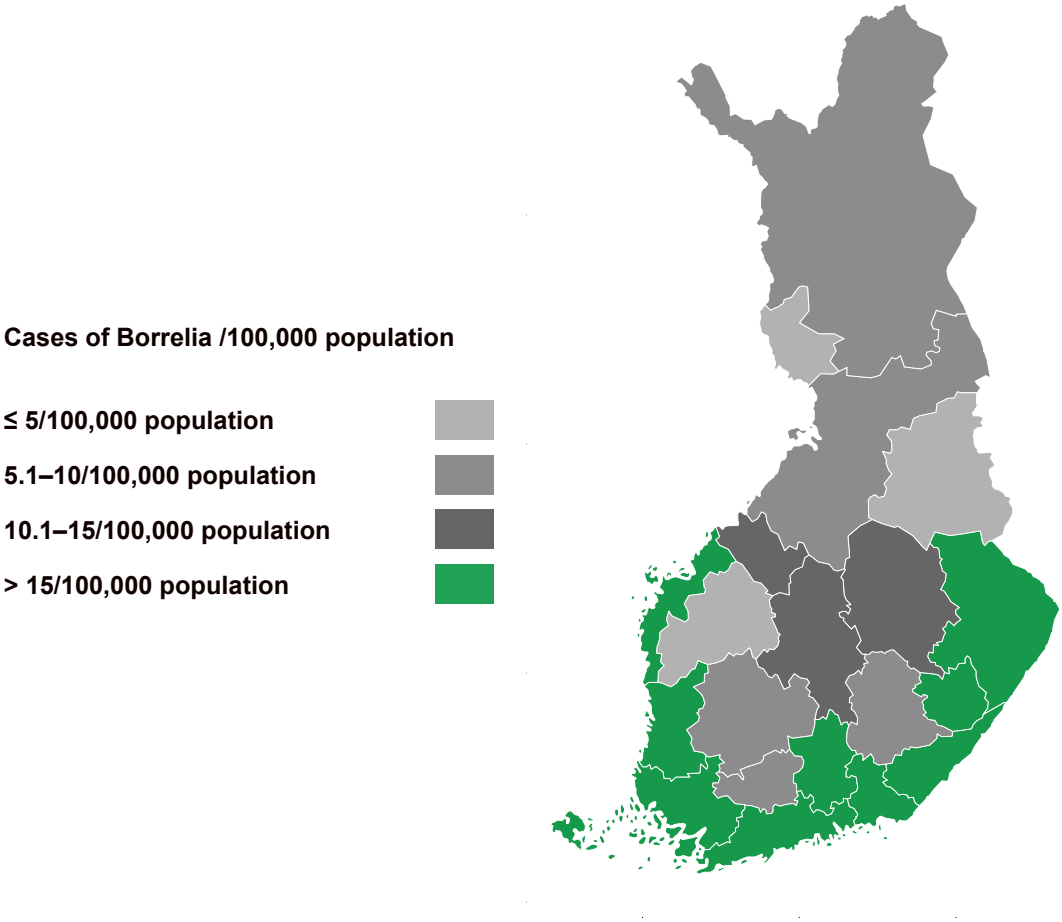

Figure 22. Incidence of Borrelia (cases/100,000 population) by hospital district, 2017.

TICK BORNE ENCEPHALITIS (TBE)

In 2017, 82 TBE antibody findings were reported to the National Infectious Diseases Register, which is the greatest number observed in Finland so far (2016: 61). Positive findings were made in June–November, with the greatest number diagnosed in August. Patients who contracted TBE were aged between 2 and 85 (average age 48), and 55/82 (67%) of them were men.

In order to identify the place of acquisition, the National Institute for Health and Welfare interviewed patients who had been diagnosed with TBE and/or studied their patient records. In Åland, 11 persons contracted TBE, 10 of whom were permanent residents of this province. In continental Finland, a TBE infection was contracted by 63 individuals. While most TBE infections were contracted in known risk areas (especially Parainen and the coastal area of Kemi-Simo), sporadic findings were also made in probable new places of infection (Table 15). Four individuals had acquired the infection abroad (in Baltic countries) and for four patients, the place of origin could not be established.

The TBE virus was identified in ticks not only in Åland but also in Turku archipelago and Lappeenranta region decades ago. TBE positive ticks have been found in collections performed in the risk areas, for example in Maksniemi in Simo and Kokkola archipelago. In the last collection, individual findings were also confirmed in traditional lower-risk areas (Tampere region, Ilomantsi).

If a patient falls ill with meningitis or encephalitis between April and November, even if he or she has not noticed a tick bite, TBE should be suspected, especially if the case occurs in a known high-risk area. As new TBE regions have been observed to emerge, however, the possibility of TBE infection should be considered even beyond the currently known risk areas.

Table 15. TBE cases by location in 2017, number of cases.

Place of infection	Number of cases	More precise area/number of cases	
Known areas			
Turku Archipelago	21	Parainen	18
Kemi-Simo (coastal area on the municipal boundary)	8		
Espoo	4	Kauklahti	1
Lohja	3	Lohjanjärvi Lake area	2
Raasepori	3		
Taipalsaari	3		
Helsinki	2	Jollas, Villinki	1*
Kotka	2	Kotka Archipelago	2
Naantali	3	Rymättylä	2
Oulu	2		
Turku	1		
Kirkkonummi	1		
Kustavi	1		
Raahe	1		
Rauma	1		
Vaasa	1	Vaasa Archipelago	
New probable places of infection			
Ii	1		
Iisalmi	1		
Kaarina	1		
Keminmaa	1		
Lapinlahti	1		
Taivassalo	1		

* one case per area

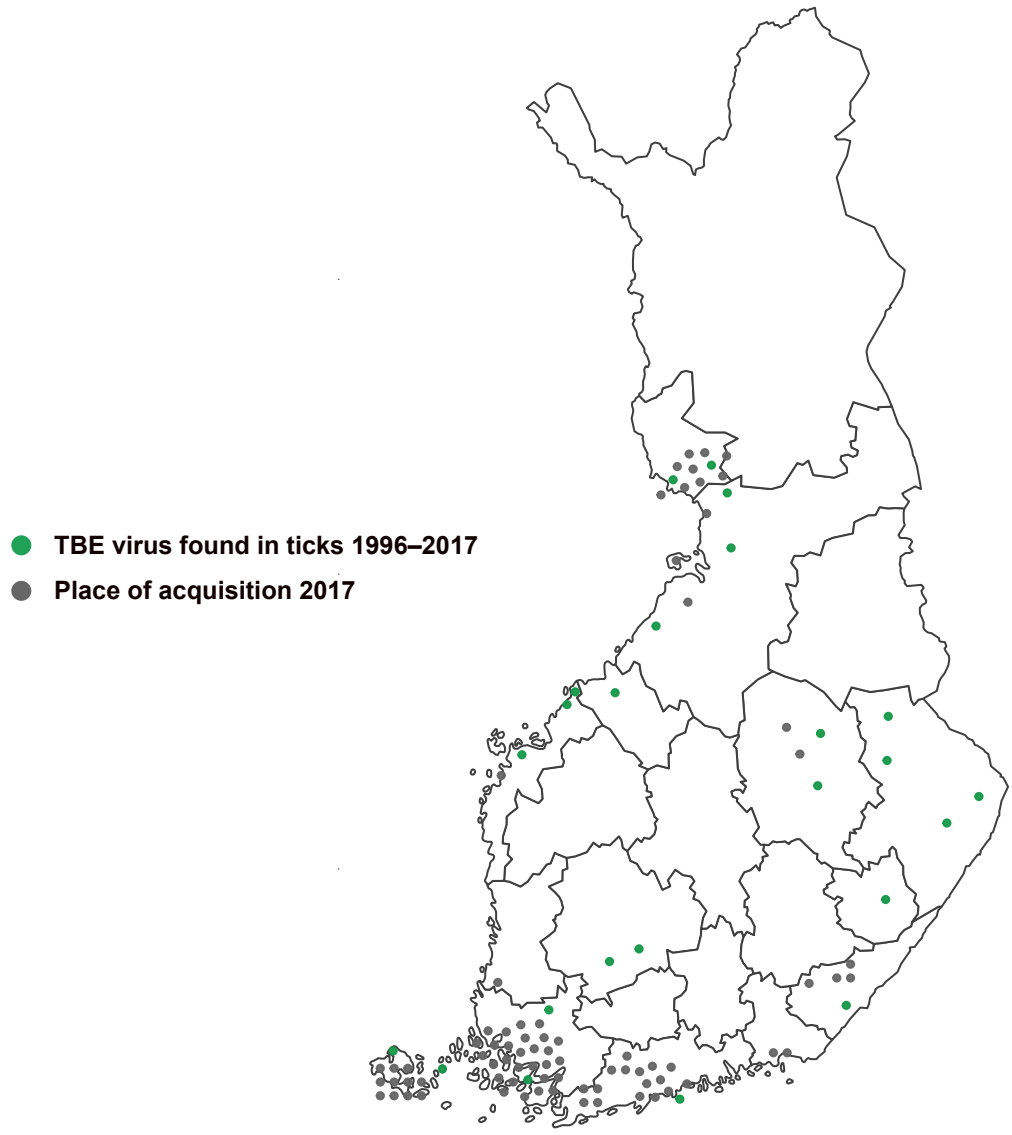

Figure 23. Cases of TBE by location of acquisition, 2017, and TBE virus findings in ticks, 1996–2017.

PUUMALA VIRUS

In 2017, a total of 1,246 cases of Puumala virus infections were reported (22.7/100,000), which is less than in 2016 (1,662). The incidence of the virus varies depending on the virus reservoir, i.e. the size of the bank vole population, following a three- or four-year cycle, in accordance with the geographical region. The previous peaks occurred in 2005, 2008, 2011 and 2014. The vole populations increased again in 2016, especially in Southern and Eastern Finland, which was reflected as a higher number of cases. 60% of the patients were men and the majority were in working age, while 34 of them were under 20 (3%). The incidence was clearly the highest in the South Savo Hospital District (125/100,000).

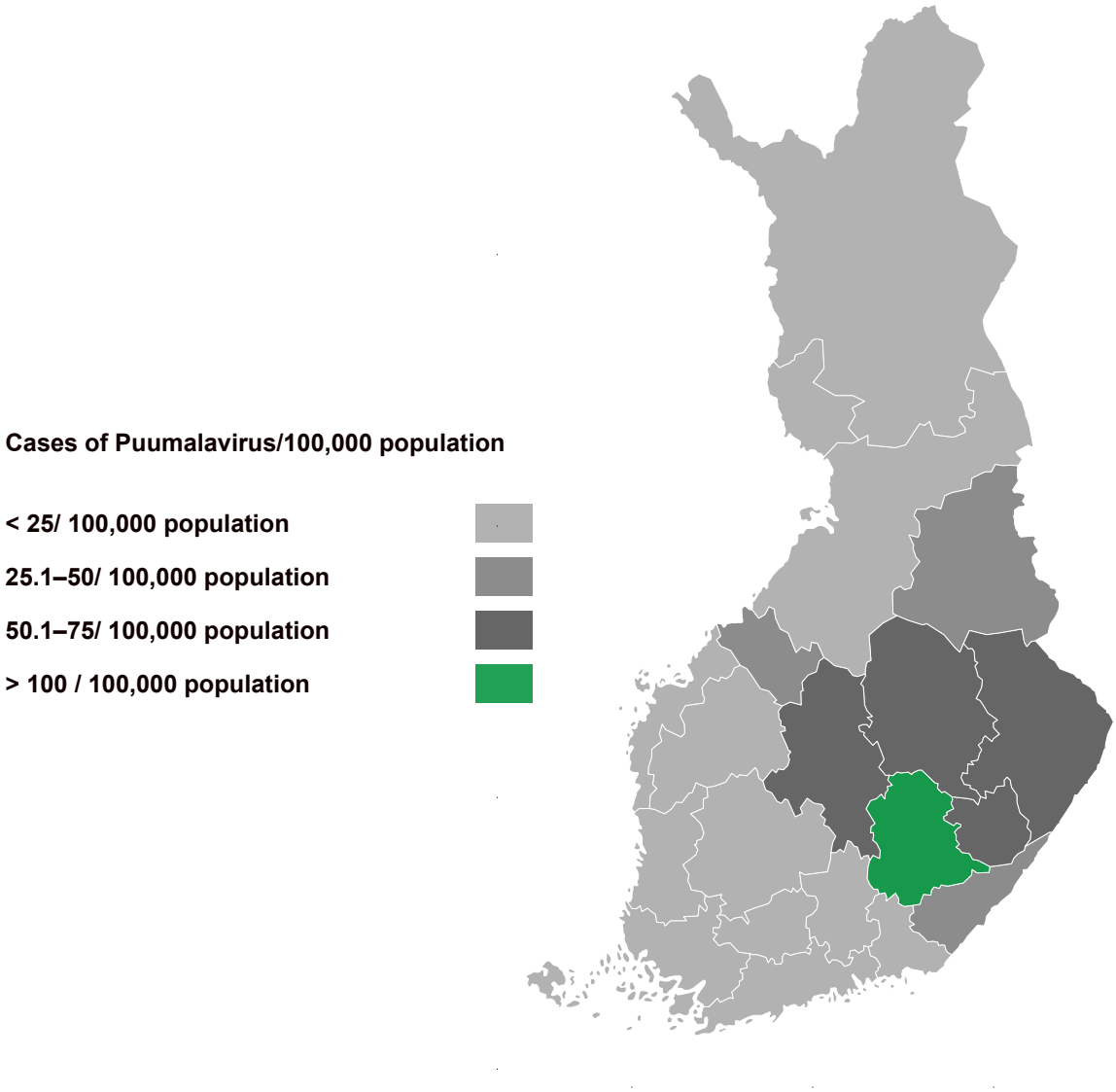

Figure 24. Incidence of Puumala virus (cases/100,000 population) by hospital district, 2017.

POGOSTA DISEASE (SINDBIS VIRUS)

In 2017, 7 cases of Pogosta disease confirmed by antibody testing were diagnosed in Finland. The is clearly less than in the previous year (31). All cases were diagnosed in different hospital districts. The patients were aged 19 to 72, and 4 of them were men. Four of the cases were diagnosed in August–September and three in June–July.

Pogosta disease has previously followed a regular seven-year cycle. The epidemic peaked in 1981, 1995 and 2002. In 2009, however, the cycle was not repeated as expected, and the number of cases in 2016 remained very low compared to years with epidemics.

TULAREMIA (FRANCISELLA TULARENSIS)

In 2017, 32 tularemia cases were reported (incidence 0.6/100,000). As expected, the case numbers reduced clearly compared to the year before (699).

As before, the incidence was highest in the hospital districts of Central Ostrobothnia (3.8/100,000) and South Ostrobothnia (3.6/100,000). Most cases were diagnosed in August–September (14/32, 44%). The annual incidence of tularemia varies considerably (between 0.2 and 18/100,000) and local epidemics break out every few years, particularly in the regions of Ostrobothnia and Central Finland, usually following years with plentiful vole populations. Weather conditions affect the number of mosquitoes and thus the scale of the outbreaks.

RABIES

Doctors are required to report cases where a person is suspected of being exposed to rabies, and risk assessment has led to the administration of a course of rabies vaccinations and, possibly, rabies immunoglobulin treatment. In 2017, 107 reports were made, which was a clear increase on the two previous years.

The number of patients who had been exposed while travelling abroad was 68 (64%), 20 of them in Thailand. The others were sporadic cases of exposure in different parts of the world. More than a half (40/68) of the exposures abroad were caused by dog bites. Twelve monkey bites were reported (2016: 21). The other reports were related to contact with cats and bats. The number of exposure cases in Finland was 39, of which ten were associated with bats. The others were contact with dogs, cats, raccoon dogs, foxes and weasels. In seven reports, the animal was not known, and one was linked to rabies baits.

TRAVEL-RELATED INFECTIONS

Malaria

Malaria was diagnosed in 36 patients in Finland in 2017. There were 30 cases of *Plasmodium falciparum*, as well as two cases each of *P. ovale*, *P. vivax* and *P. malariae* . One of the infections had been contracted in Papua New Guinea and all others in Africa. Of the patients, 27 (75%) were immigrants from a malaria area who had returned to visit their former home region, and two (6%) were immigrants who had fallen ill immediately after arriving in Finland. Six of the patients (17%) were native Finns who had stayed in a malaria region for less than six months, and one was a Finn residing in a malaria region. The countries of acquisition and risk groups of malaria have changed little from previous years. The majority of the malaria cases were diagnosed in the Helsinki region (67%). No malaria deaths were reported.

Table 16. Malaria cases in Finland in 2017 by country of acquisition.

Continent	Country	Cases
Africa	Ghana	3
	Cameroon	3
	Kenya	4
	Democratic Republic of the Congo	1
	Liberia	2
	Niger	1
	Nigeria	12
	Ivory Coast	2
	Rwanda	1
	Zambia	1
	Sierra Leone	3
	Tanzania	2
	Africa total	35
Oceania	Papua New Guinea	1
	Oceania total	1
Grand total		36

Chikungunya

Five chikungunya infections were diagnosed in Finnish tourists in 2017. The year before, there were no cases. The probable country of acquisition is only known for one case (Bangladesh). In 2017, approx. 120,000 infections caused by the chikungunya virus were reported in the Caribbean area and the Americas. The number of cases decreased clearly from the years before, however, reflecting an abatement of the epidemic in the area. On the other hand, a major chikungunya epidemic was observed in Pakistan and India. In Italy, more than 250 individuals contracted a chikungunya virus infection in August–October, and two separate clusters were found in France. Chikungunya epidemics in Europe are rare but not exceptional.

Dengue fever

The annual number of dengue fever infections has varied between 35 and 90. The laboratories reported a total of 25 findings in 2017, which is clearly less than in 2016 (66). The majority of the patients (23/25) were aged over 15. Diagnoses were made at all times of the year, the greatest numbers in January–March (14).

Eight of the infections were reportedly contracted in Asia (Thailand 6, Sri Lanka 1, Indonesia 1). Information on the country of acquisition is not available for the National Infectious Diseases Register in all cases. Finnish tourists are more likely to contract infections in countries which are popular with tourists and in which Dengue fever epidemics occur repeatedly.

Zika virus

In 2017, two infections caused by the zika virus were diagnosed in Finnish tourists. The infections originated in known risk areas (Asia, Africa), and the probable mode of transmission was mosquitoes. The zika virus epidemic in South America and Caribbean Sea abated clearly. Minor epidemics and sporadic cases were found in Western and Central Africa and in Southeast Asia where the disease has occurred for decades.

Other travel-related infections

A significant percentage of the following infections are travel-related: legionella, salmonella, campylobacter, shigella, EHEC, hepatitis A, hepatitis B, gonorrhoea, syphilis, HIV and AIDS, carbapeneme-resistant gram-negative bacilli, MMR diseases and exposure to rabies. Data on the country of acquisition and means of transmission are discussed separately for each of these diseases in the respective sections of this report.

BLOOD AND CEREBROSPINAL FLUID FINDINGS IN CHILDREN

Blood culture findings in children

In 2017, 445 cases of bacterial findings were diagnosed in blood cultures from children under 15 years of age. In comparison with previous years, their number has remained largely unchanged (in 2012–2016: 449 on average, variation 440−461), whereas in earlier years, the number of findings was clearly higher (in 2008–2011: 595 on average, variation 551–659).

One half of the findings (221/445) were made in children aged under 12 months. In infants, *Staphylococcus epidermidis* and other coagulase-negative staphylococci caused 41% of blood culture positive infections; their proportion was clearly greater than in previous years (Table 17). Although these bacteria belong to normal skin flora, they typically cause treatment-related late-onset sepsis in newborn babies in intensive care. *Streptococcus agalactiae* (Group B streptococcus, GBS), typically contracted from the mother's birth canal during labour and causing an infection (early-onset sepsis) in the newborn baby during its first days of life, caused 11% of the findings. Some of the other most common causes were *Escherichia coli* (19%), *Staphylococcus aureus* (7%), *Klebsiella* strains (3%) and *Enterococcus faecalis* (3%).

In the age group 1 to 14 years, *S. aureus* (26%) was the most common cause of blood culture positive infections in 2017 (Table 18). The number of *S. pneumoniae* findings decreased rapidly after the introduction of a pneumococcus vaccination to the national vaccination programme in 2010; in 2012–2016, 27 to 38 cases were diagnosed annually (12–18% of all findings, earlier approx. 30%). The number of pneumococcus findings in 2017 was 34 (15%). Other common findings in this age group were coagulase-negative staphylococci (18%), *E. coli* (8%), *Streptococcus pyogenes* (6%) and the *Streptococcus viridans* group (6%).

Fungal findings are rare in children's blood cultures. In 2017, Candida was found in six cases in total: *Candida albicans* was found in the blood cultures of four children and *Candida parapsilosis* in one child aged 0 to 14 years; in one case, the strain had not been identified.

Cerebrospinal fluid findings in children

The number of cerebrospinal fluid findings related to children's central nervous system infections remained similar to those in previous years, as did the distribution of pathogens. The total number of findings reported in 2016 was 20 (in 2008–2016: 25 on average, variation 14–37). Nine of these infections were diagnosed in children under the age of 12 months.

Three *S. agalactiae* findings were made in children aged under 12 months (Table 19), whereas the other findings were sporadic; in children aged 1 to 14 years, three cases of *S. pneumoniae* as well as two cases each of *E. coli* and *S. epidermidis* were diagnosed (Table 20). There were no fungal findings in cerebrospinal fluid samples.

GBS in newborns

Between 1995 and 2014, an average of 31 cases per year of early-onset GBS in newborns (diagnosed from blood and/or cerebrospinal fluid in children under the age of 7 days) were reported; the variation was 17 to 57 cases per year, and the incidence was 0.3 to 1.0 per 1,000 live births. In 2015–2016, the number of cases was clearly lower (11 to 13 cases; 0.2/1, 000 live births), and in 2017, this number was 8 (0.2/1,000 live births). The majority of early-onset GBS cases can be prevented by administering an antimicrobial

prophylaxis to mothers whose GBS colonisation puts the newborn at risk of a GBS infection. The preventive practices have improved in recent years, which is likely to explain the reduction of early-onset GBS infections in newborns. Antimicrobial prophylaxis during labour does not prevent early-onset GBS in newborns, however. An average of 14 annual cases of late GBS disease detected at the age of more than 7 days have occurred in 1995–2016 (range 6 to 24; incidence 0.1 to 0.4 cases per 1,000 live births). There were 16 cases in 2017 (0.3 cases per 1,000 live births).

Table 17. Blood culture findings in infants (under 12 months), 2008–2017 (no. of cases).

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Staphylococcus epidermidis	87	64	71	76	50	62	46	49	46	64
Escherichia coli	38	37	45	48	25	41	37	38	50	41
Staphylococcus, other coagulase-negative	34	43	32	35	26	33	45	34	33	27
Streptococcus agalactiae	49	51	54	42	36	33	31	26	20	24
Staphylococcus aureus	23	22	24	21	31	22	20	28	20	16
Enterococcus faecalis	5	10	20	12	15	16	9	10	13	6
Klebsiella species	7	9	3	7	6	6	4	3	10	6
Streptococcus viridans group	8	9	17	13	6	8	8	9	5	5
Streptococcus pneumoniae	26	25	20	11	8	8	6	6	8	5
Enterobacter species	6	3	3	10	5	4	2	7	10	5
Streptococcus pyogenes	2	4	2	0	6	1	2	0	0	3
Enterococcus faecium	1	2	2	1	2	1	1	0	1	2
Haemophilus influenzae	2	2	1	0	4	1	2	1	0	2
Streptococcus, other betahaemolytic	0	4	2	0	1	1	1	1	5	1
Listeria monocytogenes	0	1	2	0	1	1	1	0	0	1
Bacillus	4	2	1	1	1	1	1	5	1	1
Neisseria meningitidis	3	5	4	1	2	4	3	1	1	1
Haemophilus, other than influenzae	1	0	0	1	0	0	0	0	0	1
Pseudomonas aeruginosa	2	0	2	1	0	0	0	3	1	1
Serratia species	4	1	2	4	0	1	0	4	2	1
Salmonella, other than Typhi or Paratyphi	0	1	0	0	0	1	1	1	0	1
Streptococcus bovis group	0	2	0	0	0	0	0	0	0	0
Enterococcus, other or unidentified	0	2	0	0	1	0	0	0	0	0
Propionibacterium species	0	0	0	1	0	0	0	0	1	0
Clostridium other than perfringens	0	0	0	0	1	0	0	0	0	0
Peptostreptococcus and Peptococcus	0	0	1	0	0	0	0	0	0	0
Stenotrophomonas maltophilia	0	2	2	0	0	0	0	0	0	0
Acinetobacter	1	1	3	2	1	2	0	0	1	0

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Prevotella species	1	0	0	0	0	0	0	0	0	0
Bacteroides, other than fragilis group	0	0	0	0	0	0	0	1	0	0
Bacteroides fragilis group	1	0	1	0	0	0	0	0	1	0
Pseudomonas other than aeruginosa	0	0	0	0	0	0	1	0	0	0
Yersinia enterocolitica	0	0	0	0	0	0	1	1	0	0
Citrobacter species	0	1	1	0	1	0	0	0	1	0
Other bacteria	7	5	5	9	8	3	6	5	4	7
Total	312	308	320	296	237	250	228	233	234	221
Candida albicans	3	1	2	1	1	2	3	2	1	3
Other candida species	1	0	0	1	2	0	1	0	1	2
Total	4	1	2	2	3	2	4	2	2	5

Table 18. Blood culture findings in children (aged 1 to 14), 2008–2017 (no. of cases).

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Staphylococcus aureus	40	36	43	42	47	48	40	54	53	60
Streptococcus pneumoniae	87	92	95	74	35	35	32	27	38	34
Staphylococcus epidermidis	22	31	37	29	17	25	28	26	22	28
Escherichia coli	14	12	15	11	14	9	17	20	14	19
Streptococcus viridans group	21	25	37	23	27	27	14	10	10	13
Streptococcus pyogenes	11	11	6	15	9	8	14	13	10	13
Staphylococcus, other coagulase-negative	13	17	21	13	11	9	19	23	17	13
Streptococcus, other betahaemolytic	0	2	3	1	1	1	1	4	3	4
Acinetobacter	2	4	1	0	1	3	1	3	0	4
Haemophilus influenzae	3	3	2	5	0	3	5	1	1	3
Enterobacter species	4	3	2	3	1	0	0	6	1	3
Streptococcus milleri group	2	2	2	1	1	0	2	2	7	2
Enterococcus faecium	2	7	7	0	2	2	1	0	0	2
Stenotrophomonas maltophilia	4	2	2	0	1	1	1	0	2	2
Fusobacterium species	5	1	1	1	1	1	1	0	0	2
Pseudomonas aeruginosa	1	3	7	4	3	4	9	1	1	2
Bacillus	6	3	3	2	5	5	4	6	1	1
Neisseria meningitidis	4	0	6	2	2	3	1	1	0	1
Capnocytophaga canimorsus	0	0	0	0	0	0	0	0	0	1
Bacteroides fragilis group	0	1	0	2	0	0	1	1	4	1
Salmonella Paratyphi	0	0	0	0	0	0	0	0	0	1
Klebsiella species	5	2	4	2	6	3	0	1	5	1
Streptococcus bovis group	0	0	0	0	0	0	0	1	0	0
Streptococcus agalactiae	1	0	0	0	0	0	0	0	0	0
Enterococcus, other or unidentified	3	0	1	0	0	1	0	0	0	0
Enterococcus faecalis	6	4	6	3	5	1	2	3	3	0
Propionibacterium species	0	0	0	0	2	1	0	0	1	0
Mycobacterium species	0	0	0	1	0	0	0	1	0	0

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Listeria monocytogenes	0	0	0	0	0	1	0	0	0	0
Corynebacterium diphteriae	0	0	0	0	0	0	1	0	0	0
Clostridium other than perfringens	1	1	4	4	1	1	2	0	1	0
Clostridium perfringens	0	1	1	0	0	0	0	0	0	0
Peptostreptococcus and Peptococcus	0	0	0	2	1	0	0	1	0	0
Haemophilus, other than influenzae	0	0	0	0	1	1	0	1	0	0
Veillonella species	0	0	1	0	0	0	0	0	0	0
Pseudomonas other than aeruginosa	0	3	0	0	0	0	0	1	0	0
Serratia species	0	0	1	0	0	1	0	0	1	0
Salmonella, other than Typhi or Paratyphi	2	0	6	2	3	4	1	1	0	0
Salmonella Typhi	0	0	0	2	0	1	0	0	0	0
Citrobacter species	2	1	1	0	0	0	3	0	2	0
Other bacteria	10	13	24	11	14	9	12	20	9	14
Total	271	280	339	255	211	208	212	228	206	224
Candida albicans	2	0	2	0	1	2	1	1	1	1
Other candida species	1	0	0	3	0	1	0	1	1	0
Total	3	0	2	3	1	3	1	2	2	1

Table 19. Cerebrospinal fluid culture findings in infants (under 12 months), 2008–2017 (no. of cases).

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Streptococcus agalactiae	3	6	10	3	4	1	7	3	3	3
Streptococcus viridans group	0	2	0	1	0	0	0	0	0	1
Enterococcus faecalis	0	0	0	0	0	0	0	0	0	1
Staphylococcus, other coagulase-negative	4	1	0	0	2	0	0	0	2	1
Staphylococcus aureus	2	2	1	0	3	2	1	1	0	1
Haemophilus influenzae	0	1	0	0	0	0	1	0	0	1
Escherichia coli	1	1	2	1	0	0	2	2	1	1
Streptococcus pyogenes	0	1	0	0	0	0	0	0	0	0
Streptococcus pneumoniae	3	2	3	2	1	2	2	0	1	0
Staphylococcus epidermidis	1	2	2	2	1	3	2	0	0	0
Propionibacterium species	0	0	0	0	0	0	1	0	0	0
Mycobacterium species	0	0	1	0	0	0	0	0	0	0
Bacillus	0	0	0	0	0	0	1	0	0	0
Neisseria meningitidis	1	2	1	0	3	3	2	0	1	0
Klebsiella species	0	1	0	0	1	0	0	0	0	0
Citrobacter species	0	0	1	0	0	0	1	0	0	0
Other bacteria	0	1	0	0	0	1	1	0	0	0
Total	15	22	21	9	15	12	21	6	8	9
Candida albicans	0	1	0	0	0	0	0	0	0	0
Total	0	1	0	0	0	0	0	0	0	0

Table 20. Cerebrospinal fluid culture findings in children (aged 1 to 14), 2008–2017 (no. of cases).

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Streptococcus pneumoniae	2	4	2	3	0	4	2	1	1	3
Staphylococcus epidermidis	5	2	1	2	1	0	3	3	1	2
Escherichia coli	0	0	0	0	1	0	0	0	0	2
Streptococcus viridans group	0	0	0	0	0	0	0	2	1	1
Staphylococcus aureus	3	3	2	2	2	1	0	1	0	1
Haemophilus influenzae	0	0	0	1	0	0	1	0	1	1
Enterobacter species	0	1	0	0	1	0	0	0	1	1
Streptococcus, other betahaemolytic	0	1	0	0	0	0	0	0	0	0
Streptococcus pyogenes	0	0	0	0	1	0	0	0	0	0
Enterococcus faecalis	0	0	1	0	0	0	0	1	0	0
Staphylococcus, other coagulase-negative	0	1	0	0	0	1	0	1	0	0
Propionibacterium species	0	0	0	1	0	0	1	2	1	0
Neisseria meningitidis	3	2	3	4	2	3	1	2	0	0
Other bacteria	2	1	1	0	0	1	1	1	0	0
Total	15	15	10	13	8	10	9	14	6	11
Candida albicans	0	0	0	0	1	0	0	0	0	0
Total	0	0	0	0	1	0	0	0	0	0

BLOOD AND CEREBROSPINAL FLUID FINDINGS IN ADULTS

In 2017, the total number of bacterial findings in adults' blood culture samples was 17,052. The number of findings has increased continuously, and the year before, this figure was 16,323. The majority (68%, 11,548/17,052) of the blood culture findings were made in the age group 65 and over. Gram-positive bacteria were more common in the working-age population (aged 15 to 64) and gram-negative bacteria among those aged 65 and over. The number of fungi findings in adults' blood cultures has remained stable (in 2008–2016, 218 cases on average, variation 182 to 257). In 2017, a total of such 233 findings were made (1.3% of all blood culture findings in those aged 15 or over).

Escherichia coli was the most common finding in both the working age population (23% of findings) and in patients aged 65 and over (35%). Other common bacterial findings (Tables 21 and 22) were *Staphylococcus aureus* (individuals in working age 17%, those aged over 65 12%) and Klebsiella species (individuals in working age 5%, those aged over 65 7%). It is estimated that one half of *Staphylococcus aureus* findings and almost all coagulase-negative staphylococci findings are treatment-related. Anaerobic bacteria constituted around 4% of all blood culture positive findings among adults.

Cerebrospinal fluid findings in adults

In 2017, the total number of microbial findings in adults' cerebrospinal fluid was 130, which corresponds to the figures in 2008–2016 (159 on average, variation 133 to 203). Patients aged 65 and over accounted for 35% of the cases. Two fungi findings were reported.

In the working-age population, coagulase-negative staphylococci accounted for 25% of the findings. Of the actual pathogens, the most common ones were *S. pneumoniae* (15%) and *S. epidermidis* (12%) (Table 24). In patients aged 65 years or over, the most common findings were coagulase-negative staphylococci (20%), *S. pneumoniae* (15%), *Listeria monocytogenes* (11%), *E. coli* (9%) and *S. aureus* (9%) (Table 25).

Group A streptococcus

The number of invasive group A streptococcus (*Streptococcus pyogenes*) infections increased considerably in 2017 compared to previous years (2017: 295; 2016: 229; 2015: 178). As the predominant emm type in group *A streptococci* emerged *emm*1 (2017: 28%; 2016: 11%), which has been linked to increased virulence and more serious symptoms. An increase in the *emm*1 type was last observed in 2006–2008. The other predominant emm types, *emm*28, *emm*89 and *emm*12, were the same as in previous years. Of these, the proportion of *emm*12 grew in 2016 and remained high (2017: 9%; 2016: 10%; 2015: 5%). One macrolide-resistant *emm*33 type was typed. Although new emm types are continuously emerging, the four most common emm types – *emm*1, *emm*28, *emm*89, and *emm*12 – accounted for 75% of all emm types in the reporting period (Table 23).

Table 21. Blood culture findings in patients aged 15 to 64, 2008–2017 (no. of cases).

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Escherichia coli	872	884	931	934	942	951	1070	1113	1182	1174
Staphylococcus aureus	526	539	576	640	616	641	796	784	847	846
Streptococcus pneumoniae	480	440	413	391	364	356	307	350	352	341
Klebsiella species	186	189	207	166	218	221	222	206	242	249
Streptococcus, other betahaemolytic	128	122	139	154	133	177	173	156	202	225
Staphylococcus epidermidis	279	313	265	223	182	211	240	270	215	221
Staphylococcus, other coagulase-negative	156	139	140	144	104	154	191	209	242	209
Streptococcus pyogenes	157	116	113	104	126	105	122	97	117	162
Bacteroides fragilis group	109	68	110	108	103	101	132	125	164	144
Streptococcus milleri group	73	57	68	86	79	98	127	128	148	142
Streptococcus viridans group	140	144	148	159	150	151	129	107	118	119
Streptococcus agalactiae	96	95	110	75	89	96	89	113	88	103
Enterococcus faecalis	83	107	86	97	102	83	104	110	99	103
Enterobacter species	69	82	99	86	96	90	85	97	108	98
Enterococcus faecium	91	89	91	108	95	97	113	71	85	80
Pseudomonas aeruginosa	74	78	91	92	79	91	74	81	75	66
Bacillus	25	21	32	34	27	42	60	54	55	53
Peptostreptococcus and Peptococcus	12	27	15	30	18	22	38	36	48	50
Fusobacterium species	31	27	37	32	48	41	47	37	39	47
Serratia species	24	27	20	32	26	32	31	39	39	39
Citrobacter species	23	29	31	28	25	23	35	30	37	39
Salmonella, other than Typhi or Paratyphi	43	23	39	32	32	36	28	25	39	37
Clostridium other than perfringens	24	29	23	20	32	29	43	30	28	32
Proteus mirabilis	14	18	26	17	24	22	23	32	27	28
Campylobacter species	7	11	10	4	6	8	33	26	33	28
Haemophilus influenzae	18	19	18	22	25	23	18	22	28	24
Prevotella species	13	13	15	16	16	10	12	10	23	22
Capnocytophaga canimorsus	8	11	11	17	13	14	15	12	11	21

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Stenotrophomonas maltophilia	15	12	12	9	7	14	16	20	8	19
Propionibacterium species	3	9	6	9	7	9	11	8	13	19
Listeria monocytogenes	8	9	15	7	17	11	18	9	10	17
Morganella morganii	14	8	6	8	7	18	12	13	14	16
Bacteroides,other than fragilis group	5	10	1	7	3	7	8	5	8	15
Acinetobacter	13	18	14	21	14	11	15	18	11	14
Clostridium perfringens	10	16	16	8	11	8	13	12	7	14
Streptococcus bovis group	1	6	7	6	6	4	5	8	6	11
Salmonella Typhi	1	3	9	3	1	5	5	1	2	9
Enterococcus, other or unidentified	7	13	13	12	20	8	5	14	3	7
Neisseria meningitidis	9	13	13	17	12	5	10	12	7	6
Salmonella Paratyphi	5	3	3	1	3	1	2	2	2	5
Pseudomonas other than aeruginosa	5	6	6	8	8	8	14	11	5	4
Haemophilus, other than influenzae	3	0	2	3	10	5	6	8	6	4
Mycobacterium species	2	2	2	4	3	8	4	2	2	3
Proteus vulgaris	2	3	2	2	3	2	4	4	2	2
Veillonella species	3	6	5	12	5	7	8	5	0	0
Hafnia alvei	3	6	2	2	2	1	2	2	4	0
Yersinia pseudotuberculosis	1	0	0	0	1	1	1	0	0	0
Yersinia enterocolitica	0	1	1	0	0	0	0	2	1	0
Corynebacterium diphteriae	0	0	0	0	0	0	0	0	0	0
Other bacteria	94	107	92	99	112	131	157	150	173	192
Total	3,965	3,968	4,091	4,089	4,022	4,189	4,673	4,676	4,975	5,059
Candida albicans	55	55	57	74	56	64	53	47	52	52
Other candida species	41	29	37	34	31	45	44	50	33	44
Other fungi	2	3	1	3	2	3	3	1	1	1
Total	98	87	95	111	89	112	100	98	86	97

Table 22. Blood culture findings in patients aged 65 or over, 2008–2017 (no. of cases).

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Escherichia coli	1888	2054	2230	2478	2482	2876	3242	3361	3717	4011
Staphylococcus aureus	671	690	729	780	796	876	1063	1174	1265	1348
Klebsiella species	381	464	471	475	538	564	673	734	805	826
Streptococcus, other betahaemolytic	193	232	279	284	308	335	441	464	526	628
Streptococcus pneumoniae	326	294	303	295	341	318	354	425	414	436
Staphylococcus epidermidis	299	270	326	316	300	344	366	394	419	422
Enterococcus faecalis	217	222	229	275	286	301	375	334	372	395
Staphylococcus, other coagulase-negative	171	161	149	162	170	252	293	366	383	393
Bacteroides fragilis group	146	164	177	203	183	202	253	295	301	306
Pseudomonas aeruginosa	191	184	218	195	250	230	233	253	273	288
Enterobacter species	131	128	156	157	174	188	172	217	257	214
Streptococcus viridans group	141	135	133	169	175	193	164	163	194	207
Enterococcus faecium	126	175	180	196	182	209	257	204	200	203
Proteus mirabilis	99	102	106	98	130	118	156	150	190	190
Streptococcus milleri group	53	62	59	59	65	92	127	144	152	182
Streptococcus agalactiae	94	104	126	113	117	129	170	162	191	171
Citrobacter species	65	59	76	59	95	100	97	113	129	149
Streptococcus pyogenes	50	61	50	49	75	67	73	68	101	116
Serratia species	50	37	59	56	64	81	72	89	114	107
Clostridium other than perfringens	30	39	44	38	45	39	60	69	83	77
Listeria monocytogenes	26	20	45	30	36	45	41	32	49	65
Peptostreptococcus and Peptococcus	14	28	36	26	24	32	44	42	71	64
Morganella morganii	11	18	28	30	16	30	39	40	45	48
Clostridium perfringens	34	48	40	51	56	34	57	61	68	44
Haemophilus influenzae	21	22	19	37	51	20	32	28	37	42
Streptococcus bovis group	15	25	14	13	21	29	19	22	30	41
Prevotella species	11	15	13	14	7	11	16	18	19	28
Fusobacterium species	10	8	17	14	19	17	22	26	35	28

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Pseudomonas other than aeruginosa	11	10	10	8	11	12	18	13	12	23
Bacteroides, other than fragilis group	8	13	8	8	16	12	10	11	10	21
Enterococcus, other or unidentified	24	20	25	33	34	17	21	33	22	19
Propionibacterium species	5	9	10	13	6	7	12	18	12	17
Campylobacter species	5	6	3	1	4	4	13	20	20	17
Acinetobacter	12	16	16	17	19	21	16	28	17	17
Capnocytophaga canimorsus	3	2	2	6	7	12	9	9	6	15
Bacillus	11	12	7	13	7	17	23	12	25	12
Hafnia alvei	8	7	7	1	8	6	4	7	14	11
Stenotrophomonas maltophilia	3	6	7	4	8	12	7	16	8	10
Haemophilus, other than influenzae	1	1	1	0	3	8	4	5	6	8
Neisseria meningitidis	6	6	6	6	5	4	2	3	7	7
Proteus vulgaris	4	4	8	8	12	14	16	15	8	6
Mycobacterium species	4	0	5	1	1	1	2	5	2	5
Salmonella, other than Typhi or Paratyphi	19	6	8	7	13	9	14	3	13	5
Yersinia enterocolitica	0	1	1	0	3	0	0	0	2	1
Corynebacterium diphteriae	0	0	0	0	0	0	0	0	0	0
Veillonella species	8	5	2	5	4	10	8	3	0	0
Yersinia pseudotuberculosis	0	3	1	0	1	0	0	0	0	0
Salmonella Paratyphi	0	0	0	0	0	0	0	1	0	0
Salmonella Typhi	0	0	0	0	0	0	0	0	0	0
Other bacteria	120	121	115	133	144	186	236	255	276	325
Total	5,716	6,069	6,554	6,936	7,312	8,084	9,326	9,905	10,900	11,548
Candida albicans	66	49	93	65	70	77	72	71	72	73
Other candida species	26	42	31	47	39	60	44	45	47	48
Other fungi	8	3	3	4	1	3	0	2	5	9
Total	100	94	127	116	110	140	116	118	124	130

Table 23. Group A streptococcus blood findings by emm type, 2008–2017 (no. of cases and %).

Each emm type includes all variants detected.

Year	Analysed strains	emm1	emm28	emm4	emm89	emm33	emm12	Others
2008	218	51 (23 %)	46 (21 %)	4 (2 %)	10 (5 %)	0 (0 %)	18 (8 %)	89 (41 %)
2009	191	24 (13 %)	56 (29 %)	8 (4 %)	28 (15 %)	0 (0 %)	8 (4 %)	67 (35 %)*
2010	171	22 (13 %)	38 (22 %)	6 (4 %)	24 (14 %)	0 (0 %)	13 (8 %)	68 (39 %)
2011	161	24 (15 %)	37 (23 %)	6 (4 %)	30 (19 %)	0 (0 %)	16 (10 %)	48 (30 %)
2012	207	22 (11 %)	65 (31 %)	13 (6 %)	58 (28 %)	5 (2 %)	14 (7 %)	30 (14 %)
2013	176	18 (10 %)	58 (33 %)	11 (6 %)	43 (24 %)	13 (7 %)	9 (5 %)	24 (14 %)
2014	205	10 (5 %)	62 (30 %)	17 (8 %)	47 (23 %)	12 (6 %)	11 (5 %)	46 (23 %)
2015	173	19 (11 %)	60 (35 %)	15 (9 %)	33 (19 %)	2 (1 %)	8 (5 %)	36 (20 %)*
2016	222	24 (11 %)	77 (35 %)	15 (7 %)	41 (18 %)	0 (0 %)	23 (10 %)	42 (19 %)
2017	294	81 (28 %)	77 (26 %)	10 (3 %)	37 (13 %)	1 (0,3 %)	26 (9 %)	62 (21 %)

* One untyped finding in 2009 and 2015.

Table 24. Cerebrospinal fluid culture findings in patients aged 15 to 64, 2008–2017 (no. of cases).

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Staphylococcus epidermidis	27	18	11	10	21	12	17	20	12	10
Streptococcus pneumoniae	26	20	15	12	19	13	11	17	12	9
Staphylococcus, other coagulase-negative	14	11	8	6	7	12	9	11	8	6
Staphylococcus aureus	13	13	12	20	15	11	9	14	13	6
Propionibacterium species	4	4	7	4	5	6	13	12	10	4
Enterococcus faecalis	4	3	4	3	3	0	1	2	0	3
Streptococcus milleri group	1	0	0	0	0	0	1	0	0	2
Streptococcus agalactiae	2	0	2	0	1	1	1	4	0	2
Listeria monocytogenes	1	2	1	1	1	2	2	3	2	2
Neisseria meningitidis	4	9	5	7	5	1	1	3	4	2
Klebsiella species	4	2	1	2	0	1	5	0	0	2
Enterobacter species	9	3	1	2	4	2	2	1	3	2
Streptococcus viridans group	1	2	2	4	2	2	2	0	1	1
Streptococcus pyogenes	2	2	1	1	0	0	2	0	1	1
Enterococcus faecium	0	1	0	2	2	1	0	0	0	1
Mycobacterium species	2	0	0	1	2	0	0	1	1	1
Bacillus	3	0	0	0	2	0	0	1	0	1
Peptostreptococcus and Peptococcus	0	1	0	0	0	0	0	0	0	1
Haemophilus, other than influenzae	0	0	0	2	0	0	0	1	0	1
Haemophilus influenzae	3	1	0	2	1	2	3	0	2	1
Proteus mirabilis	0	0	0	1	0	0	0	0	0	1
Escherichia coli	3	4	1	1	2	1	1	0	0	1
Citrobacter species	0	0	1	0	1	0	0	1	0	1
Streptococcus, other betahaemolytic	1	2	1	2	1	0	1	0	1	0
Streptococcus bovis group	0	0	1	0	0	0	0	0	0	0
Enterococcus, other or unidentified	1	0	0	1	0	0	0	0	0	0
Clostridium other than perfringens	0	0	0	0	0	0	1	0	0	0
Stenotrophomonas maltophilia	0	0	0	1	0	0	0	0	0	0

	2008	209	2010	2011	2012	2013	2014	2015	2016	2017
Capnocytophaga canimorsus	0	1	0	0	1	0	1	0	0	0
Campylobacter species	0	0	0	0	0	1	0	0	0	0
Acinetobacter	2	3	0	2	2	0	1	2	0	0
Bacteroides, other than fragilis group	0	0	0	0	0	0	1	0	0	0
Pseudomonas other than aeruginosa	1	1	0	1	0	0	0	0	0	0
Pseudomonas aeruginosa	4	5	3	1	4	1	2	1	1	0
Serratia species	0	0	0	1	0	0	0	1	2	0
Salmonella, other than Typhi or Paratyphi	2	0	0	1	0	0	0	0	0	0
Morganella morganii	0	0	0	0	0	0	1	0	0	0
Other bacteria	2	4	0	1	2	1	5	2	1	3
Total	136	112	77	92	103	70	93	97	74	64
Muut hiivat	0	1	1	0	1	0	1	2	1	0
Other candida species	0	0	0	0	1	0	0	1	0	0
Total	0	1	1	0	2	0	1	3	1	0

Table 25. Cerebrospinal fluid culture findings in patients aged 65 or over, 2008–2017 (no. of cases).

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Streptococcus pneumoniae	7	10	6	8	4	8	1	12	6	7
Staphylococcus, other coagulase-negative	4	3	3	1	3	5	6	3	6	6
Listeria monocytogenes	2	2	6	4	4	4	4	6	8	5
Staphylococcus aureus	3	6	5	5	2	10	4	4	3	4
Escherichia coli	1	1	1	2	1	1	0	3	2	4
Staphylococcus epidermidis	10	6	3	4	7	8	8	2	5	3
Propionibacterium species	2	2	1	1	2	2	9	5	4	3
Streptococcus viridans group	0	3	1	0	3	1	0	0	1	2
Pseudomonas aeruginosa	2	0	0	0	1	2	0	0	0	2
Klebsiella species	1	1	0	0	0	0	0	0	1	2
Streptococcus agalactiae	0	1	1	0	0	1	1	1	1	1
Peptostreptococcus and Peptococcus	0	0	0	0	1	0	0	0	0	1
Neisseria meningitidis	1	0	2	0	1	1	0	0	0	1
Haemophilus, other than influenzae	0	0	0	0	0	0	0	0	0	1
Capnocytophaga canimorsus	0	0	0	0	0	0	0	0	0	1
Acinetobacter	0	0	0	0	0	0	0	0	0	1
Bacteroides fragilis group	0	1	0	0	0	0	0	0	0	1
Citrobacter species	0	0	0	1	0	1	0	1	0	1
Streptococcus, other betahaemolytic	0	1	0	0	0	1	0	0	0	0
Streptococcus milleri group	0	1	0	0	0	0	0	0	1	0
Streptococcus bovis group	0	1	0	0	0	0	0	0	0	0
Enterococcus, other or unidentified	0	0	1	0	0	0	0	0	0	0
Enterococcus faecium	0	2	0	0	1	0	0	0	1	0
Enterococcus faecalis	0	1	0	0	2	0	2	0	1	0
Mycobacterium species	1	1	0	1	0	0	1	1	1	0
Bacillus	1	0	0	2	1	0	0	1	0	0
Stenotrophomonas maltophilia	0	0	0	0	0	0	0	0	0	0
Haemophilus influenzae	1	1	0	1	0	0	0	0	1	0

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Pseudomonas other than aeruginosa	0	0	0	0	0	0	0	0	1	0
Serratia species	0	0	0	0	0	0	0	1	1	0
Enterobacter species	0	0	1	1	1	1	0	0	1	0
Other bacteria	0	0	1	0	0	1	2	2	0	0
Total	37	45	32	31	34	47	38	42	45	46
Candida albicans	1	0	0	0	1	0	0	0	0	2
Other candida species	0	1	0	1	0	0	1	0	0	0
Total	1	1	0	1	1	0	1	0	0	2

Table 26. Blood culture findings in all age groups, 2008–2017 (no. of cases).

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Escherichia coli	2,812	2,987	3,224	3,472	3,463	3,877	4,366	4,532	4,967	5,245
Staphylococcus aureus	1,260	1,288	1,372	1,483	1,490	1,587	1,919	2,040	2,185	2,270
Klebsiella species	579	664	686	651	768	794	899	944	1,063	1,082
Streptococcus, other betahaemolytic	321	360	423	440	443	514	617	627	737	858
Streptococcus pneumoniae	919	851	831	771	749	718	700	808	813	816
Staphylococcus epidermidis	687	679	699	644	549	642	680	739	702	735
Staphylococcus, other coagulase-negative	374	360	342	354	311	448	548	632	675	642
Enterococcus faecalis	311	343	341	387	408	401	490	457	487	504
Bacteroides fragilis group	256	233	289	313	286	303	386	421	470	451
Pseudomonas aeruginosa	268	265	318	293	332	325	316	338	350	357
Streptococcus viridans group	310	313	335	364	358	379	315	289	327	344
Streptococcus milleri group	128	121	129	146	145	190	256	274	307	326
Enterobacter species	210	216	260	256	276	282	259	327	376	320
Streptococcus agalactiae	240	250	290	230	242	258	290	301	299	298
Streptococcus pyogenes	220	192	171	168	216	181	211	178	228	294
Enterococcus faecium	220	273	280	305	281	309	372	275	286	287
Proteus mirabilis	113	120	132	115	154	140	179	182	217	218
Citrobacter species	90	90	109	87	121	123	135	143	169	188
Serratia species	78	65	82	92	90	115	103	132	156	147
Peptostreptococcus and Peptococcus	26	56	52	58	43	54	82	79	119	114
Clostridium other than perfringens	55	69	71	62	79	69	105	99	112	109
Listeria monocytogenes	34	30	62	37	54	58	62	41	59	83
Fusobacterium species	46	36	55	47	68	60	70	63	74	77
Haemophilus influenzae	44	46	40	64	80	47	57	52	66	71
Bacillus	46	38	43	50	40	65	89	77	82	67
Morganella morganii	25	26	35	38	23	48	51	53	59	64
Clostridium perfringens	44	66	57	59	67	42	70	73	75	58
Streptococcus bovis group	16	33	21	19	27	33	24	31	37	52

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Prevotella species	25	28	28	30	23	21	28	28	42	50
Campylobacter species	12	17	13	5	10	12	46	46	53	45
Salmonella, other than Typhi or Paratyphi	64	30	53	41	48	50	44	30	52	43
Capnocytophaga canimorsus	11	13	13	23	20	26	24	21	17	37
Propionibacterium species	8	18	16	23	15	17	23	26	27	36
Bacteroides, other than fragilis group	13	23	9	15	19	19	18	17	18	36
Acinetobacter	28	39	34	40	35	37	32	49	29	35
Stenotrophomonas maltophilia	22	22	23	13	16	27	24	36	18	31
Pseudomonas other than aeruginosa	16	19	16	16	19	20	33	25	17	27
Enterococcus, other or unidentified	34	35	39	45	55	26	26	47	25	26
Neisseria meningitidis	22	24	29	26	21	16	16	17	15	15
Haemophilus, other than influenzae	5	1	3	4	14	14	10	14	12	13
Hafnia alvei	11	13	9	3	10	7	6	9	18	11
Salmonella Typhi	1	3	9	5	1	6	5	1	2	9
Mycobacterium species	6	2	7	6	4	9	6	8	4	8
Proteus vulgaris	6	7	10	10	15	16	20	19	10	8
Salmonella Paratyphi	5	3	3	1	3	1	2	3	2	6
Yersinia enterocolitica	0	2	2	0	3	0	1	3	3	1
Corynebacterium diphteriae	0	0	0	0	0	0	1	0	0	0
Veillonella species	11	11	8	17	9	17	16	8	0	0
Yersinia pseudotuberculosis	1	3	1	0	2	1	1	0	0	0
Other bacteria	231	246	236	253	278	329	411	430	462	538
Total	10,264	10,629	11,310	11,581	11,783	12,733	14,444	15,044	16,323	17,052
Candida albicans	126	105	154	140	128	145	129	121	126	129
Other candida species	69	71	68	85	72	106	89	96	82	94
Other fungi	10	6	4	7	3	6	3	3	6	10
Total	205	182	226	232	203	257	221	220	214	233

Table 27. Cerebrospinal fluid culture findings in all age groups, 2008–2017 (no. of cases).

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Streptococcus pneumoniae	38	36	26	25	24	27	16	30	20	19
Staphylococcus epidermidis	43	28	17	18	30	23	30	25	18	15
Staphylococcus, other coagulase-negative	22	16	11	7	12	18	15	15	16	13
Staphylococcus aureus	21	24	20	27	22	24	14	20	16	12
Escherichia coli	5	6	4	4	4	2	3	5	3	8
Propionibacterium species	6	6	8	6	7	8	24	19	15	7
Listeria monocytogenes	3	4	7	5	5	6	6	9	10	7
Streptococcus agalactiae	5	7	13	3	5	3	9	8	4	6
Streptococcus viridans group	1	7	3	5	5	3	2	2	3	5
Enterococcus faecalis	4	4	5	3	5	0	3	3	1	4
Klebsiella species	5	4	1	2	1	1	5	0	1	4
Neisseria meningitidis	9	13	11	11	11	8	4	5	5	3
Haemophilus influenzae	4	3	0	4	1	2	5	0	4	3
Enterobacter species	9	4	2	3	6	3	2	1	5	3
Streptococcus milleri group	1	1	0	0	0	0	1	0	1	2
Peptostreptococcus and Peptococcus	0	1	0	0	1	0	0	0	0	2
Haemophilus, other than influenzae	0	0	0	2	0	0	0	1	0	2
Pseudomonas aeruginosa	6	5	3	1	5	3	2	1	1	2
Citrobacter species	0	0	2	1	1	1	1	2	0	2
Streptococcus pyogenes	2	3	1	1	1	0	2	0	1	1
Enterococcus faecium	0	3	0	2	3	1	0	0	1	1
Mycobacterium species	3	1	1	2	2	0	1	2	2	1
Bacillus	4	0	0	2	3	0	1	2	0	1
Capnocytophaga canimorsus	0	1	0	0	1	0	1	0	0	1
Acinetobacter	2	3	0	2	2	0	1	2	0	1
Bacteroides fragilis group	0	1	0	0	0	0	0	0	0	1
Proteus mirabilis	1	1	0	1	0	0	0	0	0	1
Streptococcus, other betahaemolytic	1	4	1	2	1	1	1	0	1	0

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Streptococcus bovis group	0	1	1	0	0	0	0	0	0	0
Enterococcus, other or unidentified	1	0	1	1	0	0	0	0	0	0
Clostridium other than perfringens	0	0	0	0	0	0	1	0	0	0
Stenotrophomonas maltophilia	0	0	0	1	0	0	0	0	0	0
Campylobacter species	0	0	0	0	0	1	0	0	0	0
Bacteroides, other than fragilis group	0	0	0	0	0	0	1	0	0	0
Pseudomonas other than aeruginosa	1	1	0	1	0	0	0	0	1	0
Serratia species	0	0	0	1	0	0	0	2	3	0
Salmonella, other than Typhi or Paratyphi	2	0	0	1	0	0	0	0	0	0
Morganella morganii	0	0	0	0	0	0	1	0	0	0
Other bacteria	4	6	2	1	2	4	9	5	1	3
Total	203	194	140	145	160	139	161	159	133	130
Candida albicans	1	1	0	0	3	0	0	1	0	2
Other candida species	0	2	1	1	1	0	2	2	1	0
Total	1	3	1	1	4	0	2	3	1	2

Authors

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Adenovirus
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Influenza A and B
Niina Ikonen, Outi Lyytikäinen, Hanna Nohynek (THL)

Parainfluenza
Niina Ikonen, Outi Lyytikäinen (THL)

Rhinovirus
Carita Savolainen-Kopra, Outi Lyytikäinen (THL)

RSV
Niina Ikonen, Outi Lyytikäinen (THL)

Enterovirus
Soile Blomqvist (THL)

Whooping cough
Jussi Sane, Emmi Sarvikivi, Hanna Nohynek (THL)

Chlamydial pneumonia
Mirja Puolakkainen (University of Helsinki)

Legionella
Sari Jaakola, Jaana Kusnetsov, Silja Mentula, Pia Räsänen, Outi Lyytikäinen (THL)

Mycoplasm
Mirja Puolakkainen (University of Helsinki)

Gastrointestinal infections

Gastrointestinal outbreaks
Ruska Rimhanen-Finne, Saara Salmenlinna, Outi Zacheus (THL)

Clostridium difficile
Silja Mentula, Outi Lyytikäinen (THL)

EHEC
Sari Huusko, Ruska Rimhanen-Finne, Ulla-Maija Nakari, Saara Salmenlinna (THL)

Campylobacter
Ruska Rimhanen-Finne, Saara Salmenlinna (THL)

Listeria
Ruska Rimhanen-Finne, Saara Salmenlinna (THL)

Salmonella
Satu Murtopuro, Ruska Rimhanen-Finne, Aino Kyyhkynen, Saara Salmenlinna (THL)

Shigella
Satu Murtopuro, Ruska Rimhanen-Finne, Salla Kiiskinen, Aino Kyyhkynen (THL)

Yersinia
Huusko Sari, Ruska Rimhanen-Finne, Salla Kiiskinen, Saara Salmenlinna (THL)

Norovirus
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Rotavirus
Leif Lakoma, Tuija Leino, Haider Al-Hello (THL)

Hepatitis

Hepatitis A
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Hepatitis B
Salla Toikkanen, Tuija Leino, Markku Kuusi, Henrikki Brummer-Korvenkontio, Kirsi Liitsola (THL)

Hepatitis C
Salla Toikkanen, Markku Kuusi, Henrikki Brummer-Korvenkontio, Kirsi Liitsola (THL)

Sexually transmitted diseases

Chlamydia
Salla Toikkanen, Kirsi Liitsola (THL)
Eija Hiltunen-Back (HUS)

LGV
Salla Toikkanen, Kirsi Liitsola (THL)
Eija Hiltunen-Back (HUS)

Gonorrhoea
Salla Toikkanen, Kirsi Liitsola (THL)
Eija Hiltunen-Back (HUS)

Syphilis
Salla Toikkanen, Kirsi Liitsola (THL)
Eija Hiltunen-Back (HUS)

HIV and AIDS
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Antimicrobial resistance

MRSA
Outi Lyytikäinen, Laura Lindholm (THL)

VRE
Outi Lyytikäinen, Laura Lindholm (THL)

ESBL
Outi Lyytikäinen, Jari Jalava, Kati Räisänen (THL)

CPE
Outi Lyytikäinen, Jari Jalava, Kati Räisänen (THL)

Tuberculosis

Tuberculosis
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Tuula Vasankari (Filha)

Other infections

Invasive pneumococcal disease
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Haemophilus
Emmi Sarvikivi, Maija Toropainen, Tuija Leino (THL)

Meningococcus
Maija Toropainen, Markku Kuusi, Anni Vainio, Hanna Nohynek (THL)

MMR diseases (measles, mumps, rubella)
Emmi Sarvikivi, Tuija Leino, Mia Kontio (THL)

Varicella virus
Emmi Sarvikivi, Tuija Leino (THL)

Borrelia
Jussi Sane (THL)

Tick-borne encephalitis (TBE)
Jussi Sane, Tuija Leino, Sari Huusko (THL)
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Puumala virus
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Pogosta disease
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Tularemia
Jussi Sane (THL)

Rabies
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Travel-related infections

Malaria
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Katariina Kainulainen (HUS)

Dengue fever
Jussi Sane, Eeva Pekkanen (THL)

Chikungunya
Jussi Sane, Eeva Pekkanen (THL)

Other travel-related infections
Eeva Pekkanen (THL)

Blood and cerebrospinal fluid findings in children
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Blood and cerebrospinal fluid findings in adults
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Group A streptococcus
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