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Infectious Diseases in Finland 2014

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INFECTIOUS DISEASES IN FINLAND 2014

NATIONAL INSTITUTE
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In addition to commentary, the report includes figures and tables that are not employed in our regular reporting. Distributions by gender, age and region are available on our website. The figures for some of the diseases in the National Infectious Diseases Register will still be updated after being published in print.
Up-to-date figures are available at **http://tartuntatautirekisteri.fi/tilastot**

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Infectious Diseases in Finland 2014.

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Introduction

Communicable and infectious diseases have by no means been completely overcome. In 2014, we had several reminders of this, at home and abroad.

Towards the end of March, the WHO issued the first alert concerning an Ebola epidemic in Guinea, West Africa (National Institute of Health and Welfare news 25 March 2014). Almost fifty cases were reported and the epidemic seemed to be spreading further. Ebola had never occurred in West Africa before. At that time, no one knew that the epidemic would expand to become the largest ever filovirus epidemic, with repercussions spreading out to other countries as well as the affected area. When this report was written in May 2015, the epidemic was not completely over, even though Liberia had been declared Ebola-free. According to the WHO's latest situation report, the case count was highest in Guinea, Sierra Leone and Liberia, where there were almost 27,000 cases altogether involving over 11,000 deaths. The epidemic will have to be completely eradicated over the next few months if we are to be certain that it cannot recur, as happened in the early summer of 2014.

The epidemic was met by a massive response: the establishment of the United Nations Mission for Ebola Emergency Response, but only in August after a considerable delay. The reasons for this will continue to be investigated for a long time to come. One reason for the delay in the WHO's response was probably the reduction in the resources available to the organisation. During the year, the European Centre for Disease Prevention and Control (ECDC) published risk assessment reports for the EU area, updated at a few weeks' interval, to supplement WHO's weekly reports. The EU Health Security Committee convened on even a weekly basis to discuss preparedness and the situation in various countries.

Preparations for Ebola cases among travellers were raised to a new level throughout the EU and preparedness plans were revised in Finland. The Ministry of Social Affairs and Health set up an inter-sectoral working group to coordinate measures in various sectors. During the summer, the Helsinki and Uusimaa Hospital District's prevention guidelines were distributed to all hospital districts. Throughout the year and in cooperation with various actors, the National Institute for Health and Welfare prepared several additional sets of detailed instructions for the Ebola website on topics such as guidelines for staff protection. In addition, the National Institute for Health and Welfare actively communicated on the status of the epidemic in What's New on Infectious Diseases (20 news items) and ensured the availability of Ebola virus diagnostics in cooperation with Huslab and the national health authorities of Sweden.

Unlike many other EU Member States, no cases proven to be Ebola were diagnosed in Finland. However, Finland's preparedness was tested by one suspected case at an airport and one case of illness that met the case definition, as well as several less severe suspected cases. A few cases of Ebola were diagnosed in the EU, all affecting health care professionals who had treated patients evacuated from the affected area of West Africa and whose protection was found to be defective afterwards. None of these cases resulted in a more widespread chain of infections.

There was also a fair number of events in Finland: early in the year, the most widespread *Yersinia pseudotuberculosis* epidemic was associated with the consumption of unpasteurized milk. At least 39 people fell ill after consuming unprocessed milk produced on a farm in the Uusimaa region. Very young babies were among those affected. This re-ignited the debate on the safety of unprocessed milk in large-scale retail, in light of the recent relaxation of restrictions on selling unpasteurised milk. Since then, the Finnish Food Safety Authority Evira has recommended that unprocessed milk be heated before use, because the pathogens that easily remain in unpasteurised milk can proliferate during refrigeration and cause gastrointestinal infections.

More cases exposed to tuberculosis were detected than in previous years. In collaboration with the Ministry of Social Affairs and Health, the National Institute for Health and Welfare (THL) prepared new instructions on the screening of immigrants for pulmonary tuberculosis. These instructions are clearly necessary in order to enhance the rapid diagnosis of cases and reduce the number of cases exposed. Unfortunately, the Act on health services for so-called undocumented persons was rejected, in an exceptional manner, during the final sessions of Parliament. This Act would have enabled the Government to meet municipalities halfway in covering the costs of treatment, in cases in which such costs cannot be collected from an uninsured person. Pursuant to the Communicable Diseases Act, municipalities have a comprehensive obligation to prevent infectious diseases in their area.

The National Institute for Health and Welfare underwent an organisational reform, becoming lighter due to

the removal of one management tier. Cuts in resources throughout the institute resulted in large personnel cuts in the new Department of Infectious Disease Surveillance and Control. The Department's bacteriological units were combined and a four or five-year genomics project was launched in order to restructure the reference laboratory's operations. The Department, and the National Institute for Health and Welfare (THL) as a whole, must engage in even closer cooperation with a range of partners in order to improve the THL's services. In addition, register and statistical data will be more extensively opened up to various users.

EPIDEMIOLOGICAL OVERVIEW OF FINLAND

Of respiratory infections, the 2013–2014 epidemic season of influenza A was exceptionally long, but its peak was brief. Unfortunately, the influenza vaccination coverage rate for small children remained low, with only 16% of the target group being vaccinated. Cases of influenza A were identified in the 0 to 4 age groups and among over-75s in particular. It was positive that fewer influenza A infections were detected in men aged 15 to 24 than in the previous year, probably due to the influenza vaccine being offered to conscripts. Cases of influenza B remained relatively few.

Enterovirus cases were considerably more numerous than in previous years, most of them being diagnosed in the autumn. More than half of the patients were children under 10 years of age. In autumn 2014, severe cases of respiratory infections were diagnosed in the United States and Canada, caused by a type D68 (EV-D68) enterovirus. Most of the patients were children and the infection required hospital treatment, particularly among asthma sufferers and a few other patients who developed polio-like paralysis symptoms after the respiratory infection. Special attention was paid to monitoring the incidence of EV-D68 throughout Europe in the autumn of 2014. In Finland, the virus was found in some 20 patients suffering from respiratory infections. No serious cases of illness or neurological symptoms appeared, with the exception of one case that required intensive care. The virus was found in Norway in two patients who displayed symptoms of paralysis, and in one in France.

In 2014, almost 80 notifications of suspected cases of food poisoning were sent to the register IT system known as RYMY, jointly maintained by the National Institute for Health and Welfare and the Finnish Food Safety Authority Evira. The National Institute for Health and Welfare contacted the municipal epidemic investigation working group with regard to 24 notifications. In 2014, the National Institute for Health and Welfare participated in the control and investigation of 38 international bacterial gastrointestinal epidemics, by providing up-to-date information on the situation in Finland. Food-borne epidemics were probably caused in Finland by e.g. hepatitis A (mixed frozen berries), EHEC O157:H7 (an unidentified food product) and *Yersinia pseudotuberculosis* (unprocessed milk).

At the year end in 2014, the National Institute for Health and Welfare published an extensive report on the occurrence and consequences of hepatitis C virus infections in Finland in 1995−2013. New, efficient medicines for the treatment of hepatitis C infections are raising hopes of the long-term eradication of the disease. In addition, the National Institute for Health and Welfare investigated several infection clusters detected by reference laboratories and international cooperation partners.

The number of gonorrhoea infections diagnosed was around 20 more than in the previous year. More than half of these were of domestic origin, which is exceptional in comparison with previous years, when it was established that most infections had been acquired abroad. The number of syphilis infections was also higher, at 50 more than in the previous year, and many of them are related to travel in Russia and Estonia. Approximately twenty more HIV infections were diagnosed than in the previous year. Most HIV infections of Finns through heterosexual contact were of foreign origin, Thailand in particular. Almost one half of syphilis, gonorrhoea and HIV infections contracted by Finnish men were the result of sexual contact between men.

An exceptionally high number of epidemics caused by bathing water were diagnosed in June−July. In some cases, the pathogen was diagnosed as norovirus. Despite the fact that the epidemics were probably not directly linked, the exceptionally hot weather conditions were likely to have caused congestion and overloading on beaches, which then manifested itself in an increasing number of notifications of suspected epidemics. These epidemics were extensively covered in the mass media.

Helsinki, 29 May 2015

Mika Salminen
Head of Department
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Respiratory infections

- The 2013–2014 epidemic season for influenza A was exceptionally long and the peak of the epidemic was brief.
- Influenza vaccination coverage remained low. Cases of influenza A were particularly found among over-75s and the 0-to-4-year-old age groups.
- The season was weak for influenza B.
- The autumn's rhinovirus epidemic partly coincided with the peak of the parainfluenza season in November–December. More than half such infections were diagnosed in children under the age of 4.
- As expected, the minor RSV winter epidemic of 2013 was followed by a major epidemic that began in January 2014 and continued until June.
- Enterovirus cases were considerably more numerous than in previous years, most of them being diagnosed in the autumn. More than half of patients were children under 10 years of age.
- The number of whooping cough cases was on a par with 2013, but the number of cases in children under the age of 12 months was higher than usual. One unvaccinated baby aged under 3 months died of whooping cough.
- Unlike previous years, only two patients who had contracted pneumonia caused by the bacterium Legionella had acquired the infection while travelling abroad. In three cases, water in the patient's home premises proved to be the source of infection.

ADENOVIRUS

In 2014, 1,003 confirmed cases of adenovirus infection were recorded (2013: 704). The highest number of cases occurred in the under-5 age group, but numerous cases also came to light in the 5 to 9, 15 to 19 and 20 to 24 age groups. An increasing number of adenovirus cases were identified on two occasions in 2014: the first peak occurred in February–April and the next in November–December (90–148 cases per month). The number of cases was lowest in the summer months (June–August, around 50 cases per month).

More than 50 types of adenovirus are known. Some cause respiratory infections, while others cause gastrointestinal, eye or other infections. Adenoviruses are common pathogens in infants and small children; they rarely occur in adults.

Laboratories have various test methods for detecting adenoviruses in clinical samples. Antigen detection, virus cultures and PCR are sensitive and reliable methods used in specialised virus laboratories.

INFLUENZA

In the winter of 2014, the epidemic season began towards the end of January, peaked in February and continued until the end of May. Viruses of the influenza A(H1N1)pdm09 subtype emerged as the epidemic dominant virus in the 2013–2014 season, but influenza A(H3N2) viruses occurred simultaneously. Only individual cases of influenza B infections were detected during the season.

Influenza A

In 2014, 6,362 findings of influenza A were reported to the National Infectious Diseases Register, almost the same number as in the previous year (2013: 6,001). National surveillance of influenza virus infections by the National Institute for Health and Welfare led to the detection of 87 influenza A infections in January–April 2014, of which 75% were diagnosed as having been caused by the influenza A(H1N1)pdm09 virus. During the epidemic season 2013–2014, both

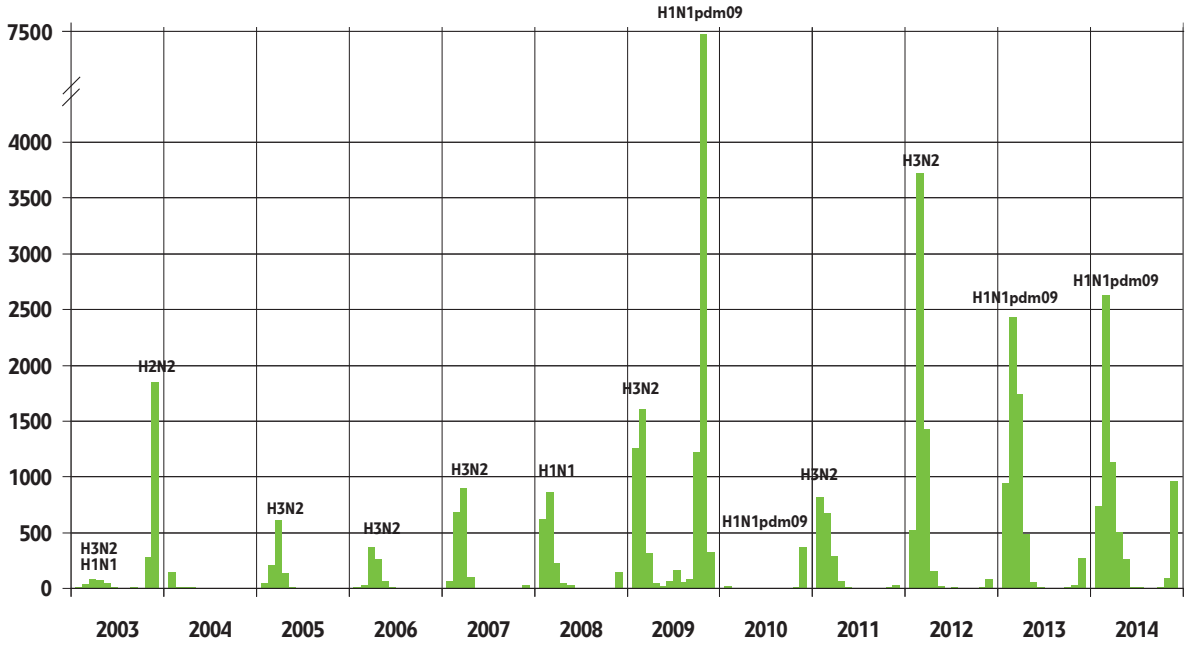


Figure 1. Cases of influenza A by month, and epidemic virus types 2003–2014 (no. of cases).

influenza A viruses (H1N1pdm09 and H3N2) were concurrently in circulation. The first cases of influenza A infections in the 2013–2014 season were reported to the National Infectious Diseases Register in October–November 2013. The number of findings increased in December.

Data in the National Infectious Diseases Register and from the national influenza surveillance of the National Institute for Health and Welfare indicate that the epidemic season peaked in February, during weeks 6 to 9. The number of cases began to decline gradually in May, until only isolated influenza A infections were being reported. The epidemic season 2013–2014 proved to be longer than the previous one, but the peak period was shorter. The number of influenza A cases began to increase markedly again in November–December 2014, which indicated an exceptionally early start to the season 2014–2015.

Influenza A infections were found in all age groups, but unlike the previous year, more were identified in the over 75 age group (2014: 603 vs. 2013: 361). Although the national influenza vaccination programme offers a seasonal influenza vaccination free of charge for children in risk groups and healthy children aged 6 to 35 months, influenza vaccination coverage has remained low: for example, at 13% for children aged 6 to 35 months in the influenza season of 2012–13 and 16% in the season of 2013–14. In 2014, cases of influenza A were reported in the 0 to 4 age group (710) in particular. In the 15 to 24 age group, fewer influenza A infections were detected in men than in the previous year (2013: 348/614 vs. 2014: 157/382). The explanation for the low percentage of influenza infections in this age group is probably the free influenza vaccination offered to conscripts since autumn 2012. Vaccination coverage is high among those in military service and the influenza viruses that circulated in Finland during the 2013–2014 season were a good match for the viruses in the vaccine.

In recent years, the genetic diversity of both the influenza A(H1N1)pdm09 and A(H3N2) viruses has increased. Several genetic groups were found in both influenza A subtypes in 2014.

Since they appeared, the diversity of A(H1N1)pdm09 viruses has increased and several genetic groups circulating as epidemics have been identified. Influenza A(H1N1)pdm09 viruses identified during the 2013–2014 epidemic season represented one of the genetic groups commonly circulating in Europe; no antigenic differences were detected between this virus and the A/California/07/2009 vaccine virus.

The viruses of the influenza A(H3N2) group circulating worldwide comprised two distinct genetic lineages, Perth/16/2009 and Victoria/208/2011, with

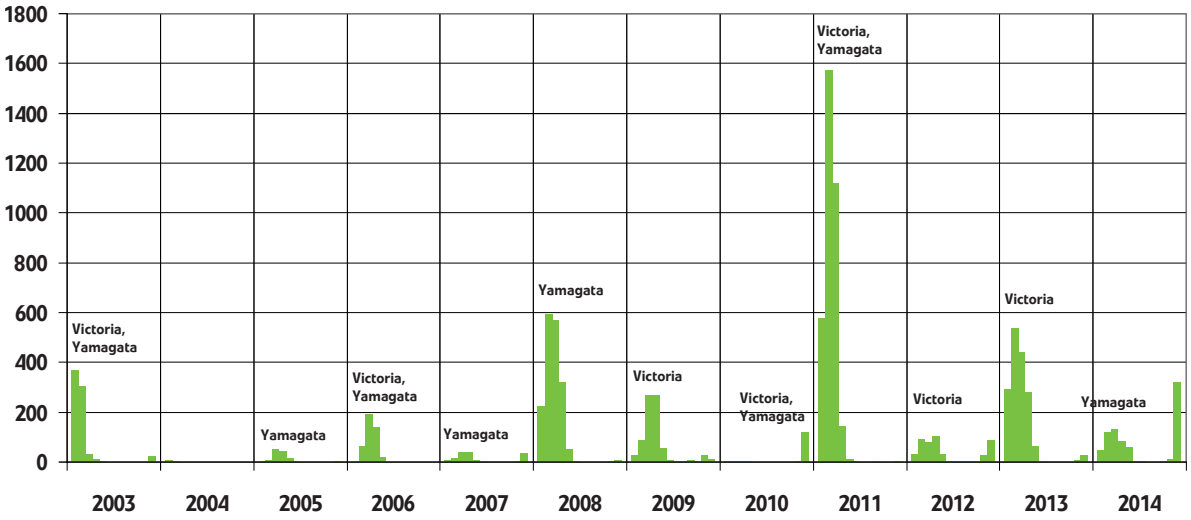


Figure 2. Cases of influenza B by month, and epidemic virus types 2003–2014 (no. of cases).

some antigenic differences. In 2012, the occurrence of viruses belonging to the Victoria/208/2011 lineage increased and, thereafter, several genetic subgroups have formed within the lineage. Almost all influenza A(H3N2) viruses found in Finland during the epidemic season 2013–2014 represented two genetic groups of the Victoria/207/2011 lineage, which commonly circulates in Europe. Towards the end of the season, after the WHO's vaccine recommendation for the northern hemisphere, transformed viruses belonging to both genetic groups were detected. These new types of viruses were found in a few countries in Europe, even in Finland, and in the United States. Some antigenic differences from the A/Texas/50/2012 vaccine virus have been detected in the transformed viruses.

Influenza B

The year 2014 was weak in terms of influenza B virus infections. A total of 775 cases of influenza B were reported to the National Infectious Diseases Register in 2014 (2013: 1652). The incidence of influenza B infections during the winter and spring (January to May) was low but steady. The incidence increased towards the end of the year in December. Influenza B infections were diagnosed in all age groups.

Of the two influenza B virus lineages that have circulated the world in recent seasons, the occurrence of the Yamagata lineage has increased. In the 2013–2014 epidemic season, only individual cases of Yamagata lineage viruses were diagnosed in Finland.

Vaccine for the epidemic season 2014–2015

Based on reports on the influenza A and B epidemic viruses circulating the world, the WHO did not recommend a change to the vaccination composition in the northern hemisphere for the epidemic season 2014–2015. The recommended virus component for influenza A(H3N2) was A/Texas/50/2012 and for A(H1N1)pdm09 it was A/California/07/2009. For influenza B, the recommended component was the B/Massachusetts/02/2012 virus of the Yamagata lineage.

Season 2014–2015

The first cases of influenza A and B infections were reported in November and December 2014. The 2014–2015 season started in December, clearly earlier than in previous seasons. By mid-March, no peak had occurred as in previous seasons. Instead, a steadily high number of influenza A infections was detected. The number of influenza B infections began to increase in February.

During the season, influenza A(H3N2) viruses that had transformed from the vaccine virus were dominant and only sporadic cases of influenza A(H1N1) pdm09 infections were diagnosed. These proved similar to the vaccine virus. Like the vaccine virus, influenza B viruses were of the Yamagata lineage. Some of the viruses were analysed in more detail and found to differ from the influenza B vaccine virus.

At the end of February 2015, the WHO issued a new vaccine recommendation for the northern hemi-

sphere 2015–2016 epidemic season, based on the then current epidemic situation, recommending that the influenza A(H3N2) virus component be replaced with the A/Switzerland/9715293/2013 virus, corresponding to the new transformed A(H3N2) viruses circulating as an epidemic. The influenza A(H1N1) pdm09 component remained unchanged as the A/California/07/2009 virus. The recommendation for the influenza B component was to change it to B/Phuket/3073/2013, which is also a virus of the Yamagata lineage but differs somewhat in antigenical terms from the previous Yamagata lineage component in the vaccine.

PARAINFLUENZA

Parainfluenza viruses are grouped under one heading in the National Infectious Diseases Register, even though laboratories usually differentiate between parainfluenza viruses 1, 2, 3 and 4. In 2014, 556 parainfluenza infections were confirmed (2013: 433), most of them in the 0 to 4 age group. Based on the number of cases, two separate epidemic peaks were detected in 2014. The first epidemic, which was smaller, occurred at the turn of the year 2013 and 2014 (71 cases in December 2013 and 61 in January 2014) and the second one at the end of the year 2014, in November–December (a total of 209 cases).

Parainfluenza virus infections are found in patients of all age groups. A child's first parainfluenza infections 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. Almost every year, parainfluenza virus type 3 causes minor epidemics in the summer and autumn, whereas type 1 and 2 viruses do not cause epidemics every year.

RHINOVIRUS

In 2014, 728 confirmed cases of rhinovirus infection were recorded (2013: 449). The numbers were highest from September to December (72–110 per month), while at other times, rhinovirus infections occurred at a steady rate every month (35–56 per month). More than 50% of these infections were diagnosed in children under the age of 4.

More than 150 types of rhinovirus are known. They are the most common cause of mild respiratory infections. Rhinovirus infections are most common in young children, but are present in all age groups. In autumn 2014, the rhinovirus epidemic partly coincided with the peak of the parainfluenza season in November–December. Since August 2013, rhinoviruses have been included in the surveillance of respiratory virus infections conducted by the National Institute for Health and Welfare (THL), which may partly contribute to the increase in the number of cases in 2013 and 2014. Laboratories use the PCR test to detect rhinoviruses in clinical samples. This test is extremely sensitive and reliable. Specialised virus laboratories are also able to culture rhinoviruses.

RSV

In 2014, 2,863 cases of RSV confirmed by laboratory tests were reported to the National Infectious Diseases Register (2013: 1,990). On the basis of long-term surveillance, a major RSV epidemic is observed in Finland every other winter, often starting in November–December. In addition, a minor epidemic occurs between the major ones. As expected, the minor winter epidemic of 2013 was followed by a major epidemic that began in January 2014 and continued until June. Individual cases of RSV infection were diagnosed during the summer and in the latter part of the year.

The majority (over 80%) of RSV infections are verified by laboratory testing in patients in the 0 to 4 age group, but RSV infections can occur in all age groups. However, cases requiring hospitalisation and laboratory diagnostics mainly involve infants and small children. In hospital conditions, RSV is easily transmitted between patients. Reliable quick tests for RSV diagnostics used in hospitals, outpatient clinics and health centres make it easier to identify RSV infections and prevent further transmission. Specialised virus laboratories increasingly use genetic replication methods for diagnosing RSV.

ENTEROVIRUS

In autumn 2014, severe cases of respiratory infection were diagnosed in the United States and Canada, caused by the type D68 (EV-D68) enterovirus. Most of the affected patients were children who required hospitalisation, particularly among asthma sufferers. EV-D68 was also identified in a few patients who developed polio-like paralysis symptoms after the respiratory infection. In the autumn of 2014, special attention was paid to monitoring the incidence of EV-D68 in Finland as in other parts of Europe. In

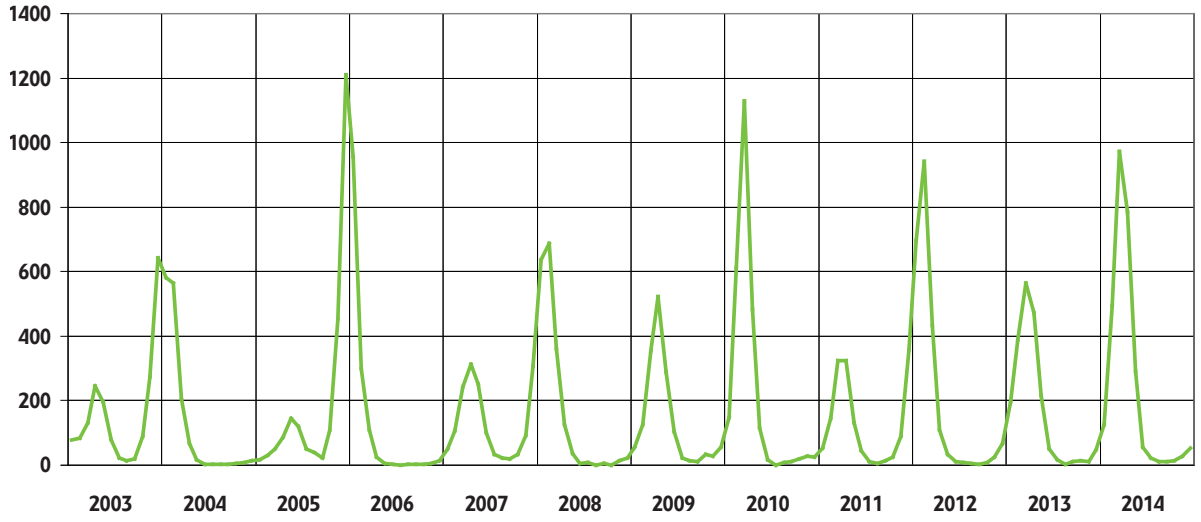


Figure 3. Cases of RSV per month, 2003–2014 (no. of cases).

Finland, the virus was diagnosed in some 20 patients with a respiratory infection, some of them children and others adults. No serious cases of illness or neurological symptoms appeared, with the exception of one case that required intensive care. Respiratory infections caused by EV-D68 were diagnosed in most European countries. In addition, the EV-D68 virus was found in Norway in two patients exhibiting symptoms of paralysis, and in one in France.

In 2014, 298 cases of enterovirus infection were reported to the National Infectious Diseases Register, considerably more than in 2013 (184) or 2012 (166). Of the cases, 154 (52%) were men and more than half (51%) in children under the age of 10. Most cases of enterovirus were found in the autumn, with 72% being diagnosed in August–November.

Enteroviruses cause not only upper respiratory tract infections but conditions such as meningitis, myocarditis, hand, foot and mouth disease and other types of eczema. Enterovirus diagnostics is based on virus cultures or increasingly on the PCR method. Virus typing is performed on the basis of antibodies or molecular genetics.

WHOOPING COUGH

In 2014, the number of whooping cough cases reported to the National Infectious Diseases Register totalled 205 (3.78/100,000), similar to 2013 (192; 3.6/100,000). As before, the cases were most common in the 0 to 14 age group, with seventeen cases in patients under 12 months of age and nine of them under 3 months of age, more than in the previous year. The only fatality due to whooping cough was the case of an unvaccinated baby under 3 months of age. The diagnosis of most patients aged under 12 months was principally based on a PCR test (14, 78%). In six cases, diagnosis was confirmed through a positive culture (22%), and for most patients of other ages, the diagnosis was made on the basis of antibody testing (173; 84%).

In 2014, all 12 strains of *B. pertussis* produced pertactin, one of the components of the vaccine used in Finland. In addition, one strain in a 5-year-old child was confirmed as *B. parapertussis*.

As previously, the incidence of whooping cough varied considerably by hospital district (0–11.6/100,000). The incidence was highest in the Kainuu Hospital District, while no cases were diagnosed in the Keski-Pohja Hospital District.

Choosing an optimum vaccination strategy for whooping cough is challenging, as the available cell-free vaccines are incomplete in terms of their efficiency and duration. 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 a cell-free combination vaccine containing the Bordetella pertussis antigen 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

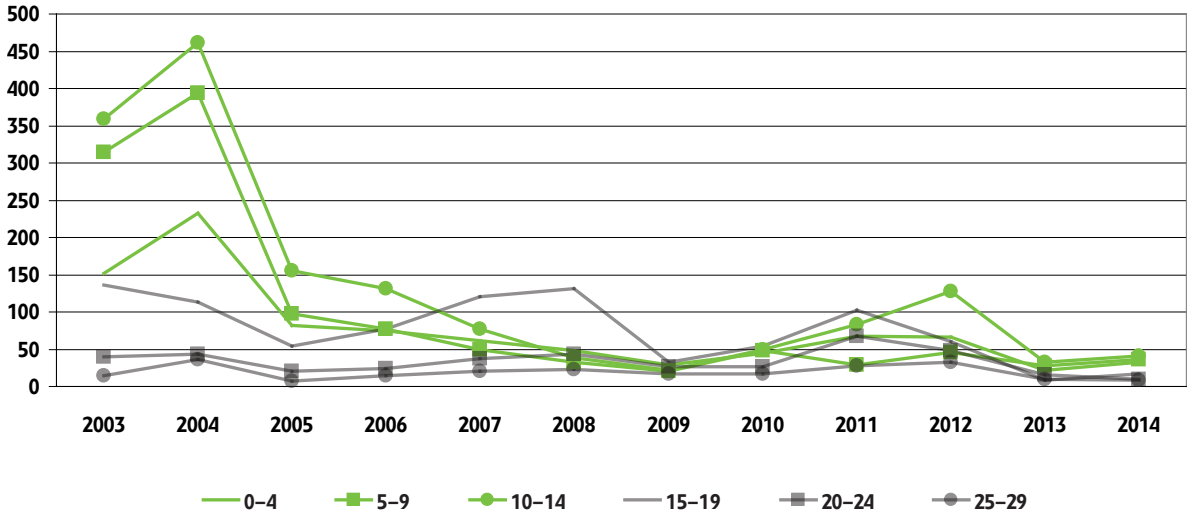


Figure 4. Cases of whooping cough in children's and young adults' age groups 2003–2014 (no. of cases).

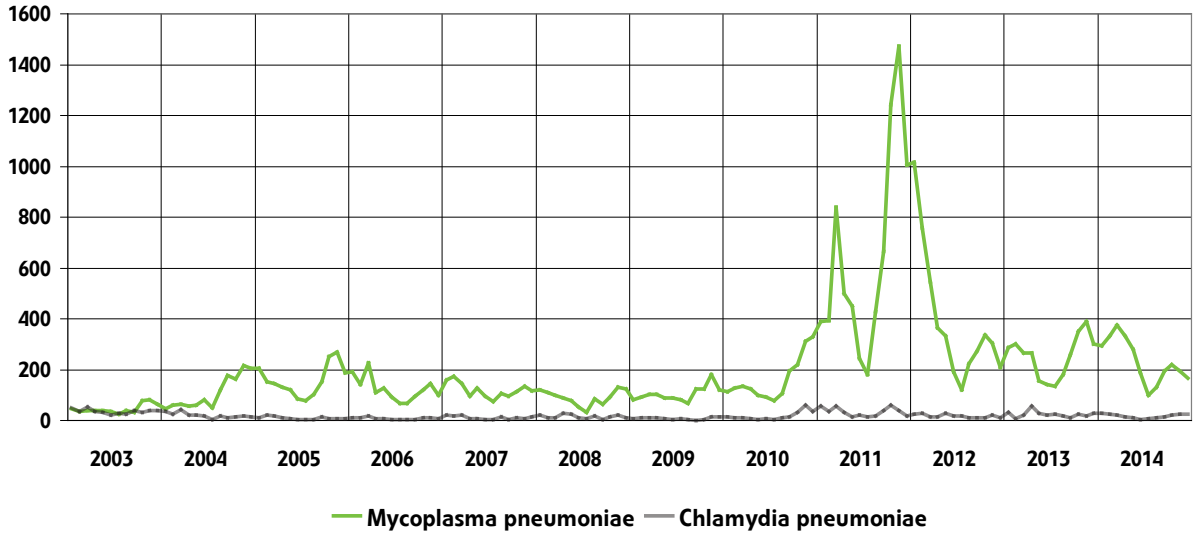


Figure 5. Cases of Mycoplasma pneumoniae and Chlamydia pneumoniae per month, 2003–2014 (no. of cases).

15, i.e. beginning in the 8th grade of comprehensive school. Due to this transition, very few of these vaccinations were administered between 2009 and 2011. This created a temporarily less well protected cohort in adolescent age groups. Illness in infancy indicates insufficient herd immunity. A whooping cough vaccine for conscripts beginning their military service was added to the Finnish Defence Forces' vaccination programme in summer 2012.

So far, Finland has been spared the extensive whooping cough epidemic that generated more than 40,000 cases in the United States and almost 10,000 cases in the UK during 2012. In 2012, the year the epidemic occurred, on the basis of an extensive strain collection in the United States it was discovered 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, in Sweden the number of whooping cough cases almost tripled in 2014.

CHLAMYDIA PNEUMONIAE

In 2014, 205 cases of *Chlamydia pneumoniae* were reported based on laboratory verification, mainly antibody testing. The highest incidence was reported in the hospital districts of Satakunta, East Savo, Länsi-Pohja and Lapland, while the number of cases was highest in the Helsinki and Uusimaa Hospital District (67). Although the number of reported infections was highest among 5 to 19-year-olds, cases can be found in all age groups. This can probably be explained by the fact that primary infections most often occur in that age group. Such primary infections often stimulate an IgM response, facilitating measurement in a single serum sample. The infection can be diagnosed even more definitively on the basis of a significant change in IgG levels in paired serum samples. It is also possible to detect nucleic acid in a sample from the respiratory tract.

LEGIONELLA

In 2014, 22 cases of legionellosis were reported. Three of these were diagnosed on the basis of two laboratory tests; nine findings were based on the detection of the antigen in urine, two on the isolation of the bacterial strain, one on the detection of nucleic acid in sputum, and 13 on serological methods. Further investigation revealed that the clinical presentation was consistent with legionella pneumonia in 10 cases (45%), nine tested positive for the presence of the legionella antigen in urine, the bacterial strain was isolated in two cases and serological proof was found in one case. Unlike in previous years, only two persons (2/10, 20%) had travelled abroad before falling ill (2011–2013: 77–100%). Eight patients were male and their age varied between 49 and 80. Of the cases found positive in the culture, one belonged to *L. pneumophila* serogroup 1 and the other to *L. pneumophila* serogroup 6.

In the case of seven of the patients who had contracted pneumonia, various premises (home, hospital, workplace) were investigated in more detail as possible sources of infection. A clinical legionella strain was available for one patient, in whose detached house the same *Legionella pneumophila* serogroup 1 sequence type (ST 1) was detected in the shower (530,000 cfu/l) and jacuzzi (45 cfu/l). In addition, *Legionella pneumophila* serogroup 1 was found in the homes of two other patients (terraced house 1,500 cfu/l and block of flats 45,000 cfu/l) . In these three homes, which were the likely source of infection, hot water temperatures were measured and found to fall below recommendations and regulations (lowest temperatures at 50–52°C). Legionellas were therefore prevented e.g. by permanently raising the temperature of hot water and by rinsing the water outlets more abundantly than usual with the water as hot as possible. Legionellas were not detected in the homes or workplaces of the four other patients. For one of them, the potential source of infection was encountered when travelling abroad, but the remaining six patients whose source of infection was examined more thoroughly had no travel history. The threshold for measures requiring cleaning is >1,000 cfu/l according to the European guideline for legionella, which is followed in Finland.

Accommodation data related to all of the patients who fell ill abroad was reported to ELDSNET (European Legionnaires' Disease Surveillance Network), which collects data on travel-related cases of legionellosis. European surveillance indicates that the majority (ca. 60-70%) of cases are of community origin, some 20% are associated with travel and fewer than 10% originate in hospitals. In Finland, cases of legionellosis are traditionally linked with travel. Legionella is therefore often ignored as the potential pathogen in pneumonia cases of domestic origin, when contracted outside hospitals.

MYCOPLASMA PNEUMONIAE

In 2014, the total number of *Mycoplasma pneumoniae* cases confirmed in laboratory tests was 2,806, having exceeded 4,600 in 2012 and 7,800 in 2011. If the occurrence of *M. pneumoniae* cases follows the previous pattern, we are now experiencing a 4–7-year period between epidemics and have a few years to wait before a new winter epidemic occurs.

As in previous years, the majority of cases (more than 900) were recorded in the Helsinki and Uusimaa Hospital District. The incidence was still highest in the Hospital District of East Savo (>190/100,000). More than 60% of the cases were diagnosed in the 5 to 24 age group, as a diagnosis confirmed by a laboratory is often gained on the basis of the primary infection.

Gastrointestinal infections

- An exceptionally high number of epidemics caused by bathing water were diagnosed in June–July. In some cases, the pathogen was diagnosed as norovirus.
- The number of *Clostridium difficile* cases has remained at the same level for the past five years and regional differences remain considerable. In 2014, more sensitive detection methods became more common.
- The number of EHEC cases was a third less year-on-year. Approximately one half of the infections were of domestic origin.
- Frozen berries were the suspected source of an international epidemic of hepatitis A.
- Campylobacter is the most common bacterial cause of gastrointestinal infections in Finland. More infections were detected in 2014 than before and one half of them were related to travel abroad.
- The number of listeria cases reported was equal to that of 2013. More than one half of patients were aged over 75.
- The number of salmonella cases was one fifth lower than in the previous year. Almost 80% of infections were of foreign origin.
- As in previous years, the number of norovirus cases was highest in January–May.
- The number of rotavirus infections has remained below 500 since the rotavirus vaccine was introduced to the national vaccination programme in September 2009.
- In the spring, *Yersinia pseudotuberculosis* in unprocessed milk caused an unusually extensive outbreak.

FOOD- AND WATER-BORNE OUTBREAKS

From the beginning of 2010, municipal epidemic investigation working groups have entered notifications of suspected food- and water-borne outbreaks into the register IT system, jointly maintained by the National Institute for Health and Welfare and the Finnish Food Safety Authority Evira and known as the RYMY information system. In 2014, 77 such notifications were entered (2013: 73). The National Institute for Health and Welfare (THL) contacted the municipal outbreak investigation working group with regard to 24 notifications. In addition, THL investigated several infection clusters detected by reference laboratories and international cooperation partners.

The National Institute for Health and Welfare is involved in the Epidemic Intelligence Information System EPIS, coordinated by the European Centre for Disease Prevention and Control (ECDC), which, if epidemics arise, enables European countries to provide and gain information on epidemic investigations in other countries. In 2014, the National Institute for Health and Welfare participated in the control and investigation of 38 international bacterial gastrointestinal epidemics by providing up-to-date information on the situation in Finland via the system. In turn, Finland sent three EPIS queries regarding *S. Typhimurium* (phage type unnamed NST, MLVA 3-15-NA-NA-0311), EHEC O157:H7 (PT88, sorbitol-fermenting, phenotype static) and EHEC O55:H7 clusters. In one report, coordinated by the ECDC and in which Finland participated, meat consumed in a restaurant was suspected to be the source of monophasic *S. Typhimurium* infections. The ECDC also coordinates the Molecular Surveillance Pilot project, in which participating countries send the most up-to-date typing data possible to the ECDC register in order to facilitate the detection of cross-

border epidemics. Strains isolated in Finland were included in 13 salmonella and four listeria clusters. Most of the clusters detected were caused by monophasic *S. Typhimurium* (7 clusters).

An EHEC epidemic caused illness in various parts of Finland

In January–February, six people fell ill with an infection caused by the EHEC O157:H7 (FT 88, *stx*$_2$, *eae*, *hlyA*, static phenotype, PFGE type 1.203) strain. A similar EHEC bacterial strain was also diagnosed in four family members who did not display any symptoms. Those who fell ill were aged between 4 and 16, from different parts of Finland. Three patients were diagnosed with hemolytic uremic syndrome (HUS). The cases are connected to the EHEC O157:H7 epidemic that began in December 2013. Laboratory tests proved the bacterial strain to be identical with the EHEC infections detected in spring 2013. The source of infection was investigated jointly by the National Institute for Health and Welfare (THL) and the Finnish Food Safety Authority Evira. The interviews conducted did not reveal any specific occasion or farm visit that constituted a link between the sufferers, nor did the diets of the families or the shops, store chains or restaurants they used. The source of the epidemic remained unidentified, but as infections were diagnosed in different parts of Finland, the pathogen most probably originated in a widespread food product or other product contaminated by the EHEC bacteria. In order to examine the extent of the infections, Finland sent an international EPIS query. No infections caused by the EHEC strain in question had been detected in Europe or the United States.

Frozen berries were the suspected source of an international epidemic of hepatitis A

In January–June, 10 cases of hepatitis A were diagnosed in various parts of Finland. They were similar in genotype to the virus (HAV IA) that caused the HAV epidemic that began in Italy in 2013 and was detected in Norway in early 2014. The affected persons had not travelled abroad prior to the onset of their symptoms. Moreover, two other IgM positive cases of hepatitis A of domestic origin were detected, but their samples could not be genotyped. Cases were diagnosed in a total of 13 EU/EEA countries, including Finland. In Italy, the HAV infections were linked with berries in a survey, and a virus identical to the patients' strains was detected in mixed frozen berries consumed in the cases in question. In Norway, the source of infection was confirmed as a frozen berry cake made in Germany. The same cake was distributed to institutional kitchens in Finland under the name 'queen cake' until the end of April. Some of the interviewed patients remembered having consumed a similar cake. After the cake was recalled, no similar new cases were detected.

Finland participated in a multinational study coordinated by the European Centre for Disease Prevention and Control (ECDC) regarding the infections diagnosed in this country. Based on epidemiological and microbiological research, frozen berries are the most probable source of infection, but the type or types of berries linking the infections could not be identified. The Finnish Food Safety Authority Evira recommends that frozen berries of foreign origin be heated before consumption.

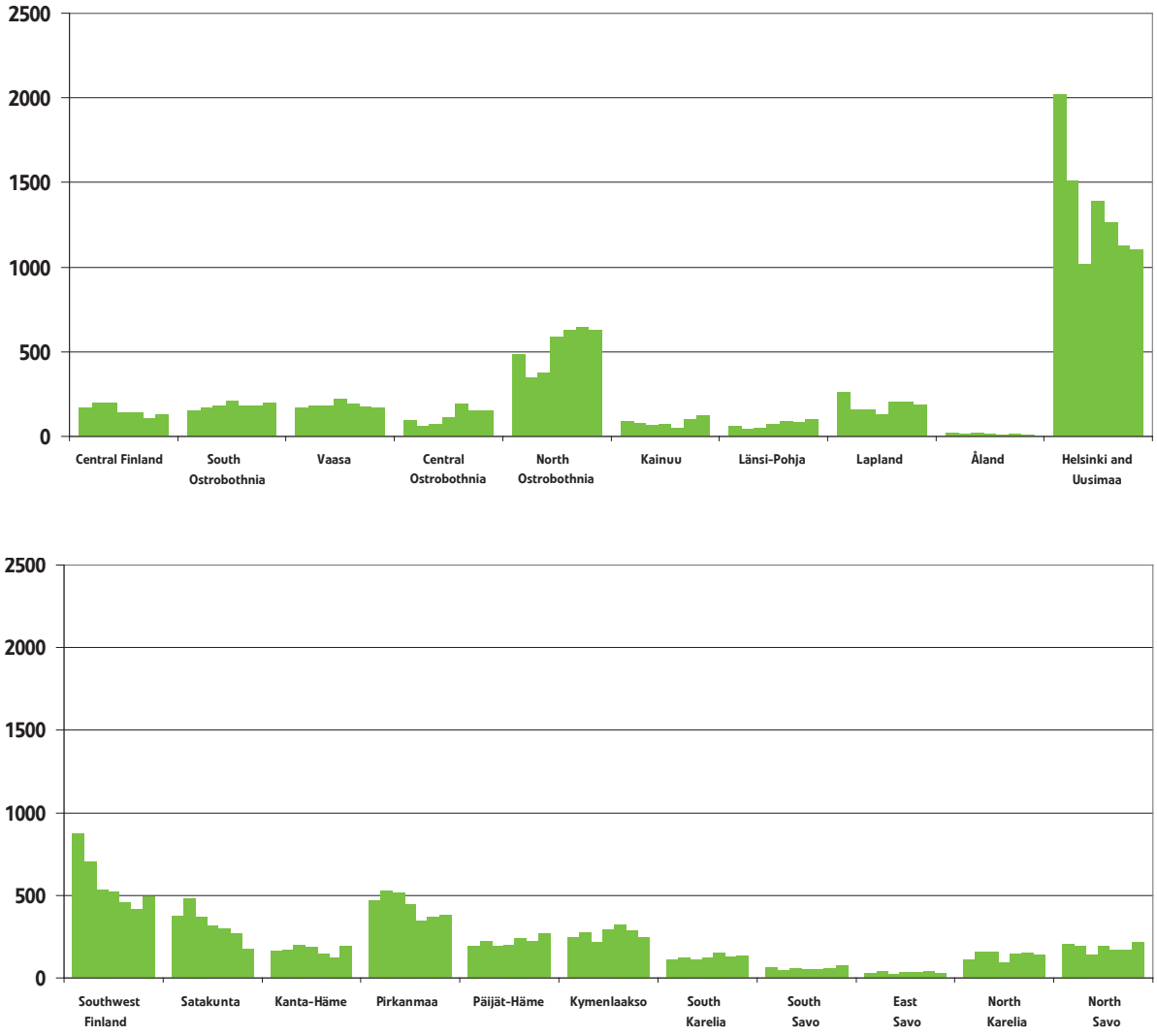
Salmonella clusters

In April–May, *S. Mikawasima*, which is susceptible to antimicrobials, caused six infections in southern and central Finland. These were identical in genotype (SMIK11). Mikawasima is a rare serotype in Finland. The same genotype was last reported in 2008. However, a different genotype of Mikawasima (SMIK3) caused a cluster of infections among the staff of a cruise vessel in November 2008 and another among bed-ridden patients of a health centre in central Finland in November–December 2010.

In May–June, a multiresistant *S. Typhimurium* (PT U302, MLVA 2-12-19-16-0212) made four persons ill in eastern Finland. The MLVA type in question is rare in Finland. A visit to a farm was the connecting factor between the patients and a multiresistant (ACSSuTG) *S. Typhimurium* FT U302 strain, with MLVA profile 2-12-19-15-0212, was isolated in the stool of cattle. Because multiresistant *S. Typhimurium* strains are rare in Finnish agriculture and the MLVA profile of the animal only differed from the strains isolated from human infections by one repeat unit at one MLVA locus, the farm was the suspected source of the infections. One patient was also diagnosed with an EHEC non-O157 infection, the source of which remained unidentified.

In June–July, a multiresistant (ASSuT) monophasic *S.* Typhimurium FT 120 caused a cluster of 10 infections in various parts of Finland. The strains in the cluster comprised two highly similar genotypes (MLVA 3-12-17-NA-0211 and 3-12-16-NA-0211). The same genotype was simultaneously detected in a total of 38 cases in six EU Member States. Analyses by ECDC and THL identified meat consumed in a restaurant as the suspected source of infection.

In June–September, susceptible *S.* Typhimurium FT NST (phage type unnamed), genotype MLVA 3-15-



Figures 6a and 6b. Cases of Clostridium difficile by hospital district, 2008–2014 (no. of cases).

NA-NA-0311 infections were diagnosed in 21 persons in different parts of Finland. Finland submitted an international EPIS query. Responses indicated that the infections were only present in Finland. Based on interviews with five patients, no specific connecting factor was found with respect to the infections.

Epidemics transmitted by bathing water and beach environment

Pursuant to Government decree 1365/2011, notifications of suspected epidemics transmitted by bathing water have been entered in the register IT system for food- and water-borne epidemics (RYMY) since the beginning of 2012. In July–August 2014, an exceptionally high number of notifications of suspected epidemics (15) were entered in the system, originating in different parts of Finland. Before then, only isolated cases of bathing water borne epidemics had been registered in the country. Eight of the suspected epidemics were classified as having been transmitted by bathing water or the beach environment. Based on the results of investigation reports by municipalities, such assessments are conducted jointly by the National Supervisory Authority for Welfare and Health (Valvira) and National Institute for Health and Welfare experts. The results for seven of the suspected epidemics did not refer to bathing water or the beach environment. In the case of three of the epidemics, the pathogenic microbe could be identified, since norovirus was found both in the patient samples and samples taken from the bathing water or the beach environment. In two of the epidemics, adenovirus was found in the bathing water but was not detected in the patient samples.

Valvira and Regional State Administrative Agencies guide municipal health protection authorities in controlling the quality of bathing waters. Municipal outbreak investigation working groups submit investigation reports on epidemics to the RYMY IT system in the manner specified by Valvira. The Infectious Disease Control Unit and the Water and Health Unit of the National Institute for Health and Welfare provide assistance in the form of consulting and, if necessary, coordinate the investigation and prevention of epidemics. In order to prevent and investigate bathing water borne epidemics, Valvira has sent instructions in letter form to health protection authorities within municipalities and Regional State Administrative Agencies regarding the 2015 bathing season.

Yersinia pseudotuberculosis caused an extensive outbreak in unprocessed milk in southern Finland

In February–April, the bacterium *Yersinia pseudotuberculosis* in unprocessed milk caused an unusually extensive outbreak in Finland. A total of 55 people contracted a gastrointestinal infection. The majority of them (51) were from Helsinki and the region of Uusimaa. In March, the Porvoo hospital reported that it had diagnosed a higher than usual number of *Yersinia pseudotuberculosis* cases. On the basis of in-depth interviews, the suspected source of infection was identified as unprocessed milk from a certain producer. This milk was sold in 3-litre containers in 24 shops in southern Finland. Due to the results of the in-depth interviews, the producer voluntarily interrupted the commercial production of unprocessed milk and recalled the products in early April. A survey was conducted to examine typical sources of the *Yersinia pseudotuberculosis* infection and exposure to unprocessed milk. Consumption of unprocessed milk from the producer in question was established as the link to the illness. Microbiological tests revealed *Yersinia pseudotuberculosis* strains, identical to the patients' strains, in the milk filter of the farm's milking machine and a milk sample taken from the refrigerator of one patient. The National Institute for Health and Welfare and Evira recommend that children, the elderly, expectant mothers and persons suffering from a severe underlying illness refrain from consuming unheated, unprocessed milk. Based on the results of the epidemic account, the consumption of unprocessed milk cannot be recommended for healthy adults either.

CLOSTRIDIUM DIFFICILE

In 2014, of the total of 5,725 cases of *Clostridium difficile* reported to the National Infectious Diseases Register, either 5,156 (90%) cases involved a toxin-producing strain or PCR was the only diagnostic method. The number of cases has been similar for the last five years (number of cases between 5,724 and 6,380, of which 4,827–5,401 were toxin positive). The slightly higher proportion of women and the age distribution also remained unchanged: in 2014, women's proportion was 58%, that of under 15-year-olds less than 4%, that of under 2-year-olds under 2% and that of 75 years or older almost 50%. Notifications were submitted by 20 clinical microbiology laboratories, the three largest of which accounted for 50% of the findings. As previously, the regional differences in incidence were notable (37–206/100, 000). This may be due to differences in diagnostic methods, the frequency of active sample-taking and/or prevention measures.

The laboratory methods used changed distinctly in 2014. The use of more sensitive PCR or other nucleic acid detection methods increased and, for the first time, were more popular than antibody testing. The proportion of nucleic acid detection rose from less than 6 per cent in the previous year to 33 per cent, and the proportion of cultures decreased by the same ratio. Slightly over one half of the findings were cultures, one third were nucleic acid detection and one fifth antibody testing. Of the laboratories, 18 perform *C. difficile* diagnostics: 12 use nucleic acid detection and 6 use cultures or antigen tests as the primary method of analysis. The use of antibody testing increased by five percentage points over previous years, but this change was much less significant than the increase in the use of nucleic acid testing and reduction in cultures, where the change was more than 30%. In *C. difficile* diagnostics, it cannot be emphasised enough that the tests should should always be performed on diarrhoeal faecal samples that take on the shape of the container, the only exception being a situation where the patient suffers from paralytic ileus or a toxic megacolon. Carriers showing no symptoms should not be screened. The National Institute for Health and Welfare types strains related to suspected epidemics and severe individual cases. The number of strains sent for typification fell markedly in 2014, partly due to the reduction in cultures.

ENTEROHAEMORRHAGIC ESCHERICHIA COLI (EHEC)

A total of 64 microbiologically confirmed cases caused by enterohaemorrhagic Escherichia coli (EHEC) were reported to the National Infectious Diseases Register (1.2/100,000), about one third less than in 2013 (98). The incidence was highest in the

0 to 9 age group (4.3/100,000). Haemolytic-uremic syndrome (HUS) was diagnosed in six cases (9%).

In 2014, approximately one half of infections (31; 48%) were deemed to be of domestic origin. Ten of these cases were connected to the EHEC O157:H7 epidemic that began in December 2013. Those who fell ill were aged between 4 and 16, from different parts of Finland. Laboratory testing indicated that the bacterial strain was identical with the EHEC infections diagnosed in spring 2013 (for a more detailed description, see the chapter Food and waterborne epidemics).

A bacterial culture for a total of 61 EHEC cases was sent to a laboratory for confirmation. Of these, 57 were confirmed using PCR methods and the EHEC strain was isolated in 56 bacterial cultures for further examination. Strains of serotype O157:H7 caused a total of 28 cases (49%), of which 19 were of domestic and 9 of foreign origin. The O157 strains were divided into 5 phage types, most generally PT 8 (14 strains) and PT 88 (9 strains). All PT 88 strains were connected to the domestic cluster first diagnosed in December 2013. These were positive with regard to the stx2 gene, were sorbitol fermenting, were immobile despite the gene coding for a H7 flagella antigen, and six of the strains were identical by PFGE genotype (1.203). Of the FT 8 strains, 9 were of domestic origin and 5 connected to travel in Turkey. All FT 8 strains were positive with regard to the stx1 and stx2 genes and were sorbitol negative. They were divided into 10 different PFGE genotypes and only 1–2 shared the same genotype. There were 28 cases of serogroup Non-O157. The strains isolated from them were divided into 10 different non-O157 serotypes, the most common being O26 (5 strains), O103 (4 strains) and O55 (4 strains). The O103 strains were all domestic and the O55 strains foreign, whereas the O26 serotype was found in both domestic and foreign ones. Almost all of the O26 and O103 strains were individual PFGE genotypes. The O55 strains originated in three different countries and divided into two, almost identical PFGE genotypes. Six strains remained untyped (ONT).

CAMPYLOBACTER

Campylobacter is the most common bacterial cause of gastrointestinal infections in Finland. In 2014, 4,887 findings of campylobacter were reported, over 800 cases more than in 2013 (4,067). *Campylobacter jejuni* remained the single most common type of campylobacter (4,143 cases); there were 326 reported cases of *C. coli*, and 393 cases in which the type of the campylobacter finding was unspecified.

The incidence in the entire population was 90.1/100,000. Men accounted for 54.4 per cent of the cases. The highest number of cases was reported in the age group 20 to 54 (136.1/100,000). Incidence was highest in the hospital district of Helsinki and Uusimaa (133.1/100,000).

The seasonal variation was typical of campylobacter: the incidence was highest in July–August. Of the cases in 2014, 828 (16.9%) were domestic in origin, although in 32.8% of the cases data was lacking on the country of acquisition. Foreign travel was a factor in 50.3% (2,457) of the cases; the most common source being Spain (291), followed by Turkey (262) and Thailand (245).

The reason for the considerable increase in the number of campylobacter infections remains unknown. There were no major outbreaks of domestic epidemics in 2014. Since a large number of notifications still lack data on the country of acquisition, it is difficult to assess the number of infections of domestic origin. More information on the country of origin and sources of campylobacter infections would be necessary if prevention measures are to be targeted.

The bacterial cultures of 17 cases of campylobacter were analysed in a laboratory; 14 of these were connected to two clusters. The PFGE genotype of each of six strains found in July in the Mikkeli and Savonlinna regions in eastern Finland was different. In relation to the waterborne outbreak in Sipoo, southern Finland, in October, four identical PFGE genotypes were diagnosed.

LISTERIA

In 2014, a total of 65 severe systemic infections caused by the bacterium *Listeria monocytogenes* were diagnosed (2013: 61). Of these cases, one half were over the age of 75 and 60 per cent were men. The listeria cases were spread out across the country. As yet, information on pregnancy is not reported to the National Infectious Diseases Register, but one case of listeriosis was diagnosed in a newborn baby on the basis of laboratory referrals. Upon the introduction of electronic notification of infectious diseases by physicians, surveillance data for listeriosis will be specified.

The Listeria monocytogenes strain of a total of 65 patients arrived for typing at a laboratory; 63 strains were isolated from the patient's blood and/or cere-

brospinal fluid, one from the genital mucous membrane and one from a paracentesis sample. The PCR method was used for determining the *Listeria monocytogenes* serotype. Of the strains, 45 (69%) were of serotype IIa (corresponding to serotype 1/2a and 3a when using the earlier method) and 16 (25%) were of serotype IVb (serotypes 4b, 4d and 4e). These strains were divided into 44 PFGE genotypes. The majority of infections (51/65, 78%) were isolated (the same strain in two persons at most). The typifications revealed three clusters of four to six persons. In June–August, the strain Asc70-Apa5 was diagnosed in four persons, in September–November the strain Asc14-Apa5 in five persons, and in January–October, the strain Asc96-Apa1 in six persons.

Up-to-date DNA typing data on *L. monocytogenes* strains was sent to the international database coordinated by the ECDC. In 2014, five international clusters were found that included the DNA profiles of Finnish strains. Of the clusters diagnosed in Finland, two (Asc70-Apa58, Asc96-Apa1) were also present in other parts of Europe.

SALMONELLA

In 2014, a total of 1,622 salmonella cases were reported (2013: 1,987), of which 54 per cent were detected in women. The annual incidence in the entire country was 29.9/100,000 population. The incidence was highest in the North Savo Hospital District (43.1/100,000) and lowest in the Åland (14.0/100,000), The highest number of infections was reported in the 50 to 54 age group.

Five cases of the S. Typhi bacterium, which causes typhoid fever, were identified. Three of the patients had travelled in India and two in Tanzania. Five cases of S. Paratyphi (Paratyphi A), which causes paratyphoid fever, were found.

The bacterial strain of a total of 1,428 cases of salmonella was sent to the National Institute for Health and Welfare, almost a fifth fewer than in the previous year (1,777). Of these, 1,113 (78%) were infections of foreign and 295 (21%) of domestic origin. The incidence of Salmonella infections contracted in Finland was 5.4/100,000 (in 2013: 6.2/100,000). In 20 (1%) cases, the origin of the salmonella infection remained unclear. All strains were serotyped. Antimicrobial susceptibility testing and further typing according to serotype was performed on all strains of domestic origin, and selectively on approximately one half of foreign strains. Selection focussed on strains originating in the WHO/European countries (53 countries in Europe and close by), but was random with regard to serotype.

Domestic salmonella infections were caused by 50 different serotypes. The three most common, including Typhimurium (92 cases), Enteritidis (49) and group B (32), caused 59% of infections. Most (206/295, 70%) cases were still susceptible to all 12 antimicrobials tested, and the proportion of multiresistant strains remained on a par with the previous year (2014: 59/295, 20% vs. 2013: 70/337, 21%) and 10% of the strains were resistant to ciprofloxacin (CIP MIC >0.06) (30/295). Five strains were resistant to cefotaxime (Kentucky, group B, Typhimurium, Thompson, Stanley). No strains with lower susceptibility to imipenem were found. Of the domestic strains of Typhimurium, 17% (16/92) were multiresistant. The percentage of the traditional endemic PT 1 phage type (32%) was higher than in the two previous years, but lower than a few years ago (2013: 27%, 2012: 23% and 2011: 60%). As in previous years, the majority of PT 1 strains (90%) were susceptible to antimicrobials and divided into ten MLVA genotypes, of which the most common was 3-16-NA-NA-0311. Unspecified phage types that caused a reaction (PT NST) were found in 38% of cases. The usual number (49) of cases were caused by the domestic Enteritidis serotype, and no clusters caused by any individual strain were found. Most strains were susceptible to all antimicrobials tested (33/49, 67%), but 30% (15/49) were resistant to ciprofloxacin. Enteritidis strains were divided into 17 different phage types, the most common being PT 8 (24%). NT and NST strains accounted for 10% of cases. A total of 21 different PFGE genotypes were found in all, the most common being SENT 115 (12), which was divided between five phage types and nine MLVA types. The number of domestic group B cases (32) has stabilised at the level of the three previous years since the increase of a few years ago. Most of the strains in group B were so-called monophasic *S.* Typhimurium strains. All monophasic Typhimurium strains isolated from infections of domestic origin were multiresistant; most commonly to ampicillin, 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 returned from 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 (PT 195, PT 193, NT/NST), but in 2014, PT 120 was most common. The multiresistant monophasic Typhimurium strain PT 120, MLVA 3-12-17-NA-0211 caused an epidemic in Finland

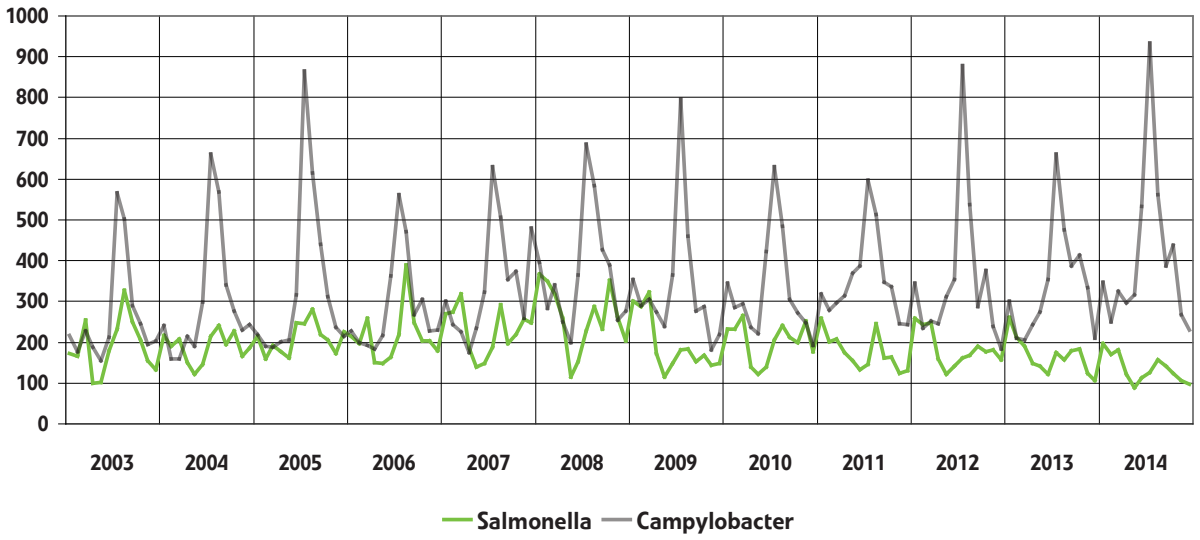


Figure 7. Salmonella and campylobacter cases by month, 2003–2014 (no. of cases).

Table 1. The most common serotypes of salmonella cases, 2007–2014 (excluding S. Typhi and S. Paratyphi) (no. of cases).

	2007	2008	2009	2010	2011	2012	2013	2014
Infection acquired abroad (Source: NIDR)								
Salmonella Enteritidis	732	1065	654	777	640	545	519	446
Salmonella group B	92	168	121	102	145	160	170	116
Salmonella Typhimurium	196	177	148	122	84	83	79	73
Salmonella Stanley	174	136	111	98	70	99	69	44
Salmonella Corvallis	58	70	68	42	46	42	35	41
Salmonella Newport	57	76	54	53	32	31	27	39
Salmonella Infantis	54	31	42	42	31	44	36	30
Salmonella Weltevreden	25	14	36	14	27	18	20	28
Salmonella Hadar	22	24	17	27	11	17	12	24
Salmonella Braenderup	52	36	39	37	22	37	13	23
Domestically acquired infections (Source: Bacterial Infections Unit)								
Salmonella Typhimurium	156	85	140	132	94	98	94	92
Salmonella Enteritidis	62	48	51	44	47	83	46	49
Salmonella group B	11	5	7	8	40	35	38	32
Salmonella Newport	28	71	9	8	6	7	11	9
Salmonella Infantis	3	7	2	9	10	36	12	9
Salmonella Agona	40	15	2	2	11	33	12	8
Salmonella Mikawasima	5	23	1	7	3	2	3	8
Salmonella Stanley	11	8	6	7	1	3	1	6
Salmonella Thompson	0	3	2	12	2	5	9	6
Salmonella Virchow	5	6	6	4	3	1	4	5

and occurred at the same time in five other European countries. The source remained undetected, but meat was suspected.

Salmonella infections acquired abroad represented 99 serotypes. The most common serotypes were the same as in the two previous years: Enteritidis (391/1,113, 35%), Group B (105), Typhimurium (67) and Stanley (44). The leading countries of acquisition for cases of foreign origin were Thailand (30%), Turkey (14%), Spain (6%), Indonesia (4%) and Russia (3%). The number of strains originating in WHO/European countries decreased by almost one quarter from the previous year (402 vs. 532). Enteritidis (256/402, 64%) was still the most common serotype. The percentage of group B strains was only 3%. The number of strains originating outside the WHO/European countries was approximately 15% lower than in the previous year (2014: 691 vs. 2013: 811). The most common serotypes were Enteritidis (128) and group B (90). More than one half (644/1,113) of the foreign strains were selected for antimicrobial susceptibility testing and further typing according to serotype. The proportion of multiresistant strains remained at the previous year's level in the WHO/European area (2014: 10% vs. 2013: 11%) and decreased slightly outside (2014: 24% vs. 2013: 28%). Enteritidis strains originating in the WHO/European countries that were selected for further typing were divided into 18 phage types; 51% were of the phage type PT 14b or PT 8, whereas the Enteritidis strains of far-off countries (N=128) were more evenly divided into 12 phage types. The group B strains (N=32) chosen for further typing and originating in far-off countries were mainly multiresistant monophasic *S.* Typhimurium strains (N=24). The most common phage type was PT 193 (N= 17).

SHIGELLA

In 2014, the incidence of shigellosis was 1.6/100,000. Of the total of 89 cases reported, 46 were in women. The median age in these cases was 36 years (range 0–74). The majority of cases (70) were detected in individuals aged 20–59. More than half of the cases (64) were reported in the Helsinki and Uusimaa Hospital District. Ten hospital districts had no diagnosed cases. The lack of findings in so many hospital districts may well be indicative of problems in the primary diagnostics of shigella, which is known to require a high level of meticulousness when reading samples. The shigella strain of 86 persons was sent to the National Institute for Health and Welfare laboratory. Of the total, 73 infections (85%) were reported as having been acquired abroad, 13 in Finland and, in three cases, the country of acquisition remained unspecified. The most common countries of origin were India (13 cases) and the Dominican Republic (5). The prevailing shigella species were *Shigella sonnei* (57 cases) and *S. flexneri* (19 cases). *S. flexneri* was divided into seven serotypes.

Antimicrobial susceptibility testing was performed on domestic strains only. One strain was susceptible to all 12 antimicrobials tested and the remaining 12 were multiresistant (R to at least four of the 12 antimicrobials tested). One domestic *S. flexneri* strain of serotype 2a was resistant to ciprofloxacin (MIC 8) and cefotaxime.

YERSINIA

Under the Communicable Diseases Decree, yersinia is among the bacteria that must be registered and reported to the National Infectious Diseases Register, but does not need to be sent for strain collection to the National Institute for Health and Welfare. However, species typing and biotyping/serotyping of yersinia strains may pose a problem for clinical microbiology laboratories. Since the beginning of 2014, even problematic strains have not been routinely accepted.

Yersinia enterocolitica

In 2014, 499 cases of *Yersinia enterocolitica* were reported to the National Infectious Diseases Register (2013: 497). The incidence rate in the entire country was 9.2/100,000 and highest in the 35–39 age group (17.0/100,000). There was great regional variation in the *Y. enterocolitica* findings, the highest incidence rate was in the Helsinki and Uusimaa Hospital District (17.1/100,000), Kymenlaakso (13.2/100,000) and Lapland (11.8/100,000), and only one case was diagnosed in each of five hospital districts in 2014.

Y. enterocolitica is most commonly confirmed from a stool culture. In 2014, stool cultures were used to confirm 450 cases, while only 44 cases were confirmed by antibody findings in serum; in five cases, both antibody typing and a stool culture were used. In the Helsinki and Uusimaa hospital district, the typing result for *Y. enterocolitica* was given in 77% (185/238) of the cases confirmed by culture. Of these, 55% were of the biotype 1A. BT 1A is a heterogenous group of strains that lack the pYV virulence plasmid typical of pathogenic yersinias. However, some BT 1A strains may have other properties affecting their pathogenic capabilities. Other hospital districts reported only individual cases of typing, which means that no conclusions on the percentage of various biotypes/serotypes

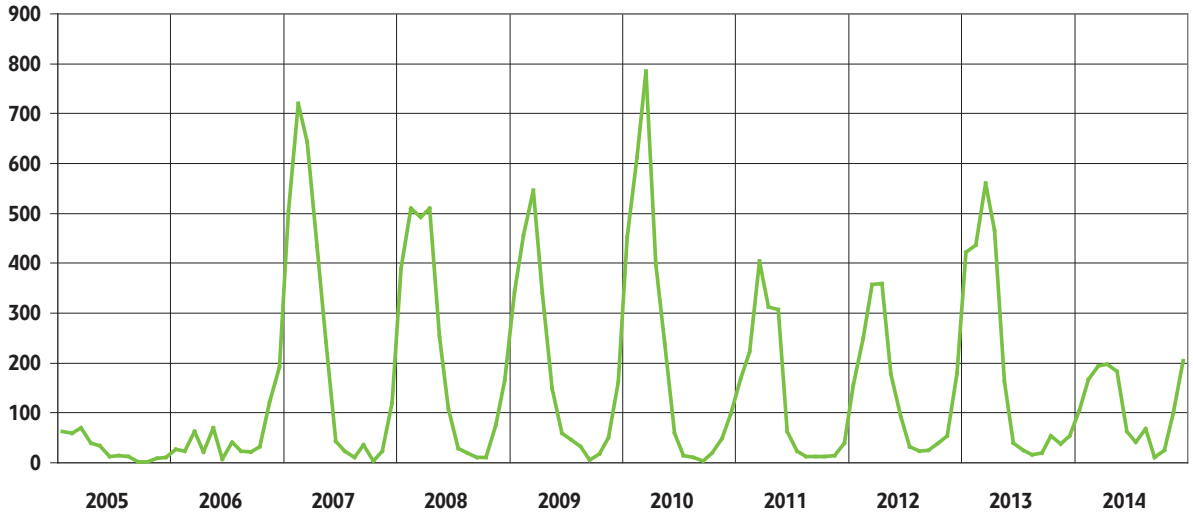


Figure 8. Cases of norovirus infection per month, 2005–2014 (no. of cases).

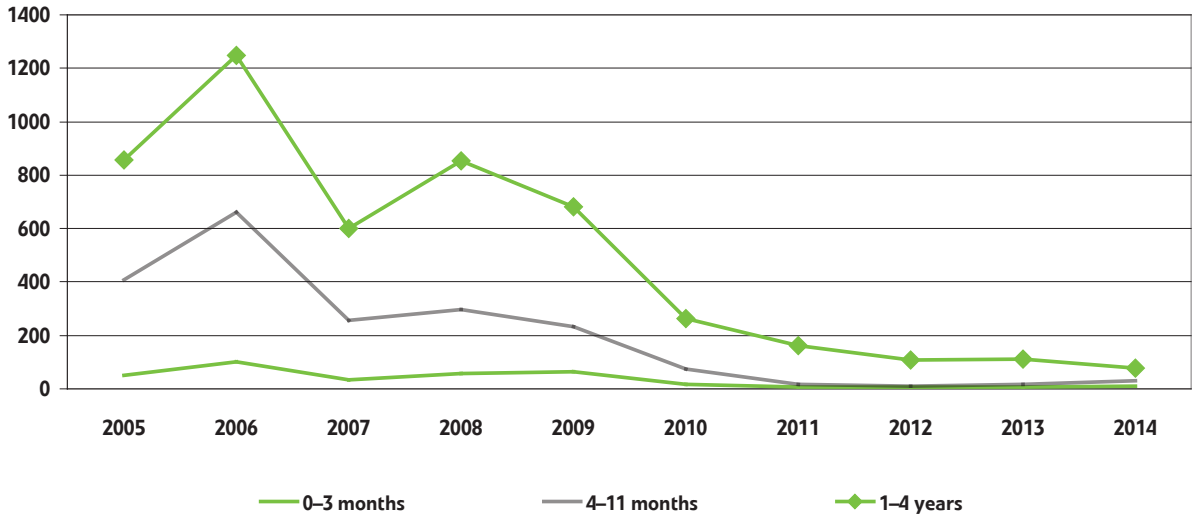


Figure 9. Rotavirus cases by age group in children aged 0 to 4, 2005–2014 (no. of cases).

or the clinical significance of findings can be drawn at national level.

Yersinia pseudotuberculosis

The number of *Yersinia pseudotuberculosis* cases (74) was clearly higher than in the previous year (39). The incidence for the entire country was 1.4/100,000 inhabitants. Of the cases, 53 were typed by culture and only 20 by antibody findings; both were used in one case. The majority of infections were diagnosed in April (44). The increase in cases in the spring was due to the *Yersinia pseudotuberculosis* outbreak connected to unprocessed milk in the region of Porvoo (for a more detailed description, see Food and waterborne epidemics).

The National Institute for Health and Welfare analysed the *Y. pseudotuberculosis* strain in relation to 42 persons. One was a strain isolated from blood and the others were analysed when investigating an epidemic caused by unprocessed milk. All strains related to the epidemic were of serotype O:1. Moreover, the strain related to eight persons was analysed using PFGE typing, and that of seven using MLVA typing. The results showed that the patients' strains were identical

with each other and the *Y. pseudotuberculosis* strains isolated from the unprocessed milk and the milk container filter on the farm. *Y. pseudotuberculosis* strains of different genotype were also isolated on the farm.

NOROVIRUS

In 2014, 1,361 cases of norovirus were reported to the National Infectious Diseases Register. Notifications were submitted by all hospital districts. Cases occurred in all age groups, but one half of them were diagnosed in persons over 75 years old. The percentage of women was 57%.

Norovirus is one of the most common causes of water and food-borne epidemics. As in previous years, most cases of norovirus occurred in January–May (842, 60%). In July–August, 15 suspected bathing water borne epidemics from different parts of Finland were reported to the national register IT system for food- and water-borne epidemics. In three epidemics, norovirus was confirmed as the cause, isolated from both patient samples and samples taken from bathing water or beach environments. Norovirus of the genotype GI.2 was diagnosed in the samples of patients who had bathed in Lake Lämsänjärvi in Oulu and contracted gastroenteritis. Likewise, the dominant norovirus type of patients who had bathed in Lake Tohloppijärvi in Tampere was GI.2. In addition, norovirus types GI.4 and GII.2, and highly transformed noroviruses of type GI.7 were detected in Tampere. GII.4 and GI.2 were diagnosed in the samples of patients who had bathed in Lake Pohjoinen Myllyjärvi in Espoo. (For a more detailed description, see Food and waterborne epidemics).

In 2014, noroviruses GII.P2, GII.4 and GIIP.7 of the genogroup II, and recombinant virus GII.3/GII.P21 caused most food-borne epidemics. Of the viruses in genogroup I, GI.2 and GI.P6 were diagnosed.

ROTAVIRUS

In 2014, 274 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 September 2009. Comprehensive rotavirus vaccinations for young children have clearly lowered the incidence of rotavirus infections in under 5-year-olds (2014: 38/100,000) 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 (2014: 63%), whereas the percentage of such cases before the vaccinations was approximately 10%. More than one half of rotavirus cases in children under 5 years of age occurred in unvaccinated individuals.

The National Institute for Health and Welfare maintains the microbial strain collection of rotaviruses in accordance with the Communicable Diseases Act and Decree and is monitoring whether the virus strains reduced by vaccination are being replaced by other virus strains. Rotavirus positive findings sent by clinical laboratories to the National Institute for Health and Welfare are typed on the basis of molecular genetics by the University of Tampere Vaccine Research Center. As in 2013, the most common type of rotavirus that caused outbreaks of cases was genotype G2P[4]. Other frequently found genotypes included G1P[8], G3P[8], G4P[8], G9P[8] and G12P[8]. Genotypes G8P[14], G6P[14] and G8P[8] also caused a few cases. The clinical presentations caused by different types of rotaviruses are highly similar.

VIBRIO CHOLERAE

Pursuant to the Communicable Diseases Decree, strains of *Vibrio cholerae* are sent to the National Institute for Health and Welfare's expert laboratory for further analysis. In 2014, 45 strains were analysed. This number was exceptionally high in comparison with previous years (1–17). The infected patients were aged between 3 and 93, 17 were under 10 and 8 were over 75 years of age. Almost two thirds of the infected patients were men. The samples were taken in July–December, mainly in August (28/45). Eight strains were isolated from blood, 11 from ear secretions. One of the strains was of serotype O1, Inaba and biotype El Tor, but it lacked the cholera toxin coding *ctx*-gene. Others belonged to groups other than O1 or O139.

Bacteria that cause the gastroenteritis cholera belong to serogroups O1 and O139, and produce toxins. They have not been found in Finland during the last century, except in 1998 when the source of infection was mussels smuggled to Finland from Thailand. More vibriobacteria are present in seawater and brackish water during warm summers. The majority of these cause skin infections.

Hepatitis

- The number of hepatitis A cases was one quarter lower year-on-year. The number of hepatitis A infections of domestic origin was relatively high for the second year running, due to an international epidemic that spread via frozen berries.
- As in recent years, very few acute hepatitis B infections were reported. Cases of chronic infection were mainly diagnosed in foreigners.
- The majority of hepatitis C infections were diagnosed in Finns, having been contracted through the use of intravenous drugs.

HEPATITIS A

In 2014, 27 cases of hepatitis A were reported (0.5/100,000), around one quarter fewer than in the previous year (2013: 41). The median age in these cases was 40 years (variation 4–82). Men accounted for 59% (16) of the cases, the highest number of them being reported in the Helsinki and Uusimaa Hospital District (9) and in the Pirkanmaa hospital district (6). Of these infections, 14 were contracted in Finland and 13 abroad. The percentage of domestic infections was relatively high for the second consecutive year. The extensive international food-borne epidemics of recent years explain the situation. The high percentage of domestic infections in 2014 was due to the epidemic that spread via frozen berries. Cases were diagnosed in 13 EU/EEA countries, including Finland (for a more detailed description, please see Food and waterborne epidemics).

HEPATITIS B

In 2014, 20 (0.4/100,000) acute hepatitis B infections were reported to the National Infectious Diseases Register. Findings tested positive for IgM antibodies are classified as acute. The number of cases was divided equally between men and women. Seven of the infected patients were of Finnish origin, 13 foreign. The mode of transmission was reported in six cases only, being sexual contact in four of these. The country of acquisition was, however, reported in 11 cases. In all of them, the infection had been acquired abroad.

In the last ten years, the reported annual average number of acute hepatitis B infections is 20 whereas in the record year, 1998, almost 180 infections were reported. This decrease is mainly due to higher vaccination coverage. Vaccination of risk groups began in the 1990s. In addition, the vaccine has been popular, particularly among travellers. Moreover, needle and syringe exchange has probably prevented infections among users of intravenous drugs.

The number of chronic hepatitis B infections reported was 259 (4.8/100,000), 56% in men and 44% in women. The majority, 86% of infections, were diagnosed in persons of foreign origin. The mode of transmission was reported in only 15% of cases, with perinatal infections and infections due to sexual contact being most common.

The number of cases of chronic hepatitis B has decreased since it peaked at over 600 in 1996. The decline has been sharp for infections in people of Finnish origin, whereas the number of infections in foreigners has not changed significantly during the monitoring period.

HEPATITIS C

In 2014, 1,225 new cases of hepatitis C (23/100,000) were reported to the National Infectious Diseases Register, the incidence being highest (89/100,000) in the 20 to 24 age group. Men accounted for 66% of the cases, and intravenous drug use was the most common transmission mode (55%). Information on the mode of transmission was lacking in 34% of the cases. Sexual contact was given as the mode of transmission in seven per cent of cases, most being heterosexual contact (55), but six were acquired through sexual contact between men.

The majority of patients (84%) were Finnish. Of the foreigners infected, more than half were born in the Soviet Union, Russia or Estonia. The country of ac-

quisition was known in 62% of the cases. In most of them (88%), the country of infection was Finland.

The highest incidence of infections in relation to population were reported in the hospital districts of East Savo (49/100,000), Länsi-Pohja (37/100,000) and South Savo (32/100,000) and the lowest in Central Ostrobothnia (12/100,000), South Ostrobothnia (16/100,000) and Satakunta (16/100,000).

The majority of hepatitis C infections were reported without an identity number 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 identity numbers being registered several times, and the probable registration for those years of many cases initially diagnosed before monitoring began. Since 2003, the annual number of cases has varied between 1,100 and 1,200, the lowest figure being recorded in 2009 (1,036). No significant changes in the distribution of age groups have occurred in the last five years.

The majority of infected patients in Finland were intravenous drug users. A very high percentage, around 80%, of intravenous drug users have been found to have hepatitis C antibodies. Because of this, it is difficult to reduce the number of infections further in this group by means of needle and syringe exchange programmes alone.

In 2014, hepatitis C genotypes completed by the end of the year 2013 (6,200 patients) were recorded in the National Infectious Diseases Register. Genotyping is principally conducted only for patients referred to treatment. The most common genotypes were GT3 (49%), GT1 (25%) and GT2 (11%).

At year end 2014, the National Institute for Health and Welfare published an extensive report on the occurrence and consequences of hepatitis C virus infections in Finland in 1995–2013.

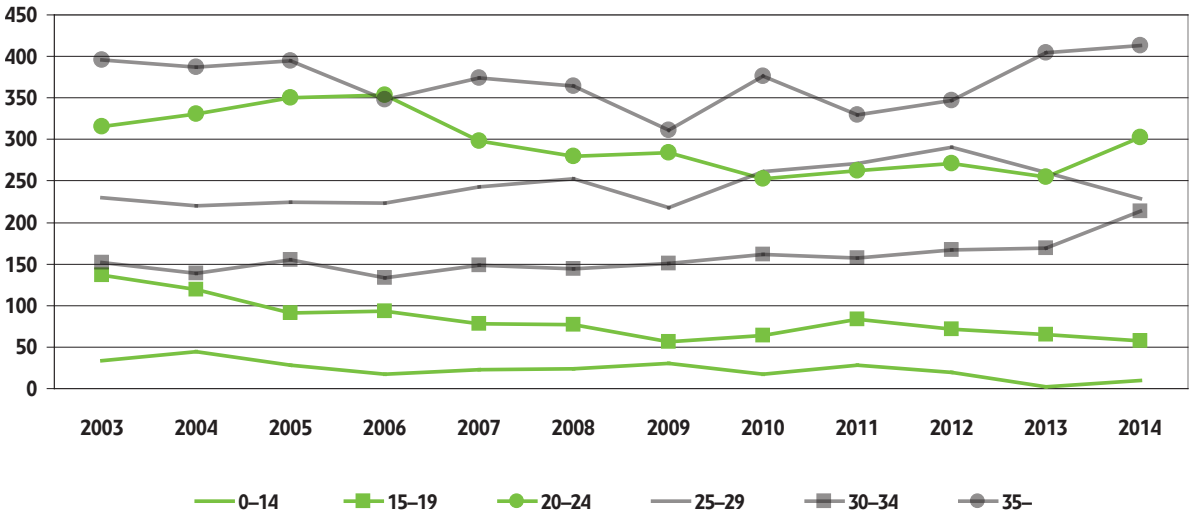


Figure 10. Hepatitis C by age group, 2003–2014 (no. of cases).

Table 2. All cases of hepatitis C according to physicians' reports, by transmission routes, 2003–2014 (no. of cases).

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Injecting drugs	640	619	638	582	480	582	520	635	615	653	648	684
Sex	48	63	65	80	71	82	75	80	88	67	88	85
Perinatal	1	11	5	5	3	11	10	10	12	7	4	4
Blood products	21	18	24	8	24	20	5	13	8	7	11	13
Other	38	34	39	45	37	41	47	50	39	31	41	35
Unknown	531	515	498	478	577	431	415	376	399	406	383	410
Total	1279	1260	1269	1198	1192	1167	1072	1164	1161	1171	1175	1231

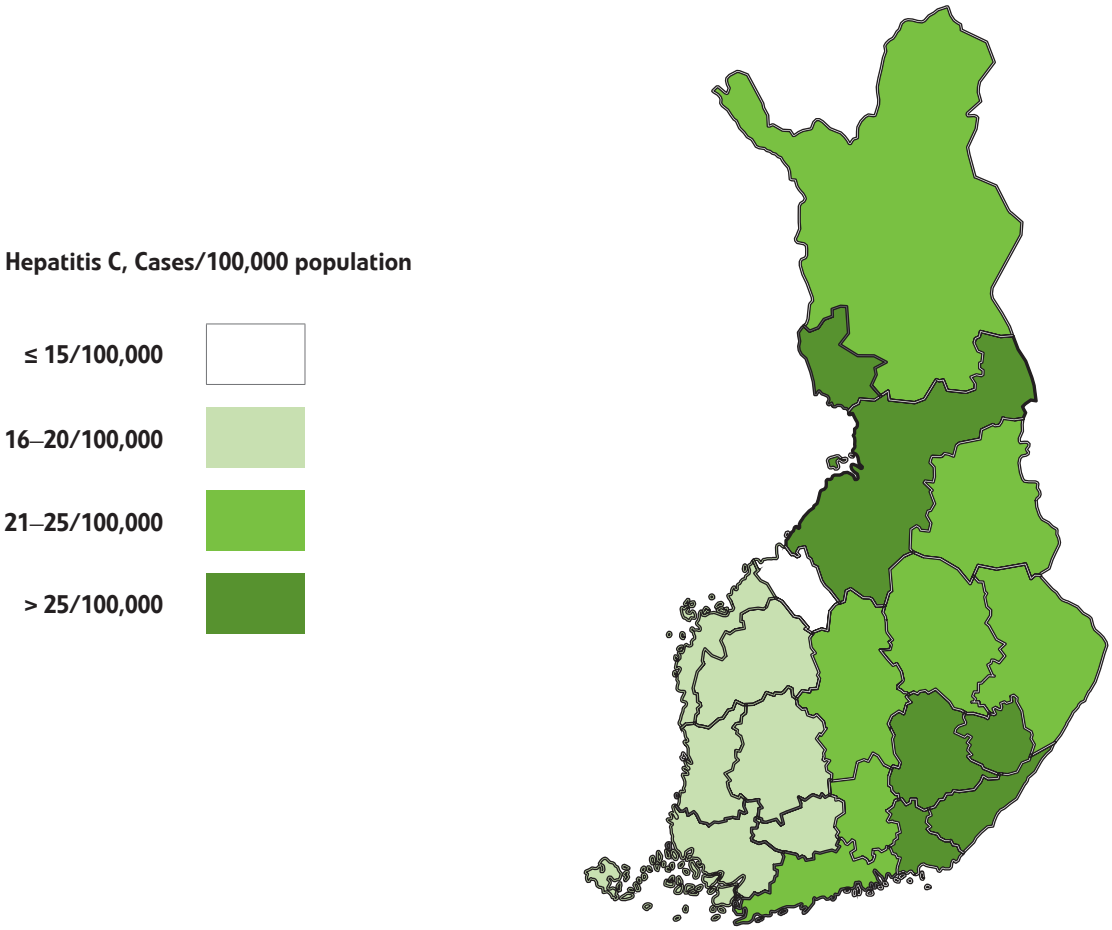


Figure 11. Incidence of hepatitis C in Finland in 2014, no. of cases per population of 100,000.

Sexually transmitted diseases

- The majority of chlamydia cases were detected in individuals aged 15–29.
- The number of gonorrhoea infections diagnosed was around 20 more than in the previous year. More than half of the infections were acquired in Finland.
- More than one in three gonorrhoea infections were contracted through sexual contact between men.
- The number of syphilis infections was 50 more than in the previous year, most originating in Russia and Estonia.
- Approximately twenty more HIV infections were diagnosed than in the previous year. Most HIV infections of Finns acquired through heterosexual contact were of foreign origin, in Thailand in particular.
- Almost one half of syphilis, gonorrhoea and HIV infections contracted by Finnish men were the result of sexual contact between men.

CHLAMYDIA (CHLAMYDIA TRACHOMATIS)

Chlamydia

In 2014, a total of 13,220 cases of chlamydia (244/100,000) were reported, a figure almost equal to that of the two previous years. The highest number of infections, accounting for 35% of all cases, was reported in the Helsinki and Uusimaa Hospital District, where the incidence was also highest at 297/100,000.

Of these infections, 58% were reported in women, 42% in men and the majority, 82%, were detected in the age group 15 to 29. The incidence was highest (1,635/100,000) in the age group 20 to 24. The majority (94%) of these patients were Finnish.

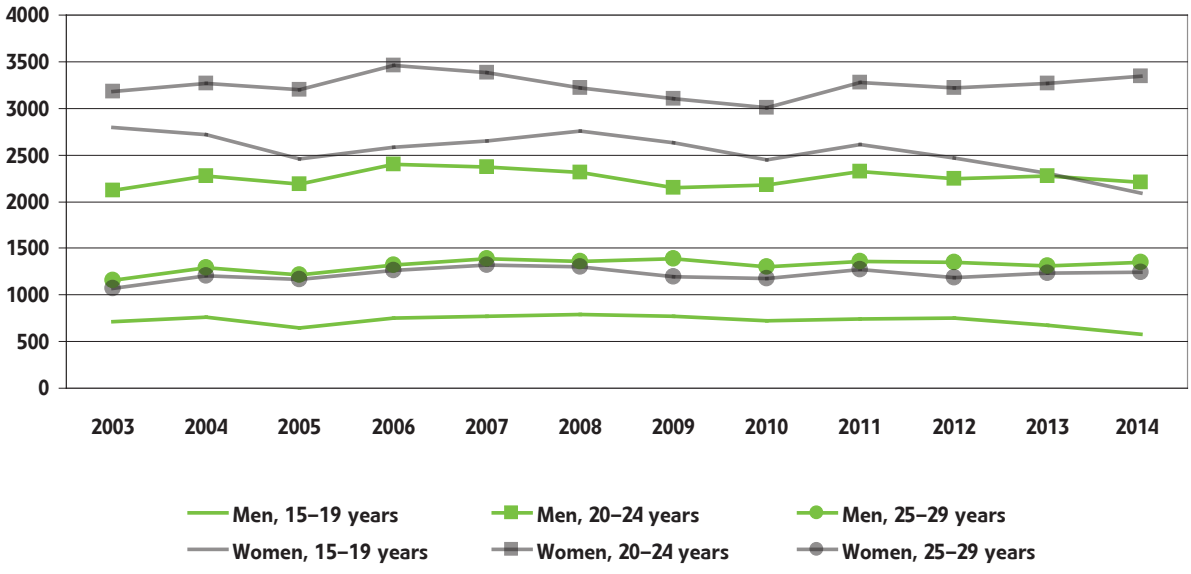


Figure 12. Chlamydia cases in the young adult age groups, 2003–2014 (no. of cases).

Table 3. Gonorrhoea infections acquired domestically and abroad, 2003–2014 (no. of cases).

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Finland	89	133	133	112	79	90	115	123	106	164	154	143
Thailand	27	38	30	42	44	34	36	45	35	35	31	23
Estonia	2	6	1	0	2	0	0	3	8	6	0	8
Russia	9	7	23	12	6	17	8	8	6	7	3	2
Other	21	21	20	25	22	24	40	33	41	55	49	63
Unknown	41	47	33	45	42	35	40	45	92	45	31	47
Total	189	252	240	236	195	200	239	257	288	312	268	286

Table 4. Syphilis infections acquired domestically and abroad, 2003–2014 (no. of cases).

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Finland	30	22	25	21	56	57	69	36	29	55	25	45
Russia	18	16	22	18	17	26	18	26	22	27	22	22
Estonia	6	1	6	3	4	9	3	9	4	6	4	11
Thailand	1	2	1	1	2	6	5	4	5	6	5	8
Other	16	12	21	20	29	43	40	50	45	41	28	48
Unknown	62	58	68	67	79	75	67	84	74	66	72	69
Total	133	111	143	130	187	216	202	209	179	201	156	203

LGV

Cases of LGV (*lymphogranuloma venereum*), caused by *Chlamydia trachomatis,* have been reported to the National Infectious Diseases Register since 2011. Of the total of 17 infections, two were reported in 2014. All infections were diagnosed in men, and all but one in Finns. The mode of transmission is known for 16 cases, and in 15 of them it is sexual contact between men. In one case, sexual contact with both genders was reported.

GONORRHOEA (NEISSERIA GONORRHOEAE)

In 2014, 286 gonorrhoea infections (5.3/100,000) were diagnosed, twenty more than in the previous year. The highest number of infections, accounting for 65% of all cases, was reported in the Helsinki and Uusimaa Hospital District, where the incidence was highest as well at 11.9/100,000.

Of these infections, 73% were reported in men and 27% in women and the majority of infections, 63%, occurred in the age group 20 to 35. The incidence was highest (20.9/100,000) in the age group 20 to 24. The majority (82%) of infections were diagnosed in Finns.

The mode of transmission was known in 90% of the cases. 39 per cent of the infections in men were contracted through sexual contact between men. The country of acquisition was reported in 83% of the cases, being Finland in 64%. As in previous years, the majority of infections contracted abroad originated in Thailand.

The infections are predominantly analysed using a nucleic acid test. In 2013, only around one half of the cases were subjected to antimicrobial susceptibility testing. By the end of the year 2013, no Gonococcus strain resistant to ceftriaxon had been reported in Finland.

SYPHILIS (TREPONEMA PALLIDUM)

In 2014, 203 gonorrhoea infections (3.7/100,000) were diagnosed, over 50 more than in the previous year. The number of cases reported annually includes both active cases of syphilis and old serological scars. Of the cases, 58% were reported in the Hospital District of Helsinki and Uusimaa. The incidence was

highest (8.3/100,000) in the Hospital District of South Karelia.

Of the infections, 64% were reported in men, 36% in women The majority of infections, 57%, were diagnosed in the age group 30 to 49. The incidence was highest (11.5/100,000) in the age group 35 to 39. Foreigners accounted for 51% of all cases.

The mode of transmission was known in 55% of the cases. More than half (56%) of the sexually transmitted infections in men were contracted through sexual contact between men.

The country of acquisition was reported in 66% of the cases, of which 71% were contracted abroad. However, around two out of three of infections in Finns were contracted in Finland. As in previous years, the majority of infections contracted abroad originated in Russia and Estonia.

HIV AND AIDS

In 2014, 181 new HIV infections were diagnosed (incidence 3.3/100,000). The highest number of infections, accounting for 57% of all cases, was reported in the Helsinki and Uusimaa Hospital District, where the incidence was also highest, at 6.6/100,000. Seventeen cases of AIDS, and two deaths due to AIDS, were reported.

Of the infections, 77% were diagnosed in men, 23% in women. Foreigners accounted for 51% of all cases.

The majority of infections in Finns (90%) were reported in men, but the percentage of women, 36%, was higher among foreigners.

The majority of infections (69%) were acquired through sexual contact. Infections acquired through heterosexual contact accounted for 38% and sexual contact between men for 31% of the cases. More than half of infections in Finnish men contracted through sexual contact were connected to sexual contact between men.

The reported number of infections contracted through heterosexual contact was 68. Foreigners accounted for 47% of all cases, and the majority of infections contracted through heterosexual contact originated abroad, both among foreigners and Finns. As in previous years, Thailand was a prominent source of infection for Finns who had acquired the infection abroad.

The number of infections due to sexual encounters between men was 56. Foreigners accounted for 25% of all cases, The majority of infections originated in Finland. In recent years, Thailand has become more common as a foreign source of infections contracted by Finns, and it was the most common country of acquisition in 2014.

Seven cases were diagnosed in which the infection was acquired through intravenous drug use, six of these patients being foreign. Since the epidemic of the turn of the millennium, efficient prevention methods have helped to keep the number infections at a low level.

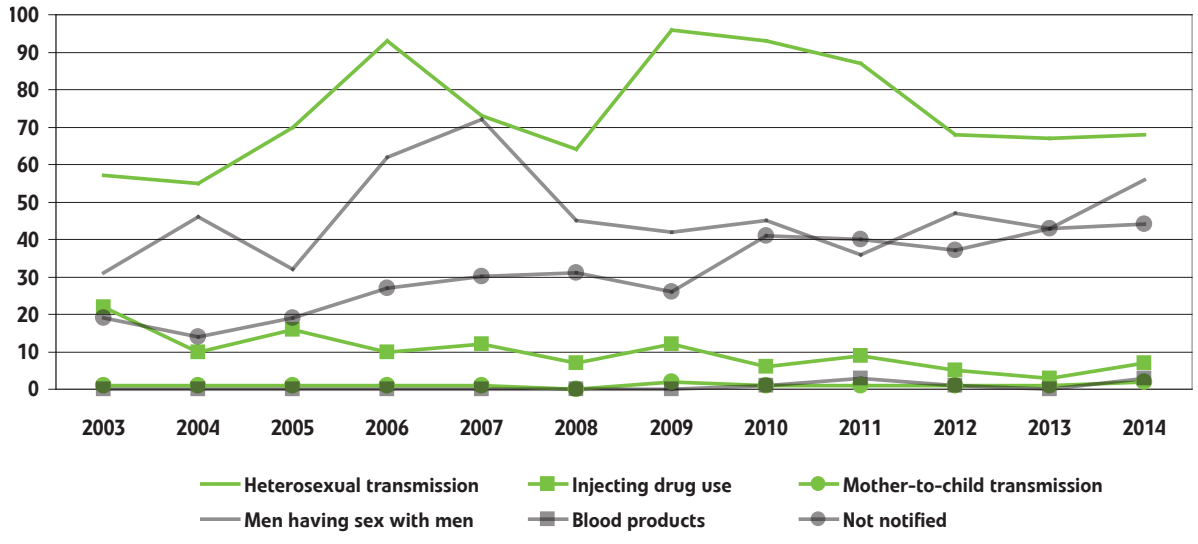


Figure 13. HIV cases by transmission route, 2003–2014 (no. of cases).

Two mother-child infections were reported, both of foreign origin. A total of 39 infections were detected in maternity clinic screenings, eight of them new infections, accounting for almost 20% of all new cases in women. In the other cases, the infection was known about before pregnancy. In cases where it is known that the mother has been infected, mother-child transmission can be effectively prevented with HIV medication.

Three infections caused by blood products were reported, all in foreigners and all contracted abroad. Since HIV testing of donated blood began in Finland in 1985, no cases have been reported of infection through blood products in Finland.

Information on the mode of transmission was lacking in 24% of cases, the notification of infectious diseases by the physician not being available in 40%. Foreigners accounted for over 80% of cases in which information on the mode of transmission was lacking.

In 2014, 17 new cases of AIDS were reported, 11 in Finns and six in foreigners. The number of HIV-positive patients who died during the year was 17, the cause of death being AIDS in two cases.

The percentage of late detection of infections (CD4 lower than 350) was 40%. Testing should therefore be further enhanced and the benefits of early diagnosis highlighted. Preliminary analyses indicate that, in 7% of new cases, primary resistance mutations (HIV drug resistance mutations transferred with the infection) were detected.

By the end of 2014, the total number of HIV infections reported in Finland was 3,396. The reported number of HIV positive patients who died was 602, the cause of death being something other than AIDS in most cases.

Antimicrobial resistance

- The number of MRSA infections was slightly higher than in the previous year, which was also revealed in blood culture findings.
- The number of VRE cases was lower year-on-year.
- The growth in the number of ESBL *E. coli* findings came to a halt. The same applied to blood culture findings.
- The number of CPE bacteria increased slightly, but no CPE outbreaks were detected.

MRSA

In 2014, 1,340 cases of MRSA (methicillin-resistant *Staphylococcus aureus*) were reported, slightly more than in the year before (2013: 1,285). The number of MRSA cases confirmed through blood culture findings was also higher than in the previous year (2014: 46; 2013: 30). Of the MRSA blood culture findings, 15 were in the Helsinki and Uusimaa Hospital District (1.0/100,000), eight in the Pirkanmaa Hospital District (1.6/100,000) and seven in the North Ostrobothnia Hospital District (1.7/100,000). The number of cases in other hospital districts varied from zero to four, totalling 16. Most (30 out of 45) of the invasive cases occurred in patients older than 65, and two in children. The total number of cases was highest in the hospital districts of Helsinki and Uusimaa and Pirkanmaa, as were incidence figures. As before, almost 40 per cent of the findings were related to patients aged 75 or over. The number of MRSA cases in children did not increase (2014:108; 2013: 113).

The MRSA strain was typed in 1,389 individuals. There were 205 different spa types among the MRSA strains (2013: 211). The three most common spa types were the same as in previous years: t172 19% (2013: 18%), t008 11% (2013: 11%) and t067 10% (2013: 16%). The next most common spa types, t002, t032, t020, t019 and t044, occur evenly at 3% (for all of them) and t172 was found in 15 hospital districts. The incidence of spa type t067 clearly decreased in 2014. As in 2013, the incidence of t067 was most frequent in the hospital districts of Pirkanmaa and South Ostrobothnia. The marked increase in the incidence of the t067 strain detected in 2013 in the Hospital District of South Ostrobothnia halted and took a downward turn in 2014 (2013: 63, 2014: 32).

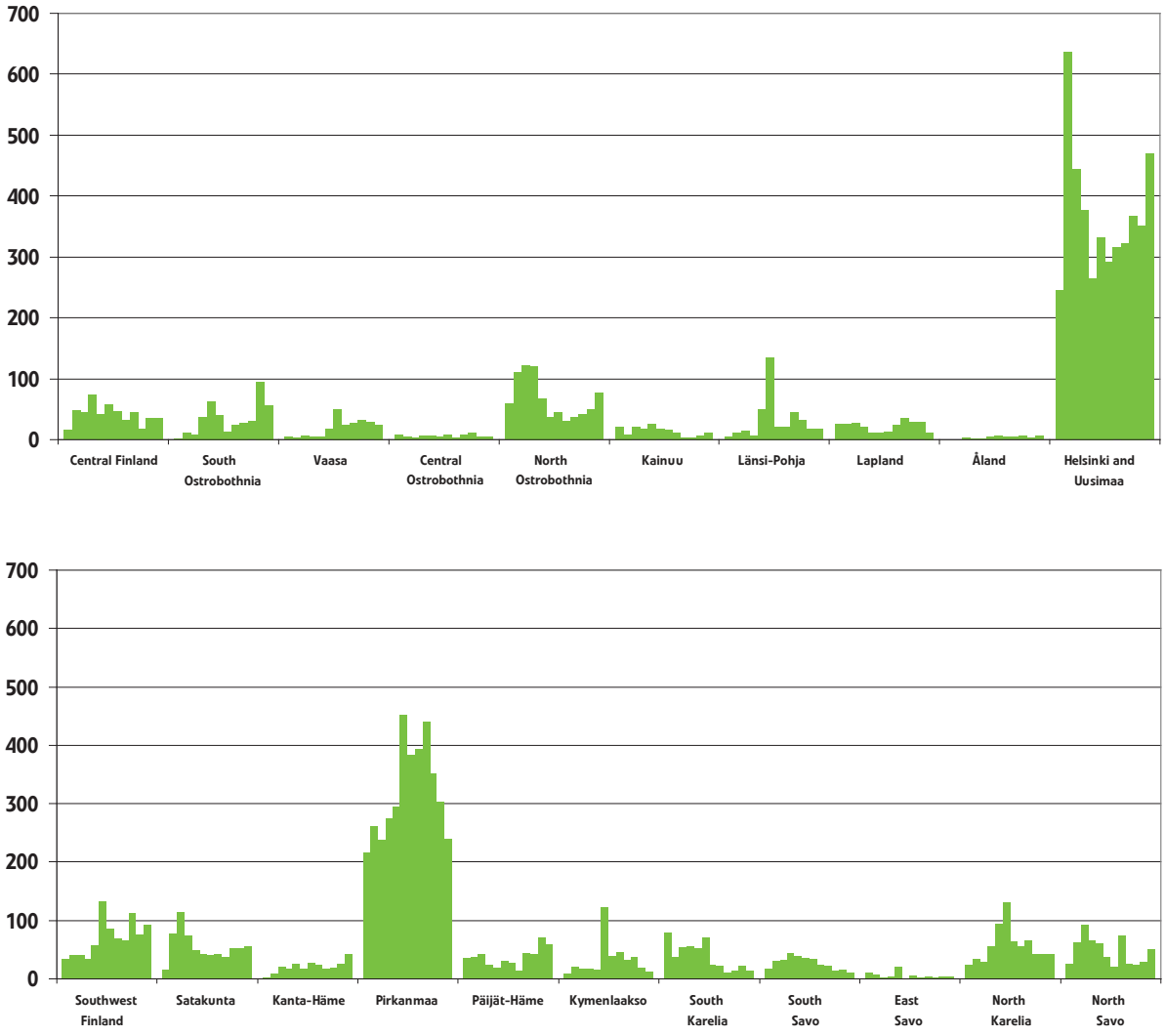
In addition, local clusters were caused, among others, by t9408 in the North Savo Hospital District, by t1012 and t310 in the Pirkanmaa Hospital District and t509 in the Helsinki and Uusimaa Hospital District.

The two most common spa types among patients over 75 were t172 at 19% (2013: 18%) alongside last year's most common spa type t067 at 17% (2013: 26%). The most common spa types among children under the age of 16 were t008 at 14% (2013: 6%), t172 at 12% (2013: 18%) and t044 at 8% (2013: 13%).

An invasive MRSA strain was typed in 39 individuals. The most common spa types were the same as in the previous year: t172 (2014: 6, 2013: 2), t008 (2014: 6, 2013: 3) and t067 (2014: 5, 2013: 5). There were three cases of spa type t032, two of each of spa types t020, t091 and t127, and the remaining cases (13/39) each represented different spa types.

In 2014, six MRSA strains with the *mecC* gene were isolated from clinical samples (2013: 3). There were two cases of spa types t10471 and t843 and one of spa types t3256 and t9397, respectively.

In recent years, spa types of the MRSA CC398 complex, related to production animals, have become increasingly common in Europe. These strains have so far been rare in Finland. In 2007–2014, 48 strains of the CC398 complex were typed. The most common spa type, t034, has caused non-invasive MRSA infections and the numbers have risen slightly (2014: 14, 2013: 5, 2012: 2). One blood finding has been recorded in Finland (2013: t12593). Other spa types of the CC398 complex found in Finland include t011, t108, t899 and t2741.



Figures 14a and 14b. MRSA cases by hospital district, 2003–2014 (no. of cases).

VRE

The number of reported cases of the vancomycin-resistant enterococcus (VRE) in 2014 decreased on the previous year (2014: 32, 2013: 45). Most cases were reported by the hospital districts of Helsinki and Uusimaa (13) and Central Ostrobothnia (12) and in the over 65 age group (17/32). In other hospital districts, the number of findings varied from zero to two. None of the findings were based on blood samples. In fact, VRE has rarely been found in blood overall (2013: 0, 2012: 1). Findings of *E. casseliflavus*- and *E. gallinarum* in strains lacking the *vanA* or *vanB* gene were erroneously recorded as VRE findings in blood in the 2013 report. Because these species are inherently less susceptible or resistant to vancomycin, they do not constitute actual VRE findings.

Of the 32 VRE findings typed in 2014, 30 were of the species *E. faecium* and two of the species *E. faecalis*. More *vanB* genes than *vanA* genes were found in these species (*vanB* 17; *vanA* 14) and one *E. faecium* strain had both genes of acquired resistance to vancomycin, *vanA* and *vanB*. In addition, one strain of *E. casseliflavus* with an acquired *vanB* gene was detected in 2014. The typed strains were all individual findings and had specific pulsed field gel electrophoresis (PFGE) profiles.

ESBL

Since the beginning of 2008, findings of *Escherichia coli* and *Klebsiella pneumoniae* exhibiting either reduced susceptibility or resistance to third-generation cephalosporin (I for intermediate and R for resistant,

Table 5. MRSA-findings and their percentage of S. aureus blood culture findings, 1995–2014 (no. of cases and %).

	All MRSA findings	S. aureus blood culture findings	MRSA blood culture findings and the methicillin resistance of S. aureus (%)
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	1478	1057	30 (2,8)
2005	1375	1012	27 (2,7)
2006	1330	1237	37 (3,0)
2007	1255	1109	32 (2,9)
2008	1729	1164	40 (3,4)
2009	1269	1208	31 (2,6)
2010	1268	1376	26 (1,9)
2011	1327	1486	44 (3,0)
2012	1288	1485	30 (2,0)
2013	1285	1590	30 (1,9)
2014	1340	1925	46 (2,4)

Table 6. E. coli findings with reduced susceptibility to third-generation cephalosporins (possible ESBL, extended-spectrum β-lactamase) and ESBL percentage, 2008–2014 (no. of cases and %).

	ESBL findings	E. coli blood culture findings	ESBL E. coli blood culture findings and percentage of ESBL of E. coli
2008	1673	2813	43 (1,5)
2009	2177	2990	77 (2,6)
2010	2559	3229	112 (3,5)
2011	3144	3476	149 (4,3)
2012	3689	3463	203 (5,9)
2013	4463	3876	233 (6,0)
2014	4190	4364	232 (5,3)

respectively) have been reported to the National Infectious Diseases Register. The majority of these bacteria are extended-spectrum beeta-lactamase- producing, so-called ESBL strains that split penicillin and cephalosporins.

In 2014, the majority of ESBL findings were *E. coli* (4,190; in 2013: 4,463) and a small minority of *K. pneumoniae* strains (312; in 2013: 238). *E. coli* ESBL findings were made in all age groups – 76% in women and over half in patients aged 65 years or more. Less than one half of findings (45%, 1,976/4,190) were based on urine cultures. The largest number of cases was found in the Hospital District of Helsinki and Uusimaa (1,319, 84/100,000), but the incidence was highest in the Central Ostrobothnia and Lapland hospital districts (113, 101/100,000, respectively) and in Åland (147/100,000). The number of

Table 7. K. pneumoniae findings with reduced susceptibility to third generation cephalosporins (possible ESBL, extended-spectrum β-lactamase) and ESBL percentage, 2008–2014 (no. of cases and %).

	ESBL findings	K. pneumonia blood culture findings	ESBL K. pneumoniae blood culture findings and percentage of ESBL of K. pneumoniae
2008	116	414	4 (1)
2009	156	476	6 (1,3)
2010	190	506	16 (3,2)
2011	243	453	16 (3,5)
2012	242	578	17 (2,9)
2013	238	567	15 (2,6)
2014	312	631	20 (3,2)

blood culture findings was equal to the figures for 2013 (232 vs. 233) (the ESBL proportion in *E. coli* blood cultures: 232/4,364, 5.3% vs. 6.0% in 2013). Of these, 24% were in the Hospital District of Helsinki and Uusimaa. However, the incidence of blood culture findings was highest in the Hospital District of Vaasa.

More than 60% of ESBL findings involving *K. pneumoniae* were diagnosed in patients aged 65 or over but, at 66 per cent, the percentage of such women was smaller than those with *E. coli* ESBL findings. More than one third of diagnoses (37%, 122/331) were based on urine. The largest number of cases was recorded in the hospital districts of Helsinki and Uusimaa (100) and North Ostrobothnia (32), while the incidence was highest in the hospital district of Kainuu. Twenty (2013:15) of the findings were based on blood (the ESBL proportion in the *K. pneumoniae* blood cultures: 20/631, 3.2% vs. 2013: 2.6%).

The percentage of *E. coli* findings exhibiting reduced susceptibility to third-generation cephalosporin had increased from 2008 to 2013, both for all findings and those isolated from blood, but this trend seemed to come to a halt in 2014.

CPE (CARBAPENEMASE-PRODUCING ENTEROBACTERIA)

In 2014, 18 strains of carbapenemase-producing enterobacteria (carbapenemase-producing *Enterobacteriaceae*, CPE) were isolated in 14 individual patients. The figure has risen slightly from 2009, when monitoring began. Most findings involved *K. pneumoniae* strains and the most common carbapenemase was NDM. No CPE outbreaks were detected in 2014. More than one strain of CPE bacteria was found in two patients.

As before, the majority (70%) of CPE infections were probably acquired abroad, but in some cases domestic infection could not be excluded. CPE infections had been acquired in Asia and Southern Europe in particular.

In 2009–2014, KPC was the most common carbapenemase found in Finland, most often in a *K. pneumoniae* strain. KPC-*K. pneumoniae* ST 512 is the only strain of CPE bacteria that has caused an outbreak in Finland. NDM is the second most common carbapenemase, most often seen in *E. coli* strains.

Table 8. Carbapenemase-producing Enterobacteriaceae (CPE), 2009–2014, (no. of cases).

	CPE findings	
	Bacterial strains	Patients
2009	5	5
2010	8	8
2011	12	11
2012	9	8
2013	13/22*	12/20*
2014	18	14

*Including KPC outbreak (10 strains from 9 patients).

Table 9. Carbapenemase-producing Enterobacteriaceae (CPE) and possible foreign contact 2014 (no. of cases).

Country	Gene	Patients
No preceding travel history	KPC*	1
	NDM	2
Unknown	OXA-23	1
India	NDM	3
Greece**	KPC	2
	VIM	1
Thailand***	NDM	1
	KPC	1
Spain	OXA-48	1
Vietnam	NDM	1

* One patient, two separate specimens.
** One patient, three different CPE-strains: KPC-*E. coli*, KPC-*K. pneumoniae* and VIM-*K. pneumoniae*
*** One patient with KPC-*E. coli* and KPC-*K. pneumoniae*

Tuberculosis

- One third of patients contracting tuberculosis were foreigners; of these, almost 80% were aged between 15 and 44.
- The number of multiresistant cases of tuberculosis was slightly higher than before.
- Several cases of mass exposure were diagnosed across the country. In all of these, the index case was a young person from a country with a high incidence of tuberculosis.

TUBERCULOSIS (MYCOBACTERIUM TUBERCULOSIS)

Incidence of tuberculosis 2014

The number of tuberculosis cases was 260 (4.8/100,000), 11 cases fewer (4%) than in 2013 (271; 5.0/100,000). Of these, 196 (75%) were cases of pulmonary tuberculosis, 80 (41%) of which produced a positive sputum stain test. There were 213 cases of tuberculosis confirmed by culture (82%), 9 more than in 2013 (204). According to physicians' notifications, 16 patients (6%) had a previous history of tuberculosis diagnosed after 1950, when anti-tuberculosis medication became available.

The increase in the overall number of tuberculosis cases in Finland in 2007 and 2008 compared to 2006 can be explained by the introduction in 2007 of the broader EU definition of tuberculosis cases. The annual numbers of cases confirmed by culture are comparable throughout the monitoring period. The number of these cases remained stable from 2007 to 2011 except in 2009, when an exceptionally large number of cases in foreigners was recorded; in 2012–2014, however, the figure became stable again.

The distribution of cases by age group was as follows: under 15, 8 (3%); 15 to 29, 39 (15%); 30 to 44, 34 (13%); 45 to 59, 40 (15%); 60 to 74, 40 (15%); and over 75, 93 (36%). In half of all cases the patients were over 60 years of age, and most of them were born in Finland; their cases involved a reactivation of a latent infection contracted decades ago. Population reduction among the age groups in whose youth the incidence of tuberculosis in Finland was high, and the increasing number of young immigrants has led to a notable decrease in the average age of tuberculosis patients between 2000 and 2014, from 64 to 56 years. In 2014, eight children were diagnosed with tuberculosis. Three of them were children of Finnish origin, who had not received the BCG vaccine.

The patient was reported to be foreign in 86 cases (33%), i.e. born abroad and assumed to have other than Finnish citizenship unless the data indicates otherwise. The distribution of these cases by age group was as follows: under 15, 3(3%); 15 to 29, 39 (45%); 30 to 44, 27 (31%); 45 to 59, 13 (15%); and over 60, 4 (5%). Among these, there were 59 cases (69%) of pulmonary tuberculosis and 27 cases (31%) of other forms of tuberculosis. Information on the patient's country of birth or citizenship was missing in three cases (1%). During the year, several cases of mass exposure were diagnosed across the country. In all of them, the index case was a young person from a country with a high incidence of tuberculosis.

In two (1%) of the tuberculosis cases reported in 2014, the patient also had an HIV infection. In one of these cases, the HIV infection was reported as a new case in 2014, and in the other, the HIV infection had been registered before. Both patients were of foreign origin.

Tuberculosis genotyping findings 2014

All new *Mycobacterium tuberculosis* strains were genotyped using the internationally standardised spoligotyping and MIRU-VNTR methods. In 2014, 35% of *M. tuberculosis* strains were connected to clusters. The

Table 10. Incidence of tuberculosis and percentage of culture-confirmed cases in Finland, 1995–2014 (no. of cases and %).

	Pulmonary tuberculosis				Other tuberculosis		All cases				Foreigners	
	Cases	Cases/ 100,000	Cases with positive sputum smear	Cases with positive sputum smear /100,000	Cases	Cases/ 100,000	Cases	Cases/ 100,000	Culture-confirmed cases	Proportion of culture-confirmed cases (%)	Cases in foreigners	Proportion of foreigners (%)
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

most common cluster in Finland is still the Jazz cluster (106), which has been spreading in the Helsinki metropolitan area for a long time. Five new cases were diagnosed in this cluster in 2014. The second most common cluster is the Nordic cluster (131), which is also widespread in Denmark and Sweden. Four new cases in different parts of Finland were diagnosed in this cluster. Two new cases were connected to the tuberculosis epidemic in Turku in 2014. Two cases of laboratory contamination were diagnosed through genotyping.

Tuberculosis strain susceptibility to medication in 2014

Of all cultured strains, 91% had full susceptibility and, in twenty cases, resistance to one or several drugs was diagnosed. Although the susceptibility to drugs of *M. tuberculosis* strains remains high, the number of multidrug-resistant (MDR) cases of tuberculosis was somewhat higher than before. Of the eight MDR cases confirmed through culture and diagnosed during the year, one case was an extended-drug resistant (XDR) tuberculosis.

Two of the MDR cases confirmed through culture were in patients born in Finland, others were from Somalia, Russia and the Philippines. In addition to these, a six-year-old child born in Finland, who had not received the BCG vaccine, contracted MDR tuberculosis after being infected by its grandfather.

Tuberculosis outcome surveillance in 2009–2013

Table 11. shows the distribution of treatment outcomes between 2009 and 2013. The domain consists of cases of pulmonary tuberculosis confirmed by culture, genetic replication or staining. Cases where the pathogen is an MDR strain are reported separately and are not included in Table 11. An outcome evaluation is performed 12 months after the case is registered.

The treatment outcome was good in 68% of cases in 2013. 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. Mortality (before beginning treatment or during treatment) was 16% in 2013.

Other mycobacteria

A total of 631 non-tuberculotic, environmental mycobacteria were identified (incidence 11.6/100,000). The most common of these found in patient samples were *Mycobacterium avium* (*n*=161), *Mycobacterium gordonae* (*n*=155) and *Mycobacterium intracellulare* (*n*=92), six of which were diagnosed in children under the age of 5.

Table 11. Results of outcome evaluation for treatment of microbiologically confirmed pulmonary tuberculosis, 2007–2013 (no. of cases and %).

	2009	2010	2011	2012	2013
Cases under surveillance	235	186	186	165	183
TREATMENT OUTCOME					
Favourable	171 (73%)	149 (80%)	131 (70%)	122 (74%)	125 (68%)
Cured	86	94	74	63	72
Treatment completed	85	55	57	59	53
Non-favourable	44 (19%)	22 (12%)	38 (20%)	27 (16%)	31 (17%)
Deceased	41	18	37	27	30
Treatment failure	3	4	0	0	0
Interrupted treatment	0	0	1	0	1
Missing	20 (9%)	15 (8%)	17 (9%)	16 (10%)	27 (15%)
Transfer	10	2	7	7	3
Treatment continues at 12 months	9	8	8	8	3
Unknown	1	5	2	1	21

Other infections

- Severe pneumococcal diseases caused by vaccine serotypes have almost vanished in young children and continued to decrease in the 18 to 64 age group, as an indirect consequence of the vaccination programme for children.
- The decrease in the penicillin resistance of pneumococcus continued, as did that of resistance to macrolides and multiresistance.
- The number of meningococcus infections was on a par with the previous year. More than half of the cases in serogroup B were diagnosed in young children, whereas cases caused by groups C and Y were mainly detected in older age groups. No clusters of the disease were found.
- Less than 500 cases of varicella virus findings were reported, on a par with the two previous years. Childhood varicella or chicken pox is a very common disease, with an estimated 57,000 cases in Finland every year. It is mainly diagnosed clinically and, in the vast majority of cases, the disease does not even result in a laboratory sample being taken.
- The incidence of borrelia is highest in the autumn, from August to October. The number of cases was equal to that of previous years.
- The number of tick-borne encephalitis (TBE) cases remained unchanged in comparison with previous years. The Raseborg region, coastal areas of Lake Lohjanjärvi, the sea coast in Kirkkonummi and the Jollas shore in Helsinki emerged as new potential areas of infection.
- Approximately a quarter more cases of Puumala virus were reported than in 2013. The majority of patients were of working age.
- A total of 30 people were exposed to rabies abroad, mainly in Thailand. Two thirds of the cases were related to dog bites.
- Most malaria cases originated in Africa. More than half of the patients were immigrants coming from a malarious area.

INVASIVE PNEUMOCOCCAL DISEASE (STREPTOCOCCUS PNEUMONIAE)

The reported number of invasive, severe cases of pneumococcal disease, in which the pathogen was identified in a blood or cerebrospinal fluid culture, was 703 (13/100,000; in 2013 723, 13/100,000). In addition, the number of cases reported on the basis of antigen or nucleic acid detection totalled 21. No serotype data is available for these cases and they are not included in the statistics below.

Children under the age of 5 accounted for 3.8% of the patients and over 65-year-olds for 50.4%. As before, the incidence was higher among men than among women (16 vs. 10/100,000). Regional variation between hospital districts was approximately triple (8–23/100,000), which may be due to differences in how actively blood cultures are taken.

In 2014, 697 cases of pneumococcal disease confirmed by culture were serotyped. The National Institute for Health and Welfare did not obtain the strain of six cases confirmed by culture, and the serotype remained unknown for these. The cases were divided into 37 serotypes or serogroups. In addition, one unencapsulated strain was detected. The most common serotype, 3, caused almost one fifth (122; 17.3%) of all cases. The next most common serotypes were 19A (95; 13.5%) and 22F (71; 10.1%). These three were

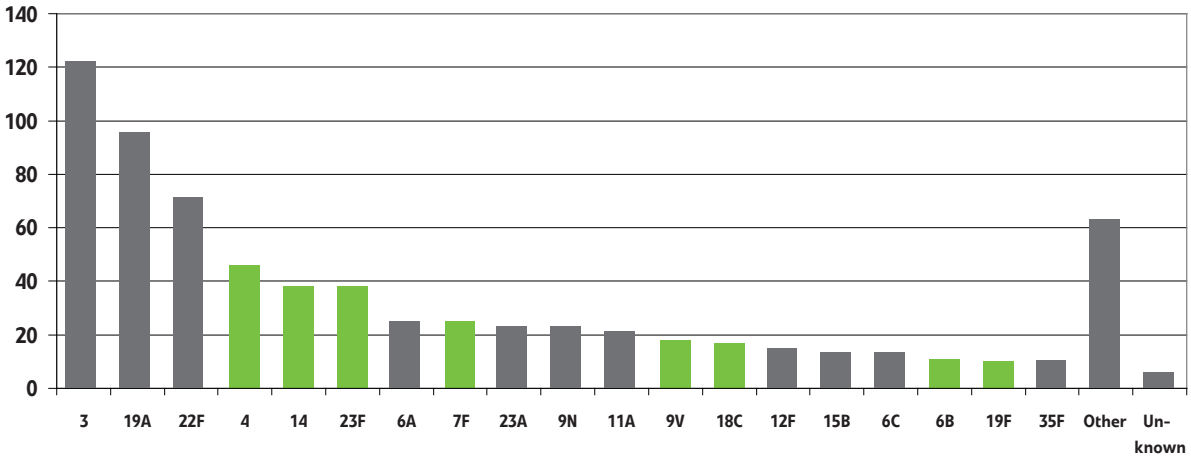


Figure 15. Serotypes of Streptococcus pneumoniae findings in blood and cerebrospinal fluid 2014 (no. of cases). The column "Other" includes serotypes that caused fewer than 10 cases.
PCV10 serotypes, green columns.

Table 12. Streptococcus pneumoniae findings in blood and cerebrospinal fluid by age and vaccine serotype, 2005–2014 (no. of cases). The column "Unknown" includes cases, whose strains the National Institute for Health and Welfare did not receive.

	PCV10 vaccine serotypes						Non-vaccine serotypes						Un-known	Total
	<2	2–4	5–17	18–64	65–	Total	<2	2–4	5–17	18–64	65–	Total		
2005	52	26	15	244	132	469	15	7	3	120	86	231	37	737
2006	67	26	16	227	160	496	14	5	3	106	102	230	22	748
2007	63	38	12	226	176	515	15	5	6	117	111	254	17	786
2008	49	26	18	288	198	579	14	6	4	173	119	316	31	926
2009	47	26	23	277	165	538	12	4	8	141	117	282	33	853
2010	51	35	11	246	166	509	8	5	5	150	124	292	32	833
2011	34	16	15	217	150	432	11	11	6	166	144	338	5	775
2012	8	15	7	188	149	367	7	2	8	172	191	380	3	750
2013	6	3	9	164	112	294	13	11	5	192	206	427	2	723
2014	2	3	8	99	93	205	11	11	10	203	257	492	6	703

common, particularly in adults, and covered 41.0% of all cases. In comparison with the previous year, serotypes 3 (2014: 122 vs. 2013: 88), 19A (95 vs. 68) and 23A (23 vs. 10) were the ones that became more frequent.

The 10-valent pneumococcal conjugate vaccine (PCV10) has been included in the basic 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 almost been eliminated in young children and have continued to decrease, particularly in the 18 to 64 age group in 2014, compared to the years (2008–2009) which were prior to the introduction of the vaccine. This is an indirect consequence of the vaccination programme for children. In children under 2 years of age, two cases caused by PCV10 serotypes were diagnosed. In addition, two other cases caused by PCV10 serotypes were found in children aged 2 and 3, vaccinated in accordance with the programme. The number of cases caused by serotypes other than PCV10, including 19A, increased as in the two previous years, particularly in the oldest age group (65 and over). For more detailed statistics by age and serotype, please see the National Institute for Health and Welfare website.

Antimicrobial sensitivity was determined for 716 strains of invasive pneumococcus. Strains with re-

Table 13. Antimicrobial resistance of Streptococcus pneumoniae findings in blood and cerebrospinal fluid, 1998–2014 (no. of cases and %).

	Cases reported to the NIDR	Studied strains	Erythromycin (R) (%)	Penicillin (I+R) (%)	Multidrug resistance (%)
1998	561	84	3,6	0	0
1999	568	471	5,9	7,2	0
2000	601	439	8	3,7	1,4
2001	658	360	18,8	7,5	5
2002	599	594	16,3	8	3,7
2003	721	739	21,9	12,7	5,7
2004	748	748	20,5	9,6	3,7
2005	737	731	20,5	9,6	4,4
2006	748	760	27,9	16,4	5,4
2007	786	794	23,2	14,4	3,5
2008	926	930	24,5	17,7	3,4
2009	853	848	28,4	19,9	4,7
2010	833	819	28,6	23,4	1,7
2011	775	780	26,8	21,9	2,8
2012	750	754	22,2	27,7	5
2013	723	668	16,8	18,7	4
2014	703	716	14,5	14,8	2,4

I – reduced susceptibility: R – resistant; Multidrug resistance – strains simultaneously resistant to penicillin (I+R), erythromycin (R) and tetracycline (R)

duced susceptibility to penicillin (MIC > 0.06 mg/L) accounted for 15% of the strains, and two strains completely resistant to penicillin (MIC > 2 mg/L) were found. The percentage of macrolide-resistant strains continued to decrease; 15% of invasive pneumococcal strains were resistant to erythromycin. Multiresistant strains (PEN IR–ERY R–TET R) accounted for 2% of the strains. No strains resistant to levofloxacin (MIC > 2 mg/L) or ceftriaxon (MIC > 2 mg/L) were found in 2014. The decrease detected in 2013 in the percentage of penicillin resistant strains and those with lower susceptibility seems to be continuing. The decline in macrolide resistance and multiresistance continued further.

HAEMOPHILUS (HAEMOPHILUS INFLUENZAE)

A total of 59 infections were caused by the *Haemophilus influenzae* bacterium and were diagnosed in blood or cerebrospinal fluid. This was somewhat above the average rate in recent years, but was clearly less than in the peak year 2012 (81). One third of cases (20, 34%) were diagnosed in patients aged 75 or older.

All cases were diagnosed through culture findings. The majority of these (48, 81%) were caused by unencapsulated strains of *Haemophilus influenzae*, as in earlier years. There were five cases caused by serotype b. Three of these were diagnosed in individuals of an age (11 months, 9 years and 18 years) that would have entitled them to receive the Hib vaccine as part of the national vaccination programme. The youngest of these patients had been vaccinated accordingly, but had only received two doses. The second-youngest had received all three doses and the oldest only one dose at the age of three. Serotype f caused disease in six individuals, three of them young children (8 months, 12 months and 6 years) and three adults. No other serotypes were detected.

Children born in 1985 or later have been given the Hib vaccine at their child care clinics. The vaccination programme has succeeded in reducing the number of serious diseases caused by bacteria of serotype b, and the circulation of bacteria within the population, but cases may still occur in children with incomplete vaccination coverage. Not only serotype b but other serotypes may cause severe infections in young children. The vaccine does not protect patients from other serotypes.

Table 14. Meningococcal infections by serogroup, 2003–2014 (no. of cases).

	Group A	Group B	Group C	Group Y	Group W135	Unknown	Total
2003	0	36	6	4	1	2	49
2004	0	28	5	6	0	2	41
2005	0	29	5	4	2	4	44
2006	0	33	1	3	0	3	40
2007	0	38	5	1	0	1	45
2008	0	18	8	1	0	1	28
2009	0	19	8	2	0	0	29
2010	0	14	4	13	1	3	35
2011	0	19	6	7	1	1	34
2012	0	17	3	8	1	4	33
2013	0	10	2	8	0	0	20
2014	0	7	5	5	1	3	21

MENINGOCOCCUS (NEISSERIA MENINGITIDIS)

In 2014, the number of meningococcus infections detected in blood or cerebrospinal fluid totalled 21 (0.39/100,000), which is around the same as in 2013. Of these cases, 18 were diagnosed through a bacterial culture finding and three through nucleic acid detection. All bacterial strains were serogrouped and genotyped: 7 (33%) were of serogroup B, 5 (24%) of serogroup C, 5 (24%) of serogroup Y and 1 (5%) of serogroup W. The serogroup remained unknown for three cases diagnosed through nucleic acid detection. One quarter (5, 24%) of the cases were diagnosed in 0–4-year-olds and one half (10, 48%) in patients over 30. More than half (57%) of the cases caused by serogroup B were diagnosed in young children, whereas cases caused by groups C and Y were mainly detected in older age groups. No epidemics or disease clusters were detected.

The strains of group B were highly heterogeneous, having been divided on the basis of genotypes into seven types, while the strains of group Y were divided into four types. In group C, the strains were of two types, one responsible for three (C:P1.5,2:F3-3) and the other for two (C:P1.5-1,10-8:F3-6) cases, mainly in Southern Finland. The latter strain type has caused epidemics in Central Europe among sexual minorities and reportedly has a higher than usual mortality rate. Both Finnish patients died.

The incidence of serogroup B bacteria in particular has decreased in recent years. This declining trend has been witnessed in other industrialised countries and may be due not only to changes in treatment practices, such as the earlier administration of antibiotic drugs, but also to natural variation in strain types. For instance, with regard to serogroup B, certain hypervirulent, previously common strain types such as B:P1.7-2,4:F1-5 have almost disappeared in recent years, whereas the incidence of serogroup Y has slightly increased lately, as in other Nordic countries.

In sporadic cases of meningococcus, all persons in close contact with the patient – except for health care personnel – should be given prophylactic medication and a vaccination, if infection with the strain in question can be prevented by vaccination. Finland has vaccines against the meningococcus serotype groups A, C, Y and W. The Defence Forces are administering a quadrivalent polysaccharide vaccination to all recruits, but infections belonging to serogroup B are still being found among them, as the vaccine affords no protection from it. Conjugated meningococcus vaccines are mainly used in connection with epidemics and travel. New vaccines against group B meningococcus strains are entering the market.

MMR DISEASES (MEASLES, MUMPS, RUBELLA)

In 2014, two cases of measles were reported, on a par with recent years, but clearly fewer than in the peak year of 2011 (27). One of the patients was an unvaccinated young person who had been travelling in Southeast Asia. The other patient, who had also been infected while travelling abroad, was a foreign-born adult whose vaccination coverage is unknown.

In 2014, two cases of mumps were reported, both in adults. One of the patients was a person of foreign origin, who had visited the home country immediately before falling ill, and whose vaccination coverage is unknown. The other patient was a man born in Finland. No precise information is available on the place of infection or possible vaccination status.

No cases of rubella were recorded in Finland in 2014.

VARICELLA VIRUS

The number of varicella findings reported to the National Infectious Diseases Register was 476 in 2014 (2013: 455), which corresponds to the level of the two previous years. Of these findings, 197 were diagnosed by antigen detection, 130 by nucleic acid detection and 165 by serological diagnostics. There were 54 (10.8%) reports based on a diagnosis from cerebrospinal fluid, involving the identification of a varicella nucleic acid in 49 cases, a varicella antigen in three cases and varicella antibodies in nine cases.

Infected patients came from all age groups, the youngest being 2 and the oldest 90 years old. Childhood varicella or chicken pox is a very common disease, with an estimated 57,000 cases in Finland every year. In most cases, it is diagnosed clinically and in the great majority of cases the disease does not even result in a laboratory sample being taken. In contrast, herpes zoster, or shingles, causes far more use of health care services, especially by the elderly, which can be seen in the age distribution of the virus findings. The incidence was 8.8/100,000 on average, being highest in the over 70 age group: 15.8/100,000 in the 70 to 74 age group and 15.9/100,000 in the over 75 age group. Varicella vaccination is currently recommended to everyone aged 13 or over who has not had chicken pox. Moreover, a vaccine for herpes zoster will become available in pharmacies in 2015.

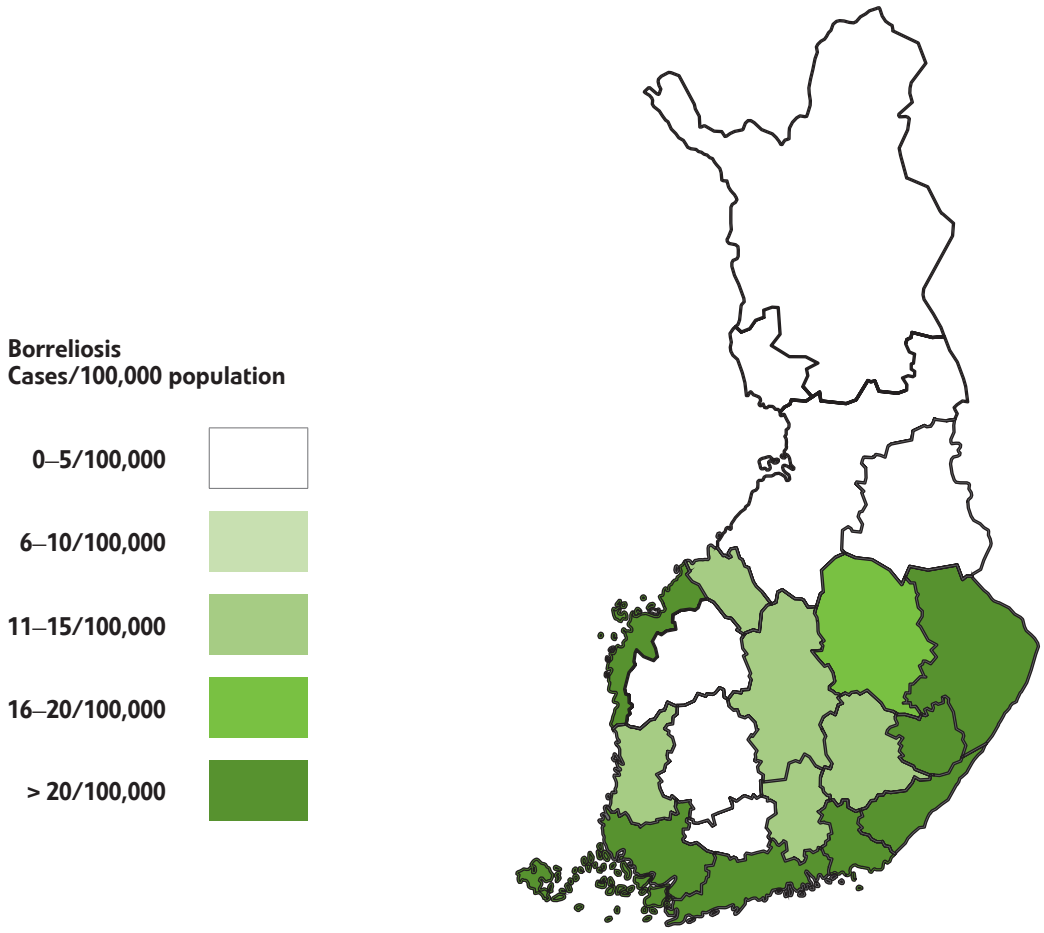


Figure 16. Borrelia cases by hospital district, 2014 (no. of cases/100,000).

BORRELIA (LYME DISEASE)

In 2014, 1,679 cases of borrelia were reported, on a par with previous years (2013: 1,707; 2012: 1,587 and 2011: 1,662). Of these reports, 37 were based on nucleic acid detection and 1,633 on a serological test. Cases were reported in all parts of the country. The average incidence was 31/100,000, but there was considerable regional variation. As in previous years, the incidence was highest in the Åland Islands (1,449/100,000), the 413 cases diagnosed there accounting for a quarter of all cases of borrelia in Finland. As before, the frequency of borrelia was highest in the autumn, the majority of cases occurring from August to October. The majority of the patients (75%) were aged over 45; 53% of the patients were women.

TICK-BORNE ENCEPHALITIS (TBE)

In 2014, 47 TBE antibody findings were reported to the National Infectious Diseases Register, similar to the figures for previous years. Positive TBE findings were reported between June and November, the largest number being reported in July. Patients who contracted TBE were aged between 15 and 83.

In order to identify the place of acquisition, the National Institute for Health and Welfare interviewed patients who had been diagnosed with TBE in 2014 and/or studied their patient records. Three patients contracted TBE on Åland, 43 in mainland Finland and two in Estonia. All residents of Åland have been entitled to a TBE vaccination free of charge since 2006. No cases of TBE were diagnosed in vaccinated Åland residents.

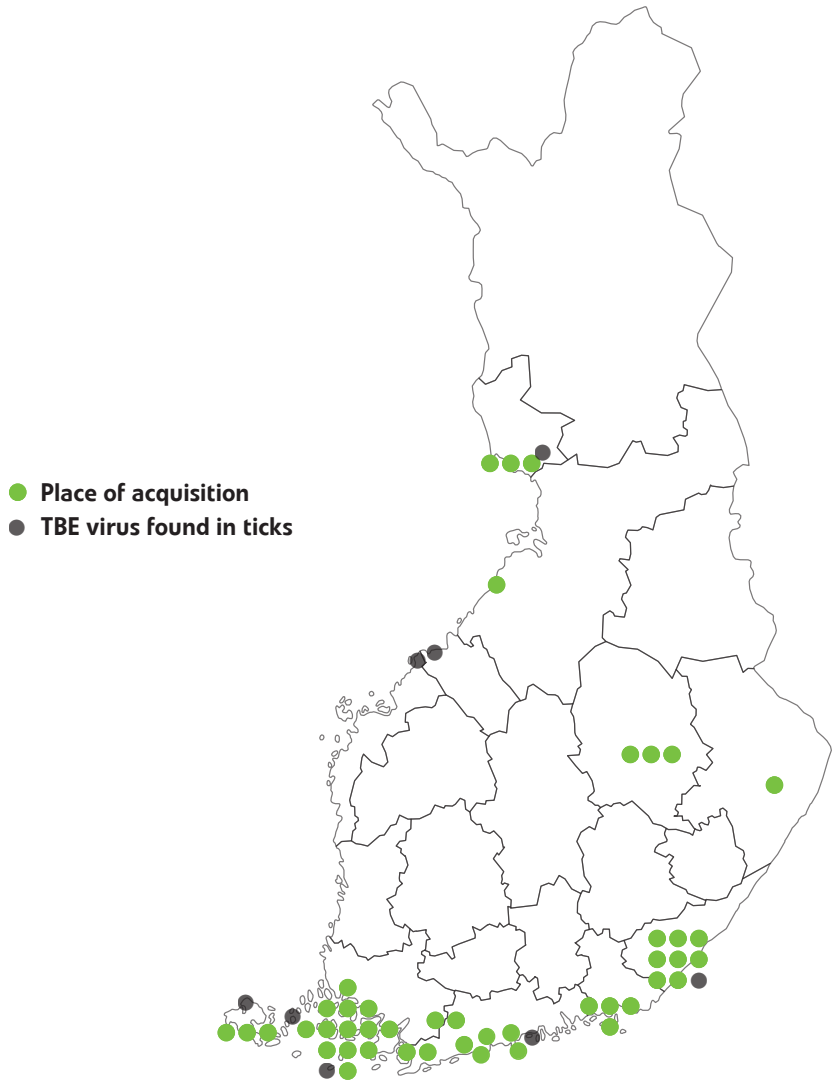


Figure 17. Cases of TBE by location of acquisition, 2014, and TBE virus findings in ticks, 1996–2014.

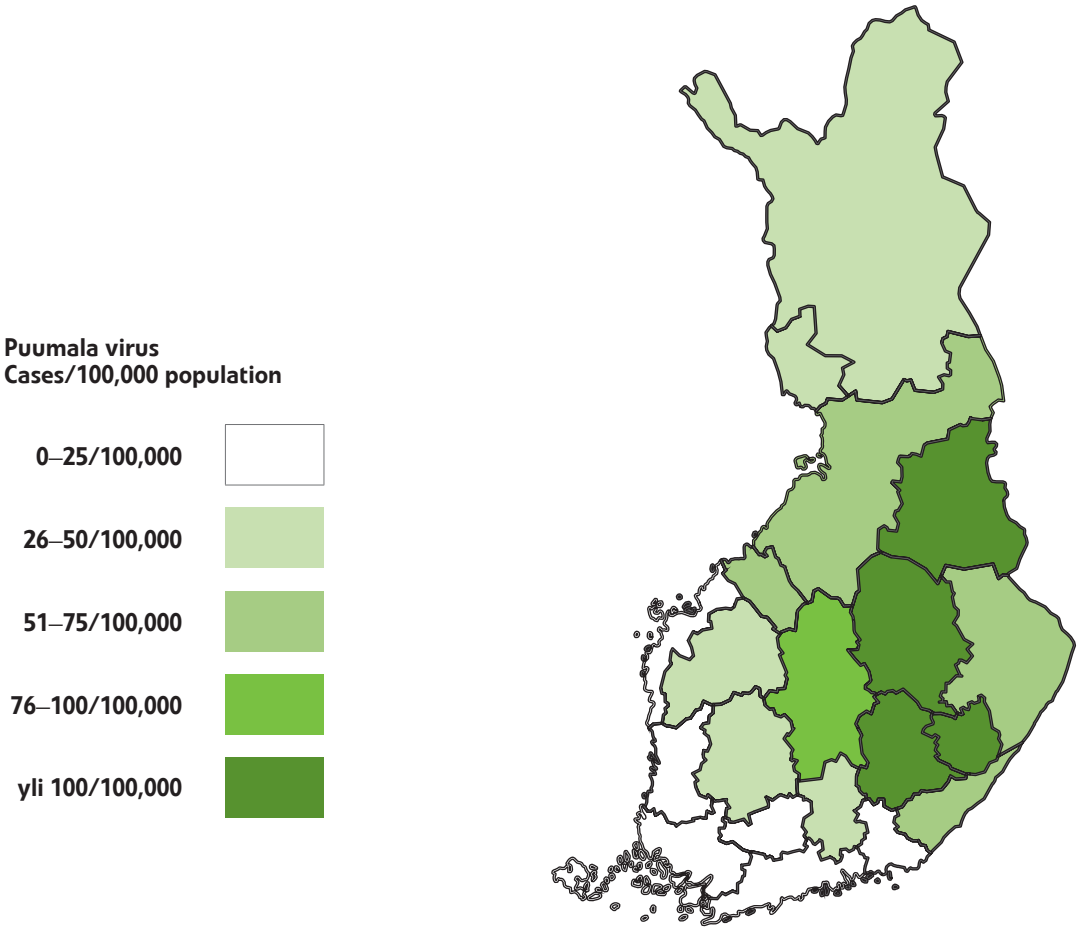


Figure 18. Cases of Puumala virus by hospital district, 2014 (no. of cases per 100,000 population).

Some of the cases in mainland Finland originated in previously known TBE risk areas: the Turku archipelago (13), of which eleven occurred in Parainen; the Lappeenranta region (8), of which three occurred in the Sammonlahti area; the Kemi region (3); the Raahe archipelago (1); the Kotka archipelago (4) and the Kuopio region (3). The Raasepori region (2), coastal areas of Lake Lohjanjärvi (2), the sea coast in Kirkkonummi (3) and the Jollas shore in Helsinki (2) emerged as new, potential areas of infection. In addition, one infection originated in Kiihtelysvaara in the Joensuu region. In addition to this year's cases, previously identified places of infection include Närpiö, Maalahti and the Sipoo archipelago.

As well as in Åland, the TBE virus was identified in ticks in the Turku archipelago and the Lappeenranta region decades ago, and in collections performed in the following risk areas in recent years: Isosaari in Helsinki, the Kokkola archipelago and Maksniemi in Simo.

If a patient falls ill with meningitis or encephalitis between May 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. Because new endemic TBE regions may continue to emerge, the possibility of TBE infection should be considered even beyond currently known risk areas.

PUUMALA VIRUS

In 2014, a total of 2,088 cases of Puumala virus infection were reported (38.5/100,000), more than in 2013 (1,685). The incidence of the virus varies depending on the virus reservoir, i.e. the size of the bank vole population. Such variation usually follows a three-year cycle: two abundant winters are followed by a quieter year. The previous peaks occurred in 2002, 2005 and 2008, with a slight increase also occurring in 2011. Of the patients, 58% were men, and most patients were of working age. One hundred (4.8%) cases oc-

curred in patients under 20 years of age. The incidence was highest in the hospital districts of North Savo (137/100,000) and East Savo (127/100,000).

POGOSTA DISEASE (SINDBIS VIRUS)

In 2014, 32 cases of Pogosta disease, confirmed with antibody testing, were diagnosed in Finland, one third of the case count (99) being diagnosed in the previous year. The incidence was highest in the hospital districts of South Savo (1.9/100,000), South Karelia and Central Finland (1.5/100,000, respectively). Of the patients, 66% were of working age, 59% women and 88% of the cases were diagnosed in August–September.

The Sindbis virus is principally borne by mosquito species prevalent in late summer. Temperatures in the early summer and rainfall and snowfall in the previous winter significantly affect the incidence of the virus. Waterway regulation, other local ecological factors together with cyclical variation in available animal reservoirs (forest game birds) may also play a role in the cyclical incidence of the disease in Finland.

Table 15. Malaria cases in Finland in 2014 by country of acquisition.

Continent	Country	Cases
Asia	Pakistan	1
	Thailand	3
	Total	4
Africa	Angola	1
	Benin	1
	Burkina Faso	2
	Cameroon	5
	Democratic Republic of the Congo	1
	Gambia	2
	Ghana	5
	Kenya	3
	Liberia	1
	Malawi	2
	Mozambique	1
	Nigeria	7
	Ivory Coast	2
	Sierra Leone	2
	Total	35
Total		**39**

Cases of Pogosta disease tend to cluster in the period from late July to September.

Sindbis virus infection is more common in Finland than elsewhere in the world. The virus has an incubation period of one week, after which the infection presents with a fever commonly accompanied by a rash and muscle and joint symptoms. Some patients may suffer from pain in the joints for years, and it is not always easy to associate the pain with Pogosta disease. Genetic factors probably influence both the risk of contracting the disease and the presentation of symptoms.

Pogosta disease has followed a regular seven-year cycle since 1974, except for in 2009. The epidemic peaked in 1981, 1995 and 2002; in 2009, however, only 106 cases were reported (2/100,000).

TULAREMIA (FRANCISELLA TULARENSIS)

At only 9, the reported number of tularemia cases in 2014 was the lowest on record (incidence 0.17/100,000). More than half of the cases (5/9) were diagnosed in September and the others individually in different months. The annual incidence of tularemia varies considerably (between 0.3 and 18/100,000) and local epidemics break out every few years, particularly in the regions of Ostrobothnia and Central Finland.

RABIES

Doctors are required to report cases where risk assessment after exposure has led to the administration of a course of rabies vaccinations and possibly rabies immunoglobulin treatment. In 2014, 53 reports were made, fewer than in 2013 (88). The number of patients who had been exposed while travelling abroad was 28: eight in Thailand, four in Turkey, three in Russia and two in Estonia and Indonesia, respectively. Other cases were individual cases of exposure in different countries. Almost two thirds of the cases of exposure abroad were related to a dog bite, and six (19%) to a monkey bite.

Exposure in Finland was reported in 25 cases, nine (41%) of which were related to bats and four (16%) to cat bites. Only one case of exposure associated with a dog bite was reported, while the corresponding figure for the previous year was eighteen. Two persons had been exposed to rabies bait vaccine. In addition, one exposure of a veterinarian at work and two suspected clinical cases were reported. Of the remaining cases of exposure, all but one were associated with contact with wild animals.

TRAVEL-RELATED INFECTIONS

Malaria

Malaria was diagnosed in 39 patients in Finland in 2014. There were 32 cases of *Plasmodium falciparum*, plus one case of *P. falciparum* + *P. ovale* double infection, four of *P. vivax,* one *P. ovale* + *P. vivax* double infection and one case of *P. malariae*. Most infections were contracted in Africa (35 cases, or 90%), 27 (77%) in western Africa. All *P. falciparum* infections originated in Africa. One infection was acquired on the Indian subcontinent, and three *P. vivax* infections in Southeast Asia. Of these patients, eleven (28%) were native Finns who had been travelling in a malarious area for less than six months, one was a Finnish resident in a malarious area; 20 (51%) were immigrants from a malarious area who had been visiting their home country, five were immigrants who had fallen ill immediately after their arrival in Finland, and two were visitors to Finland. The countries in which patients contracted malaria and the related risk groups remained approximately the same as in previous years.

Dengue fever

The annual number of dengue fever infections has varied between 35 and 90. In 2013, laboratories reported 80 findings. The corresponding figure for 2014 was 38, of which the majority (36/38) occurred in 15–59-year-olds. In addition, two cases were reported in the 65 to 69 age group. Diagnoses were made around the year. No comprehensive data is available on the countries of acquisition. Four infections were reported as having been contracted in Africa (Tanzania 2, Mozambique 1, Senegal 1), eight in Asia (Thailand, Cambodia, Malaysia and Singapore 6, India 1, the Philippines 1), two in the Caribbean and Americas, and one in Tahiti.

Chikungunya

In 2014, laboratories reported four findings of Chikungunya. In the previous year, there was one case. No comprehensive information is available on the countries of infection, but in 2014 more than a million infections caused by the chikungunya virus were reported in the Caribbean and Americas. Outbreaks of epidemics were also reported in the Pacific islands.

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, carbapenem-resistant gram-negative bacilli, MMR diseases and rabies. Data on the country of acquisition and mode of transmission is discussed separately for each of these diseases in the respective section of this report.

BLOOD AND CEREBROSPINAL FLUID FINDINGS IN CHILDREN

Blood culture findings in children

In 2014, 446 cases of blood culture positive findings in children under 15 years of age were reported, which is slightly more than in the previous year. However, in comparison with recent years, the number has remained largely unchanged (in 2000–2013, 570 on average, variation 426–686).

Less than half of the findings (234/446) were in babies under 12 months of age. Among infants, *Staphylococcus epidermidis* and other coagulase-negative staphylococci caused 29% of blood culture positive infections (table 16). Although these bacteria belong to normal skin flora, they typically cause late-onset sepsis related to treatment in newborn babies in intensive care. The second-most common cause (14% of the findings) was *Streptococcus agalactiae* (Group B streptococcus, GBS). This is typically contracted from the mother's birth canal during labour and causes an infection (early-onset sepsis) in the newborn baby during its first days of life. Other common causes of infection were *Escherichia coli* (16% of the findings), *Staphylococcus aureus* (9%), *Enterococcus faecalis* (4%) and *Streptococcus pneumoniae* (3%).

In the age group of 1 to 14 years, *S. aureus* (19%) was the most common cause of blood culture positive infections in 2014 (table 17). As in 2013 and 2012, the incidence of *S. pneumoniae* (15%) was less than half of what it had been in previous years. A pneumococcus vaccination for children was added to the national vaccination programme in 2010. Other common findings in this age group were coagulase-negative staphylococci (20%), *E. coli* (8%), *Streptococcus pyogenes (7%) and the Streptococcus viridans* group (3%).

Cerebrospinal fluid findings in children

The number of bacterial and fungal findings related to children's central nervous system infections remained at the same level as in the preceding years, as did the distribution of pathogens. The total number of cases reported in 2014 was 30 (the annual average from 2000 to 2012 was 34, variation 22–57), of which 21 were diagnosed in infants under 12 months old. The most common findings in the under 12 month age group were *S. agalactiae,* meningococcus, *S. epider-*

midis and *S. pneumoniae* (Table 18); in the 1 to 14 age group, *S. pneumoniae* and meningococcus were most common (Table 19).

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. There were 17 cases in 2014 (0.3 cases per 1,000 live births). An average of 15 annual cases of late GBS disease cases detected at the age of more than 7 days have occurred during the fifteen-year surveillance period (range 6–24; incidence 0.1–0.4 cases per 1,000 live births). There were 15 cases in 2014 (0.3 cases per 1,000 live births).

Table 16. Blood culture findings in infants (under 12 months), 2003–2014 (no. of cases).

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Staphylococcus epidermidis	61	110	98	100	92	87	64	70	76	50	62	46
Staphylococcus, other coagulase-negative	23	42	34	42	43	33	43	32	35	26	33	45
Escherichia coli	39	37	41	44	42	38	37	45	48	25	41	37
Streptococcus agalactiae	37	44	73	55	51	49	51	54	42	36	33	33
Staphylococcus aureus	23	32	32	37	25	23	22	24	21	31	22	20
Enterococcus faecalis	11	9	15	22	8	5	10	20	12	15	16	9
Streptococcus viridans group	14	16	12	9	9	8	9	16	13	6	8	8
Streptococcus pneumoniae	26	28	26	27	21	26	25	20	11	8	8	6
Klebsiella species	8	7	9	8	6	7	9	3	7	6	6	4
Neisseria meningitidis	2	5	3	2	3	3	5	4	1	2	4	3
Streptococcus pyogenes	1	3	0	0	3	2	4	2	0	6	1	2
Haemophilus influenzae	0	1	2	1	1	2	2	1	0	4	1	2
Enterobacter species	6	5	3	13	8	6	3	3	10	5	4	2
Streptococcus, other beta-haemolytic	0	1	0	3	0	0	4	2	0	1	1	1
Enterococcus faecium	2	3	2	3	0	1	1	1	1	2	1	1
Listeria monocytogenes	0	0	0	2	1	0	1	1	0	1	1	1
Bacillus	1	2	2	1	4	4	2	1	1	1	1	1
Pseudomonas, other than aeruginosa	0	0	0	0	0	0	0	0	0	0	0	1
Yersinia enterocolitica	0	0	0	0	0	0	0	0	0	0	0	1
Salmonella, other than Typhi or Paratyphi	0	0	0	0	0	0	1	0	0	0	1	1
Streptococcus milleri group	0	0	0	1	0	0	0	0	0	0	0	0
Streptococcus bovis group	1	1	1	0	0	0	2	0	0	0	0	0
Enterococcus, other or unidentified	0	1	0	0	0	0	2	0	0	1	0	0
Propionibacterium species	0	0	0	0	1	0	0	0	1	0	0	0
Clostridium, other than perfringens	0	1	0	1	0	0	0	0	0	1	0	0
Clostridium perfringens	0	0	1	0	0	0	0	0	0	0	0	0
Peptostreptococcus and Peptococcus	0	0	0	0	0	0	0	1	0	0	0	0
Stenotrophomonas maltophilia	1	0	1	0	2	0	2	2	0	0	0	0

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Haemophilus, other than influenzae	0	0	1	1	0	1	0	0	1	0	0	0
Acinetobacter species	3	1	1	3	2	1	1	3	2	1	2	0
Veillonella species	0	0	0	1	0	0	0	0	0	0	0	0
Prevotella species	0	0	0	0	0	1	0	0	0	0	0	0
Bacteroides fragilis group	0	0	0	0	1	1	0	1	0	0	0	0
Pseudomonas aeruginosa	1	4	0	0	0	2	0	2	1	0	0	0
Serratia species	2	4	0	2	3	4	1	2	4	0	1	0
Proteus mirabilis	0	1	0	1	1	0	0	0	0	0	0	0
Citrobacter species	1	0	1	1	0	0	1	1	0	1	0	0
Other bacteria	8	6	3	8	7	7	5	5	9	8	3	6
Bacteria, total	271	364	361	388	334	311	307	316	296	237	250	230
Candida albicans	2	3	4	4	2	3	1	2	1	1	2	3
Other candida species	2	0	1	0	2	1	0	0	1	2	0	1
Fungi, total	4	3	5	4	4	4	1	2	2	3	2	4

Table 17. Blood culture findings in children (aged 1 to 14), 2003–2014 (no. of cases).

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Staphylococcus aureus	48	58	41	37	42	40	36	43	42	47	48	40
Streptococcus pneumoniae	94	88	101	100	115	87	92	95	74	35	35	32
Staphylococcus epidermidis	30	25	41	40	33	22	31	37	29	17	25	28
Staphylococcus, other coagulase-negative	18	13	16	8	19	13	17	21	13	11	9	19
Escherichia coli	13	15	10	16	12	14	12	15	11	14	9	17
Streptococcus viridans group	13	18	24	25	21	21	25	37	23	27	27	14
Streptococcus pyogenes	12	4	0	9	13	11	11	6	15	9	8	14
Pseudomonas aeruginosa	6	3	6	3	2	1	3	7	4	3	4	9
Haemophilus influenzae	0	0	1	1	2	3	3	2	5	0	3	5
Bacillus	6	2	7	6	0	6	3	3	2	5	5	4
Citrobacter species	0	0	1	0	2	2	1	1	0	0	0	3
Streptococcus milleri group	0	0	3	2	0	2	2	2	1	1	0	2
Clostridium, other than perfringens	0	0	1	0	1	1	1	4	4	1	1	2
Streptococcus, other beta-haemolytic	3	2	2	3	4	0	2	3	1	1	1	1
Enterococcus faecium	1	2	1	3	4	2	5	7	0	2	2	1
Enterococcus faecalis	2	2	4	2	6	6	4	6	3	5	1	1
Corynobacterium difteriae	0	0	0	0	0	0	0	0	0	0	0	1
Stenotrophomonas maltophilia	1	3	0	1	3	4	2	2	0	1	1	1
Neisseria meningitidis	5	2	7	5	3	4	0	6	2	2	3	1
Acinetobacter species	2	1	4	1	2	2	4	1	0	1	3	1
Fusobacterium species	0	1	2	3	5	5	1	1	1	1	1	1
Bacteroides fragilis group	0	2	3	0	0	0	1	0	2	0	0	1
Salmonella, other than Typhi or Paratyphi	1	1	1	2	5	2	0	6	2	3	4	1
Streptococcus bovis group	0	0	0	1	0	0	0	0	0	0	0	0
Streptococcus agalactiae	2	1	0	0	2	1	0	0	0	0	0	0
Enterococcus, other or unidentified	2	2	0	2	2	3	0	1	0	0	1	0
Propionibacterium species	1	0	0	0	0	0	0	0	0	2	1	0
Mycobacterium species	0	0	0	0	0	0	0	0	1	0	0	0

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Listeria monocytogenes	1	0	0	0	0	0	0	0	0	0	1	0
Clostridium perfringens	1	0	0	1	2	0	1	1	0	0	0	0
Peptostreptococcus and Peptococcus	0	0	0	0	0	0	0	0	2	1	0	0
Haemophilus, other than influenzae	0	0	0	1	0	0	0	0	0	1	1	0
Veillonella species	0	0	0	1	0	0	0	1	0	0	0	0
Prevotella species	0	1	0	0	0	0	0	0	0	0	0	0
Pseudomonas, other than aeruginosa	0	0	1	0	1	0	3	0	0	0	0	0
Yersinia pseudotuberculosis	1	0	0	0	0	0	0	0	0	0	0	0
Serratia species	0	0	1	2	1	0	0	1	0	0	1	0
Salmonella Typhi	1	1	2	0	2	0	0	0	2	0	1	0
Proteus mirabilis	0	1	0	0	1	0	0	0	0	0	0	0
Klebsiella species	4	5	10	3	6	5	2	4	2	6	3	0
Enterobacter species	6	3	3	1	2	4	3	2	3	1	0	0
Other bacteria	8	14	22	14	15	10	13	24	11	14	9	12
Bacteria, total	282	270	315	293	328	271	278	339	255	211	208	211
Candida albicans	1	0	1	1	0	2	0	2	0	1	2	1
Other candida species	2	1	0	3	3	1	0	0	3	0	1	0
Fungi, total	3	1	3	4	3	3	0	2	3	1	3	1

Table 18. Cerebrospinal fluid culture findings in infants (under 12 months), 2003–2014 (no. of cases).

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Streptococcus agalactiae	1	10	7	8	8	3	6	10	3	4	1	7
Streptococcus pneumoniae	6	8	4	1	4	3	2	3	2	1	2	2
Staphylococcus epidermidis	3	3	3	3	2	1	2	2	2	1	3	2
Neisseria meningitidis	2	4	0	1	2	1	2	1	0	3	3	2
Escherichia coli	1	2	0	2	1	1	1	2	1	0	0	2
Staphylococcus aureus	4	2	1	0	1	2	2	1	0	3	2	1
Propionibacterium species	1	1	0	0	0	0	0	0	0	0	0	1
Bacillus	0	0	0	1	0	0	0	0	0	0	0	1
Haemophilus influenzae	0	0	1	0	0	0	1	0	0	0	0	1
Citrobacter species	0	0	0	0	1	0	0	1	0	0	0	1
Streptococcus viridans group	1	0	0	0	0	0	2	0	1	0	0	0
Streptococcus pyogenes	0	0	0	0	0	0	1	0	0	0	0	0
Enterococcus faecium	0	0	0	1	0	0	0	0	0	0	0	0
Enterococcus faecalis	1	1	0	2	1	0	0	0	0	0	0	0
Staphylococcus, other coagulase-negative	1	2	1	0	0	4	1	0	0	2	0	0
Mycobacterium species	0	0	0	0	0	0	0	1	0	0	0	0
Acinetobacter species	0	0	0	1	0	0	0	0	0	0	0	0
Bacteroides, other than fragilis group	0	0	0	0	1	0	0	0	0	0	0	0
Serratia species	0	1	0	0	0	0	0	0	0	0	0	0
Klebsiella species	0	1	0	0	0	0	1	0	0	1	0	0
Enterobacter species	0	1	0	0	0	0	0	0	0	0	0	0
Other bacteria	1	1	0	0	0	0	1	0	0	0	1	1
Bacteria, total	22	37	17	20	21	15	22	21	9	15	12	21
Candida albicans	0	0	0	0	0	0	1	0	0	0	0	0
Fungi, total	0	0	0	0	0	0	1	0	0	0	0	0

Table 19. Cerebrospinal fluid culture findings in children (aged 1 to 14), 2003–2014 (no. of cases).

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Staphylococcus epidermidis	1	4	2	0	1	5	2	1	2	1	0	3
Streptococcus pneumoniae	10	2	1	5	5	2	4	2	3	0	4	2
Propionibacterium species	0	0	1	0	0	0	0	0	1	0	0	1
Neisseria meningitidis	4	4	5	7	6	3	2	3	4	2	3	1
Haemophilus influenzae	1	0	0	0	0	0	0	0	1	0	0	1
Streptococcus, other beta-haemolytic	0	0	0	0	0	0	1	0	0	0	0	0
Streptococcus viridans group	1	1	0	2	0	0	0	0	0	0	0	0
Streptococcus pyogenes	0	0	0	0	0	0	0	0	0	1	0	0
Enterococcus faecium	0	1	0	0	0	0	0	0	0	0	0	0
Enterococcus faecalis	0	1	1	0	0	0	0	1	0	0	0	0
Staphylococcus, other coagulase-negative	2	2	2	0	0	0	1	0	0	0	1	0
Staphylococcus aureus	2	2	0	0	2	3	3	2	2	2	1	0
Mycobacterium species	1	0	0	0	0	0	0	0	0	0	0	0
Peptostreptococcus and Peptococcus	0	0	0	1	0	0	0	0	0	0	0	0
Stenotrophomonas maltophilia	1	0	0	0	0	0	0	0	0	0	0	0
Acinetobacter species	0	1	1	0	0	0	0	0	0	0	0	0
Bacteroides fragilis group	0	0	0	1	0	0	0	0	0	0	0	0
Klebsiella species	1	0	0	0	0	0	0	0	0	0	0	0
Enterobacter species	0	1	0	0	0	0	1	0	0	1	0	0
Other bacteria	0	0	1	0	0	2	1	1	0	0	1	1
Bacteria, total	24	19	14	17	14	15	15	10	13	8	10	9
Candida albicans	0	1	0	0	0	0	0	0	0	1	0	0
Fungi, total	0	1	0	0	0	0	0	0	0	1	0	0

BLOOD AND CEREBROSPINAL FLUID FINDINGS IN ADULTS

Blood culture findings in adults

The total number of blood culture findings in adults in 2014 was 14,140 (2013: 11,658). The number of blood culture findings in the over 65 age group continued to grow, as previously, being 9,385 (2013: 7,614). Gram-positive bacteria were more common in the working-age population (aged 15 to 64) and gram-negative bacteria among those aged 65 or more. Anaerobic bacteria constituted about 4% and fungi 2% of all blood culture positive findings among adults.

In the working-age population, the most common bacterial finding was *Escherichia coli*, constituting almost a quarter of all cases (Table 20). The next most common findings were *Staphylococcus aureus* (17%), *Streptococcus pneumoniae* (7%), coagulase-negative staphylococci (8%), and *Klebsiella* species (5%).

E. coli was also the most common blood culture finding among patients aged 65 years or more, accounting for over a third of all findings (Table 21). The next most common findings were *Klebsiella* species (31%), *S. aureus* (11%) and coagulase-negative staphylococci (6%).

Cerebrospinal fluid findings in adults

In 2014, the total number of cerebrospinal fluid findings in adults was 132 (2000–2013 average 159, variation 111–180). Patients over the age of 65 accounted for 30% of cases (39 out of 132).

Coagulase-negative staphylococcus was reported in 21 per cent of cases involving working-age patients (Table 23). The most common actual pathogens were pneumococcus (18%) and *S. aureus* (10%). In patients aged 65 years or older, coagulase-negative staphylococcus accounted for one third of the findings (Table 24). *S. aureus* (10%), *Listeria monocytogenes* (10%) and pneumococcus (3%) were the most commonly reported actual pathogens.

Group A streptococcus

In 2014, the number of invasive infections of Group A streptococcus (Streptococcus pyogenes) increased slightly in comparison with the previous year (2014: 211 and 2013: 191). The prevalent *emm* types of Group A streptococci were the same as in previous years: *emm28* and *emm89* (Table 22). The increase in the macrolide-resistant type *emm33* in 2013 (13; 7%) evened out in 2014 (12; 6%). The previously prevalent *emm1* was not dominant in 2014: the decline that began in 2013 (18; 10%) continued in 2014 (10; 5%). In addition to the aforementioned, the percentages of emm types *emm4* (16; 8%), *emm12* (11; 5%) and emm66 (11; 5%) have remained elevated. As last year, the previously common emm84 was not detected at all. Although new emm types are continuously emerging, the four most common emm types – *emm28*, *emm89*, *emm4* and *emm33* – accounted for 66% of all emm types in 2014 (Table 22).

Table 20. Blood culture findings in patients aged 15 to 64, 2003–2014 (no. of cases).

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Escherichia coli	644	707	779	797	837	871	884	930	934	942	952	1068
Staphylococcus aureus	472	486	457	565	544	526	541	579	641	617	645	800
Streptococcus pneumoniae	412	391	377	348	352	480	441	413	391	364	356	307
Staphylococcus epidermidis	286	294	286	281	265	278	312	263	223	182	210	240
Klebsiella species	122	150	183	144	157	185	186	207	164	217	220	218
Staphylococcus, other coagulase-negative	126	141	117	128	147	156	136	140	144	104	154	191
Streptococcus, other beta-haemolytic	89	114	103	135	129	128	122	139	154	133	177	173
Bacteroides fragilis group	59	67	83	85	82	109	68	110	108	103	101	132
Streptococcus viridans group	120	136	141	130	115	137	144	147	153	149	149	129
Streptococcus milleri group	48	49	55	63	65	73	57	68	86	79	98	127
Streptococcus pyogenes	77	100	76	105	133	157	116	113	104	126	105	122
Enterococcus faecium	50	44	63	64	80	91	87	85	101	88	96	103
Enterococcus faecalis	84	80	100	83	105	83	107	86	97	102	83	99
Streptococcus agalactiae	68	64	99	76	83	96	95	110	75	89	96	88
Enterobacter species	60	62	49	77	70	69	81	99	86	96	90	85
Pseudomonas aeruginosa	85	58	88	62	72	74	78	91	92	79	91	74
Bacillus	22	15	18	22	24	25	21	32	34	27	42	60
Fusobacterium species	21	32	31	19	31	31	27	37	32	48	41	47
Clostridium, other than perfringens	14	12	29	25	18	24	29	23	20	32	29	43
Peptostreptococcus and Peptococcus	23	14	21	18	11	12	27	15	30	18	22	38
Citrobacter species	10	21	15	27	19	23	29	31	28	25	23	35
Campylobacter species	10	13	5	3	8	7	11	10	4	6	8	33
Serratia species	14	10	16	18	19	24	26	20	32	26	32	31
Salmonella, other than Typhi or Paratyphi	19	27	27	47	52	43	23	39	32	32	36	28
Proteus mirabilis	11	15	12	18	14	14	18	26	17	24	22	23
Listeria monocytogenes	12	7	10	10	9	8	9	15	7	17	11	18
Haemophilus influenzae	10	11	13	9	25	18	19	19	22	25	23	18
Stenotrophomonas maltophilia	6	12	12	7	5	15	12	12	9	7	14	16

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Capnocytophaga canimorsus	6	6	8	8	8	8	11	11	17	13	14	15
Acinetobacter species	10	16	16	10	21	13	18	14	21	14	11	15
Pseudomonas, other than aeruginosa	3	5	2	0	3	5	6	6	8	8	8	14
Clostridium perfringens	9	6	16	11	12	10	16	15	8	11	8	13
Prevotella species	11	11	15	11	8	13	13	15	16	16	10	12
Morganella morganii	4	4	3	8	7	14	8	6	8	7	18	12
Propionibacterium species	11	6	9	7	5	3	9	6	9	7	9	11
Neisseria meningitidis	18	19	16	20	21	9	13	14	17	12	5	10
Veillonella species	3	1	6	3	5	3	7	5	13	6	9	9
Bacteroides, other than fragilis group	0	5	2	4	3	5	10	1	7	3	7	8
Haemophilus, other than influenzae	0	5	6	3	3	3	0	2	3	10	5	6
Streptococcus bovis species	2	3	8	5	7	1	6	7	6	6	4	5
Enterococcus, other or unidentified	10	10	11	6	4	7	13	13	12	20	8	5
Salmonella Typhi	3	4	3	3	4	1	3	9	3	1	5	5
Proteus vulgaris	3	4	3	7	3	2	3	2	2	3	2	4
Mycobacterium species	5	0	3	4	5	2	2	2	4	3	8	3
Salmonella Paratyphi	3	8	2	3	6	6	3	3	1	3	1	2
Hafnia alvei	5	4	3	0	1	3	6	2	2	2	1	2
Yersinia pseudotuberculosis	1	1	0	0	0	1	0	0	0	1	1	1
Yersinia enterocolitica	0	0	1	0	1	0	1	1	0	0	0	0
Other bacteria	75	80	94	92	77	94	106	92	98	111	129	156
Bacteria, total	3156	3330	3492	3571	3675	3960	3960	4085	4075	4014	4189	4654
Candida albicans	42	45	42	54	54	55	55	57	74	56	64	53
Other candida species	31	24	23	22	26	41	29	37	34	31	45	44
Other fungi	5	4	5	2	4	2	3	1	3	2	3	3
Fungi, total	78	73	70	78	84	98	87	95	111	89	112	100

Table 21. Blood culture findings in patients aged 65 or over, 2003–2014 (no. of cases).

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Escherichia coli	1313	1466	1624	1706	1760	1887	2054	2234	2479	2482	2874	3242
Staphylococcus aureus	483	483	483	601	568	671	692	729	780	797	876	1065
Klebsiella species	257	304	339	326	339	375	462	469	471	537	556	664
Streptococcus, other beta-haemolytic	137	148	159	190	180	193	232	279	285	308	335	442
Staphylococcus epidermidis	231	254	284	264	275	299	271	326	316	300	344	366
Streptococcus pneumoniae	242	238	228	270	290	326	294	303	295	342	319	355
Enterococcus faecalis	146	192	183	202	220	217	222	229	275	286	301	345
Staphylococcus, other coagulase-negative	133	139	123	132	144	171	161	149	162	170	252	293
Bacteroides fragilis group	118	120	135	119	135	146	164	178	203	183	201	253
Pseudomonas aeruginosa	147	138	151	154	188	191	184	218	196	250	230	233
Enterococcus faecium	76	96	69	100	132	126	170	159	172	166	208	231
Enterobacter species	99	92	115	95	104	131	128	156	156	174	188	172
Streptococcus agalactiae	62	76	84	81	77	94	104	126	113	117	129	171
Streptococcus viridans group	101	102	101	110	113	140	135	132	168	172	190	161
Proteus mirabilis	62	80	57	68	92	99	102	106	98	130	116	156
Streptococcus milleri group	43	47	52	67	54	53	62	59	59	65	92	127
Citrobacter species	44	43	42	42	35	65	59	76	59	95	99	97
Streptococcus pyogenes	28	33	34	47	58	50	60	50	49	75	67	73
Serratia species	28	18	33	27	33	50	37	59	56	64	81	72
Clostridium, other than perfringens	18	26	29	30	33	30	39	44	38	45	39	60
Clostridium perfringens	27	32	29	36	39	34	49	40	51	56	34	57
Peptostreptococcus and Peptococcus	20	13	17	22	25	14	29	36	26	24	32	44
Listeria monocytogenes	19	18	20	25	26	26	20	44	31	36	45	43
Morganella morganii	10	14	21	14	26	11	18	29	30	16	30	39
Haemophilus influenzae	8	13	28	21	25	21	22	19	37	51	20	32
Bacillus	10	10	10	17	9	11	12	7	13	7	17	24
Fusobacterium species	7	13	10	9	15	10	8	17	14	19	18	22
Enterococcus, other or unidentified	19	16	17	19	15	24	20	25	33	34	17	21

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Streptococcus bovis group	9	20	12	17	17	15	25	14	13	21	29	19
Pseudomonas, other than aeruginosa	6	2	6	9	9	11	10	10	8	11	12	18
Acinetobacter species	8	13	10	18	11	12	16	16	17	19	21	16
Prevotella species	4	11	10	10	8	11	15	13	14	7	11	16
Proteus vulgaris	8	7	9	9	9	4	4	8	8	12	14	16
Salmonella, other than Typhi or Paratyphi	5	6	14	11	8	19	6	8	7	13	9	14
Campylobacter species	1	5	3	5	3	5	6	3	1	4	4	13
Propionibacterium species	4	8	13	9	4	5	9	10	13	6	7	12
Veillonella species	1	1	7	2	6	9	5	4	6	5	10	12
Bacteroides, other than fragilis group	5	8	4	3	5	8	13	8	8	16	12	10
Capnocytophaga canimorsus	1	1	1	4	2	3	2	2	6	7	12	9
Stenotrophomonas maltophilia	6	10	6	10	8	3	6	7	4	8	12	7
Haemophilus, other than influenzae	0	3	2	2	1	1	1	1	0	3	8	4
Hafnia alvei	1	4	4	3	6	8	7	6	1	8	6	4
Mycobacterium species	2	3	1	5	1	4	0	5	1	1	1	2
Neisseria meningitidis	4	3	2	5	2	6	6	6	6	5	4	2
Yersinia pseudotuberculosis	1	2	2	1	1	0	3	1	0	1	0	0
Yersinia enterocolitica	3	1	1	1	1	0	1	1	0	3	0	0
Salmonella Typhi	1	0	1	0	0	0	0	0	0	0	0	0
Other bacteria	61	74	90	87	80	119	121	113	133	142	186	232
Bacteria, total	4019	4406	4675	5005	5192	5708	6066	6534	6911	7293	8068	9266
Candida albicans	63	50	40	54	56	66	49	93	65	70	77	72
Other candida species	41	28	25	21	26	26	42	31	47	39	60	44
Other fungi	6	5	4	5	7	8	3	3	4	1	3	0
Fungi, total	110	83	69	80	89	100	94	127	116	110	140	116

Table 22. Group A Streptococcus blood findings by emm-type, 2006–2014 (no. of cases and %).
The figures contain all variants of the emm-type in question.

	Strains examined	emm1	emm28	emm84	emm89	emm33	Other	NT
2006	163	25 (15%)	33 (20%)	24 (15%)	11 (7%)	0 (0%)	59 (36%)	11 (7%)
2007	205	58 (28%)	26 (13%)	32 (16%)	12 (6%)	0 (0%)	72 (35%)	5 (2%)
2008	225	52 (23%)	47 (21%)	9 (4%)	10 (4%)	0 (0%)	102 (45%)	5 (2%)
2009	191	25 (13%)	56 (29%)	4 (2%)	29 (15%)	0 (0%)	74 (39%)	3 (2%)
2010	167	22 (13%)	37 (22%)	4 (2%)	26 (16%)	0 (0%)	77 (46%)	1 (<1%)
2011	163	25 (15%)	37 (23%)	4 (2%)	30 (18%)	0 (0%)	66 (40%)	1 (<1%)
2012	210	23 (11%)	66 (31%)	1 (<1%)	58 (28%)	5 (2%)	52 (25%)	5 (2%)
2013	176	18 (10%)	58 (33%)	0 (0%)	43 (24%)	13 (7%)	44 (25%)	0 (0%)
2014	205	10 (5%)	62 (30%)	0 (0%)	48 (23%)	12 (6%)	73 (36%)	0 (0%)

Table 23. Cerebrospinal fluid culture findings in patients aged 15 to 64, 2003–2014 (no. of cases).

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Staphylococcus epidermidis	22	24	34	32	17	26	18	11	10	21	12	17
Propionibacterium species	6	11	5	5	5	4	4	7	4	5	6	13
Streptococcus pneumoniae	26	21	15	17	14	26	20	15	12	19	13	11
Staphylococcus, other coagulase-negative	7	16	15	12	7	14	11	8	6	7	12	9
Staphylococcus aureus	10	17	10	9	16	13	13	12	20	15	11	9
Klebsiella species	1	1	3	2	1	4	2	1	2	0	1	5
Haemophilus influenzae	0	1	0	0	0	3	1	0	2	1	2	3
Streptococcus viridans group	2	1	5	7	2	1	2	2	4	2	2	2
Streptococcus pyogenes	1	0	0	1	0	2	2	1	1	0	0	2
Listeria monocytogenes	2	1	0	2	1	1	2	1	1	1	2	2
Pseudomonas aeruginosa	4	2	4	6	3	4	5	3	1	4	1	2
Enterobacter species	0	3	5	2	2	9	3	1	2	4	2	2
Streptococcus, other beta-haemolytic	0	1	0	0	0	1	2	1	2	1	0	1
Streptococcus milleri group	0	0	0	0	0	1	0	0	0	0	0	1
Streptococcus agalactiae	0	2	0	1	5	2	0	2	0	1	1	1
Clostridium, other than perfringens	0	0	0	0	0	0	0	0	0	0	0	1
Neisseria meningitidis	14	11	15	20	16	4	9	6	7	6	1	1
Capnocytophaga canimorsus	0	0	1	0	0	0	1	0	0	1	0	1
Acinetobacter species	1	1	3	3	5	2	3	0	2	2	0	1
Bacteroides, other than fragilis group	0	0	0	0	0	0	0	0	0	0	0	1
Morganella morganii	0	0	0	0	0	0	0	0	0	0	0	1
Escherichia coli	0	0	7	4	3	3	4	1	1	2	1	1
Streptococcus bovis group	0	0	0	0	0	0	0	1	0	0	0	0
Enterococcus, other or unidentified	0	0	0	1	0	1	0	0	1	0	0	0
Enterococcus faecium	0	2	1	0	1	0	1	0	2	2	1	0
Enterococcus faecalis	3	5	2	4	5	4	3	4	3	3	0	0
Mycobacterium species	1	1	0	0	1	2	0	0	0	2	0	0

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Bacillus	0	0	3	6	4	3	0	0	0	2	0	0
Peptostreptococcus and Peptococcus	2	0	0	0	0	0	1	0	0	0	0	0
Stenotrophomonas maltophilia	0	1	0	0	1	0	0	0	1	0	0	0
Haemophilus, other than influenzae	0	0	0	0	1	0	0	0	2	0	0	0
Campylobacter species	0	0	1	0	0	0	0	0	0	0	1	0
Pseudomonas, other than aeruginosa	1	0	0	1	0	1	1	0	1	0	0	0
Serratia group	2	1	1	0	3	0	0	0	1	0	0	0
Salmonella, other than Typhi or Paratyphi	1	0	0	0	0	2	0	0	1	0	0	0
Proteus mirabilis	0	0	0	0	0	0	0	0	1	0	0	0
Citrobacter species	1	1	2	0	1	0	0	1	0	1	0	0
Other bacteria	2	2	2	4	3	2	4	0	1	2	1	5
Bacteria, total	109	126	134	139	117	135	112	78	91	104	70	92
Other candida species	0	3	0	2	3	0	1	1	0	1	0	1
Candida albicans	1	2	1	0	1	0	0	0	0	1	0	0
Fungi, total	1	5	1	2	4	0	1	1	0	2	0	1

Table 24. Cerebrospinal fluid culture findings in patients aged 65 or over, 2003–2014 (no. of cases).

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Propionibacterium species	0	1	0	2	0	2	2	1	1	2	2	9
Staphylococcus epidermidis	5	6	10	9	12	10	6	3	4	7	8	8
Staphylococcus, other coagulase-negative	5	6	6	3	2	4	3	3	1	3	5	6
Staphylococcus aureus	7	7	5	3	2	3	6	5	5	2	10	4
Listeria monocytogenes	4	2	4	3	2	2	2	6	4	4	4	4
Enterococcus faecalis	3	0	2	2	3	0	1	0	0	2	0	2
Streptococcus pneumoniae	5	4	8	10	4	7	10	6	8	4	8	1
Streptococcus agalactiae	1	0	0	0	0	0	1	1	0	0	1	1
Mycobacterium species	4	1	4	0	0	1	1	0	1	0	0	1
Streptococcus, other beta-haemolytic	2	0	1	1	0	0	1	0	0	0	1	0
Streptococcus viridans group	0	1	0	1	1	0	3	1	0	3	0	0
Streptococcus milleri group	0	0	0	0	0	0	1	0	0	0	0	0
Streptococcus bovis group	0	0	0	0	0	0	1	0	0	0	0	0
Enterococcus, other or unidentified	0	0	0	0	0	0	0	1	0	0	0	0
Enterococcus faecium	1	0	0	0	0	0	2	0	0	0	0	0
Bacillus	0	0	0	0	0	1	0	0	2	1	0	0
Peptostreptococcus and Peptococcus	1	0	0	0	0	0	0	0	0	1	0	0
Stenotrophomonas maltophilia	0	1	0	0	0	0	0	0	0	0	0	0
Neisseria meningitidis	1	1	2	1	0	1	0	2	0	1	1	0
Haemophilus influenzae	0	0	1	2	2	1	1	0	1	0	0	0
Acinetobacter species	1	0	0	1	1	0	0	0	0	0	0	0
Bacteroides fragilis group	0	0	0	0	0	0	1	0	0	0	0	0
Pseudomonas, other than aeruginosa	0	1	0	0	0	0	0	0	0	0	0	0
Pseudomonas aeruginosa	0	1	0	1	0	2	0	0	0	1	2	0
Proteus vulgaris	0	0	1	0	0	0	0	0	0	0	0	0
Proteus mirabilis	0	0	0	0	0	1	1	0	0	0	0	0
Klebsiella species	1	1	0	0	0	1	1	0	0	0	0	0
Escherichia coli	2	2	1	1	0	1	1	1	2	1	1	0

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Enterobacter species	0	1	0	0	1	0	0	1	1	1	1	0
Citrobacter species	0	0	0	0	0	0	0	0	1	0	1	0
Other bacteria	2	1	0	0	0	0	0	1	0	0	1	2
Bacteria, total	45	38	45	40	30	37	45	32	31	33	46	38
Other candida species	0	1	0	0	0	0	1	0	1	0	0	1
Candida albicans	0	0	1	0	0	1	0	0	0	1	0	0
Fungi, total	0	1	1	0	0	1	1	0	1	1	0	1

Table 25. Blood culture findings in all age groups, 2003–2014 (no. of cases).

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Escherichia coli	2009	2225	2454	2563	2651	2810	2987	3224	3472	3463	3876	4364
Staphylococcus aureus	1026	1059	1013	1240	1179	1260	1291	1375	1484	1492	1591	1925
Klebsiella species	391	466	541	481	508	572	659	683	644	766	785	886
Streptococcus pneumoniae	774	745	732	745	778	919	852	831	771	749	718	700
Staphylococcus epidermidis	608	683	709	685	665	686	678	696	644	549	641	680
Streptococcus, other beta-haemolytic	229	265	264	331	313	321	360	423	440	443	514	617
Staphylococcus, other coagulase-negative	300	335	290	310	353	373	357	342	354	311	448	548
Enterococcus faecalis	243	283	302	309	339	311	343	341	387	408	401	454
Bacteroides fragilis group	177	189	221	204	218	256	233	289	313	286	302	386
Enterococcus faecium	129	145	135	170	216	220	263	252	274	258	307	336
Pseudomonas aeruginosa	239	203	245	219	262	268	265	318	293	332	325	316
Streptococcus viridans group	248	272	278	274	258	306	313	332	357	354	374	312
Streptococcus agalactiae	169	185	256	212	213	240	250	290	230	242	258	292
Enterobacter species	171	162	170	186	184	210	215	260	255	276	282	259
Streptococcus milleri group	91	96	110	133	119	128	121	129	146	145	190	256
Streptococcus pyogenes	118	140	110	161	207	220	191	171	168	216	181	211
Proteus mirabilis	73	97	69	87	108	113	120	132	115	154	138	179
Citrobacter species	55	64	59	70	56	90	90	109	87	121	122	135
Clostridium, other than perfringens	32	39	59	56	52	55	69	71	62	79	69	105
Serratia group	44	32	50	49	56	78	64	82	92	90	115	103
Bacillus	39	29	37	46	37	46	38	43	50	40	65	89
Peptostreptococcus and Peptococcus	43	27	38	40	36	26	56	52	58	43	54	82
Clostridium perfringens	37	38	46	48	53	44	66	56	59	67	42	70
Fusobacterium species	28	46	43	31	51	46	36	55	47	68	60	70
Listeria monocytogenes	32	25	30	37	36	34	30	60	38	54	58	62
Haemophilus influenzae	18	25	44	32	53	44	46	41	64	80	47	57
Morganella morganii	14	18	24	22	33	25	26	35	38	23	48	51
Campylobacter species	11	18	8	8	11	12	17	13	5	10	12	46

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Salmonella, other than Typhi or Paratyphi	25	34	42	60	65	64	30	53	41	48	50	44
Pseudomonas, other than aeruginosa	9	7	9	9	13	16	19	16	16	19	20	33
Acinetobacter species	23	31	31	32	36	28	39	34	40	35	37	32
Prevotella species	15	23	25	21	16	25	28	28	30	23	21	28
Enterococcus, other or unidentified	31	29	28	27	21	34	35	39	45	55	26	26
Streptococcus bovis group	12	24	21	23	24	16	33	21	19	27	33	24
Stenotrophomonas maltophilia	14	25	19	18	18	22	22	23	13	16	27	24
Capnocytophaga canimorsus	7	7	9	12	10	11	13	13	23	20	26	24
Propionibacterium	16	14	22	16	10	8	18	16	23	15	17	23
Veillonella species	4	2	13	7	11	12	12	10	19	11	19	21
Proteus vulgaris	11	11	12	16	12	6	7	10	10	15	16	20
Bacteroides, other than fragilis group	5	13	6	7	8	13	23	9	15	19	19	18
Neisseria meningitidis	29	29	28	32	29	22	24	30	26	21	16	16
Haemophilus, other than influenzae	0	8	9	7	4	5	1	3	4	14	14	10
Hafnia alvei	6	8	7	3	7	11	13	8	3	10	7	6
Mycobacterium species	7	3	4	9	6	6	2	7	6	4	9	5
Salmonella Typhi	5	5	6	3	6	1	3	9	5	1	6	5
Salmonella Paratyphi	3	8	2	3	6	6	3	3	1	3	1	2
Corynobacterium diphteriae	0	0	0	0	0	0	0	0	0	0	0	1
Yersinia pseudotuberculosis	3	3	2	1	1	1	3	1	0	2	1	1
Yersinia enterocolitica	3	1	2	1	2	0	2	2	0	3	0	1
Other bacteria	152	174	209	201	179	230	245	234	251	275	327	406
Bacteria, total	7728	8370	8843	9257	9529	10250	10611	11274	11537	11755	12715	14361
Candida albicans	108	98	87	113	112	126	105	154	140	128	145	129
Other candida species	76	53	49	46	57	69	71	68	85	72	106	89
Other fungi	11	9	11	7	11	10	6	4	7	3	6	3
Fungi, total	195	160	147	166	180	205	182	226	232	203	257	221

Table 26. Cerebrospinal fluid culture findings in all age groups, 2003–2014 (no. of cases).

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Staphylococcus epidermidis	31	37	49	44	32	42	28	17	18	30	23	30
Propionibacterium species	7	13	6	7	5	6	6	8	6	7	8	24
Streptococcus pneumoniae	47	35	28	33	27	38	36	26	25	24	27	16
Staphylococcus, other coagulase-negative	15	26	24	15	9	22	16	11	7	12	18	15
Staphylococcus aureus	23	28	16	12	21	21	24	20	27	22	24	14
Streptococcus agalactiae	2	12	7	9	13	5	7	13	3	5	3	9
Listeria monocytogenes	6	3	4	5	3	3	4	7	5	5	6	6
Haemophilus influenzae	1	1	2	2	2	4	3	0	4	1	2	5
Klebsiella species	3	3	3	2	1	5	4	1	2	1	1	5
Neisseria meningitidis	21	20	22	29	24	9	13	12	11	12	8	4
Escherichia coli	3	4	8	8	4	5	6	4	4	4	2	3
Streptococcus viridans group	4	3	5	10	3	1	7	3	5	5	2	2
Streptococcus pyogenes	1	0	0	1	0	2	3	1	1	1	0	2
Enterococcus faecalis	7	7	5	8	9	4	4	5	3	5	0	2
Pseudomonas aeruginosa	4	3	4	7	3	6	5	3	1	5	3	2
Enterobacter species	0	6	5	2	3	9	4	2	3	6	3	2
Streptococcus, other beta-haemolytic	2	1	1	1	0	1	4	1	2	1	1	1
Streptococcus milleri group	0	0	0	0	0	1	1	0	0	0	0	1
Mycobacterium species	6	2	4	0	1	3	1	1	1	2	0	1
Clostridium, other than perfringens	0	0	0	0	0	0	0	0	0	0	0	1
Bacillus	0	0	3	7	4	4	0	0	2	3	0	1
Capnocytophaga canimorsus	0	0	1	0	0	0	1	0	0	1	0	1
Acinetobacter species	2	2	4	5	6	2	3	0	2	2	0	1
Bacteroides, other than fragilis species	0	0	0	0	1	0	0	0	0	0	0	1
Morganella morganii	0	0	0	0	0	0	0	0	0	0	0	1
Citrobacter species	1	1	2	0	2	0	0	2	1	1	1	1
Streptococcus bovis group	0	0	0	0	0	0	1	1	0	0	0	0
Enterococcus, other or unidentified	0	0	0	1	0	1	0	1	1	0	0	0

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Enterococcus faecium	1	3	1	1	1	0	3	0	2	2	1	0
Peptostreptococcus and Peptococcus	3	0	0	1	0	0	1	0	0	1	0	0
Stenotrophomonas maltophilia	1	2	0	0	1	0	0	0	1	0	0	0
Haemophilus, other than influenzae	0	0	0	0	1	0	0	0	2	0	0	0
Campylobacter species	0	0	1	0	0	0	0	0	0	0	1	0
Bacteroides fragilis group	0	0	0	1	0	0	1	0	0	0	0	0
Pseudomonas, other than aeruginosa	1	1	0	1	0	1	1	0	1	0	0	0
Serratia species	2	3	1	0	3	0	0	0	1	0	0	0
Salmonella, other than Typhi or Paratyphi	1	0	0	0	0	2	0	0	1	0	0	0
Proteus vulgaris	0	0	1	0	0	0	0	0	0	0	0	0
Proteus mirabilis	0	0	0	0	0	1	1	0	1	0	0	0
Other bacteria	5	4	3	4	3	4	6	2	1	2	4	9
Bacteria, total	200	220	210	216	182	202	194	141	144	160	138	160
Other candida species	0	4	0	2	3	0	2	1	1	1	0	2
Candida albicans	1	3	2	0	1	1	1	0	0	3	0	0
Fungi, total	1	7	2	2	4	1	3	1	1	4	0	2

Authors

Respiratory infections

Adenovirus
Niina Ikonen, Outi Lyytikäinen (THL)

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
Katrine Pesola, Hanna Nohynek (THL)
Qiushui He (University of Turku)

Chlamydia pneumoniae
Mirja Puolakkainen (University of Helsinki)

Legionella
Katrine Pesola, Jaana Kusnetsov, Silja Mentula, Sari Jaakola, Outi Lyytikäinen (THL)

Mycoplasma pneumoniae
Mirja Puolakkainen (University of Helsinki)

Gastrointestinal infections

Food- and water-borne outbreaks
Sari Huusko, Markku Kuusi, Saara Salmenlinna, Ulla-Maija Nakari, Taru Lienemann, Aino Kyyhkynen (THL)

Clostridium difficile
Silja Mentula, Outi Lyytikäinen (THL)

EHEC
Sari Huusko, Markku Kuusi, Ulla-Maija Nakari (THL)

Campylobacter
Sari Huusko, Markku Kuusi, Ulla-Maija Nakari (THL)

Listeria
Sari Huusko, Markku Kuusi, Saara Salmenlinna (THL)

Salmonella
Sari Huusko, Markku Kuusi, Saara Salmenlinna, Taru Lienemann, Aino Kyyhkynen (THL)

Shigella
Sari Huusko, Markku Kuusi, Saara Salmenlinna, Aino Kyyhkynen (THL)

Yersinia
Sari Huusko, Markku Kuusi, Saara Salmenlinna, Aino Kyyhkynen (THL)

Norovirus
Sari Huusko, Markku Kuusi, Haider Al-Hello, Jaana Pirhonen (THL)

Rotavirus
Katrine Pesola, Haider Al-Hello, Jaana Pirhonen, Tuija Leino (THL)

Vibrio cholerae
Katrine Pesola, Saara Salmenlinna (THL)

Hepatitis

Hepatitis A
Sari Huusko, Markku Kuusi, Mia Kontio, Tuija Leino (THL)

Hepatitis B
Markku Kuusi, Henrikki Brummer-Korvenkontio, Kirsi Liitsola, Tanja Karvonen, Tuija Leino (THL)

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

Sexually transmitted diseases

Chlamydia
Kirsi Liitsola (THL)
Eija Hiltunen-Back (HUS)

Gonorrhoea
Kirsi Liitsola (THL)
Eija Hiltunen-Back (HUS)

Syphilis
Kirsi Liitsola (THL)
Eija Hiltunen-Back (HUS)

HIV and AIDS
Henrikki Brummer-Korvenkontio, Kirsi Liitsola (THL)

Antimicrobial resistance

MRSA
Outi Lyytikäinen, Laura Lindholm, Hanne-Leena Hyyryläinen (THL)

VRE
Outi Lyytikäinen, Hanne-Leena Hyyryläinen, Laura Lindholm (THL)

ESBL
Outi Lyytikäinen, Jari Jalava, Monica Österblad (THL)

CPE
Outi Lyytikäinen, Jari Jalava, Monica Österblad (THL)

Tuberculosis

Tuberculosis
Hanna Soini, Outi Lyytikäinen, Hanna Nohynek (THL)
Tuula Vasankari (Filha)

Other infections

Invasive pneumococcal disease
Maija Toropainen, Jari Jalava, Lotta Siira, Arto Palmu, Pekka Nuorti (THL)

Haemophilus
Maija Toropainen, Tuija Leino (THL)

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

MMR diseases (measles, mumps, rubella)
Katrine Pesola, Mia Kontio, Tuija Leino (THL)

Varicella virus
Katrine Pesola, Tuija Leino (THL)

Borrelia (Lyme disease)
Katrine Pesola, Markku Kuusi (THL)

Tick-borne encephalitis (TBE)
Katrine Pesola, Markku Kuusi, Tuija Leino, Pirjo Turtiainen (THL)
Olli Vapalahti (University of Helsinki)

Puumala virus
Katrine Pesola, Markku Kuusi (THL)

Pogosta disease
Katrine Pesola (THL)

Tularemia
Heidi Rossow (THL)

Rabies
Katrine Pesola, Eeva Pekkanen (THL)

Malaria
Heli Siikamäki (HUS)

Dengue fever
Eeva Pekkanen (THL)

Chikungunya
Eeva Pekkanen (THL)

Other travel-related infections
Eeva Pekkanen (THL)

Blood and cerebrospinal fluid findings in children
Katrine Pesola, Outi Lyytikäinen, Arto Palmu (THL)

Blood and cerebrospinal fluid findings in adults
Katrine Pesola, Outi Lyytikäinen (THL)

Group A streptococcus
Hanne-Leena Hyyryläinen, Laura Lindholm (THL)