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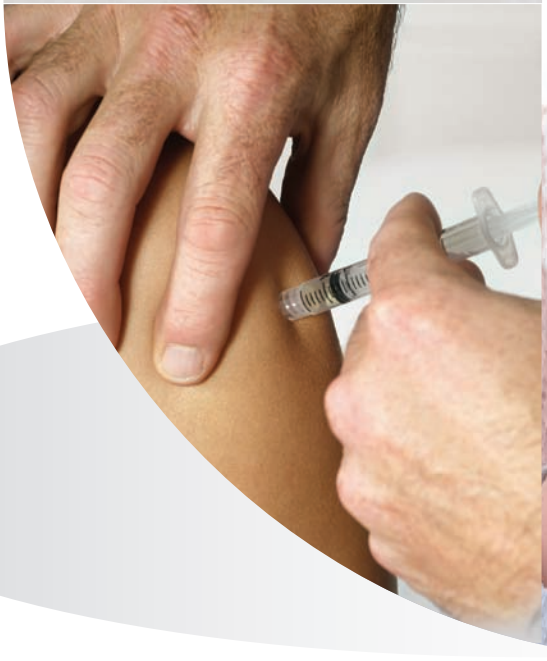
Infectious Diseases in Finland 1995–2009

REPORT



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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 at our website. The figures for some of the diseases in the National Infectious Diseases Register (NIDR) will still be updated after the figures have been published in print. Up-to-date figures are available at **http://tartuntatautirekisteri.fi/tilastot**

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Foreword

On January 1, 2009, the National Public Health Institute (KTL) and Stakes merged as the National Institute for Health and Welfare (THL). Since then, infectious disease surveillance is developed in a national framework that includes the National Infectious Diseases Register, other infectious diseases surveillance systems (from KTL) and a number of national health registers (from Stakes). As a result of the merger, register data will be more readily available for research purposes, and clinical surveillance will be developed by automated collection of data on causes of visits in primary care for the early detection and surveillance of epidemics as part of the out-patient care HILMO Project. The interaction between epidemiological surveillance and microbiological expert laboratory activities will be further strengtened, and prioritizations will be made in order to utilise resources for the activities with highest impact.

Versatile cooperation between various health care operators and administrative sectors strengthened the networks required for preparedness and improved know-how in Finland. The WHO International Health Regulations (IHR 2005) have proved useful, and as an expert organisation, the European Centre for Disease Prevention and Control (ECDC) provided versatile and timely support to the Member States' activities.

EPIDEMIOLOGICAL OVERVIEW 2009 AND 1995–2009

In 2009, the predominant activity was related to the pandemic caused by the influenza A/H1N1 2009 virus, with the first epidemic wave occurring in Finland from October to November. Although the disease was usually mild, it causes a hospital and intensive care work load that required extraordinary arrangements in many hospitals. The pandemic revealed development needs of the Finnish influenza surveillance systems, and brought influenza vaccines to the fore in various ways, including the need to include health care personnel also among those to be vaccinated against seasonal influenza. The intense epidemic wave of RSV, expected for the turn of the year as part of the regular cycle, was delayed. Compared to the other Nordic countries, the legionella figures for the entire 15-year surveillance period indicate that legionella infections are still clearly underdiagnosed, stressing the need for a much wider use of the urine antigen test. Cyclic epidemics typical of whooping cough, which normally occur every few years, have no longer occurred since the changes made in the vaccination programme in 2003 and 2005.

Among gastrointestinal infections, campylobacter has been reported more commonly than salmonella since 1998. For both diseases, the majority of the infections have been acquired abroad. In Finnish studies on *Yersinia enterocolitica*, it was discovered that findings reported particularly among older persons were related to non-pathogenic strains, which makes it more difficult to interpret statistics. The norovirus has caused major epidemics throughout the existence of the National Infectious Diseases Register. The use of laboratory diagnostics has increased, adding the number of reported norovirus disease cases in the 2000s. During this period, strain typing has also commenced. The new norovirus sub-types, which arrived in Finland in the 2000s, have caused large epidemics in treatment facilities and in the population at large. In addition, numerous norovirus epidemics caused by imported frozen berries have been identified since the late 1990s. In some years, enteroviruses have caused meningitis and hand, foot and mouth disease epidemics. There have been 50 to 100 suspected food- and water-borne epidemics a year since the late 1990s, when a system of suspected epidemic notification was implemented. For over 10 years, there has been a high incidence of *Yersinia enterocolitica* and *Yersinia pseudotuberculosis* outbreaks related to fresh produce.

The number of hepatitis A cases decreased after 2005. The number of acute hepatitis B cases has also significantly decreased in the 2000s compared to the late 1990s. The number of new hepatitis C cases significantly decreased in the 2000s: for patients under 20, it fell to less than half from the baseline. The favourable trend is clearly due to the large-scale vaccination by hepatitis A and B vaccines of travellers and the injecting drug users, as well as the needle and syringe exchange programs in the low-threshold counselling centres established in a number of locations in Finland, in order to reduce the infectious complications from injecting drugs.

Among sexually transmitted diseases, the number of chlamydia cases has remained on a stable, high level for nearly 10 years. Chlamydia infections, which are found predominantly in the young age groups, are mainly domestically acquired. For syphilis, the pro-

portion of cases associated with sex between men has been clearly on the increase in recent years. In HIV infections cases mainly associated with sex between men, acquired mainly domestically, and with heterosexual sex acquired abroad, are increasing. A considerable proportion of infections acquired through heterosexual sex has been found among immigrants from high-prevalence countries. The number of new HIV infections among injecting drug users has remained low after the successful control of the epidemic between 1998 and 1999.

There are both positive and alarming trends in antimicrobial resistance. After the regional MRSA epidemics of the early 2000s, the total number of new infections remained high, but it clearly decreased in 2009. The number of VRE infections also decreased at the same time. There is a large number of *E. coli* and *K. pneumoniae* findings resistant to 3rd generation cephalosporins (ESBL), which have been under national surveillance since 2008, clearly exceeding the number of MRSA findings. As a new threat in Finland, the emergence of resistance to carbapenems has been reported among gram-negative rods. The resistance to bacteria causing gastrointestinal infections has deteriorated: the proportion of e.g. salmonellae resistant to ciprofloxacin has increased significantly.

The cases of invasive (findings in blood or cerebrospinal fluid) pneumococcal disease have increased throughout the surveillance period. In the 2000s, the resistance of invasive pneumococcal strains to penicillin and particularly to macrolides has gradually increased. In 2010, Finland will include a pneumococcal conjugate vaccine in the basic childhood vaccination programme for children. It is hoped that this will have similar favourable effects on the development of pneumococcal resistance, as those attained in some other countries. The situation regarding pneumococcal resistance in Finland is worse than in the other Nordic countries, even though the resistance situation of other invasive microbes under surveillance inthe EU is similar to other Nordic countries.

After a long decline, the number of tuberculosis cases increased in 2009. This was due to the increase of tuberculosis cases among young and working-age immigrants. Infections transmitted by immigrants to the main population are rare. Infections in small children did not increase after 2006, when Finland started vaccinating newborns and children belonging only to specified risk groups with BCG vaccine. The new tuberculosis treatment outcome monitoring revealed that Finland does not reach WHO's target of 85% for favourable treatment outcomes.

Among vaccine-preventable infections, invasive *Haemophilus influenzae* type b infections remain rare, and there are no indications about replacement by other serotypes, which has been an issue of international concern. The high coverage of the children's vaccination programme has ensured that no domestic transmission of MMR (measles, mumps, rubella) infections have occurred since the mid-1990s. The tick-borne encephalitis (TBE) vaccination programme for the residents of the Åland Islands, initiated in 2006, has decreased encephalitis cases in Åland residents, but tick-borne encephalitis has been found in travellers to Åland Islands from other regions. New TBE -affected areas have been discovered in detailed investigations.

The extremely regular cycles of the Pogosta disease, occurring in seven-year intervals since the 1970s, did not continue as expected in 2009. The number of cases of epidemic nephropathy caused by the Puumala virus has varied annually. Epidemic cycles occur at three-year intervals depending on the bank vole population density. Tularemia epidemics have occurred at three-year intervals as well. The number of borrelia infections has increased throughout the surveillance period.

Among the malaria cases of the 2000s, two groups have emerged: persons immigrated from countries endemic for malaria, who visit their former home country without preventive medication, and Finns who travel to malaria countries without preventive medication due to a very short interval between decision to travel and departure.

Between 1997 and 2009, there have been no cases of the variant Creutzfeldt-Jakob disease (vCJD) in Finland. The disease is associated with the mad-cow disease found in bovines (BSE). During the 1995-2009 surveillance period, there was one imported case of rabies.

The number of blood and cerebrospinal fluid findings in children has remained approximately the same over the 15-year surveillance period. The group B betahaemolytic streptococcus remains a significant and serious newborn infant disease, preventable through a screening and treatment programme. During the surveillance period, the total number of blood culture findings in adults has consistently increased reaching more than 10,000 cases. The most likely reasons for this rise are the continuous expansion of the proportion of the population

with increased susceptibility to infections, as well as changes in diagnostic practices. The increase has been greatest among those over 65. The proportions caused by various microbe species have remained unchanged. In 2009, the pneumococcus, caused 10% of blood culture findings among children and adults, and 15–20% in cerebrospinal fluid culture findings among children and adults. Apart from preventing childhood pneumococcal infections by pneumococcal conjugate vaccine from 2010 onwards, there has been a clear decrease in many countries in invasive pneumoccal infections among older age groups after the introduction of childhood vaccination as a sign of herd immunity.

Helsinki, 16 April 2010

Petri Ruutu	Pekka Puska
Head of Department	CEO

The use of the National Infectious Diseases Register's statistical database

- Cases reported to the National Infectious Diseases Register can be viewed on public network services.
- The National Infectious Diseases Register's statistical database is available at **http://tartuntatautirekisteri.fi/tilastot**.

In the network service, cases can be searched on **quick tables** displaying the most common cases of infectious disease, or as a **database search**, where the information searched can be grouped independently using several variables.

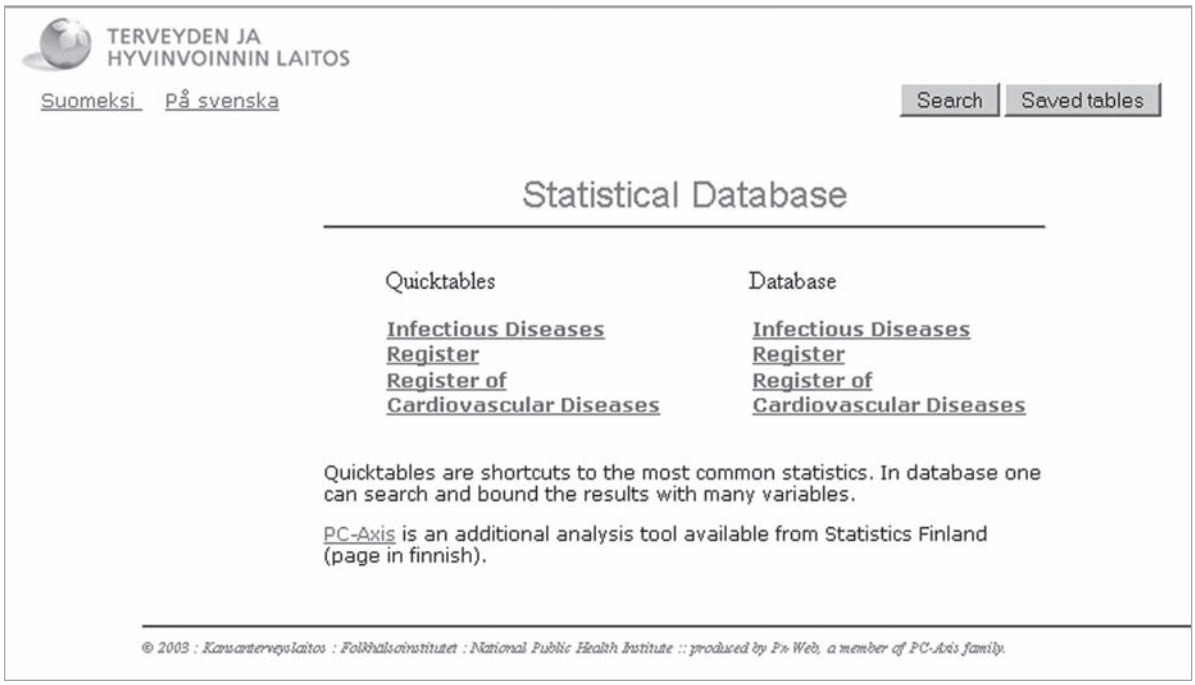
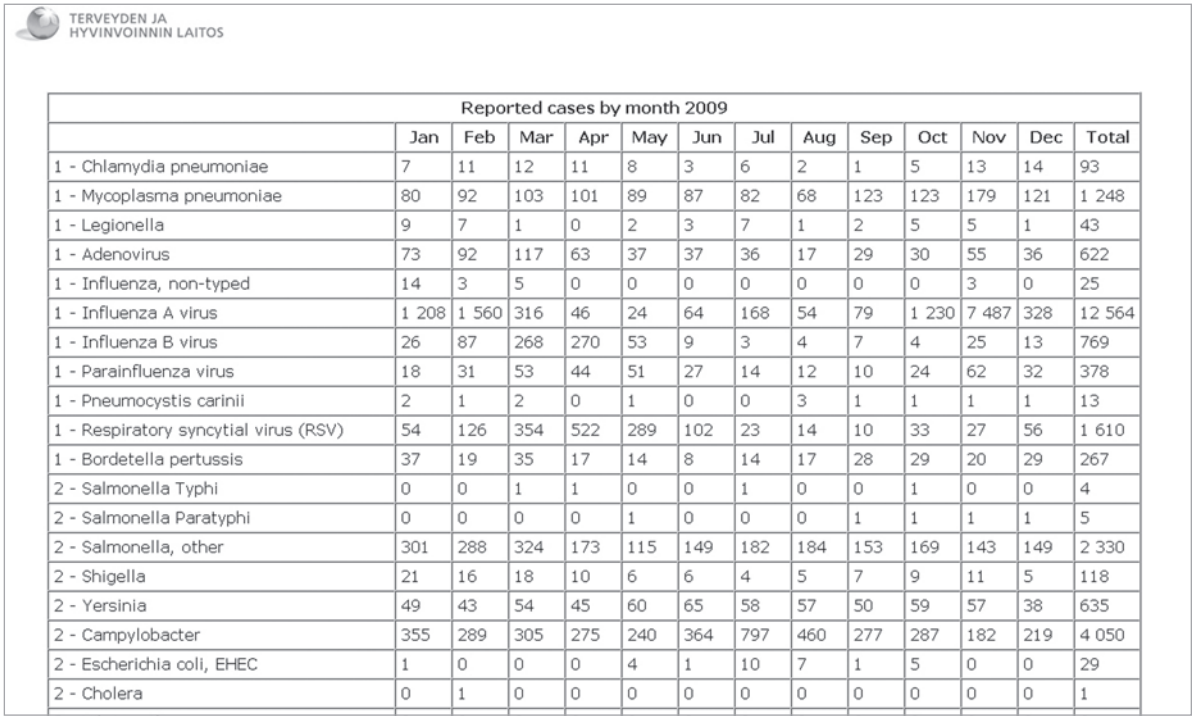


Figure 1. Front page of the National Infectious Diseases Register's statistical database.

QUICK TABLES

Quick tables can be searched for information on a yearly or a regional basis.



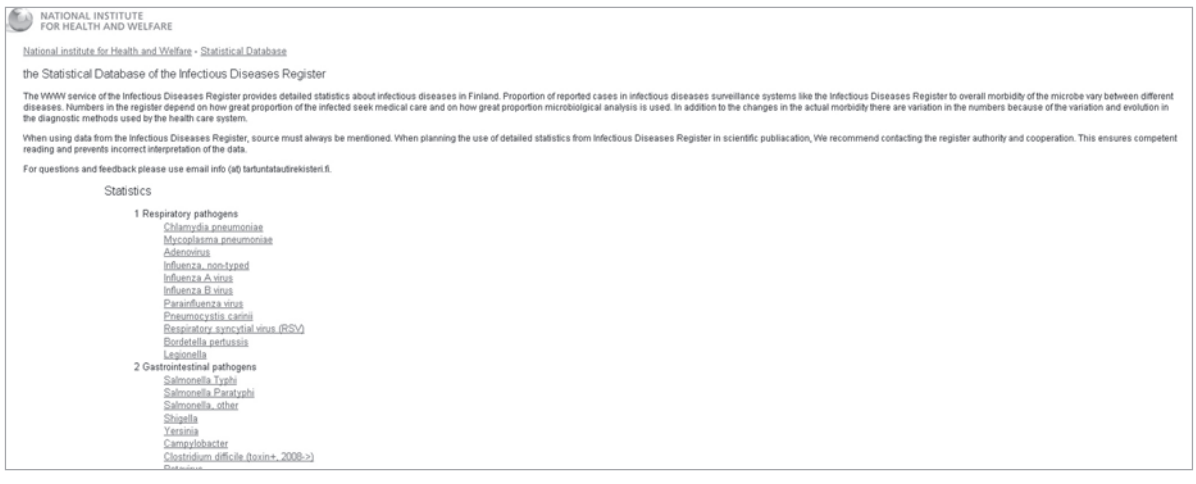
TERVEYDEN JA HYVINVOINNIN LAITOS

Reported cases by month 2009													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1 - Chlamydia pneumoniae	7	11	12	11	8	3	6	2	1	5	13	14	93
1 - Mycoplasma pneumoniae	80	92	103	101	89	87	82	68	123	123	179	121	1 248
1 - Legionella	9	7	1	0	2	3	7	1	2	5	5	1	43
1 - Adenovirus	73	92	117	63	37	37	36	17	29	30	55	36	622
1 - Influenza, non-typed	14	3	5	0	0	0	0	0	0	0	3	0	25
1 - Influenza A virus	1 208	1 560	316	46	24	64	168	54	79	1 230	7 487	328	12 564
1 - Influenza B virus	26	87	268	270	53	9	3	4	7	4	25	13	769
1 - Parainfluenza virus	18	31	53	44	51	27	14	12	10	24	62	32	378
1 - Pneumocystis carinii	2	1	2	0	1	0	0	3	1	1	1	1	13
1 - Respiratory syncytial virus (RSV)	54	126	354	522	289	102	23	14	10	33	27	56	1 610
1 - Bordetella pertussis	37	19	35	17	14	8	14	17	28	29	20	29	267
2 - Salmonella Typhi	0	0	1	1	0	0	1	0	0	1	0	0	4
2 - Salmonella Paratyphi	0	0	0	0	1	0	0	0	1	1	1	1	5
2 - Salmonella, other	301	288	324	173	115	149	182	184	153	169	143	149	2 330
2 - Shigella	21	16	18	10	6	6	4	5	7	9	11	5	118
2 - Yersinia	49	43	54	45	60	65	58	57	50	59	57	38	635
2 - Campylobacter	355	289	305	275	240	364	797	460	277	287	182	219	4 050
2 - Escherichia coli, EHEC	1	0	0	0	4	1	10	7	1	5	0	0	29
2 - Cholera	0	1	0	0	0	0	0	0	0	0	0	0	1

Figure 2. Quick table "Notified cases per month 2009".

DATABASE SEARCH

For more detailed, microbe-specific statistics, a database search can be performed.



NATIONAL INSTITUTE FOR HEALTH AND WELFARE

National institute for Health and Welfare - Statistical Database

the Statistical Database of the Infectious Diseases Register

The WWW service of the Infectious Diseases Register provides detailed statistics about infectious diseases in Finland. Proportion of reported cases in infectious diseases surveillance systems like the Infectious Diseases Register to overall morbidity of the microbe vary between different diseases. Numbers in the register depend on how great proportion of the infected seek medical care and on how great proportion microbiological analysis is used. In addition to the changes in the actual morbidity there are variation in the numbers because of the variation and evolution in the diagnostic methods used by the health care system.

When using data from the Infectious Diseases Register, source must always be mentioned. When planning the use of detailed statistics from Infectious Diseases Register in scientific publiacation, We recommend contacting the register authority and cooperation. This ensures competent reading and prevents incorrect interpretation of the data.

For questions and feedback please use email info (at) tartuntatautirekisteri.fi.

Statistics

1 Respiratory pathogens
- Chlamydia pneumoniae
- Mycoplasma pneumoniae
- Adenovirus
- Influenza, non-typed
- Influenza A virus
- Influenza B virus
- Parainfluenza virus
- Pneumocystis carinii
- Respiratory syncytial virus (RSV)
- Bordetella pertussis
- Legionella

2 Gastrointestinal pathogens
- Salmonella Typhi
- Salmonella Paratyphi
- Salmonella, other
- Shigella
- Yersinia
- Campylobacter
- Clostridium difficile (toxin+, 2008->)

Figure 3. The view of database search.

In the example, a database search is performed to find shigella cases reported in 2009 among 65-year-olds or older, according to gender.

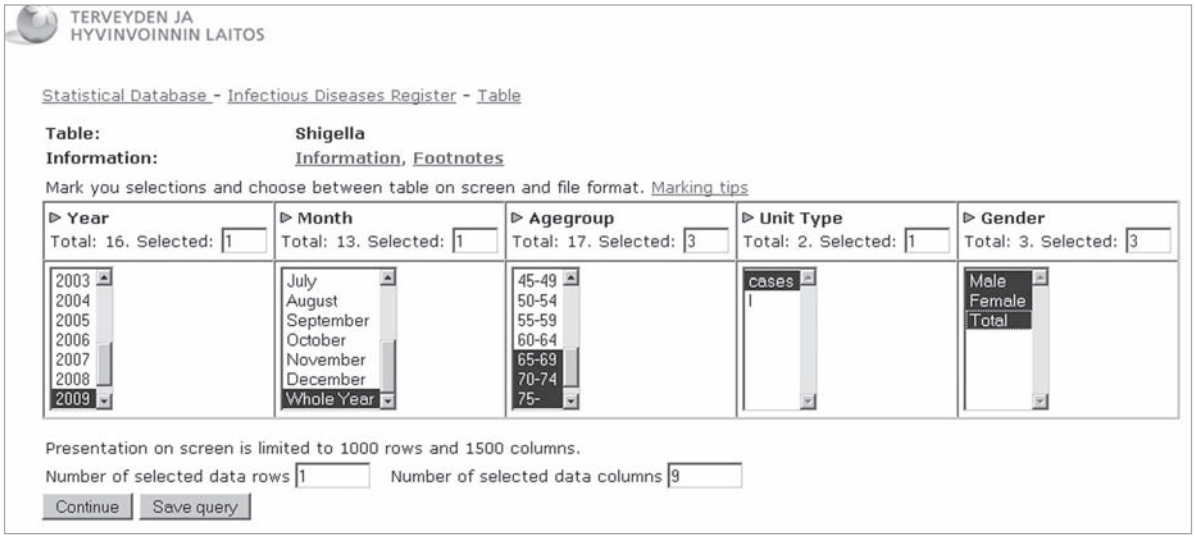
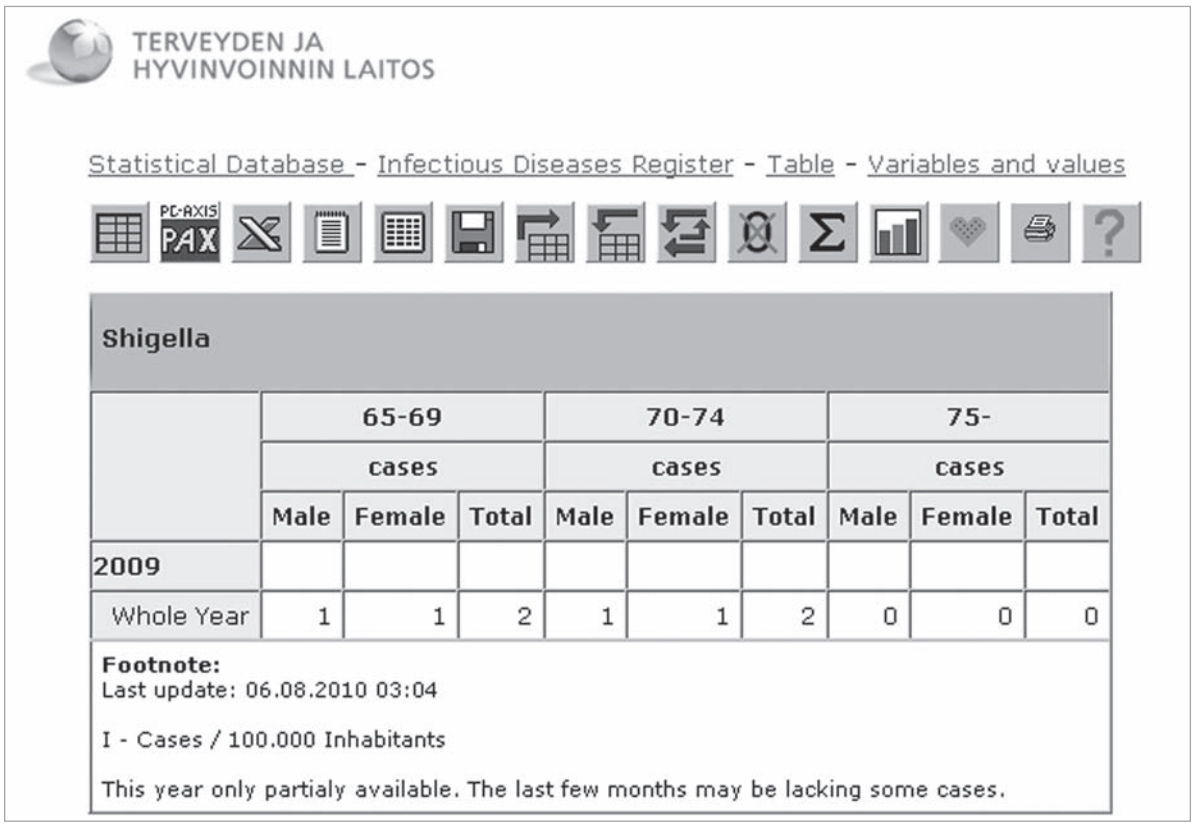


Figure 4. Database search.



Shigella

	65-69			70-74			75-		
	cases			cases			cases		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
2009									
Whole Year	1	1	2	1	1	2	0	0	0

Footnote:
Last update: 06.08.2010 03:04

I - Cases / 100.000 Inhabitants

This year only partialy available. The last few months may be lacking some cases.

Figure 5. Search result.

Search results can be saved in different forms and they are printable.

When the statistics of the National Infectious Diseases Register are used, the source of information should always be mentioned. When planning the detailed use of statistics in scientific publications, we recommend that you contact the register administrator and work together to obtain information from the register. This allows you to ensure the competent use of the information and to help you avoid reaching erroneous conclusions due to inadequate knowledge of the system.

Respiratory tract infections

- The first influenza pandemic since the 1968 Hong Kong influenza pandemic began in spring 2009.
- The RSV epidemic expected for the turn of the year was delayed.
- Influenza epidemics are often followed by adenovirus epidemics. Among small children, infections occur in summer as well.
- Legionellosis remains a underdiagnosed disease. Finland is one of the European countries that reports low incidence.

INFLUENZA A

2009 H1N1 pandemic

The first influenza pandemic since the 1968 Hong Kong influenza pandemic (influenza A/H3N2 subtype) began in spring 2009. With its new genetic composition, the influenza A(H1N1) 2009 subtype virus spread quickly from North America to other parts of the world. The new virus is a mixture of swine, human and bird genes. In 2009, the National Infectious Diseases Register received reports of 12,564 influenza A cases, of which 7,646 were pandemic influenza A(H1N1) 2009 infections. Finland's first pandemic influenza A (H1N1) 2009 case occurred on 6 May 2009, and the patient's diagnosis was confirmed at a laboratory on 11 May. The pandemic influenza A(H1N1) 2009 infections discovered in Finland between May and July 2009 had mainly been acquired abroad.

The actual epidemic started in early October (weeks 41 to 42), and the peak of the epidemic occurred first in northern Finland (weeks 43 to 45) and then in southern Finland (weeks 45 to 48). Based on the positive samples, the incidence was highest among children. The number of hospitalised patients was biggest in the latter part of November. As for hospitalised patients (median age 32 years; range 0–89), 43% had a chronic disease, 2% were pregnant, 8% were in intensive care and 5% in ventilator. The most common chronic diseases included pulmonary and cardiac diseases and diabetes. Morbid obesity was exhibited in 37 cases. Patients in intensive care were older (median age 48 years), and 59% had a chronic disease. None of them was pregnant. There were 44 fatalities (median age 56 years; range 1–88) related to swine influenza: 4 of the deceased were children, 40 (93%) belonged to risk groups based on their underlying condition, and 3 had no known underlying illness.

Winter 2008/2009 seasonal influenza

The winter 2008–2009 influenza A virus seasonal epidemic started as early as December 2008 and reached its peak in January and February 2009. In Finland and in other parts of Europe, it was caused by the H3N2 subtype, and the spreading viruses were closely related to the A/Brisbane/10/2007 virus included in the autumn 2008 vaccine. The influenza A epidemic was followed by a minor epidemic caused by influenza B viruses. In early summer of 2009, when influenza diagnostics were made more effective in many laboratories, a few seasonal influenza A virus cases were also detected. The detailed virus analyses revealed that all A(H3N2) viruses discovered in the spring were closely related to the A/Perth/16/2009 virus which had emerged in Australia. Without the pandemic, this virus would probably have caused the winter 2009/2010 seasonal influenza epidemic.

Seasonal influenza A, 1995–2009

During the 15-year surveillance period, two significant new variants of influenza A(H3N2) viruses have emerged. The A/Sidney/5/97 virus and the A/Fujian/411/2002 virus circulated around the world in winter 1997–1998 and 2002–2003. Both viruses exhibited considerable antigenic and genetic differences compared to their predecessors, and as a result, very powerful epidemics were observed. As both viruses emerged in late spring, they could not be used as vaccine viruses until the following year. Descendants of the A/Sidney virus were in circulation until the A/Fujian viruses started to circulate. The current A/Perth type viruses have developed further from the A/Fujian descendant viruses. The H3N2 viruses have developed so quickly that the vaccine viruses have had to be changed nine times during the surveillance

period. As for A(H1N1) viruses, the transformation has been slower, which is why the H1N1 subtype vaccine component has only been changed six times during the surveillance period. In winter 2000–2001 and 2007–2008, the epidemic was mainly caused by the H1N1 subtype viruses. During these epidemic periods, children and young adults in particular were ill with influenza. Older population groups had at least partial immunity against the H1N1 viruses.

Avian influenza

The avian influenza caused by the H5N1 subtype has not been detected in Finland. The H5N1 subtype is easily transmitted between birds, but it is difficult for humans to contract it from birds. Until now, H5N1 does not seem to have developed into a strain that spreads between humans. The occurrence of avian influenza antibodies in poultry and wild birds has been monitored in Finland since 2003.

INFLUENZA B

Seasonal influenza B 1995–2009

Epidemics caused by influenza B viruses have mainly occurred later than influenza A epidemics, from March to April (Figure 7). Except for the large winter 2002–2003 epidemic, the epidemics caused by B viruses have been small in some cases; in others, only sporadic cases have occurred. Since the 2002–2003 epidemic period, both Yamagata/16/88 and Victoria/2/87 viruses of the B virus development branch have been in circulation in the world. The power structure of the B viruses, which belongs to different branches, has varied annually, which has made it more difficult to choose a vaccine virus. After the return of the Victoria branch viruses during the three epidemic seasons of 2005–2006, 2007–2008 and 2008–2009, the epidemic virus has belonged to a development branch other than the vaccine virus of the autumn in question. Over 15 years, the vaccine has contained seven different influenza B viruses.

New influenza drugs, diagnostics and pandemic preparedness

The surveillance period also includes other important events related to influenza. At the turn of the millennium, new influenza drugs, the so-called neuraminidase inhibitors, were introduced in clinical use. Due to the desire to avoid the unnecessary use of these drugs, diagnostic tests were developed to be able to detect the influenza virus in patient samples within 15 to 30 minutes. These rapid tests are used at policlinics, health centres and private clinics. This has also had an effect on the numbers of influenza cases reported to the National Infectious Diseases Register.

The first influenza A(H5N1) cases caused by the avian influenza virus were found in humans in Hong Kong in 1997. It was feared that this virus could develop into a pandemic virus. At the WHO's suggestion, many countries including Finland began to prepare for a possible pandemic and stored virus drugs. This proved extremely useful when the spring 2009 (H1N1) pandemic started.

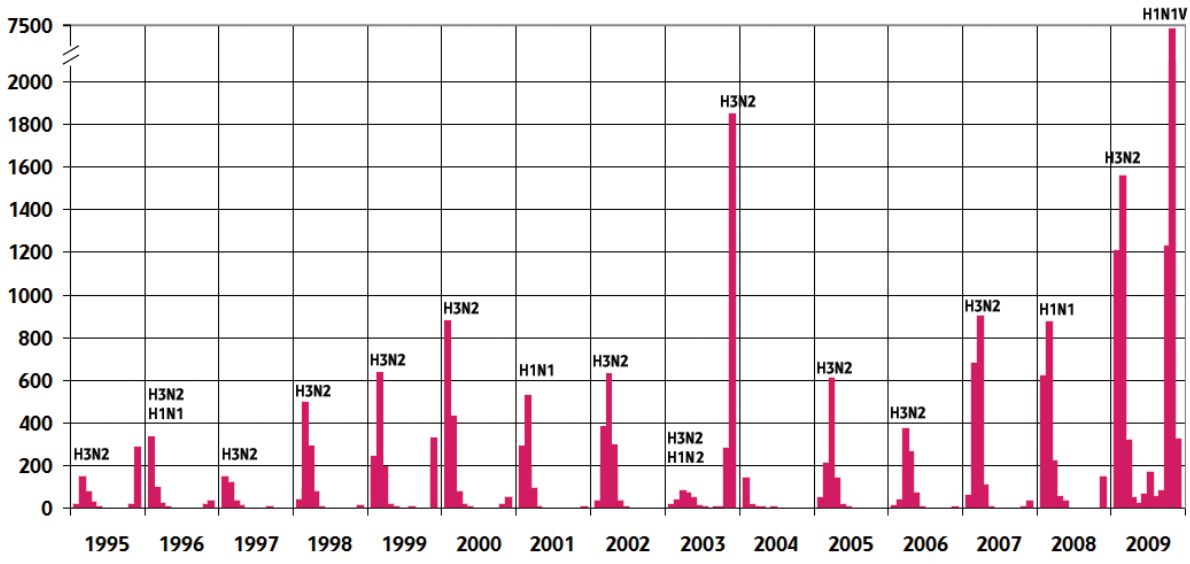


Figure 6. Influenza A cases by epidemic virus type 1995–2009, number.

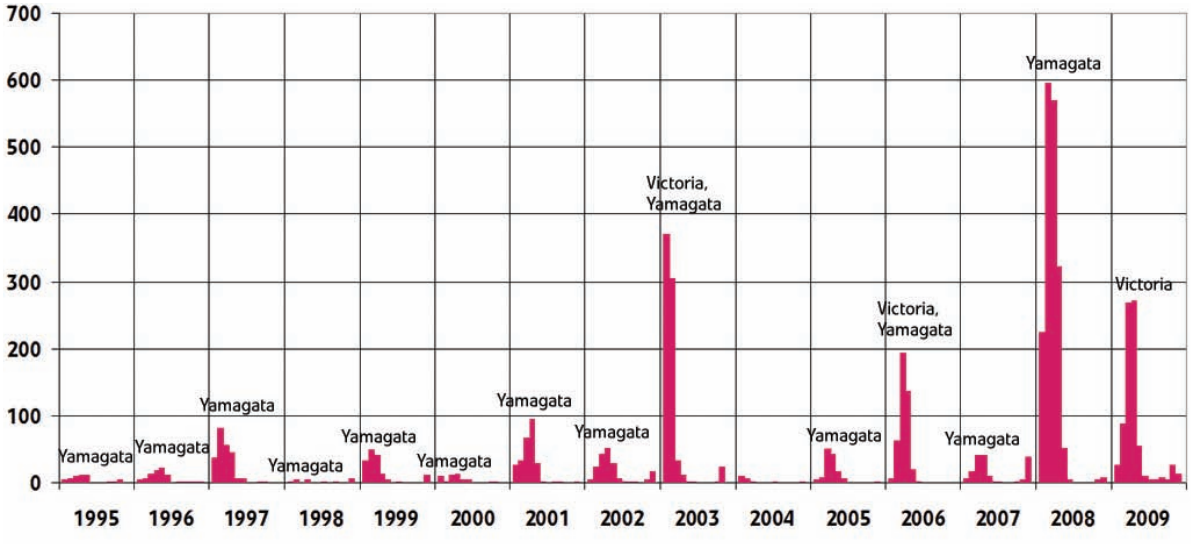


Figure 7. Influenza B cases by epidemic virus type 1995–2009, number.

RSV

In 2009, the National Infectious Diseases Register received reports of 1,611 RSV cases confirmed by laboratory tests (incidence: 30/100,000). At the turn of the year, a higher epidemic peak was expected but did not occur.

RSV – A common infection among infants and small children but also among the elderly

The respiratory syncytial virus (RSV) causes serious respiratory infections, particularly among infants and small children. However, it is also a significant pathogenic agent among adults and the elderly, although only 6.6% of the approx. 23,500 RSV findings reported between 1995 and 2009 concerned patients aged five or older, and the percentage among those over 60 was 1.6. This may also be due to the fact that small children are more frequently subject to laboratory testing. Symptoms related to the RSV infection in adults and the elderly may vary greatly, ranging from a common cold and a sore throat to serious pneumonia. An American study has shown that over 4% of adult patients hospitalised with pneumonia are RSV positive. Almost all American children under the age of one who are placed in day care facilities acquire the RSV infection during the first year of life. However, renewed infections are common during the second and third year of life and afterwards as well. The most common clinical diagnoses in RSV-positive children under the age of one are bronchiolitis and pneumonia. Later, particularly among school-age children, the RSV infection is manifested as an upper respiratory tract infection.

During the surveillance period, RSV has caused annual epidemics and has constantly circulated among the population. RSV epidemics follow the same pattern year by year: in the spring of odd years, there is an epidemic peak, which subsides before summer (Figure 8). The cases increase gradually in the autumn, and a larger epidemic occurs at the turn of the year. In the winter of even years, the epidemic still continues, but in summer, few cases remain, and the turn of the year does not necessarily increase the figures by much. A new epidemic does not occur until the following spring of an odd year.

RSV causes global epidemics annually, but the regular recurrence of the epidemic described above has only been detected in the Nordic countries. The smallish spring epidemic in the odd years always ends by summer. The exceptional recurrence may be affected by the immunological characteristics of the relatively scarce population. The RS virus occurs in two types, the RSV A and RSV B types, both of which contain subtypes. In Finland, one of the main types, RSV A or RSV B, prevails for a few years at a time, after which the other becomes more prevalent. A more effective antibody protection does not develop until a child has acquired both RSV type infections. However, the antibody protection does not last: the RS viruses will cause recurrent infections. The majority of the cases detected in children under ten, 55–59%, are found in boys.

The first vaccine experiments were done decades ago and the results were very poor overall. As an effective RSV medication does not yet exist, a vaccine would be highly desirable. The first RSV vaccines may be introduced in clinical use during the next few years. The

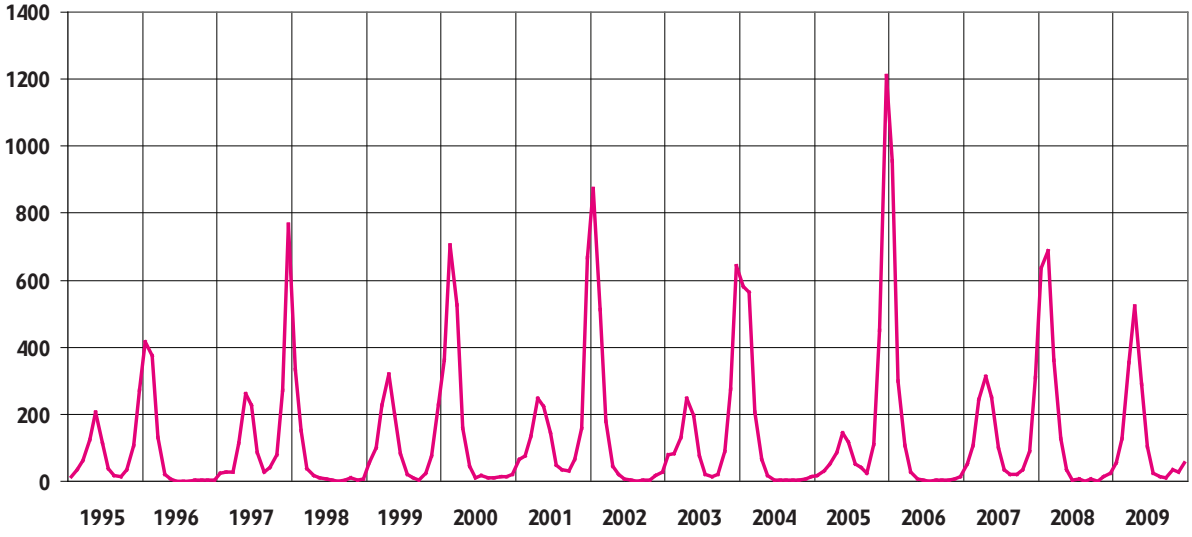


Figure 8. RSV cases by month 1995–2009, number.

elderly may be the first target group for the vaccines. This is why additional information is required on the frequency of RSV infections and on their clinical significance for all age groups in the Finnish population. Recurrent infections indicate that the immunity acquired after the infection does not provide full protection. The antigenic and genetic characteristics of RSV change year by year. This is why it may be necessary to change the vaccine virus every few years.

LEGIONELLA

In 2009, 42 legionella cases were reported based on positive laboratory findings: 8 cases were diagnosed by the urine antigen test, 5 were by bronchoalveolar lavage (BAL) culture or PCR and the rest by serological methods. More detailed follow-up indicated that the clinical presentation of 20 cases corresponded to legionellosis, which means that pneumonia had been detected by x-ray. In 8 cases where legionella was diagnosed by the urine antigen test and in the cases where it was diagnosed by BAL culture, the patients had pneumonia. Of all cases, 31 were found in men and 11 in women. Their age varied from 18 to 85 years. In 2009, 2 people died of legionellosis. They both had underlying illness. As in previous years, approximately half (11/20) of legionellosis patients had spent time abroad before the illness. The information related to the accommodation of these patients was transmitted to the EWGLINET (the European Surveillance Scheme for Travel Associated Legionnaires' Disease) which collects data on travel-associated legionellosis. One legionellosis cluster was related to a cultural society's trip to Crimea and another to a Turkish holiday resort. In Finland, a pneumonia cluster was found in employees of a thermal power plant construction site. Antibodies indicating a legionella infection were found among some of those infected.

Legionellosis remains a underdiagnosed disease

Between 1995 and 2009, laboratories reported 5 to 46 annual findings that indicated legionellosis (positive serology, antigen test, PCR or culture). The number of annual legionellosis cases has slowly increased based on the information obtained from clinical follow-ups. The greatest number of cases occurred in 2007 (31 cases). However, Finland has not been able to keep up with the European pace of diagnostic development. Between 1995 and 2009, the prevalence of legionellosis in Finland was on average 3.0 cases per million inhabitants, whereas in Europe, the equivalent figure was 7.7. The incidence of legionellosis varies greatly in Europe, and Finland is one of the European countries that reports lowincidence.

The source of sporadic legionella infections often remains unclear. The *Legionella pneumophila* serogroup 5, isolated in 1995 from domestic hot water, caused infections in two or possibly four hospitalised patients, and the same occurred again three years later. In 1999, the *Legionella pneumophila* serogroup 6 strain detected in the domestic hot water of a newborn infant's home was established as the source of the infant's legionellosis infection. In 2006, two forest industry employees contracted the legionella infection, after working at and in the vicinity of different factory sewage treatment plants. In 2007, two passengers

contracted the legionella infection, suspectedly from a cargo vessel's cold water system. The same year, at least five employees of a chemical factory's sewage treatment plant presented the symptoms of Pontiac fever or a milder legionella infection.

Between 2007 and 2008, the EWGLI detected 243 clusters of legionellosis, suspectedly contracted from a common source of infection. Of the clusters, 62% were related to holiday resorts, 12% to hospitals and 26% to other community-based sources of infection.

It is likely that legionellosis is still a underdiagnosed disease in Finland. In addition to inadequately sensitive and unspecific laboratory methods, the possibility of legionellosis may not be considered when evaluating the etiology of pneumonia. In most cases, the legionella infection is taken into account when studying severe travel-related infections, though a great number of legionella infections are probably contracted from water systems at home, at a hospital or at work. The urine antigen test combined with the culture of respiratory tract secretions is the best method for diagnosing legionellosis.

SUCCESSFUL WHOOPING COUGH BOOSTER VACCINATIONS SINCE 2003

In 2009, the total number of whooping cough cases was 267 (5.0/100,000), the smallest since the register began. In 20 cases, the diagnosis was based on PCR and in the rest of the cases, on antibodies. Twelve findings were made in infants under the age of one. Seven of them occurred in unvaccinated infants under three months of age. The number of cases occurring in children of 1–4 years of age amounted to 17, with 20 cases in children of 5–9 years, a further 22 cases in children of 10–14, and 33 cases in children of 15–19 years. The percentage of over-19-year-olds has increased since the booster vaccinations decreased infections in younger children: in 2007, the figure was 36%, in 2008, 51%, and in 2009, 61%.

In the peak year of 2004, 1,631 cases (31.3/100,000) were detected (Figure 9). The previous peak occurred in 1999 with 918 cases. When surveillance began in 1995, there were 505 cases, and in 2001, the number was also low at 315 cases.

The epidemic of 2003–2004 particularly affected the unvaccinated and inadequately vaccinated part of the population from infants to school-age children. The short duration of the protection by antibodies explained the percentage of school-age children: the levels of protection decrease after the age of five. Booster vaccinations for six-year-olds were initiated in 2003. In the framework of the vaccination programme modernised at the beginning of 2005, booster vaccines are now given to four- and fourteen-year-olds.

The National Infectious Disease Register's figures are based on antibody, culture and PCR findings. Findings in small children are based on traditional culture and the PCR method which has been readily available throughout the country over the last decade. The majority of the cases were based on antibody findings, particularly exclusive of epidemics. The increase in the percentage of cases detected by the genetic multiplication method indicates an increase in the number of infants and small children who contracted the disease during an epidemic. They often contract

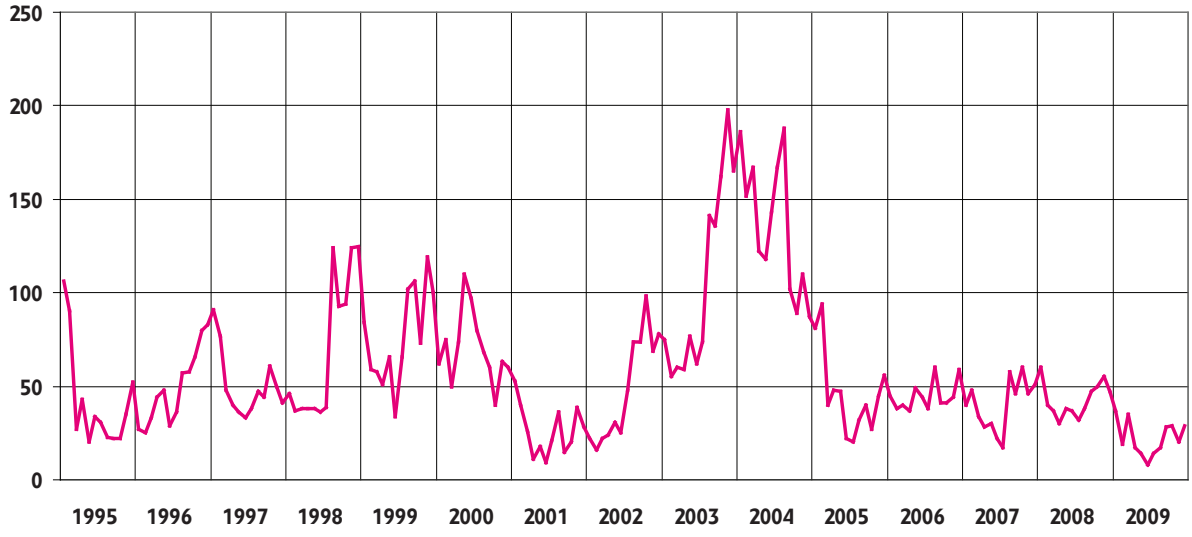


Figure 9. Whooping cough cases by month 1995–2009, number.

the disease from their school-age siblings. This is why the improvement of the vaccination programme was also designed to reduce the incidence in infants.

ADENOVIRUS – RARE IN ADULTS?

A total of 622 confirmed adenovirus infections were discovered in 2009. Most of the cases occurred between January and April (63 to 117 monthly cases), but adenovirus infections are also found in summer, particularly among small children.

There are more than 50 known types of adenoviruses. Some of them cause respiratory infections and others, intestinal infections. Adenoviruses are common pathogens in infants and small children but less common in adults. Intense adenovirus epidemics occur often in the Defence Forces. They often follow influenza epidemics.

Respiratory adenovirus infections are diagnosed with antigen detection, genetic multiplication tests or virus culture from aspirated mucus or equivalent samples (sputum or bronchoscopy samples) and also serologically. During the surveillance period, the number of cases was highest in children under 4 years (an average of 342 cases/year), and the number of cases was also relatively high among the following age groups: 5–9 (an average of 57 cases/year), 15–19 (an average of 77 cases/year) and 20–24 (an average of 39 cases/year), i.e. the normal military service age. Among conscripts, adenovirus infections were found in epidemics after the new arrivals joined the services, particularly between February and March. In older age groups, fewer cases were found, and they occurred continuously throughout the year (Figure 10).

In 2006, a new variant of adenovirus type 14 was discovered in North America. It has caused epidemics which have occurred in connection with highly severe, even fatal, respiratory infections. This virus has so far only been detected in North America. However, it is extremely likely that this respiratory virus will spread elsewhere at some point.

PARAINFLUENZA – ESPECIALLY IN CHILDREN

Parainfluenza viruses are gathered under the same heading in the National Infectious Diseases Register, even though laboratories often separate parainfluenza viruses 1, 2 and 3. In 2009, 378 parainfluenza infections were confirmed. Among children aged 0–4 there were 212 confirmed infections. Most of the cases occurred in March (53 cases) and in November (62 cases).

Parainfluenza virus infections were found particularly in infants and small children and to some extent, in young schoolchildren, though more boys than girls were infected. Parainfluenza was found in only a few adults, and 64% of cases were detected in children aged four and under. Parainfluenza viruses generally cause common upper respiratory tract infections, and it is rare to attempt to identify the pathogen by laboratory studies.

In 1996, 1997, 2001, 2004, 2006 and 2007, the highest peaks occurred between March and May and in 1998 and 2002, between November and December. The parainfluenza virus type 3 causes small epidemics almost every year, often in summer and in

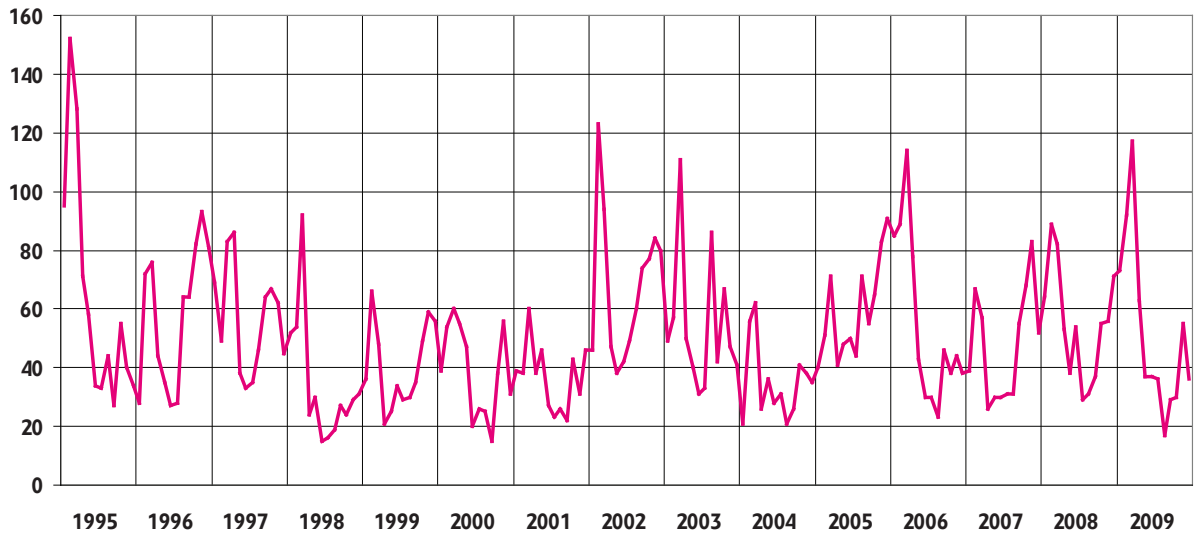


Figure 10. Adenovirus cases by month 1995–2009, number.

autumn. Parainfluenza viruses type 1 and 2 do not cause epidemics every year.

Parainfluenza viruses, particularly type 1, often cause laryngitis in small children. In out-patient care, the lower respiratory tract infections caused by parainfluenza viruses are the least common. There is no virus medication against parainfluenza viruses. However, some vaccine experiments are being carried out.

MYCOPLASMA

In 2009, there were 1,248 (23/100,000) mycoplasma cases, most of which occurred between October and December. Of these cases, 62% were found in women. Twenty one diagnoses were based on PCR, one on culture and the rest on antibodies.

M. pneumoniae infections typically occur as epidemics lasting several months every few years, but cases are also detected between epidemics.

Between 1995 and 1996, there were 597 and 467 cases, respectively. Between 1997 and 1999, the numbers were less than half this amount. In 2000 and 2001, an epidemic occurred (1,012 cases in 2001). In the peak year of 2005, 1,881 cases (36/100,000) were detected. However, from 2004 onwards, at least 1,000 cases have been diagnosed annually.

In addition to large nation-wide epidemics, mycoplasma causes small local outbreaks, for instance, in garrisons or classrooms.

In each year of surveillance, a few cases have been detected every month (Figure 11). In the years with the fewest cases, there has been no distinct monthly variation. Epidemics have always begun in autumn, in October–November at the latest, continuing over the New Year and subsiding in spring. During the summer months, findings have been scarce. From 2004 onwards, Finnish mycoplasma findings have clearly followed this seasonal rhythm.

In 1995, mycoplasma infections occurred slightly more frequently among men than among women; the difference was significant only among the age groups 15–19 and 20–24 and can probably be explained by conscript infections. Between 1996 and 2000, approximately the same number of infections occurred among both genders. After this, a clear change occurred, and since 2000 the percentage of women diagnosed with mycoplasma has been 55–62%.

Infections occur in all age groups, most frequently among 10–14-year-olds, but many cases are also detected among 5–9-year-olds and 15–19-year-olds. There were few *M. pneumoniae* findings among small children and the elderly. This can probably be explained by the fact that fewer paired serum samples are taken from these groups, and also by the lower sensitivity of serology in small children.

CHLAMYDIA PNEUMONIAE

In 2009, there were 93 laboratory-confirmed cases of *Chlamydia pneumoniae*. The number of cases has varied during the last 15 years between 93 and 430, so last year's level was the lowest on record (Figure 11). During the surveillance period, the incidence of *Chlamydia pneumoniae* was highest in 1996–1997

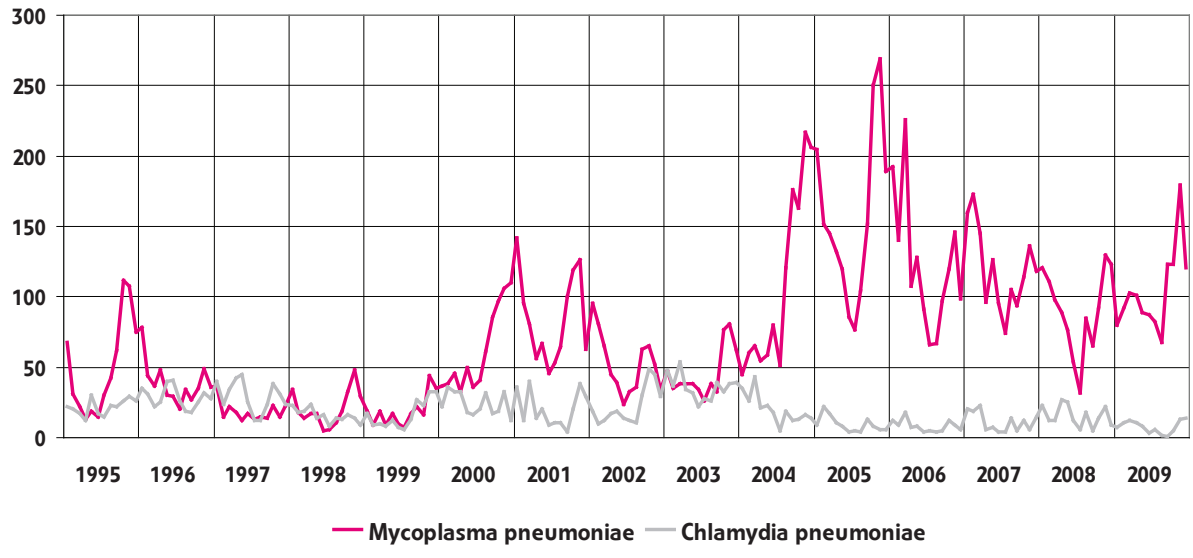


Figure 11. Mycoplasma pneumoniae and Chlamydia pneumoniae cases by month 1995–2009, number.

and 2003. The figure for 2008 was 185. Finland has suffered *Chlamydia pneumoniae* epidemics in the late 1950s and in 1977–1978 and 1986–1987. Epidemics seem to occur at about 10-year intervals in Finland.

Between 2005 and 2009, most of the cases have occurred between January and March, but *Chlamydia pneumoniae* infections are also detected in summer.

In 2009, more *Chlamydia pneumoniae* infections were reported in under 24-year-old males than females, while in the age group 30–49, the clear majority of cases occurred among females. This is in line with the view that schoolchildren transmit the disease to their mothers and that the incidence of *Chlamydia pneumoniae* is higher among conscripts in the military, where it is also diagnosed more actively. Among older age groups, the differences between males and females are small.

In 2009, the incidence was highest in the provinces of Southern and Western Finland, and in 2003, in the provinces of Western Finland and Lapland, while in 1996–1997, the highest number of cases was detected in Oulu, Lapland and Åland. In the province of Southern Finland, the annual incidence does not vary nearly as much as in the less densely populated regions. Differences in diagnostic activity may partly explain the differences.

The diagnostics of *Chlamydia pneumoniae* infections are mainly based on serology.

Gastrointestinal infections

- Salmonella and campylobacter infections acquired abroad were mainly contracted in Thailand.
- The annual incidence of the *Yersinia pseudotuberculosis* cases varies greatly.
- Norovirus outbreaks occurred mainly at the beginning of the year and were often caused by the new GII.4 norovirus variant. Imported frozen raspberries were often the source of infection for the epidemic.

SALMONELLA

In 2009, there were a total of 2,329 reported cases of salmonella, versus 3,129 cases in the previous year. Of the cases, 55% were found in women. The annual incidence in the entire country was 44 cases per 100,000. The incidence was highest in the hospital districts of Pohjois-Savo (57/100,000) and Vaasa (54/100,000) and lowest in the hospital districts of Länsi-Pohja (23/100,000) and Kainuu (25/100,000). The incidence was highest in 20–29-year-olds (71/100,000) and lowest in those over 70 (9/100,000).

The most common *Salmonella* serotypes included Enteritidis (792 cases), Typhimurium (214), Stanley (118 cases) and Virchow (98 cases). Several salmonella serotypes were found in 23 patients.

Four cases of *S.* Typhi bacteria, the agent of typhoid fever, were detected. One case of *S.* Paratyphi A, the agent of paratyphoid fever, was detected, as well as three cases of *S.* Paratyphi B and one case of *S.* Paratyphi C. All patients had acquired the infection abroad.

Of the salmonella cases, 309 (13%) were acquired in Finland; the figure was approximately the same as in 2008. The incidence of domestic infections was 6/100,000 inhabitants. Forty-three different serotypes caused domestic salmonella infections. The four most common serotypes were the following: Typhimurium (43%), Enteritidis (16%), Bovismorbificans (10%) and Poona (4%). The *S.* Bovismorbificans cases were associated with an epidemic caused by the serotype. Endemic phage type FT1 caused 60% of the domestic *S.* Typhimurium cases. Of these cases, 65% were susceptible to antimicrobials with a STYMXB.0098 DNA profile. Of the S. Typhimurium FT1 cases, 60% indicated the MLVA profile 2-12-0-0-3.

The total number of foreign salmonella infections was 1,939, and the incidence was 36/100,000 population. The salmonella infections acquired abroad represented 110 serotypes. The *S.* Enteritidis serotype caused 658 (34%) of the cases of foreign origin. The next most common serotypes acquired abroad were Typhimurium (166 cases), Stanley (111), Virchow (90), and Corwallis (68). The leading countries of acquisition were Thailand (31%), Turkey (5%), Egypt (5%), and Spain (5%).

There were 586 strains phage-typed from the foreign Enteritidis strains and 137 from the Typhimurium strain. The prevailing phage types among Enteritidis were FT 1 (16%), FT 21 (14%) and FT 4 (11%) and among Typhimurium, FT NST (19%), FT 120 (12%) and FT 195 (9%).

In 2009, it remained unknown whether 63 (2.7%) cases were of domestic or foreign origin.

Fewer salmonella cases than 15 years ago

The annual numbers of salmonella cases have clearly decreased in Finland during the surveillance period, apart from a few exceptions. In the late 1990s, there were approx. 3,000 a year, whereas the annual number of cases has been clearly below 3,000 cases during the 2000s, except in 2008. The decrease is evident in both domestic and foreign infections. (Table 1). Until 2001, most cases were reported as being acquired in Spain, but since then, the leading country of acquisition has been Thailand (366–922/year).

Table 1. The most common serotypes of salmonella cases 1995–2009 (S. Typhi and S. Paratyphi not included), number.

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Infections acquired abroad															
Salmonella Enteritidis	1033	976	929	951	893	1052	1243	904	887	758	834	879	735	1066	658
Salmonella Typhimurium	141	176	168	137	104	205	143	115	155	183	194	141	246	198	166
Salmonella Virchow	80	155	88	83	76	50	79	55	67	74	88	80	135	115	90
Salmonella Hadar	56	66	63	81	113	125	96	69	58						
Salmonella Newport										53		66		76	
Salmonella Infantis	179	62		69											
Salmonella Braenderup			35		38	49									
Salmonella Stanley							63	65	67	105	113	116	175	136	111
Salmonella Corvallis											60		59		68
Other	820	897	735	812	678	747	757	636	628	665	654	745	923	1014	846
Total	2309	2332	2018	2133	1902	2222	2376	1844	1862	1839	1945	2027	2273	2605	1939
Domestically acquired infections															
Salmonella Typhimurium	306	212	526	229	379	124	152	222	137	132	241	170	150	80	134
Salmonella Enteritidis	424	112	78	59	83	52	63	42	61	81	75	69	61	49	48
Salmonella Hvittingfoss								26							
Salmonella Hadar			33		10	17									
Salmonella Infantis	76	31	26	21			19				11				
Salmonella Newport			24	67					16			9	23	70	9
Salmonella Saintpaul				22											
Salmonella Agona					85	27	41	16	12	27	32		40		
Salmonella Poona		18			10				9						12
Salmonella Virchow						15						11			
Salmonella Ohio							12								
Salmonella Abony								15							
Salmonella Stanley	105	15								7	5		12		
Salmonella Give												39			
Salmonella Bovismorbificans															31
Salmonella Panama	27														
Salmonella Reading														25	
Salmonella Mikawasima														23	
Salmonella Braenderup										7					
Other	158	93	121	114	89	90	103	85	75	82	79	99	86	127	75
Total	1096	481	808	512	656	325	390	406	310	336	443	397	372	374	309
Country of acquisition not specified															
Number of cases	159	140	232	301	476	224	145	102	107	86	111	151	92	150	81
Total	**3564**	**2953**	**3058**	**2946**	**3034**	**2771**	**2911**	**2352**	**2279**	**2261**	**2499**	**2575**	**2737**	**3129**	**2329**

CAMPYLOBACTER

In 2009, the National Infectious Diseases Register received reports of 4,048 campylobacter infections. This is 405 cases less than in 2008. *Campylobacter jejuni* was clearly still the most common campylobacter species (2,923 cases). There were 199 reported cases of *C. coli* and as many as 925 cases of untyped campylobacter findings. The incidence rate in the entire population was 76/100,000. Of the patients, 52% were men. The highest incidence was among the 25–49 age group. In 2009, 17% of the infections (685 cases) were domestic. Most of the infections acquired abroad were contracted in Thailand (519 cases). The incidence was highest in the Helsinki and Uusimaa hospital district (117/100,000 inhabitants). The seasonal variation was typical for campylobacter: incidence was highest between July and August. (Figure 12)

In Finland, campylobacter is the most common bacterium causing intestinal infections (Figure 12). Over 3,000 cases have been reported annually since 1999.

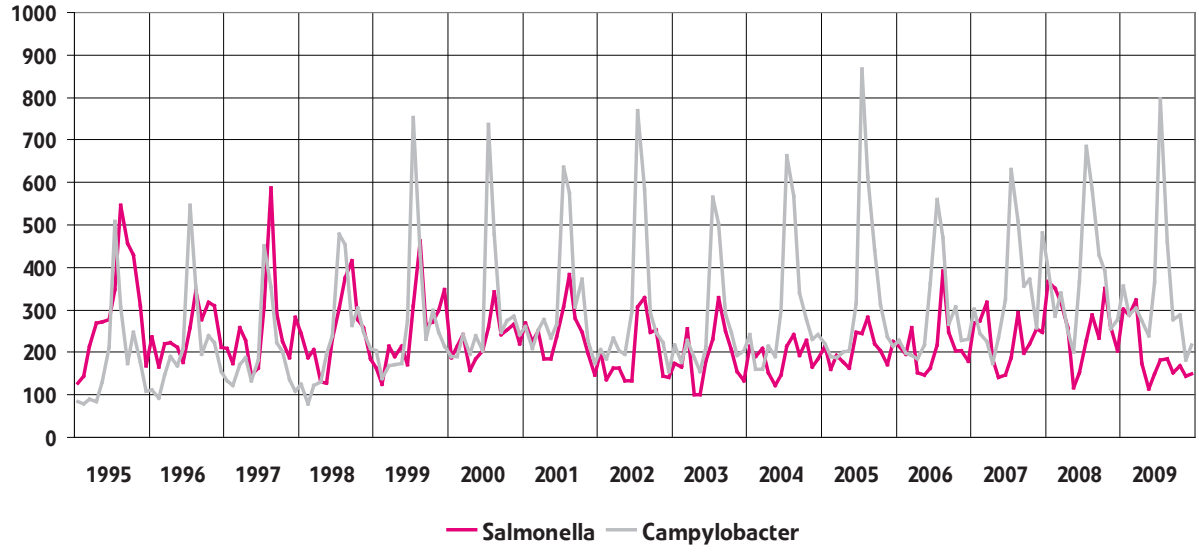


Figure 12. Salmonella and campylobacter cases by month 1995–2009, number.

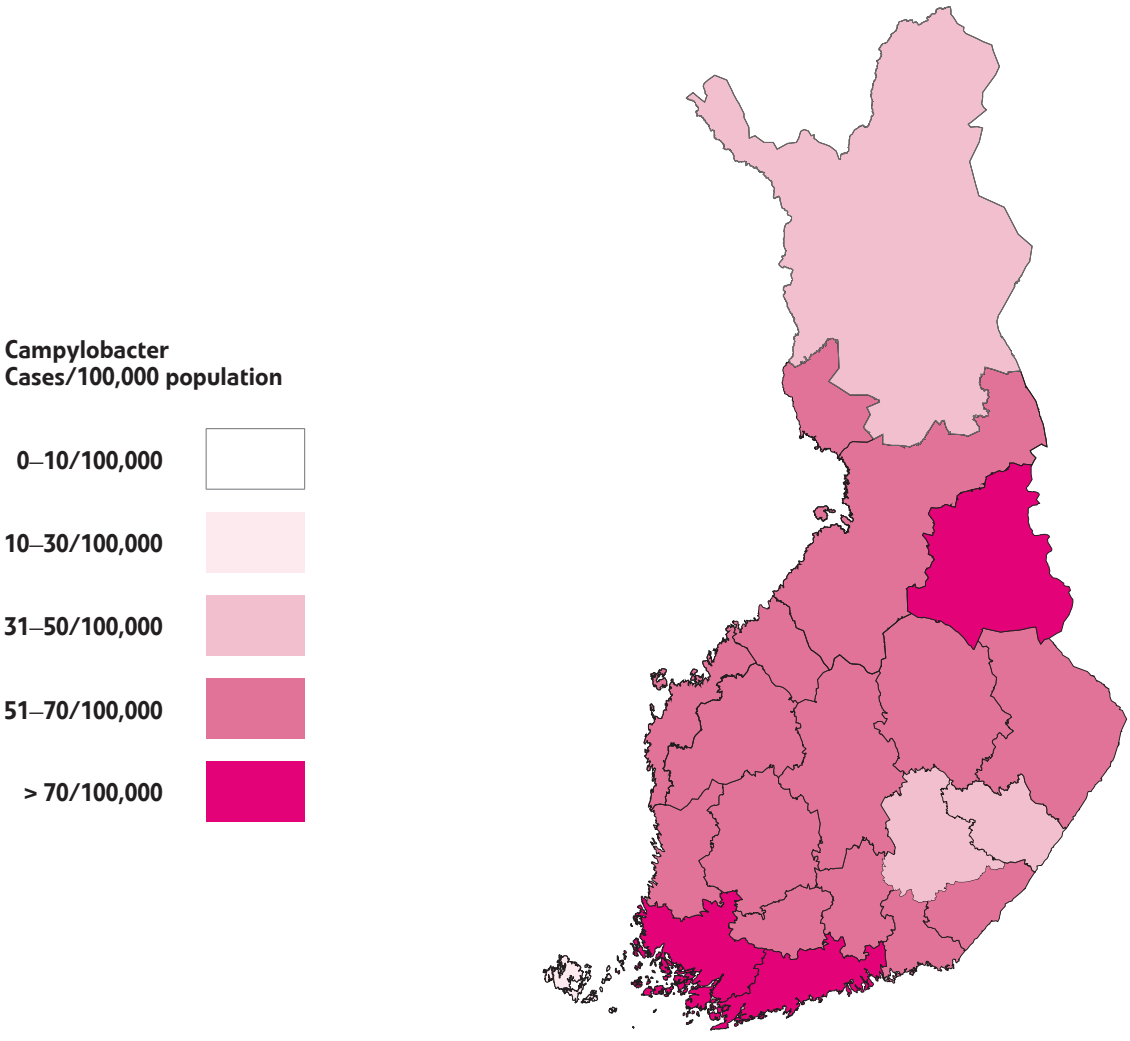


Figure 13. Incidence of campylobacter cases by hospital district 2009, cases/100,000 population.

The seasonal variation typical of campylobacter cases was regular between 1995 and 2009. The incidence has always been highest in July. An equivalent seasonal variation has also been noted in the other Nordic countries.

The majority of campylobacter infections clearly occur among young adults, which probably reflects the fact that this group travels substantially. Between 1995 and 2009, the regional incidence has been highest in the Helsinki and Uusimaa hospital district, where the incidence per 100,000 inhabitants has varied between 100 and 150 cases. The exception was 1998, when the Åland hospital district detected the highest individual regional incidence (173/100,000) of the ten-year surveillance period. Last year, the incidence in Finland was lowest in Åland (29/100,000) (Figure 13).

YERSINIA

Yersinia enterocolitica

In 2009, the National Infectious Diseases Register received notifications of 534 *Yersinia enterocolitica* cases, which is 15% higher than in 2008 (466 cases). In 2009, the incidence was 10/100,000 in the entire country. Based on the cases reported to the register, the incidence was highest among those over 75 (15/100,000). The register receives notifications of all *Y. enterocolitica* subtypes. Separate studies have indicated that the *Y. enterocolitica* bacteria isolated from older persons are mainly so-called non-pathogenic strains, and most strains categorised as pathogenic occur in children under the age of two. There is great regional variation in the *Yersinia enterocolitica* findings. Incidence was highest in the Kainuu hospital district (24/100,000) and lowest in the Länsi-Pohja hospital district (1.5/100,000). In 1995, the number of *Y. enterocolitica* cases reported to the register was 879 and in 1996, 768. Since then, approximately 400–600 cases have been reported annually.

Yersinia pseudotuberculosis

The number of *Yersinia pseudotuberculosis* infections (80 cases) decreased after the peak in 2008 (132 cases). In 2009, the incidence was 1.5/100,000 inhabitants in the entire country. The figures are too low to indicate regional variation. In 2009, no infections were detected in eight hospital districts. Outbreaks cause variation in the annual incidence of *Y. pseudotuberculosis* cases (Figure 14 and Table 2).

SHIGELLA

In 2009, the incidence of shigellosis was 2.2/100,000. A total of 118 cases were reported, 43 in men and 75 in women. Incidence was highest among 20–24-year-olds. More than half of the cases (61) were reported in the Helsinki and Uusimaa hospital district. No infections were diagnosed in five hospital districts. Of the infections, 94% were acquired abroad. The leading countries of acquisition were Egypt (37 cases) and India (26 cases). The prevailing shigella species were *Shigella sonnei* (80 cases) and *S. flexneri (31 cases)*. There was only one reported case of *S. dysenteriae*. Two patients returning from India had a dual infection caused by shigella and salmonella.

In Finland, 70–120 cases of shigella are reported annually. Most of them have been acquired abroad.

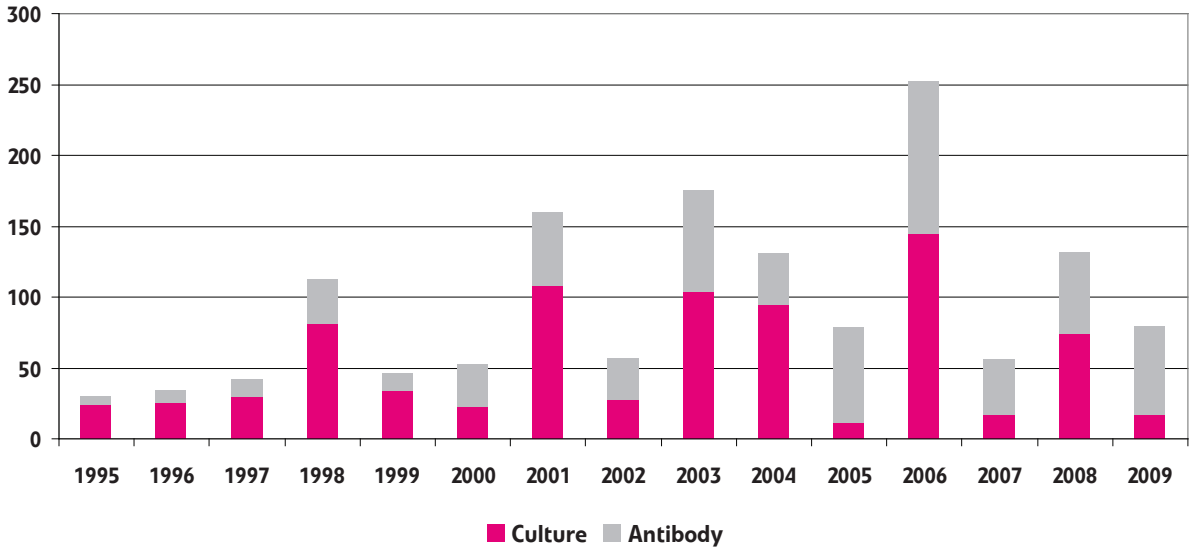


Figure 14. Yersinia pseudotuberculosis cases 1995–2009, number.

There are a fewer than 10 domestic infections. During the surveillance period, the number of cases was exceptionally high only in 2001, when as many as 223 shigella infections were reported to the National Infectious Diseases Register. Of these cases, 50 were domestic. The higher-than-average incidence was explained by a restaurant outbreak in Kymenlaakso and by the increase of tourism to Egypt.

Throughout the period, Egypt has been the leading country of acquisition for shigellosis, followed by India and Turkey. Between 1995 and 2009, *Shigella sonnei* caused 44% and *Shigella flexneri* 14% of the cases.

ENTEROHAEMORRHAGIC ESCHERICHIA COLI (EHEC)

In 2009, 31 EHEC infections were detected. This is more than in previous years. However, the disease is relatively rare in Finland. Twenty-five of the infections were domestic. Fifteen infections (48%) were found in under-15-year-olds, and nine of them in children aged four and under. Two patients suffered from haemolytic-uremic syndrome (HUS) as a complication. At least nine EHEC-positive patients were members of the same households and displayed no symptoms.

Table 2. Yersinia pseudotuberculosis outbreaks 1995–2009.

Time	Place	Number of schools or educational institutes	Number of cases/ number of laboratory confirmed cases	Study design	Vehicle	Serotype
8/1997	Pirkkala	1	35/6	Descriptive	Unknown	O:3
9/1998	Mänttä	1	60/11	Descriptive	Unknown	O:3
10–11/ 1998	Southern Finland	2	/40	Case-control	Iceberg lettuce	O:3
10–11/ 1999	Helsinki Metropolitan area, Turku Region	3	31/25	Descriptive	Unknown	O:3
5–7/2001	Whole Finland	2	/123	Case-control	Unknown	O:3 and O:1
5/2003	Kotka	36	111/79	Case-control	Carrot	O:1
3/2004	Bothnia	5	58/7	Case-control	Carrot	O:1
5–6/2006	Nurmes	13	42/17	Descriptive	Carrot	O:1
8–9/2006	Tuusula-Kerava	28	402/127	Cohort	Carrot	O:1
6–8/2008	Kainuu	0	50/38	Descriptive	Carrot	O:1

Table 3. Shigella infections acquired domestically and abroad 1995–2009, number.

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Domestically acquired infections	5	11	9	8	4	8	50	6	3	9	14	6	21	3	7
Infections acquired abroad	69	99	96	82	68	72	178	81	63	102	111	68	91	121	111
Egypt	3	8	9	1	11	16	54	18	18	37	35	20	12	22	37
India	16	14	22	8	2	10	11	10	8	13	19	19	28	26	26
Turkey	8	16	3	20	6	2	21	10	1	5	2	2	-	4	2
Other	42	61	62	53	49	44	92	43	36	47	55	27	51	69	46
Were shigella infections travel-related?															
Yes	68	88	87	74	64	66	174	77	60	99	110	67	83	116	108
No	5	11	9	8	4	8	51	6	3	9	14	6	12	3	7
Unknown	3	12	9	9	4	7	4	4	3	3	1	1	8	5	3
Total	76	111	105	91	72	81	229	87	66	111	125	74	103	124	118

The annual incidence of EHEC cases has been relatively low in Finland (0.3-0.9/100,000) compared to high-prevalence countries (1-5/100,000). However, in 2009, more cases were discovered than in previous years. In 1998, the percentage of the O157 serogroup was more than half of all cases, but the percentage of non-O157 strains has been significant ever since.

The serogroup O157 caused 16/31 (52%) cases. Of these infections, four were acquired abroad. There were 15 reported non-O157 serogroup cases. The most common serogroups were O78 and O103. 42% of the EHEC strains produces stx1 toxins, 23% produced stx2 toxins and 35% produced both toxins. A non-O157 strain producing stx1 toxin detected by blood culture in a newborn was an extremely rare finding.

NOROVIRUS

In 2009, 2,185 norovirus cases were reported, 1,300 (59%) in women. The incidence, 41/100,000, remained nearly as high as in 2008. More than 80% of the cases were reported between January and May. Although more than half (52%) of the cases were found in over-75-year-olds, infections occurred in all age groups. Incidence was highest in the province of Lapland (117/100,000).

As in 2007 and 2008, the accumulation of the norovirus epidemics of 2009 in the first part of the year was the result of a high number of outbreaks in institutional settings. This also explains the high incidence among the elderly and the considerable re-

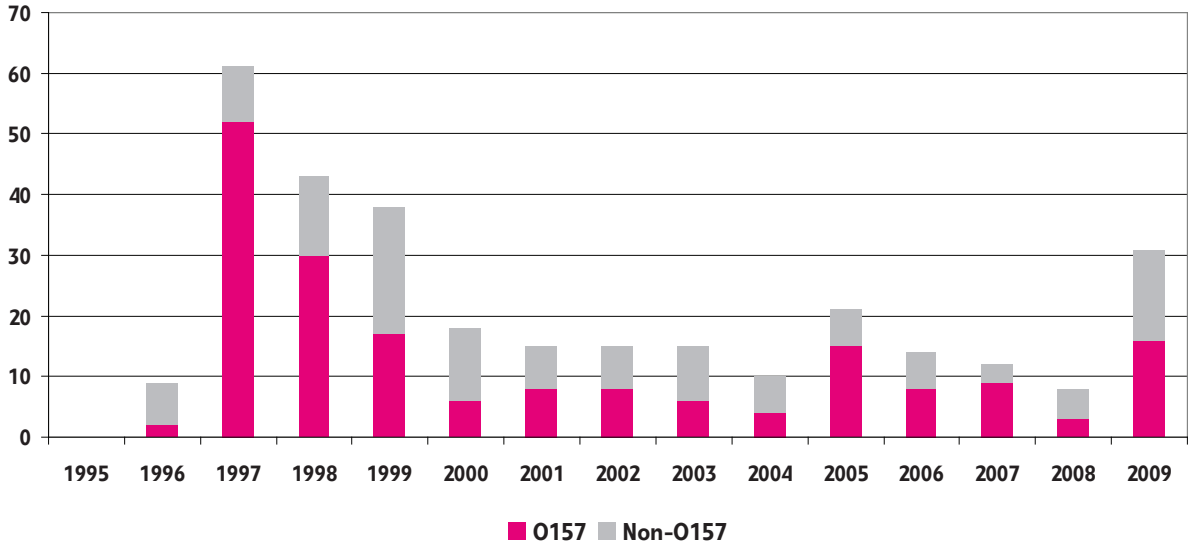


Figure 15. EHEC cases 1995–2009, number.

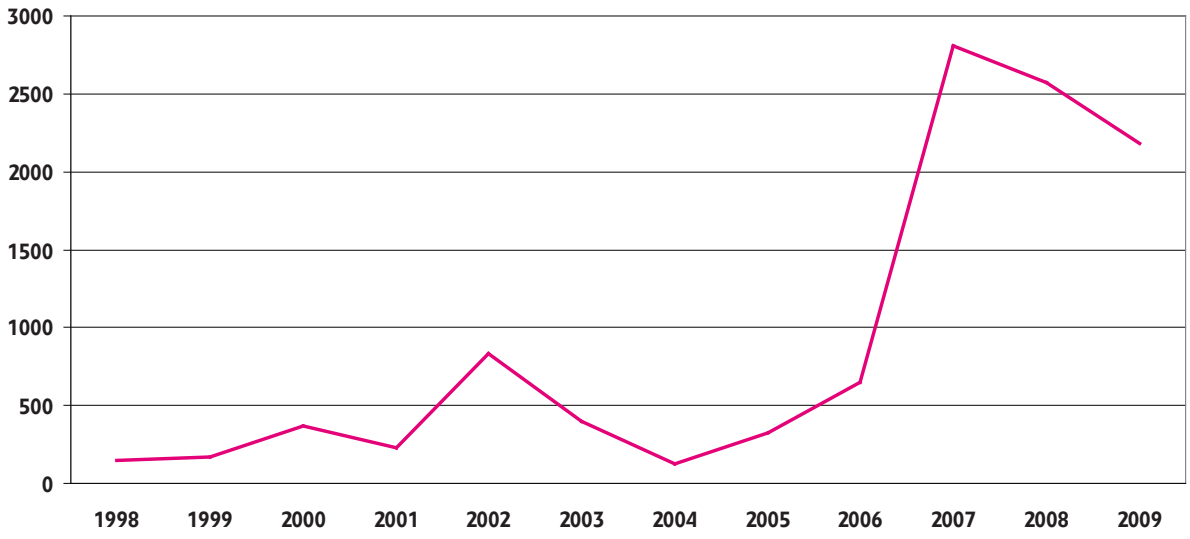


Figure 16. Norovirus cases 1998–2009, number.

gional variation. The main cause of these outbreaks was the GII.4 norovirus variant (GII4-2006b), which emerged in 2006. In addition to the dominant variant GII4-2006b, some epidemics caused by other genotypes (GI.3, GI.4, GII.3, GII.6, GII.7, and GII.M) were diagnosed throughout the year.

In the 2000s, the norovirus has become one of the most common causes of food- and water-borne epidemics. In 2009 in particular there were several outbreaks due to imported frozen raspberries. Two different norovirus genotypes, GI.4 and GII.4 2006b, were identified as the cause of the outbreaks.

At the beginning of the 1995-2009 reporting period, the diagnostics of norovirus infections were mainly based on electron microscopy and, later, mainly on PCR studies. The currently used real-time PCR method, which multiplies the conserved area between the virus polymerase and capsid, was implemented in the mid-2000s. A small amount of the noroviruses reported to the National Infectious Diseases Register has also been identified by immunological methods whose sensitivity and scope are at best not equal to those of the genetic multiplication test. In addition to outbreak investigations, norovirus diagnostics are currently also used in determing the etiology of gastroenteritis in individual patients.

Between 1998 and 2004, 125 to 836 annual norovirus cases were reported to the National Infectious Diseases Register. Incidence increased in 2002, when a new GII.4 norovirus genotype variant arrived in Finland. Globally, it caused more epidemics than had previously occurred. In 2007, there was another abrupt change in the situation, as the next variant that had emerged in 2006, GII.4 2006b, arrived in Finland. This variant has been predominant ever since, causing epidemics of unprecedented number and scope both in Finland and in the rest of the world. In 2007, the other variant that had emerged in 2006, GII.4 2006a, also caused a large number of epidemics, but it decreased proportionally in 2008, and eventually disappeared entirely.

In late 2009, yet another norovirus variant, GII.42008r, was detected in Finland and in other European countries, and the increase in norovirus incidence at the end of the year is related to the emergence of this new variant.

ROTAVIRUS

In 2009, there were 1,092 reported cases of rotavirus. Of the cases, 90% were found in under-5-year-olds, and the incidence was high in this age group, with over 3 cases per 1,000 children (330/100,000). Of the cases, 608 were found in boys and 484 in girls. The monthly variation in incidence followed the usual pattern: the number of cases increased in spring, peaked in April and decreased during June and July. Cases were reported in all hospital districts.

During the 15-year surveillance period from 1995–2009, an average of 1,400 annual rotavirus cases were notified to the register. However, based on disease burden studies, it is estimated that the number of hospital-treated cases alone is much higher than the number of cases reported to the register. Of the cases, 90% were found in children under 5. In this age group, the incidence per 100,000 children has varied annually between 305 and 705 cases. Rotavirus patients are typically small children; 6–24 months is the age group with the highest incidence. It is interesting that each year, the incidence has been a little higher among boys (55%). It is also known that the majority of hospitalised children are boys.

The annual incidence has varied. The period includes two peak years, 2003 and 2006, which clearly differ from the rest of the period. In recent years, the G9 virus type has become more common in Europe, which might partly explain the higher incidence. During the surveillance period, rotavirus cases have peaked between February and April, and there have been only sporadic cases between August and November. In southernmost countries, the peak incidence occurs in winter months.

In recent years, vaccines may also have had some effect on the epidemiology of rotavirus diseases. In 1999 and 2005, thousands of rotavirus vaccine studies were conducted on children in Finland. The rotavirus vaccine was launched on the Finnish market in summer 2006. Initially, the vaccine was not widely used, but in 2008 as many as one in three children were vaccinated against the rotavirus (the cost of the vaccine was paid by parents). In September 2009, Finland became one of the first European countries to include the rotavirus vaccine in the national vaccination programme. At the end of the surveillance period, the first children vaccinated as part of the programme are only 6 months old. Since the incidence of the disease is naturally low during the first months of infant life, probably due to protection received from the mother, the effect of the programme is not yet evident in the figures.

Figure 17. Enterovirus cases 1995–2009, number.

ENTEROVIRUS

The official taxonomy of enteroviruses changed between 1995 and 2009. Today, rhinoviruses, which cause common colds, are included in the same family with enteroviruses. In addition, human enteroviruses are now divided into four species, "A to D", or the Human enterovirus A–D (abbreviated HEV-A – HEV-D). In the new division, the poliovirus has been included in the same species with HEV-C enteroviruses, which closely resemble it. However, the old subgroup names are still used in the serotype nomenclature. Enteroviruses cause, for example, infections of the central nervous system (aseptic meningitis, encephalitis, myelitis, neuritis, etc.), myocarditis and typical enterovirus diseases (hand, foot and mouth disease, epidemic myalgia, etc.). The notifications sent to the National Infectious Diseases Register do not include data on the clinical presentation.

Incidence peak in autumn

During the reporting period, a total of 2,383 laboratory-confirmed enterovirus infections were reported to the National Infectious Diseases Register. More than half of the cases occurred in men. In addition to the item "enterovirus", this figure also includes all the traditional subgroups, i.e. polio, coxsackie and echovirus infections. The number of findings varies annually (Figure 17). The variation is explained by epidemics. For instance, echovirus 30 caused extensive meningitis epidemics in 1996, 2000–2001 and 2009 among subteens and young adults. In autumn 2008, extensive hand, foot and mouth disease epidemics with strong symptoms occurred in various parts of Finland. In addition to the typical rash symptoms, the symptoms included viral meningitis and the loss of nails. Large numbers of pre-schoolers as well as many adults contracted this exceptional disease. The epidemic was caused by the CAV-6 coxsackie virus, which was previously unknown in Finland, and the poorly known CAV-10 coxsackie virus. Enterovirus 71, which has caused many severe hand, foot and mouth disease epidemics in Asia, has remained relatively unknown in Finland, as it has been detected here only in autumn 2007, and even then, it only occurred in a few individual meningitis patients. Between 2006 and 2009, a total of 10 polioviruses have been isolated from faeces. In follow-up studies, they have all proved to be Sabin vaccine virus strains originating from a live polio vaccine.

The most significant technical change during the period has been the fact that the RT-PCR method has become more common along with virus culture and/or instead of it. Unlike traditional serology, the common enterovirus RT-PCR does not separate subgroups or serotypes. Testing faeces for the virus culture is still the most recommended and useful way to detect an enterovirus infection, though in certain situations – for instance, in the diagnostics of aseptic meningitis – the RT-PCR method can easily detect the virus in cerebrospinal fluid. In that case, it is possible at the same time to monitor the potential circulation of polioviruses in the population, which is still important in Finland.

Upper respiratory tract infections caused by both enteroviruses and rhinoviruses occur today in addition to the "typical" enterovirus diseases. The implementation RT-PCR methods has revealed how common they are. Although enterovirus infections occur year

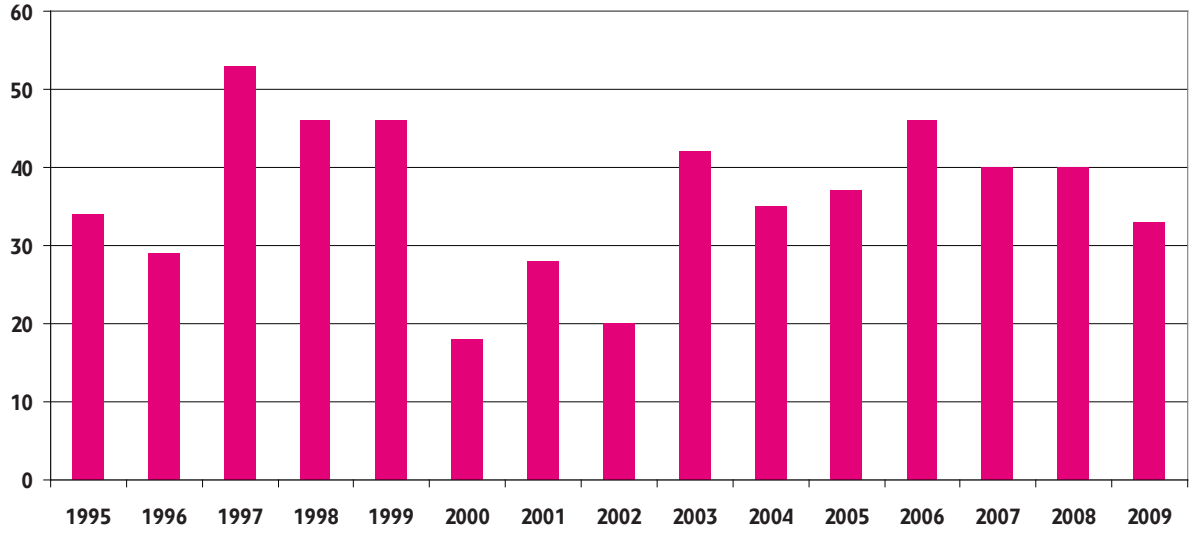


Figure 18. Listeriosis cases in Finland 1995–2009, number.

Table 4. Serotype distribution of Listeria monocytogenes strains 1995–2009, number.

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1/2a	12	12	26	19	25	12	18	12	32	23	25	36	23	26	24
1/2b	2	2	1	0	0	3	0	0	3	0	1	0	22	1	1
1/2c	1	1	0	0	0	1	2	1	1	1	0	1	0	2	1
3a	0	0	4	19	10	0	0	0	0	0	0	0	0	0	0
4b	5	6	16	5	10	3	7	7	4	9	10	8	12	13	7

round, autumn is the typical enterovirus season in Finland. The autumn peak incidence was particularly evident in 1996, 2000–2001 and 2008–2009 for echovirus 30, CAV-6 and -10 epidemics.

LISTERIA

In 2009, 33 infections caused by the *Listeria monocytogenes* bacterium were detected. The majority of cases were found in those over 65 (67%). The median age of the cases was 73, and 23 (70%) of the patients were male. There was one detected case of newborn listeriosis. One patient died of the infection. The incidence of listeria varies between different hospital districts. There are no known geographical risk factors for the disease. In 30 (91%) cases, listeria was isolated by blood culture, in 4 cases, listeria was detected in cerebrospinal fluid. In three of these four cases, it was also isolated in blood culture. Of the cases, 24 (73%) were caused by serotype 1/2a, 7 (21%) by serotype 4b, 1 (3%) by serotype 1/2b and 1 (3%) by serotype 1/2c. Of the serotype 1/2a strains 9 were of the same listeria genotype which is currently being studied epidemiologically.

Listeria monocytogenes causes serious infections among newborn infants, pregnant women, immune-deficient patients and the elderly. Listeriosis cases have been on the increase internationally in recent years, particularly in the elderly, who are predisposed to the disease due to other factors. In Finland, the number of listeria infections has remained at the same level in recent years (Figure 18). The infection is food-borne, and hazardous foods include products made of non-pasteurised milk and other food products of animal origin and ready-made meals which are preserved in cold environments for long periods of time. In Finland, high-risk foods have included particularly vacuum-packed smoked and rawpickled fish. The food production environment may also contain listeria bacteria, which can contaminate food. In Finland, most cases are sporadic infections, though a few larger epidemics have been described, such as the butter-transmitted outbreak. A *L. monocytogenes* genotype 1/2a-96 cluster, which has caused infections previously as well, is currently under study. However, the source of infections often remains unclear, even when an epidemiological study is done. It is important to prevent additional infections by informing people quickly and in real time of possible risks.

CLOSTRIDIUM DIFFICILE

Cases of *Clostridium difficile* have been reported to the National Infectious Diseases Register since 2008. In 2009, over 7,000 cases were reported (in 2008, there were over 8,000 notifications), 5,684 (2008: 6,276) of which were of a toxin-producing strain. Almost 60% of patients diagnosed with *C. difficile* were women, and half were 75 years of age or older. Less than 130 (2%) cases of toxin-positive strains were reported in those under the age of 15 (2008: over 200, 3%), and half of these had been isolated in infants under the age of 1. There was a significant regional variation in the incidence rate (38–208/100,000), with the hospital districts of Satakunta, Kymenlaakso, Varsinais-Suomi and Lappi showing the highest incidence.

In severe cases or when a local outbreak is suspected, clinical laboratories have been asked to send *C. difficile* strains for further examination by the THL reference laboratory. The number of strains sent still varied greatly by region: although all hospital districts reported toxin-positive *C. difficile* cases, only 13 sent strains for genotyping. The strains sent for further examination totalled approx. 6% of the cases reported to the National Infectious Diseases Register. A third of the strains studied represented PCR ribotype 027, which has so far been diagnosed in at least nine hospital districts: Helsinki and Uusimaa, Southwest Finland, Satakunta, Central Bothnia, Northern Bothnia, Pirkanmaa, Kanta-Häme, Kymenlaakso, and Southern Karelia. In addition to PCR ribotype 027, other ribotypes that may be possible hyper-producers of toxin were detected. PCR ribotypes other than 027 also caused severe cases of *C. difficile*. So far, more than 90 different PCR ribotypes have been detected in Finland, of which about 30 have been identified as internationally reported genotypes.

GIARDIASIS

In 2009, 378 giardiasis cases (7.1/100,000) were reported to the National Infectious Diseases Register. The incidence was highest in Western Bothnia hospital district (23/100,000) and lowest in Southern Bothnia hospital district (1.0/100,000). The median age for the cases was 24, and 52% of the cases occurred in men. Until 2008, the incidence of giardiasis varied between 4.3/100,000 and 6.5/100,000. In 2007, the Giardia protozoan was identified as one of the most important pathogens in the large water-borne outbreak in Nokia. The majority of the infections related to the water-borne outbreak were detected in 2008.

CRYPTOSPORIDIOSIS

In 2009, 11 cryptosporidiosis cases (0.2/100,000) were reported to the National Infectious Diseases Register. The cases were sporadic and occurred in a few hospital districts. The cases were equally divided between men and women. During the surveillance period, there were 4 to 18 reported cases a year, amounting to a total of 163 cases. The low number of cases is probably due to the small number of samples examined.

CHOLERA

Only the *Vibrio cholerae* serogroups O1 and O139 cause cholera. Between 1995 and 2009, a total of five cholera cases were detected. However, the *V. cholerae* strain (the so-called non-cholera vibrio) was isolated in more than a hundred patients, in some cases by blood culture. All cholera cases detected were caused by the O1 serogroup El Tor biotype.

In 1995, cholera (the Ogawa serotype) was detected in a small boy from Ghana. In 1998 (the Ogawa serotype), 2006 (the Inabe serotype) and 2008 (the Ogawa serotype), three Finns were diagnosed after a trip to India. In addition, cockles smuggled from Thailand in 1998, which were sold under the counter in an ethnic shop, caused a domestic cholera case (the Ogawa serotype).

FOOD- AND WATER-BORNE EPIDEMICS

Significant food- and waterborne epidemics in 2009

In 2009, the National Institute for Health and Welfare received 100 reports of suspected food or waterborne epidemics. These included several norovirus epidemics transmitted by frozen raspberries, a sprout-borne *Salmonella* Bovismorbificans epidemic and a French botulism cluster caused by smoked whitefish bought in Finland. Several other clusters of intestinal infection were studied as well.

Norovirus epidemics

In 2009, there were reports of a total of 36 suspectedly food-borne norovirus epidemics. Imported frozen raspberries were a likely or certain vehicle of a total of 21 food-borne norovirus epidemics. In five of these epidemics, the norovirus was also detected in raspberries. In addition, it is known that in 11 other epidemics, raspberries from the same batches

Table 5. Aetiology of food- and water-borne epidemics in Finland 2003–2006, number and %.

Infectious agent	n	%
Unknown	65	44
Norovirus	39	26
Bacillus cereus	10	7
Salmonella sp.	8	5
Biogenic amine	6	4
Clostridium perfringens	6	4
Yersinia sp.	5	3
Other bacteria	4	3
Stafylococcus aureus	3	2
Campylobacter jejuni	3	2
Total	149	100

were served. An infected food industry employee had probably spread infections in at least eight epidemics. Forty-one out of sixty-six campers contracted the disease during an epidemic caused by the norovirus at Orivesi at the turn of June and July. The infection was probably caused by well water which was found to contain a genogroup 2 norovirus similar to the one found in the patients.

A nationwide Salmonella Bovismorbificans epidemic

A nationwide epidemic caused by the *Salmonella* Bovismorbificans bacterium was detected in June. *S.* Bovismorbificans was detected in the stool sample of a total of 42 patients. A connection between alfalfa sprouts and the disease was discovered in a case-control study. An identical salmonella strain was also isolated from sprouts of the same batch germinated in a laboratory, and from the water used to germinate and rinse the sprouts. Once the contaminated batch was withdrawn from the market, no more infections were detected.

Botulism cases in France

At the beginning of September, a type E botulism caused by the *Clostridium botulinum* bacterium was found in three persons from the same French household. The suspected source of the infection was hot smoked whitefish acquired from Finland. The smoked whitefish had been bought in a Finnish retail shop in late August, taken to France by aeroplane and consumed two weeks later. During the journey, the fish had been stored in a cool bag at an unknown temperature for 14 hours, and after the journey, in a home refrigerator. In inspections made at the retail shop that sold the fish and the fish processing facility, the food control authorities called for no comments. The fish products had been transported to the shop and stored at a temperature between 0 and 3°C, in accordance with national legislation.

EHEC clusters

A total of eight EHEC clusters were detected in several localities between May and October: the number of cases totalled 2 to 5 per cluster, and some of them were infections within families. Five clusters were caused by the O157:H7 serotype and the rest by non-O157 serotypes. One of the clusters was related to a trip to Russia, and the others were domestically acquired. Despite thorough examinations, the origin of the infections has not been discovered.

Outbreak investigation carried out by THL between 1995 and 2009 provided new information to support the development of food safety

In outbreak investigations, THL assists municipal authorities when necessary or may take main responsibility, particularly when the number of patients is high or when the epidemic region covers several municipalities or hospital districts. The outbreak investigations conducted by THL between 1995 and 2009 have identified new vehicles such as butter (a listeria epidemic), iceberg lettuce and Finnish carrots (a *Yersinia pseudotuberculosis* epidemic).

A notification system for suspected food- and water-borne outbreaks has been in use in Finland since 1997. It is intended to exchange information as early and quickly as possible when local health or control authorities have detected cases of gastroenteritis which are suspectedly caused by food or domestic water. Of outbreaks notified between 2004 and 2008, 339 of the 359 in total were suspected to have spread through food or domestic water. Of these, 233 were suspected to be food-borne, and 36, water-borne epidemics. A large proportion of the outbreak and suspectedly spread in other ways (22 epidemics) were norovirus outbreaks. In 68 epidemic reports, the suspected source of the infection was not indicated. Since 2001, the THL and the Finnish Food Safety Authority Evira working group have used common criteria to estimate the strength of evidence for reported food- and water-borne epidemics. The connection to foods or domestic water has been estimated as strong, probable, possible, weak or non-existent (no evidence of food-borne transmission). The microbes causing the most common food-borne epidemics include norovirus, salmonella, *Clostridium perfringens*, and the yersinias (Table 5).

Salmonella – One to eight annual epidemics

During the current epidemic notification practice, one to eight annual food-borne salmonella outbreaks have been reported in Finland. At the turn of 1997 and 1998, approx. 100 people contracted the *Salmonella* Newport infection at two funerals. Ham was identified as the source of infection based on a questionnaire study. At the same time, infections caused by the same salmonella strain were detected in England. In May 1999, more than 70 people in Southern Finland contracted *S.* Typhimurium FT 193. Alfalfa sprouts were identified as the source of infection in a case-control study. In August 1999, cheese made from milk bought directly from a farm caused an outbreak with more than 100 persons becoming ill in Southwest Finland. In May 2001, approx. 20 of 40 people travelling to Riga contracted diarrhoea. The epidemic was studied in collaboration with Latvian health authorities. Based on a questionnaire and microbiological studies, a yoghurt cake served at a restaurant in Riga was confirmed as the source of infection. In May 2005, a multi-resistant *Salmonella* Typhimurium var copenhagen phage type FT 104B caused a food poisoning epidemic in South-eastern and Western Finland. Seventy of the cases were microbiologically confirmed. The strain, with an identical phage type, genotype and antibiotic resistance profile, was isolated from Spanish arctic lettuce which the patients may have consumed.

Campylobacter – The cause of many water-borne epidemics

Food poisonings caused by Campylobacter have mainly occurred as sporadic cases, and outbreaks have been minor (3 to 15 patients). The vehicles or suspected vehicles have included turkey, milk bought directly from a farm, chicken prepared with sour cream, fresh strawberries and chicken fillets. However, campylobacter has caused many water-borne outbreaks during the surveillance period. Extensive outbreaks associated with municipal water intake plants occurred in Haukipudas in 1998, in Asikkala in 2000 and in Vihti and Kangaslampi in 2001. Several thousands of people became ill in these outbreaks. In 2001, an outbreak transmitted by natural water occurred in Lapland, with all 17 members in a group of hikers becoming ill after drinking creek water. In 2003, there was a small family outbreak in Lapland, after drinking spring water at a rental cottage. In October 2005, a campylobacter epidemic with 600 gastroenteritis patients occurred in Vihti. The incidence of the disease was clearly highest in the area where the water supply system's water tower was located. There was no campylobacter detected in the water samples, but bacteria indicating stool contamination were found in samples from the water tower. Several dead squirrels were also found in the water tower. *Campylobacter jejuni* strains with a serotype and genotype identical to those of the patient strains were isolated from squirrels' intestinal specimens.

Shigella – A rare cause of epidemics in Finland

Between August and September 2001, a *Shigella sonnei* epidemic occurred in Kymenlaakso, with more than 40 persons falling ill. The patients had dined at the same café, which served home-made food. One of the employees of the cafe had a shigella infection, probably acquired in Tallinn. A *Shigella boydii* outbreak was detected in connection with an extensive paramedic symposium organised in Tampere in November 2007.The questionnaire designed for the outbreak investigation was completed by 223 participants, of which 90 contracted gastroenteritis.

The study did not identify a particular food served at the event that could explain the illnesses. Samples taken from the kitchen and service personnel did not contain shigella, and their interviews did not reveal trips abroad which could have lead to the shigella infection. Despite large-scale studies, the cause and the infection mechanism of the outbreak remain unknown. The same rare *S. boydii* strain was later found in a few persons taken ill during the water-borne epidemic of Nokia.

EHEC – Outbreak caused by kebab

In 2001, a small EHEC O157:H7 outbreak occurred in Finland, and foreign kebab meat was identified as the source of infection.

Listeria – Outbreak caused by butter

In 1998–1999, *Listeria monocytogenes* serotype 3a caused an outbreak transmitted by butter, with 25 people becoming ill. The listeria strains isolated from the patients and the butter produced by one manufacturing plant also had similar genotypes.

Yersinia – Several outbreaks caused by school food

During the surveillance period, *Y. pseudotuberculosis* has caused recurring outbreaks of food poisoning. Many have been associated with food served at schools. In 1997–1999, the most common cause of outbreaks was *Y. pseudotuberculosis* serotype O:3. Serotypes O:3 and O:1 were identified in the 2001 epidemic. From 2003 onwards, the serotype de-

tected in connection with epidemics has been O:1 (Table 2, page xx). Studies identified iceberglettuce and Finnish carrots as the source of infection in the outbreaks.

In late 2003, *Y. enterocolitica* serotype O:3 caused an outbreak in Kymenlaakso with more than 20 patients experiencing intensive symptoms of gastroenteritis, and three people underwent unnecessary appendectomies. In December 2004, serotype O:3 caused an infection cluster in a ski centre.

Norovirus – The cause of outbreaks transmitted by domestic water

In Finland, norovirus caused several extensive epidemics transmitted by domestic water during the surveillance period. In 1998, 1,700 to 3,000 people in Heinävesi were estimated to have fallen ill due to a water-borne norovirus infection. In 2000, it was estimated that up to 5,000 persons fell ill in Nurmes.

In July 2006, over 400 persons contracted gastroenteritis in Pirkanmaa. A majority of the cases occurred in clients of various lunchrooms. Norovirus genogroup 2 was isolated from samples taken from clients who dined at five different lunchrooms. Several questionnaire studies were conducted to investigate the extent, clinical presentation and origin of the virus. Based on the questionnaire used for the study, eating fresh vegetables in lunchrooms increased the risk of contracting the infection. Trace-back studies indicated that the restaurants shared a common supplier of fresh vegetables. However, the norovirus was not detected in the food samples taken from the restaurants or the vegetable supplier. In the late 1990s, imported frozen berries were identified as a source of infection in several epidemics. In the most extensive epidemic, occurring in 1998, approx. 500 people fell ill. The same phenomenon recurs in the late 2000s: in 2009, imported frozen raspberries were a likely or confirmed vehicle in more than half of the norovirus outbreaks.

Cryptosporidium – A new cause of outbreaks

In 2008, an extensive stomach disease outbreak was detected in Helsinki. A total of 72 people experienced symptoms typical of cryptosporidiosis. The Cryptosporidium protozoan was detected in the stools of four tested persons. A more detailed typing identified the protozoan as belonging to the *Cryptosporidium parvum* species. The suspected cause of the epidemic was a salad of foreign origin.

The water-borne outbreak in Nokia – Several pathogens at the same source

In late November 2007, approx. 450,000 litres of purified water entered the City of Nokia watersystem. Based on epidemiological investigation, approx. 9,000 inhabitants of Nokia were exposed to contaminated water, and approx. 5,000 of them contracted gastroenteritis. More than 1,000 people sought treatment for their symptoms. The main pathogens detected at the early stage of the epidemic were norovirus and campylobacter, but salmonella, giardia, rotavirus, *Shigella boydii* and *Clostridium difficile* were also found in the patients. A wide spectrum of microbes was found in the water samples. They were mainly the same as those found in the patients. The outbreak was unusually extensive, and the number of microbe findings was exceptionally high.

Hepatitides

- The number of hepatitis cases has decreased among injecting drug users.
- At the turn of the millennium, there were two hepatitis A outbreaks among injecting drug users. A vaccination campaign efficiently controlled the spread of the outbreak.

HEPATITIS A

In 2009, the National Infectious Diseases Register received reports of 22 hepatitis A cases (incidence 0.4/100,000), which remained on a par with the previous years. Seven of the cases were found in men and 16 in women. More than half of the cases (14) occurred in the Helsinki and Uusimaa hospital district. No cases were detected in 16 hospital districts. Seven infections had been contracted in Finland and eight abroad. The country of acquisition was not indicated in seven cases.

In recent years, hepatitis A has been a rare disease in Finland. Between 1994 and 1995, a hepatitis A epidemic occurred among injecting drug users of the Helsinki Metropolitan Area. In 1994, more than 400 cases were registered. After this, the incidence decreased gradually. Between 1999 and 2001, approximately 50 cases per year were reported, about half of which were acquired abroad (Table 6). In association with the outbreak among injecting drug users between 2002 and 2003, the incidence increased nearly tenfold from the previous years. In connection with this epidemic, an extensive vaccination campaign was carried out among injecting drug users, and this effectively controlled the epidemic.

Since the outbreak among injecting drug users recurred within less than 10 years, the hepatitis A vaccination for this risk group was included in the general vaccination programme at the beginning of 2005.

After 2005, an average of 20 hepatitis A cases have been reported per year. Most of them have been associated with travelling abroad. This is why the prevention of hepatitis A infections in Finland is mainly based on vaccinating injecting drug users and people travelling to endemic countries.

HEPATITIS B

Fewer acute hepatitis B cases among injecting drug users

In 2009, the number of new hepatitis B cases (acute hepatitis B infections) reported was slightly lower (34 cases) than in the previous year. The number is still considerably lower than in the peak years of the 1990s. There are hardly any differences in the incidence between the hospital districts.

Twenty-five of the cases were found in men and nine in women. The number of cases seems to remain low due to the inclusion of the hepatitis B vaccination for risk groups in the general vaccination programme, and the counselling offered to injecting drug users (Figure 19). In 2009, there were no reported acute cases of hepatitis B related to injecting drugs.

The numbers of acute cases of hepatitis B reported to the National Infectious Diseases Register have clearly decreased during the past 15 years (Table 7). Cases transmitted by injecting drugs have shown the most rapid decrease. Early in the surveillance period, distinct smaller outbreaks occurred among drug users in different parts of the country, for example, in Kuopio and Turku.

Probable reasons for the decreased number of cases include both the extensive needle and syringe exchange programme and the hepatitis B vaccinations offered to drug users especially at the needle/syringe exchange centres. The decreased number of hepatitis C infections also indicates the importance of clean injection equipment in hepatitis prevention.

Table 6. Hepatitis A cases by origin 1995–2009, number.

	Foreign origin	Domestic origin	Unknown	Total
1995	33	81	49	163
1996	40	90	56	186
1997	48	72	49	169
1998	34	58	26	118
1999	19	17	12	48
2000	24	18	9	51
2001	20	25	6	51
2002	37	293	63	393
2003	16	155	72	243
2004	21	9	12	42
2005	17	7	2	26
2006	11	7	8	26
2007	9	4	2	15
2008	13	3	6	22
2009	8	7	7	22

Mode of transmission is not always reported

The mode of transmission has been reported for only about one of every three hepatitis B cases. While in 1998, two-thirds of the acute infections whose mode of transmission was reported were still related to drug use, these cases constituted only about one-third of the cases in 2003 and 2004. In 2007, one case of acute hepatitis B infection related to injecting drug use was detected, and in 2008, two cases occurred.

Due to efficient screening during pregnancy, practically all infected neonates in Finland are foreigners. The last cases were diagnosed in 2007. These cases were babies born and infected with HBV in countries with inadequate or non-existent screening during pregnancy. In the 2004 statistics, one-third of acute cases were diagnosed in foreign patients.

There were still sporadic travel-related cases, though the combined hepatitis A and B vaccine marketed to travellers has become more and more common among travelling Finns over the past decade. In re-

Table 7. Acute hepatitis B cases and all hepatitis C cases by route of transmission 1995–2009, number*)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Acute HBV															
Injecting drug use	14	55	55	76	107	82	28	44	17	8	3	4	1	2	0
Sex	21	43	55	45	36	39	41	37	19	16	10	15	7	13	11
Perinatal	0	1	1	0	1	1	0	1	1	0	0	0	1	0	0
Blood products	22	66	50	4	1	1	1	1	0	3	0	0	0	0	0
Other	3	18	11	5	9	8	7	2	1	4	3	2	1	2	0
Unknown	53	94	134	121	105	112	54	94	69	28	19	17	17	32	23
Total	113	277	306	251	259	243	131	179	107	59	35	38	27	49	34
HCV															
Injecting drug use	147	207	251	1063	1007	936	826	716	635	614	626	577	464	571	433
Sex	4	12	13	56	35	40	42	45	7	60	62	72	68	76	65
Perinatal	1	0	3	3	10	6	3	3	1	11	5	5	3	11	9
Blood products	10	8	12	28	23	25	19	19	22	18	24	7	21	20	1
Other	9	6	7	24	40	30	31	28	34	30	35	37	27	34	26
Unknown	1193	1542	1620	636	637	702	566	562	566	508	492	470	582	431	527
Total	1364	1775	1906	1810	1752	1739	1487	1373	1265	1241	1244	1168	1165	1143	1061

*) Between 1995–2003 four HBV cases have been notified to have been transmitted by Finnish blood products. Since 2000 no cases of HCV transmitted by Finnish blood products have been notified. The surveillance for the route of transmission for HCV was started in 1998.

cent years, more than half of the hepatitis B vaccine used in Finland has been administered to travellers.

Chronic hepatitis B

The notified chronic hepatitis B carrier states indicate both infections contracted in the past and current potential sources of infection.

Chronic carrier states accumulate among foreigners. In recent years, more than half of the notified carriers have been foreign, while their proportion of the population has been only about three per cent during the same period. In 2009, 324 cases of chronic hepatitis B were reported. Of the cases, 239 were detected in people of foreign origin. The highest incidence was among 20–39-year-olds.

HEPATITIS C

As the tendency of the last decade indicates, the number of new hepatitis C cases is decreasing slowly. This trend continued in 2009, although there was some regional variation. In the peak year of 1997, 1,906 HCV infections were detected. In 2009, the number of infections was 1,061, cf. Figure 19. Since it is difficult to separate acute hepatitis C infections

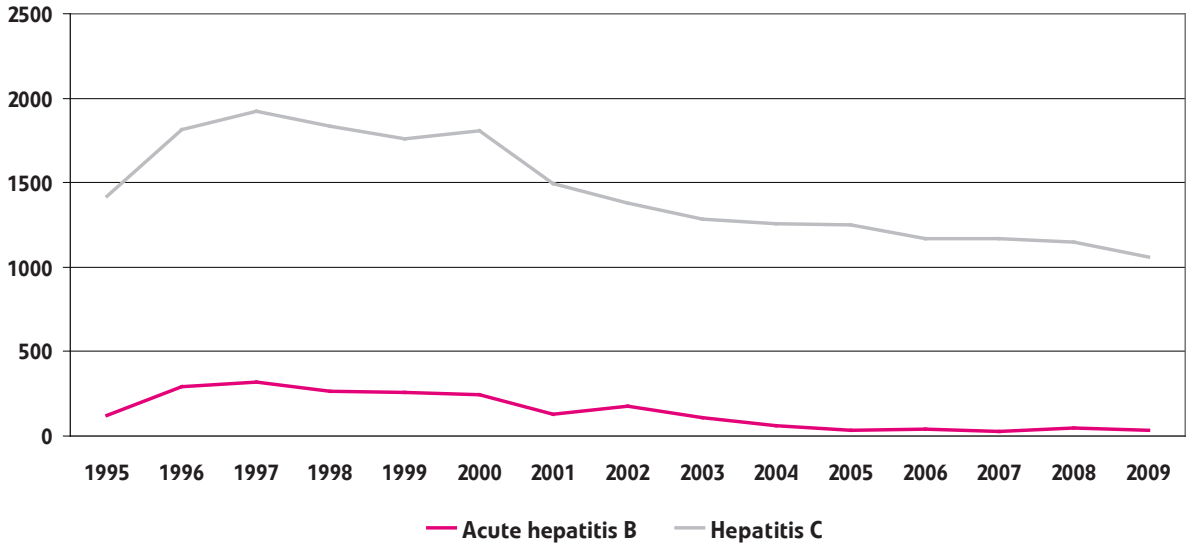


Figure 19. Acute hepatitis B cases and all hepatitis C cases 1995–2009, number.

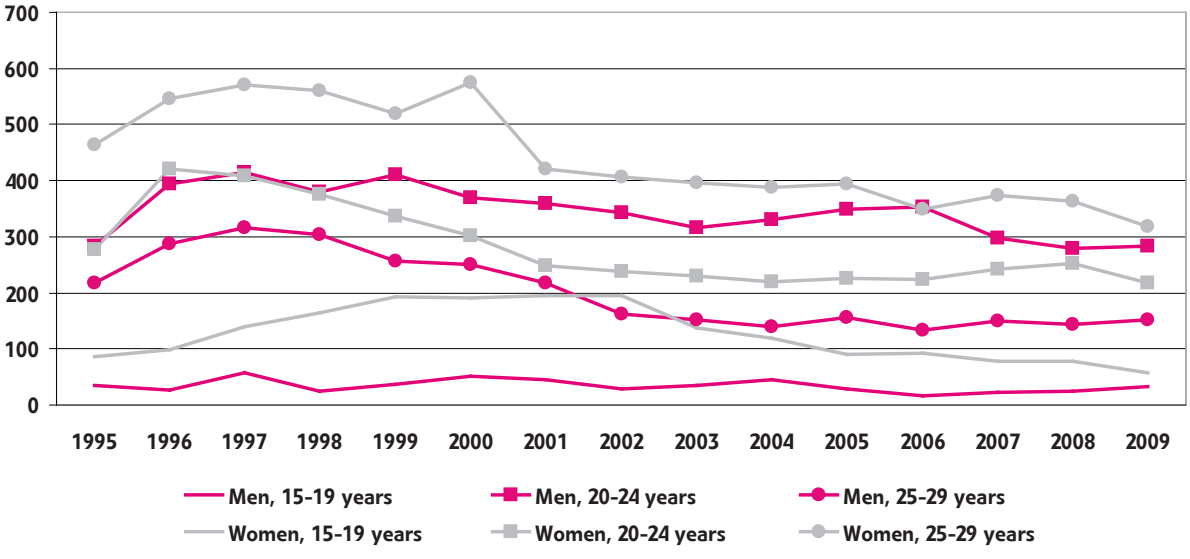


Figure 20. Hepatitis C cases among young adults 1995–2009, number.

from infections acquired years earlier, the changes in the figures should be interpreted cautiously. The incidence of hepatitis is so high among injecting drug users that changes in the incidence occur slowly, even where the risks are well under control.

According to notifications, most hepatitis C infections have been related to injecting drug use (Table 7). The number of these cases has decreased throughout the 2000s (936 cases in 2000 and 433 cases in 2009). The number of cases whose mode of transmission remains unknown (527 cases in 2009) is still high for both HCV and HBV. In general, these HCV cases are considered to be related to injecting drug use, since HCV is not easily transmitted during sex, and community transmission do not occur. However, the yearly number of unclear cases is surprisingly high, and the underlying hidden risk factors behind the cases should be more closely investigated in the future.

In a differentiation based on age groups, HCV has decreased by more than half in 15–19-year-olds since 2002 (Figure 20). Among older age groups, the decrease in the number of cases has been slower. This may be a sign of how health counselling and harm reduction policy for injecting drug users and thus reduce infection risks have become so efficient that long-term drug users now acquire the HCV infection later in life. Health counselling for injecting drugs users and harm reduction measures seem to have been most successful among the youngest age groups, which has also been one of the target groups of these activities.

Regionally, the incidence of HCV cases has lowered in the provinces of Western and Southern Finland, and in 2009, in the province of Lapland as well.

Infections among injecting drug users

Based on seroepidemiological studies, practically all infections caused by the hepatitis C virus (HCV) in Finland are related to injecting drug use. Before the 1990s, blood transfusions, primarily fresh blood transfusions, could transmit infections, but such cases were rare.

The infection is nearly always asymptomatic and therefore it is detected by chance, in connection with examinations performed for other reasons. The majority of patients develop a chronic infection, which can lead to serious liver disease even decades after the onset of the infection. Today, a chronic infection can be treated with medication.

The data on hepatitis C infections recorded in the National Infectious Diseases Register are based on laboratory diagnosis. Even though physicians are required to report all cases, this is not always done. One reason may be that the treating physicians consider the detected cases to be old infections already notified to the register.

Sexually transmitted diseases

- Chlamydia infections are still common among young people.
- Syphilis infections among men have increased.
- Endemic syphilis infections are increasing.
- Half of the gonorrhoea infections contracted abroad were acquired in the Far East, and >60% of the strains are resistant to fluoroquinolones.
- A majority of HIV infections are sexually transmitted.
- Among Finnish HIV cases, infections acquired in sex between men constitute the largest transmission category.
- Heterosexual infections among men are often travel-related.

CHLAMYDIA (CHLAMYDIA TRACHOMATIS)

In 2009, the number of reported chlamydia cases totalled 13,317 (250/100,000), which is less than in 2008 (13,873). The highest incidence of chlamydia cases was detected in the hospital districts of Lapland (356/100,000), Western Bothnia (300/100,000), and Helsinki and Uusimaa (284/100,000). Of the cases, 59% occurred in women. The majority of the cases were diagnosed in women aged 15–24 (73%) and in men aged 20–29 years (65%). As previously, among those cases under 20 years, women constituted a significantly larger group (2,658) than men (778). (Figure 21)

Since 1998, the surveillance of chlamydia has based on notifications by laboratories. The incidence of chlamydia has varied between 158–265/100,000. The number of chlamydia cases increased until 2002, when the number of cases exceeded 13,000 for the first time. The highest number of chlamydia cases, almost 14,000, was reported in 2007. The incidence of chlamydia has been highest in the Helsinki and Uusimaa hospital district, and in the Lapland hospital district. Women constituted 59–63% of the chlamydia cases. The highest number of cases was detected among 20–24-year-olds. Particularly the proportion of adolescent remained high. The proportion of under-20-year-olds has varied from 31% to 34% among women and from 11% to 15% among men. The current laboratory notification system does not provide information on the country of origin. According to the data collected by the Sexually Transmitted Diseases sentinel surveillance system, which includes the largest STD clinics, the majority of chlamydia infections are of domestic origin. Less than 10% of chlamydia infections are contracted abroad.

GONORRHOEA (NEISSERIA GONORRHOEAE)

The number of gonorrhoea cases increased from the previous year. There were 238 notified cases (4.5/100,000), 75% in men. A majority of the cases (74%) were detected in the age group of 20–44. In the age group of under-20-year-olds, more cases were detected than in previous years. The highest incidence was detected in the hospital district of Helsinki and Uusimaa (10.1/100,000), where the incidence increased from 2008 (7.7/100,000). The country of origin was reported in 75% of the cases. 40% of the cases were contracted abroad, mostly from Thailand (32 cases, table 8).

A significant change has occurred in the drug resistance of *N. gonorrhoeae* to antimicrobials: in 1999, approx. 20% of gonococci were resistant to fluoroquinolones, but in 2008, the resistance was as high as 60% (Finres 2008). Today, the first line of treatment for gonorrhoea is ceftriaxone. Nucleic acid amplification tests are generally used in gonorrhoea screening, but the gonorrhoea culture remains an important test method for enabling the surveillance of antimicrobial susceptibility. The incidence of gonorrhoea has slowly decreased between 1995 and 2004: in 1995, 7.41/100,000, and in 2009, 4.49/100,000. The highest number of gonorrhoea cases was reported in 1995 (378) and lowest in 2003 (189), since then the number of cases has varied

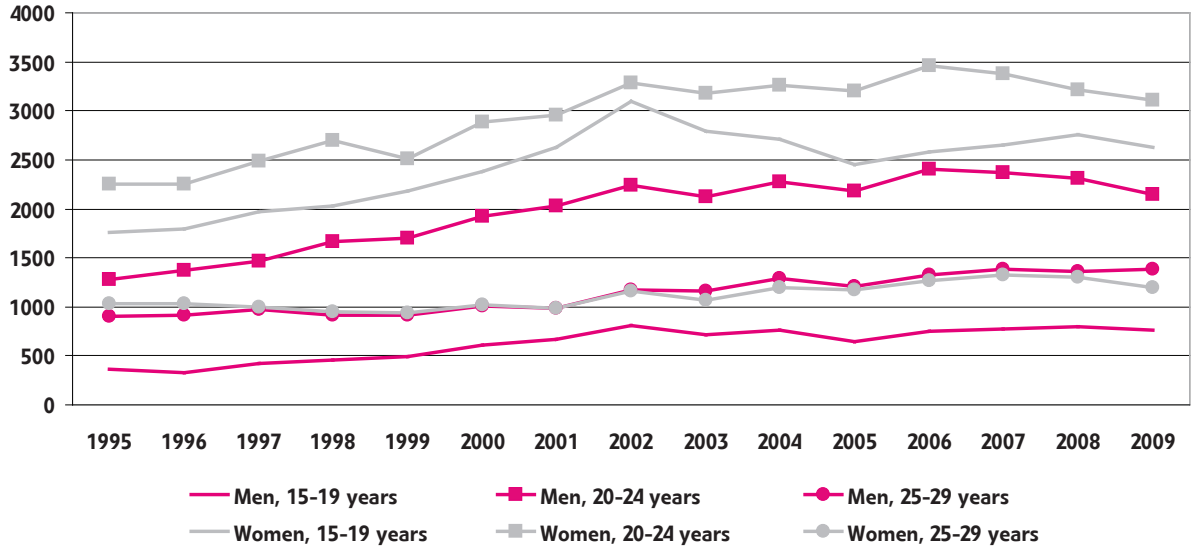


Figure 21. Chlamydia cases among young adults 1995–2009, number.

Table 8. Gonorrhoea infection acquired domestically and abroad 1995–2009, number.

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Finland	185	83	94	100	108	129	113	100	89	133	133	112	79	90	106
Russia	70	50	42	49	42	47	34	27	9	7	23	12	5	17	5
Estonia	26	8	7	8	8	6	3	5	2	4	1		2	24	
Thailand	9	9	7	16	19	18	17	31	26	38	30	42	44	34	32
Other	25	21	19	25	16	34	26	19	22	23	20	25	23		36
Unknown	63	55	49	71	62	50	54	53	41	47	33	45	42	35	59
Total	378	226	218	269	255	284	247	235	189	252	240	236	195	200	238

Table 9. Syphilis infections acquired domestically and abroad 1995–2009, number.

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Finland	48	53	50	46	21	54	32	25	30	22	25	20	55	57	68
Russia	48	57	48	33	43	80	49	22	18	16	21	18	16	26	16
Estonia	5	8	4	5	3	3	1	1	6	1	5	3	4	9	3
Somalia		1	2	5	2		1	2	2		3	3	4	8	8
Thailand	1		1	4		1	1		1	2	1	1	2	6	5
Other	10	15	15	13	14	17	12	12	14	12	19	17	22	34	21
Unknown	57	83	53	81	57	49	63	67	62	58	69	69	85	76	77
Total	169	217	173	187	140	204	159	129	133	111	143	131	188	216	198

(195 to 252). The majority of gonorrhoea cases were detected in men (69–85%). Gonorrhoea patients are usually older than chlamydia patients. The proportion of under-20-year-olds has been under 11%. The highest incidences were reported in Helsinki and in the hospital districts of Kymenlaakso, Southern Karelia and Northern Karelia. Of gonorrhoea cases, 35–50% have been contracted abroad. In 1995, 54% of infections contracted abroad were from Russia. Cases contracted in the Far East have continued to increase ever since.

SYPHILIS (TREPONEMA PALLIDUM)

In 2009, the number of syphilis cases reported totalled 198 (3.7/100,000), which is less than in 2008 (216). Of the cases, 73% were found in men. Of all cases, the proportion of 25–49-year-olds was 61%. Incidence was highest in the Helsinki and Uusimaa (6.6/100,000), Southern Karelia (5.5/100,000) and Kymenlaakso (5.6/100,000) hospital districts. In the Helsinki and Uusimaa hospital district, a high number of syphilis cases were detected among men (10.7/100,000), as in the previous year. The country of acquisition was reported in 61% of the cases. In 44% of these cases, the infection had been contracted abroad, mainly in Russia (16 cases).

The number of syphilis cases increased in the early 1990s due to increased travelling to Russia, where syphilis was common. The highest number of cases (217) was detected in 1996. After this, the number of cases decreased, and in 2004, there were 111 reported cases. In 2005– 2009, the number of syphilis cases has been increasing once again. In 2008, the number of 200 cases was exceeded (Table 9). The incidence of syphilis has varied (2.1–4.2/100,000). Most cases of syphilis have occurred in the Helsinki and Uusimaa, Southern Karelia and Kymenlaakso hospital districts. The proportion of men has been 50–59%, but this has increased during the last few years. In 2009, 73% of the cases were detected in men. In the Helsinki and Uusimaa hospital district, the number of cases among men have doubled. The majority of these infections were in men having sex with men (MSM).

Of syphilis cases, 40–67% have been acquired abroad, usually in Russia. The number of endemic-syphilis cases has increased, and in the last few years, the proportion of infections contracted abroad has been 27–35%. Positive syphilis serology has been detected annually in 10–20 pregnant women screened by maternity clinics. The majority of these findings have been due to the serological scars of previous infections detected by new Trpa test.

HIV AND AIDS – SEX IS THE MOST COMMON MODE OF TRANSMISSION

In 2009, the National Infectious Diseases Register received reports of 180 new HIV infections, which is 32 cases more than in the previous year (148). The number is at the same level as in the peak years of the epidemic, 2006–2007. By the end of 2009, a total of 2,592 HIV infections were reported in Finland (Figure 22). The HIV infections reported have clearly increased: in the 1980s, an average of 30 annual infections were reported. In the 1990s, the figure was 80, and in the 2000s, 150. In the 2000s, HIV infections acquired through sex (men having sex with men and heterosexual transmissions) have particularly increased, whereas a relatively small number of infections caused by injecting drug use has been reported. (Figure 23)

In 2009, there were 41 reported infections among men who have sex with men. The number is at the same level as in 2008. Over 60% of all men's HIV infections acquired through sex were contracted in sex between men (Figure 24); in this group, the prevalence of HIV is several times higher than the average prevalence in the population. In the early stages of the epidemic, in the 1980s, the majority of HIV infections were acquired through men having sex with men. In this group, the number of annually reported infections decreased in the 1990s but started to increase again in 1999 (Figure 23). The majority of infections acquired through sex between men have been found among Finnish citizens, and they have been acquired in Finland.

In 2009, there were a total of 86 infections acquired through heterosexual contact, which is 22 cases more than in the previous year. The increase is partly explained by the increase in infections reported in foreigners, but Finns too exhibited more infections acquired through heterosexual contact than in the previous year. HIV infections acquired through sex between men and women have gradually increased, and they have yet to be successfully reduced to a significant degree (Figure 23). Among Finns and particularly Finnish men, a considerable proportion of infections acquired through heterosexual contact is travel-related.

In 2009, 10 HIV infections were acquired through injecting drugs, which is similar to the figures for previous years. Before 1998, only sporadic annual infections related to injecting drugs had been detected in Finland, and they had mainly been acquired abroad. In 1998, an HIV epidemic among injecting drug us-

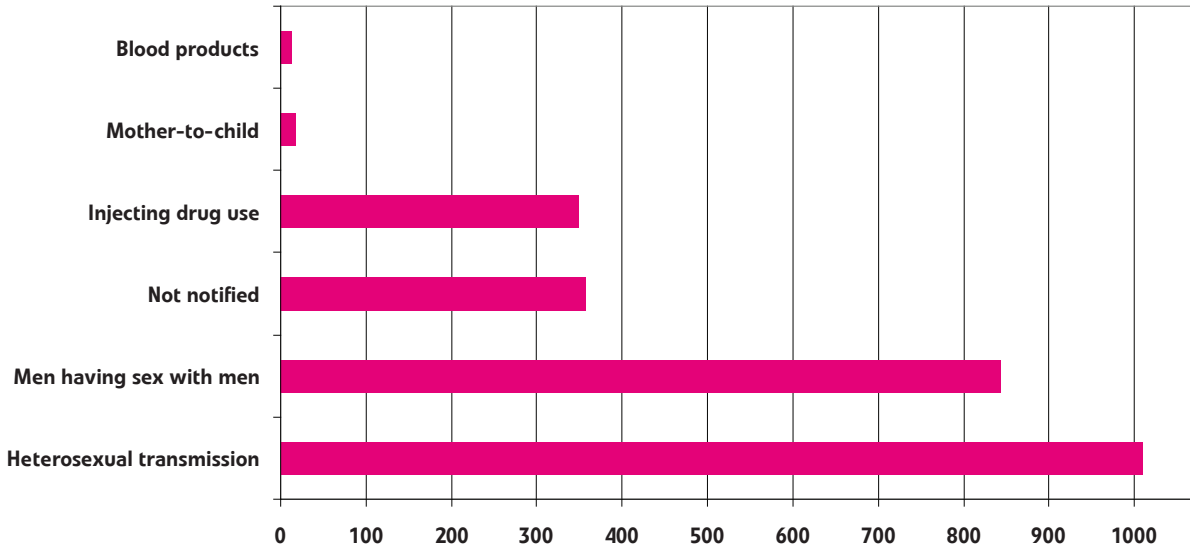


Figure 22. HIV cases by transmission routes 1980–2009, number.

ers was detected in Helsinki. The number of cases increased drastically until the end of 1999; since then, the number of infections has been reduced by using efficient prevention methods, and it has been successfully kept at a low level (Figure 23).

There were two reported mother-to-child infections in 2009. In both cases, the child was born abroad. A total of 17 mother-to-child infections have been detected in Finland (Figure 22). Many of them have been acquired abroad. Mother-to-child infections can be efficiently prevented by treatment, if the mother's HIV infection is diagnosed in good time.

The HIV testing of blood donated in Finland was initiated in 1985. No blood-borne infections have been reported since. After the initiation of blood testing, infections acquired through blood products have been reported in Finland, but they were all contracted abroad, and the latest occurred in 2001. A total of 13 infections acquired through blood products have been reported in Finland (Figure 22).

In 2009, a record number of HIV infections (82) was detected in foreigners; this represents 45% of all 2009 HIV infections. A majority of foreign HIV-infected patients come from countries with a high HIV prevalence, and the infections were acquired through heterosexual contact before their arrival in Finland.

In 2009, there was a total of 21 AIDS cases, and AIDS was the cause of 6 deaths. There have been no significant changes in the number of AIDS cases and AIDS -induced deaths after the mid-1990s, when efficient combination therapy to hiv was introduced. A total of 285 people had died from AIDS by the end of 2009.

In 2009, approximately half of the infections were diagnosed at a stage which, by current recommendations, would have required the initiation of treatment (CD4<350). Half of them were diagnosed very late or at the AIDS stage or close to it. By early diagnosis of hiv, AIDS could be prevented in most of the HIV-infected patients. The early diagnosis of infections have also been found to decrease the number of new HIV infections. Consequently, seeking HIV testing should be facilitated, and more tests should be offered.

In Finland, HIV drug resistance has been detected relatively rarely in untreated HIV positive individuals. Primary resistance mutations were detected in 3% of samples taken in 2009. The primary resistance analysis of HIV strain collection samples was initiated in 2007. Primary resistance mutations have been found in 5% of all samples analysed. In the whole of Europe, the corresponding figure is approx. 10%.

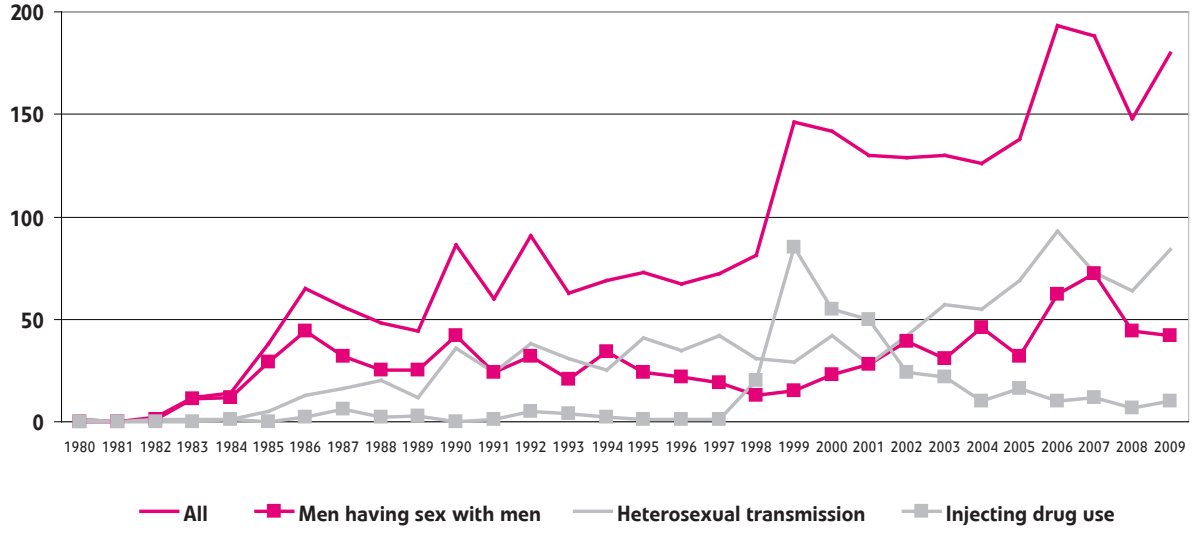


Figure 23. HIV cases by route of transmission 1980–2009, number.

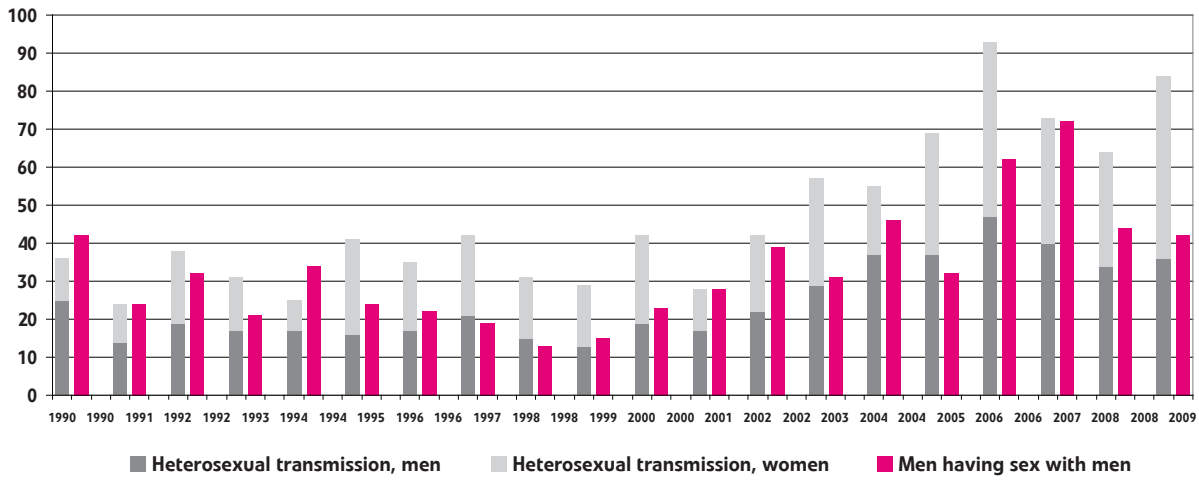


Figure 24. HIV infections acquired through sex by gender and route of transmission 1990-2009, number.

Antimicrobial resistance

- The MRSA situation improved in 2009. The number of MRSA findings isolated from blood has remained unchanged between 2004 and 2009.
- The number of VRE findings decreased since the previous year.
- The number of *E. coli* ESBL blood findings nearly doubled since the previous year.
- The first two *K. pneumonia* strains with a KPC gene were isolated in Finland.
- There was a significant increase in the incidence of the invasive *S. pneumoniae* disease between 1995 and 2009. The antimicrobial resistance of invasive pneumococcus strains has increased, particularly where macrolides are concerned.

MRSA

The methicillin-resistant *Staphylococcus aureus* (MRSA) situation improved in 2009. MRSA cases reported to the National Infectious Diseases Register increased to 1,267 (2008: 1772). A quarter of them (25%, 316/1,267) were diagnosed from samples taken from the nose or the nostrils. There were 30 MRSA isolated from blood (2008: 40) and none isolated from cerebrospinal fluid. Of the MRSA findings isolated from blood, 18 (60%) were from Pirkanmaa (3.8/100,000) and 3 (10%) from the Helsinki and Uusimaa hospital district (0.2/100,000). In other hospital districts, there were 1–3 such findings, 9 in total. A majority (17/30) of the findings were isolated from the blood of patients aged 75 or older.

As in previous years, the total number of cases was highest in the Pirkanmaa and Helsinki and Uusimaa hospital districts. The incidence per 100,000 inhabitants was highest in the Pirkanmaa, Northern Karelia, Western Bothnia, Southern Savo, and Vaasa hospital districts. Less than half of the cases were found in patients aged 75 or older. The proportion was slightly lower than before. The number of children's MRSA infections remained unchanged (83 to 84), but they increased proportionally, to over 5%.

In early 2009, *spa* typing instead of the Pulse Field Gel Electrophoresis (PFGE) became the primary typing method of MRSA strains. The PFGE type (FIN name) corresponding to the *spa* type was usually already known. Otherwise, a PFGE typing was carried out in addition to the *spa* typing.

In 2009, a MRSA strain was typed in over 1,300 individuals. The MRSA strains were divided into 155 different *spa* types. Over one-fourth (26%) of all MRSA strains represented *spa* type t067. Other common *spa* types included t172 (16%), t008 (7%) and t032 (6%). Among patients aged 75 or older, the most common *spa* type was t067 (35%), and among under-16-year-olds, t172 (32%). t172 (FIN-4) occurred in 16 hospital districts and t067 (FIN-16) in 11 hospital districts, most commonly in Pirkanmaa. The t008 strains were divided into several different PFGE types (FIN-7, FIN-15, FIN-18, FIN-25, FIN-29, FIN-33, and FIN-41). The ten most common *spa* types included three FIN-12 strains (t032, t020 and t022), which were also divided geographically according to their *spa* type: t032 mainly occurred in the Central Finland and Pirkanmaa hospital districts, t022 mostly in Pirkanmaa and t020 almost exclusively in the HUS hospital district. *Spa* typing also identified other local clusters or continua of previous epidemics, as t4819 (FIN-10) in Kymenlaakso, t1997 (FIN-37) in Northern Karelia, t148 (FIN-20) in Southern Savo and t596 (FIN-7) in Northern Bothnia. An MRSA strain isolated from blood was typed in 22 individuals. Under half (10/22) represented *spa* type t067. The rest (12/22) represented six different *spa* types, each occurring in 1–4 individuals.

PFGE was used to identify many of the current MRSA strains (FIN-3, FIN-4, FIN-5, FIN-7, FIN-10) starting in the mid-1990s. Of the 1990s strains, FIN-1 and FIN-2 (e.g. the Southwest Finland epidemics) are almost disappeared. The FIN-21 (t041) strain, which caused an extensive epidemic in the Helsinki Metropolitan Area between 2003 and 2004 and was

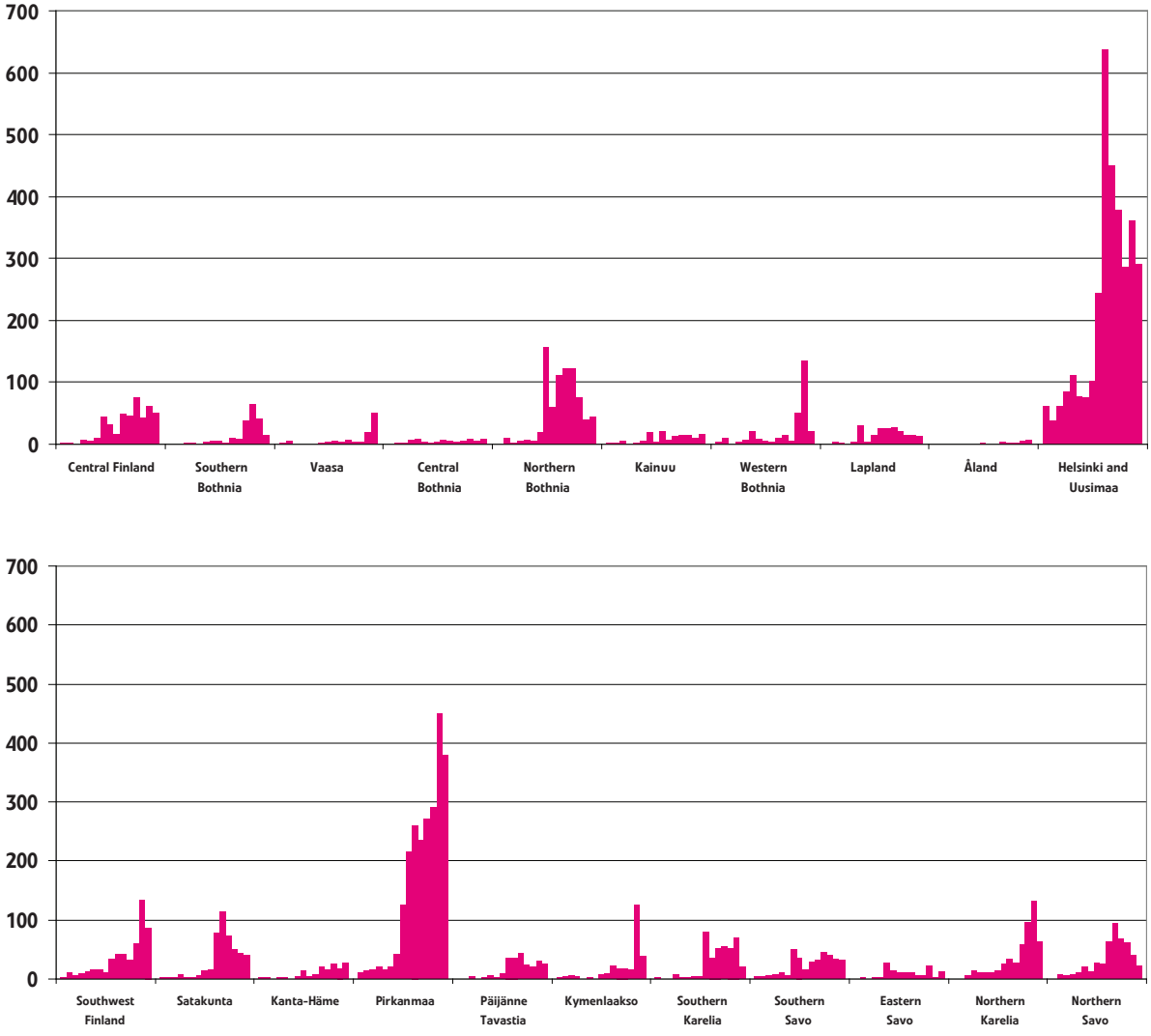


Figure 25a/25b. MRSA cases by hospital district 1995–2009, number.

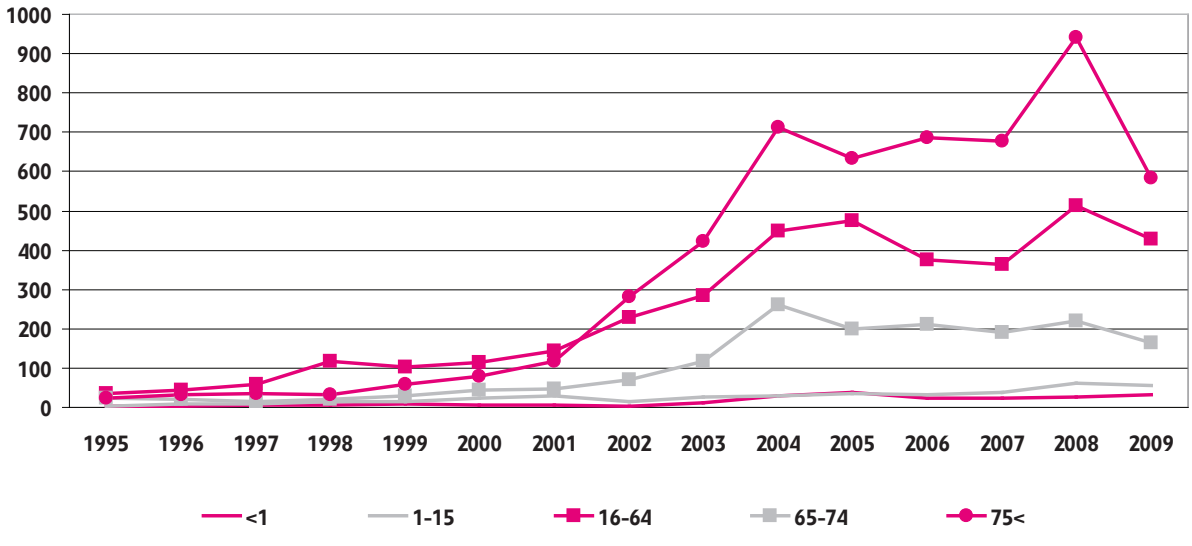


Figure 26. MRSA cases by age group 1995–2009, number.

Table 10. MRSA findings and their proportion of S. Aureus blood culture findings 1995–2009, number and %.

	All MRSA findings	S. aureus blood culture findings	MRSA blood culture findings and the meticillin 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	1059	30 (2,8)
2005	1381	1013	27 (2,7)
2006	1330	1239	37 (3,0)
2007	1297	1179	32 (2,7)
2008	1772	1261	40 (3,2)
2009	1267	1288	30 (2,3)
Total	11312	14319	239 (1,7)

then the most common strain in the country, is also vanished. Between 2004 and 2009, FIN-4 (t172) and FIN-16 (t067) were the geographically most widespread strains in Finland. Since 2005, FIN-16 (t067) has been the most common MRSA strain. FIN-4 (t172) and FIN-12 (t032) have become more common in recent years. Some of the most common MRSA strains of recent years (FIN-7, FIN-10 and FIN-12) encompass several *spa* types, and some of them also seem to be geographically divided into separate clusters. A majority of the MRSA strains occurring in Finland were also internationally known. Each year, the most common types were also in the majority in blood culture findings.

Findings in blood

The number of MRSA findings isolated from blood has remained unchanged (27–40) between 2004 and 2009. Previously, (1995–2003) MRSA findings from blood were sporadic, and the proportion of methicillin-resistant *Staphylococcus aureus* findings from blood remained below 1%. In 2004, the proportion of MRSA strains among *S. aureus* findings from blood rose above 3% and has remained on this level. There have been a total of five MRSA findings from cerebrospinal fluid: one in 1998, three in 2004 and one in 2008.

Most of the MRSA findings from blood occurred in the hospital district of Helsinki and Uusimaa and in the Pirkanmaa hospital district. It is also noteworthy that the total number of *S. aureus* findings from blood doubled between 1995 and 2009 (624–1288; 12–24/100,000). Most of the increase occurred among adults, with more cases among the elderly.

Healthcare-associated infections

S. aureus is a common cause of nosocomial infections. In the hospital infection surveillance programme SIRO, *S. aureus* was the second most common microbe in 1999–2007 in both nosocomial blood stream infections (13%) and surgical site infections (25%), but infections caused by MRSA were rare. Among nosocomial blood stream infections caused by *S. aureus*, the proportion of MRSA was 4% and in surgical site infections, 3%.

VRE

In 2009, the number of vancomycin-resistant enterococcus (VRE) findings notified to the National Infectious Diseases Register decreased from the previous year's figure. Most of the findings (6/11) were in the hospital district of Northern Bothnia in patients aged 75 or older (8/11) and in women (10/11). In other hospital districts, the number of findings varied

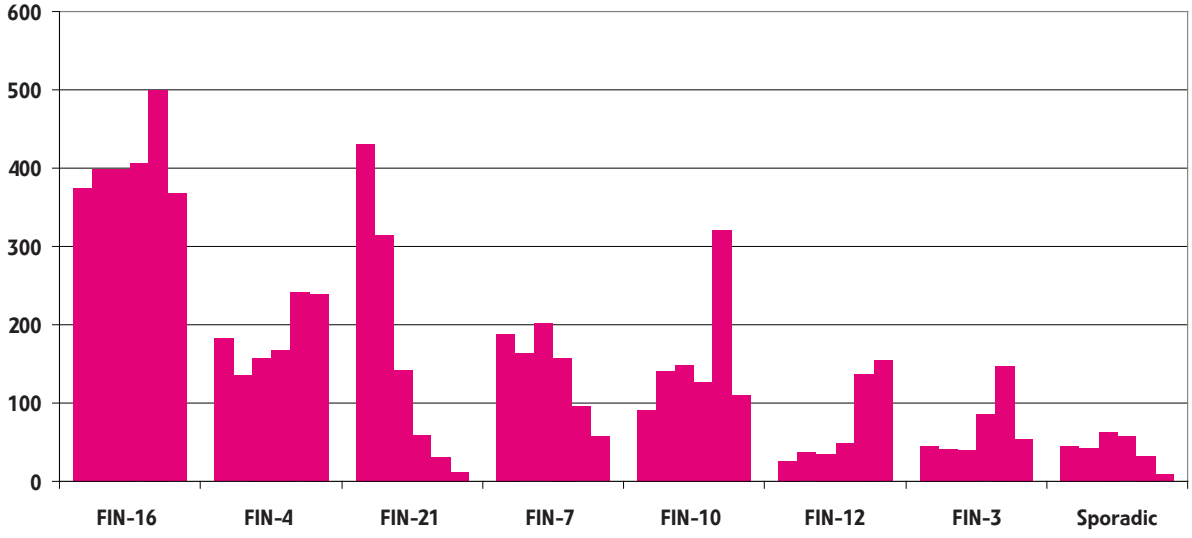


Figure 27. Most common MRSA strains 2004–2009, number.

from one to two. No VRE findings were made from blood or cerebrospinal fluid.

In 2009, a VRE finding was typed in 12 individuals. All findings except one represented the *E. faecium* species and the *vanB* type. Based on pulse field gel electrophoresis (PFGE), the common VRE IV epidemic strain of previous years was found in three individuals. In Northern Bothnia, four individuals exhibited a similar, new strain type, and the rest (5/12) exhibited unique findings.

Between 1995 and 2009, there was significant annual variation in the number of VRE findings (5 to 171). Over 80 of the 1995–2004 VRE cases occurred in the Helsinki and Uusimaa hospital district, with emphasis on the period between 1996 and 2000 (the Helsinki Metropolitan Area VRE epidemics). VRE clusters with approx. a dozen cases occurred between 1999 and 2000 in the Vaasa hospital district and in 2004 in Northern Bothnia. A few sporadic VRE findings were made each year in the Southwest Finland hospital district. Most of the VRE findings in recent years (2005-2009) occurred in the Northern Bothnia hospital district. Between 1995 and 2009, there were a total of 10 VRE findings from blood (none were isolated from cerebrospinal fluid).

Between 1995 and 2009, eight different epidemic strains of VRE were identified and named based on PFGE. Apart from one, all epidemic strains (VRE V) represented the *E. faecium* species and the *vanB* type. The strains which caused the Helsinki Metropolitan Area epidemics in the late 1990s have not occurred since 2001. In recent years (2005–2009), the most common epidemic strains have been VRE II and VRE IV in Northern Bothnia and VRE VII in the Helsinki Metropolitan Area. Based on the MLST (multilocus sequence typing), six out of seven *E. faecium* epidemic strains and some of the strains that are unique according to PFGE typing belong to the nosocomial, pandemic VRE CC-17 clone.

ESBL

Since the beginning of 2008, third-generation *Escherichia coli* and *Klebsiella pneumoniae* exhibiting reduced susceptibility to cephalosporin (I, intermediate) or showing resistance to cephalosporin (R, resistant) have been notified to the National Infectious Diseases Register. The majority of these bacteria are enzyme-producing ESBL strains, that split penicillin and extended-spectrum cephalosporins. In 2009, the majority of ESBL bacteria were *E. coli* (2,139; in 2008: 1,707) with a small proportion of *Klebsiella pneumoniae* (154; in 2008: 111).

ESBL in *E. coli* was diagnosed in all age groups – over 75% in women and over half among patients aged 65 years or older. The majority of cases (77%, or 1,645/2,139) were diagnosed from urine. The number of cases was highest in the hospital district of Helsinki and Uusimaa (769; 51/100,000), but the incidence was highest in the hospital districts of Kymenlaakso (59/100,000) and Southern Bothnia (57/100,000). The number of blood findings was significantly higher than in 2008 (77 vs. 42) (the ESBL proportion in *E. coli* blood cultures: 77/2,991, 2.6 %). A large number

of these occurred in the Helsinki and Uusimaa hospital district. However, the incidence in blood findings was highest in the hospital districts of Lapland, Kanta-Häme and Vaasa.

Over half of the ESBL cases reported that involved *K. pneumoniae* were also diagnosed in patients aged 65 years or older, but the proportion of women was smaller (60%). The majority of cases (62%, 95/154) were diagnosed from urine. The number of cases was highest in the hospital district of Helsinki and Uusimaa (50/154), but the incidence was highest in the hospital districts of Northern Bothnia, Vaasa and Lapland. Six (2008: 4) of the findings were made from blood (the proportion of ESBL in *K. pneumoniae* blood cultures: 6/480, 1.3%).

In 2009, genes encoding extended-spectrum beta-lactamases were specified in 167 bacterial strains. The strains had been collected in context of epidemics, research, and the confirmation of third-generation cephalosporin resistance. The figure includes 142 *E. coli* and 25 *K. pneumoniae* strains. Of the *E. coli* strains studied in 2009, 88% had an extended-spectrum beta-lactamase of the CTX-M group. The CTX-M gene breakdown was as follows: 66% had a CTX-M-1 group ESBL gene, and 34% had a CTX-M-9 group ESBL gene. Of the *K. pneumoniae* strains studied, 44% had an extended-spectrum beta-lactamase of the CTX-M group, with the CTX-M-1 group being the most common. The CTX-M group ESBL genes were still very common in 2009. Compared to 2008, there were few changes in the *E. coli* ESBL genetic profile.

In summer 2009, the first two *K. pneumonia* strains with a KPC gene were isolated in Finland. The strains were isolated in patients who had been hospitalised in Greece and in Italy and transferred to Finland for further treatment. Based on sequence typing, both strains belonged to the globally widespread *K. pneumoniae* ST258 clone. According to the PFGE analysis, the *K. pneumoniae* strain isolated from a patient transferred from Greece was very closely related to a *K. pneumoniae* clone which is widespread in Greece. In autumn 2009, another twonew *K. pneumoniae* strains was isolated. The two were of the sequence type ST258, and both had the KPC gene. In these cases as well, the patients had contacts to a foreign hospital.

INVASIVE PNEUMOCOCCAL DISEASE (STREPTOCOCCUS PNEUMONIAE)

There were a record of 854 cases (16/100,000) of invasive pneumococcal disease reported (2008: 924, 17/100,000). As earlier, incidence rates were higher in men than in women (17 vs. 15/100,000). Regional variation was significant (13–25/100,000), which may be partly due to differences in how actively blood cultures were taken.

The serotype breakdown of invasive pneumococcus strains changed little from that of 2008. The prevailing serotype 14 still covered one-fifth of all typed strains.

Table 11. Antimicrobial resistance of Streptococcus pneumoniae findings in blood and CSF 1998–2009, number and %.

	Cases reported to the National Infectious Diseases Register	Studied strains	Erythromycin (R) (%)	Penicillin (I+R) (%)	Multidrug resistance (%)
1998	561	84	3,6	0,0	0,0
1999	568	471	5,9	7,2	0,0
2000	601	439	8,0	3,7	1,4
2001	658	360	18,8	7,5	5,0
2002	599	594	16,3	8,0	3,7
2003	721	739	21,9	12,7	5,7
2004	748	748	20,5	9,6	3,7
2005	735	731	20,5	9,6	4,4
2006	741	760	27,9	16,4	5,4
2007	788	794	23,2	14,4	3,5
2008	924	930	24,5	17,7	3,4
2009	854	848	28,4	19,9	4,7

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

In 2009, the antimicrobial susceptibility of 848 pneumococcal strains isolated from invasive infections was analysed. Compared with 2008, 2009 saw the proportion of strains with reduced susceptibility to penicillin (MIC ≥0.125 mg/l) increase slightly to 20%. The proportion of penicillin-resistant strains (MIC ≥2 mg/l) was 3.8%. The proportion of macrolide-resistant strains has also increased slightly; 28% of invasive pneumococcal strains were resistant to erythromycin. The proportion of multiresistant (PEN IR-ERY R-TET R) strains was 4.7%, which is higher than in 2008. In 2009, one levofloxacin-resistant (MIC ≥8 mg/l) and two ceftriaxone-resistant (MIC ≥2 mg/l) strains were detected. In general, the changes in the susceptibility of invasive pneumococcus strains were minor when compared with 2008 findings, but the proportion of resistant strains is slightly on the rise.

Invasive pneumococcal disease – Susceptibility of pneumococcus to macrolides and penicillin

The incidence of the invasive *Streptococcus pneumoniae* disease significantly increased between 1995 and 2009 from approximately 10 to 16 cases per 100,000 inhabitants. The incidence rose in both men and women and among all age groups. The incidence was highest in small children and the elderly, but the disease burden is greatest in the working-age population. Some of the variation in annual incidence is related to the variable magnitude and timing of influenza seasons.

The proportion of pneumococci resistant to macrolides was about 6% in 1999, but it has subsequently risen rapidly. In 2003, the proportion of macrolide-resistant strains was already more than 20%, and in 2009, it had increased to 28%. Resistance to macrolides was more common among children under 5 than among children aged 5 or older (48% vs. 26%).

The proportion of strains with reduced susceptibility to penicillin (MIC ≥0.125 mg/l) also grew between 1995 and 2009. In 2009, these strains were most common in 2–64-year-olds (22%). The proportion of penicillin-resistant (MIC ≥2 mg/l) strains was approx. 4% in 2009. These strains were most common in children under 2 (7%) and least common in 2–64-year olds (3%). In 1999, no multiresistant (PEN IR-ERY R-TET R) pneumococcal strains had been found. In 2000, their proportion was more than 1%, and in 2009, it had increased to 5%. Multiresistant pneumococcal strains were detected in all age groups, but their proportion was highest among children under two (7%). To summarise, the antimicrobial resistance of invasive pneumococcal strains – and particularly, their resistance to macrolides – has increased. The increase in the proportion of multiresistant pneumococcal strains to 5% can be considered an alarming trend.

The most common pneumococcal serotypes causing invasive infections between 2002 and 2009 were 14, 4, 23F, 6B, 3, 7F, 9V, 19F, 18C and 19A. Five of the most common serotypes caused half of the cases and ten of the most common serotypes caused three-quarters of all invasive pneumococcal infections. Resistance to macrolides and penicillin was detected particularly for serotype 14 but also for serotypes 19F, 9V, 6B and 23F. Resistance to macrolides was also common in serotypes 19A and 6A. Most multiresistant strains were of serotypes 14, 19F or 6B. In 2009, two ceftriaxone-resistant strains were discovered. They were both serotype 19F.

GASTROINTESTINAL INFECTIONS AND ANTIMICROBIAL RESISTANCE

In tourist destinations popular among Finns, particularly Southeast Asia and India, the susceptibility to the most prevalent bacteria that cause gastrointestinal infections has worsened in recent years. Domestic bacteria are still susceptible.

As for **salmonellae**, the percentage of strains with reduced susceptibility to fluoroquinolone (MIC >0.025 mg/l) has more than doubled (10% vs. 22%), and by 2009, the proportion of highly resistant (MIC >4 mg/l) strains had increased by more than tenfold (0.05% vs. 0.6%) since 2000. In addition, the proportion of strains with reduced susceptibility to cephalosporins has increased nearly 15 times (1.3% vs. 0.09%). In 2009, almost 1% of salmonellae were ESBL producers, while in 2000, none of these strains occurred.

Between 1995 and 2000, the fluoroquinolone resistance of **campylobacters** had increased from 40% to 60%, and in infections acquired in Asia, the percentage was as high as 72%. So far, macrolide resistance has been rare, although it seems to be on the increase according to recent reports. In campylobacter strains isolated in Finland between 2003 and 2005, erythromycin resistance was detected in 1.1% of the strains. Up to 95% of these strains were also resistant to ciprofloxacin. The corresponding figure for erythromycin-resistant strains was 41%.

As for **shigella strains**, 38% were resistant to nalidixic acid, and in 95% of these strains, resistance to fluoroquinolones had reduced in 2009. In 3% of the

strains, a reduced susceptibility or resistance to cefotaxim was detected. In addition, strains whose susceptibility to both ciprofloxacin and cefotaxim was either reduced or which were highly resistant to them were detected for the first time. In recent years, an increasing number of shigella strains has been multiresistant: in the early 1990s, this was the case with 51% of the strains, in the mid-2000s, 82%, and in 2009, 89%.

Yersinia enterocolitica is naturally resistant to penicillins and cephalosporins. When reviewing the susceptibility of the yersinia strains isolated in 2006, strains also resistant to sulfonamide, tetracycline, streptomycin and chloramfenicol were detected. This includes strains related to the 2004 *Y. enterocolitica* epidemic in Kotka. The review mentioned above also helped detect a few strains resistant to nalidixic acid whose susceptibility to fluoroquinolones was reduced as well. These strains were found in patients who had been travelling in Spain or in South America. The susceptibility of *Yersinia pseudotuberculosis* bacteria has not been studied at THL.

ANTIMICROBIAL RESISTANCE IN FINLAND, IN OTHER NORDIC COUNTRIES AND IN EUROPE

The European Antimicrobial Resistance Surveillance System EARSS, launched in 1999 (http://www.earss.rivm.nl) only collects antimicrobial susceptibility data on invasive microbe isolates (from blood and cerebrospinal fluid): *Streptococcus pneumoniae*, *Staphylococcus aureus*, *Escherichia coli, Enterococcus faecalis* and *faecium, Klebsiella pneumoniae* and *Pseudomonas aeruginosa*. The two latter microbes have been under surveillance since 2004. Between 1999 and 2008, 13 to 17 FiRe laboratories (http://www.finres.fi) out of Finland's 28 clinical microbiology laboratories participated in the EARSS.

The susceptibility results for *S. aureus* and enterococci were very similar to the data in the National Infectious Diseases Register. Signs of the worsening MRSA situation could already be seen in the EARSS report in 2003, as the proportion of methicillin-resistant strains exceeded 1% (1.4%, 10/727). In 2004, the proportion of probable extended-spectrum β-lactamase-producing strains (ESBL) of all *E. coli* strains rose above 1% for the first time, and it has remained largely the same (2%). The proportion of ESBL strains in *K. pneumoniae* is also on the same level (2%). The proportion of both fluoroquinolone resistant *E. coli* strains and the macrolide resistance of pneumococci almost doubled (5–9% and 12–24 %, respectively). In contrast, the carbapenem resistance of *P. aeruginosa* has decreased (15–6%).

Except for pneumococci, the antimicrobial resistance situation in Finland is largely the same as in the other Nordic countries and the Netherlands as regards the invasive microbial pathogens mentioned above; however, it is better than the situation in Central and Southern Europe. The most significant changes have been taking place in terms of MRSA, the susceptibility of pneumococci to macrolides and the emergence of invasive ESBL strains.

Mycobacterial infections

- The number of tuberculosis cases increased in 2009.
- The number of cases increased among the young and working-age immigrants.
- Infections transmitted by immigrants to the main population are rare.
- Infections in young children did not increase.

TUBERCULOSIS – MYCOBACTERIUM TUBERCULOSIS

Tuberculosis surveillance

Between 1995 and 2006, the registered tuberculosis cases included all cases confirmed by culture, as reported by the laboratories. In addition, cases reported by a physician only were included if the diagnosis was based on histology or a case of pulmonary tuberculosis was confirmed by positive sputum staining for tuberculosis bacilli. Since 2007, Finland has used the case definition of the European Union infectious disease surveillance for tuberculosis: in addition to cases fulfilling the criteria mentioned above, the statistics also include cases in which a physician suspected tuberculosis on the basis of clinical evidence and decided to give full tuberculosis treatment even though the infection was not confirmed by microbiological tests or histology. The new basis for the compilation of statistics does not affect the number of cases confirmed by culture or cases based on histology.

Tuberculosis incidence in 2009

In 2009, there were 411 (7.7/100,000) tuberculosis cases, which is 19% more than in 2008 (346) (6.5/100,000). Of the 2009 cases, 295 (72%) were pulmonary tuberculosis, and 96 (33%) of these were sputum staining-positive. In 2009, there were 303 cases of tuberculosis confirmed by culture, which is 23% more than in 2008 (247). Based on physicians' notifications, 19 patients (5%) had a previous history of tuberculosis diagnosed after 1950, when anti-tuberculosis medication became available.

Of the tuberculosis cases, 7 (2%) were reported in under-15-year-olds, 78 (19%) in those aged 15 to 29 years, 55 (13%) in 30–44-year-olds, 70 (17%) in 45–59-year-olds, 96 (23%) in 60–74-year-olds, and 105 (26%) in persons aged 75 or older.

In 2009, 124 of all reported cases of tuberculosis (30%) were of foreign origin (patients born abroad, or citizens of other countries than Finland if the country of birth is not available). Of these, 4 (3%) were under 15 years of age, 100 (81%) were aged 15 to 44 years, 10 (8%) were 45–59 years old and 10 (8%) were aged 60 or older. Pulmonary tuberculosis made up 81 (65%) of the cases, and 43 (35%) cases presented other forms of tuberculosis. Two cases included no information on the country of birth or citizenship.

In 6 (1%) of the tuberculosis cases reported in 2009, the patient also had an HIV infection. In five of these cases, the HIV infection was reported as a new case in 2009, and in one case, the HIV infection had been registered previously.

Molecular epidemiology findings of tuberculosis in 2009

All new *M. tuberculosis* strains were genotyped in 2009. The typing was carried out according to internationally harmonised typing methods (spoligotyping and MIRU-VNTR typing). Genotyping was used to trace the source of infection in 17 different incidents, which altogether included 46 cases of tuberculosis. Genotyping also detected a cross-contamination of samples in a laboratory.

Tuberculosis incidence between 1995 and 2009

The favourable development of the previous decades continued in Finland between 1995 to 2006, as the incidence of tuberculosis (Table 12) fell to less than half from the baseline (12.8–>5.6/100,000). The introduction of a wider case definition of the European Union surveillance system for tuberculosis in Finland in 2007 fully accounts for the increase in the total number of cases in 2007 and 2008, compared

Table 12. Incidence of tuberculosis in Finland 1995–2009, number and %.

	Pulmonary tuberculosis				Other tuberculosis		All cases			
	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 (%)
1995	436	8,6	241	4,7	217	4,3	653	12,8	475	72,7
1996	442	8,6	232	4,5	193	3,8	635	12,4	513	80,8
1997	360	7,9	185	3,6	197	3,8	557	10,9	442	79,4
1998	397	7,7	203	3,9	213	4,1	610	11,9	494	81
1999	405	7,8	185	3,6	188	3,6	593	11,5	510	86
2000	376	7,3	227	4,4	171	3,3	547	10,6	460	84,1
2001	312	6	150	2,9	181	3,5	493	9,5	411	83,4
2002	299	5,8	136	2,6	175	3,4	474	9,1	392	82,7
2003	290	5,6	144	2,8	122	2,3	412	7,9	348	84,5
2004	233	4,5	128	2,5	103	2	336	6,4	291	86,6
2005	269	5,1	136	2,6	100	1,9	369	7	321	87
2006	212	4,0	101	1,9	83	1,6	295	5,6	270	91,5
2007	235	4,5	93	1,8	111	2,1	346	6,6	250	72,3
2008	222	4,2	109	2,1	124	2,3	346	6,5	247	71,4
2009	295	5,5	96	1,8	116	2,2	411	7,7	303	73,7

Table 13. Tuberculosis cases in foreigners 1995–2009, number and %.

	Pulmonary tuberculosis		Other tuberculosis		All cases	
	Cases in foreigners	Proportion of foreigners (%)	Cases in foreigners	Proportion of foreigners (%)	Cases in foreigners	Proportion of foreigners (%)
1995	25	5,7	13	6	38	5,8
1996	17	3,8	24	12,4	41	6,5
1997	23	6,4	23	11,7	46	8,3
1998	26	6,5	31	14,6	57	9,3
1999	25	6,2	21	11,2	46	7,8
2000	29	7,7	16	9,4	45	8,2
2001	34	10,9	28	15,5	62	12,6
2002	23	7,7	24	13,7	47	9,9
2003	36	12,4	13	10,7	49	11,9
2004	22	9,4	20	19,4	42	12,5
2005	28	10,4	24	24	52	14,1
2006	30	14,2	22	26,5	52	17,6
2007	45	19,1	28	25,2	73	21,1
2008	31	14	22	17,7	53	15,3
2009	81	27,4	43	37,1	124	30,1

to 2006. The total number of pulmonary tuberculosis cases confirmed by culture or by positive sputum staining did not increase in these years. Instead, the downward trend continued. Due to the wider case definition, the proportion of cases confirmed by culture decreased significantly in 2007 to 70%. Previously, it was clearly over 80%.

Changes in the surveillance system do not explain the increase in the number of cases in 2009. In 2009, the number of cases confirmed by culture clearly increased compared to the three previous years, reaching the levels of 2004 and 2005. The increase between 2008 and 2009 was manifested only in cases of pulmonary tuberculosis. However, the number of infectious sputum staining-positive cases of pulmonary tuberculosis remained on the same level as in the previous years. During the entire 1995–2009 period, the number of sputum staining-positive cases of pulmonary tuberculosis has decreased to 40% from the baseline. The change in the case definition does not affect this phenomenon.

The distribution of tuberculosis cases in Finland has long been dominated by reactivated tuberculosis in aging patients who contracted the infection in their youth decades earlier. With the shrinking of the age groups that contracted their infection during the first half of the 20th century, when a severe tuberculosis epidemic occurred in Finland, and as the number of immigrants to Finland from countries of high incidence has been relatively small, the total number of tuberculosis cases has gradually decreased. However, the situation is changing. The number of cases in foreigners remained stable between 1995 and 2006 with approximately 50 cases per year . However, the proportion gradually increased from 6% to 18%, as the number of cases reported in individuals born in Finland decreased. Between 2007 to 2009, the number of cases in foreigners increased to 124 in 2009, which is 30% of all cases. Finland is approaching the situation in the other Nordic countries where the proportion of immigrants from high-incidence countries has been more than half for a long time. In the other Nordic countries, the incidence in the main population has been very low for a long time.

Between 1995 and 2009, one to seven tuberculosis cases were reported annually in children under 15. A clear majority of these has been foreigners. In 2006, Finland transferred to vaccinating only children at risk in the national vaccination programme. After the change in the vaccination programme, there has not been an increase of cases in children under 5.

In the age group of 15-59-year-olds, the total number of cases was well over 200 between 1995 and 1996. Approx. 15% of the cases were found in foreigners. In 2006, the total number of cases in this age group was at its lowest, totalling only 126. In 2007 and 2008, it increased slightly due to the adoption of the wider EU case definition. In 2009, it increased to well over 200. The number and proportion of foreigners has increased particularly in this age group, totalling 110 (54%) in 2009. The number of cases in patients aged 60 or older has dropped by half, from 400 cases in 1995 and 1996 to approximately 200 cases between 2007 and 2009. While this group constituted 60-66% of all cases between 1995 and 2005, the proportion has decreased in recent years. In 2009, it was less than half, 49%, for the first time. The group of patients aged 60 or older has included few foreigners.

Between 1995 and 2009, the National Infectious Diseases Register received reports of 68 tuberculosis cases where the patient also had an HIV infection reported the same year or the earlier. One to eleven of such cases of combined infection have occurred each year. There was a total of 10 cases with both tuberculosis and HIV between 1995 and 1999, 25 cases between 2000 and 2004 and 33 between 2005 and 2009. The delay between the HIV infection and the onset of tuberculosis has been 0 to 15 years. Due to the frequent delay between the HIV infection and the onset of tuberculosis, the figures concerning the 5-year periods mentioned above are not comparable, since both diseases have only been reported to the National Infectious Diseases Register since 1995. During the 5-year periods mentioned above, 50%, 56% and 79% of the cases of combined infection have occurred in foreigners.

Multiresistant strains between 1995 and 2009

As regards the antimicrobial susceptibility of *Mycobacterium tuberculosis* strains, the situation has remained relatively good in Finland, even though strains resistant to both isoniazid and rifampicin, i.e. multidrug resistant (MDR), strains are common in Russia and Estonia. Zero to four multidrug resistant strains (0–1%) have been reported each year. However, in 2009 an MDR strain was found in 6 patients (2%), which reflects the increased immigration from countries with a high tuberculosis incidence. In 2009, 93% of strains were susceptible to all basic drugs. XDR strains, which are resistant to nearly all drugs, have not yet been found in Finland.

Molecular epidemiology of tuberculosis between 2000 and 2009

Molecular epidemiology typing of *Mycobacterium tuberculosis* strains is essential to tracing the transmission routes of tuberculosis. The Mycobacterial Reference Laboratory of the National Institute for Health and Welfare collects and types all new *M. tuberculosis*

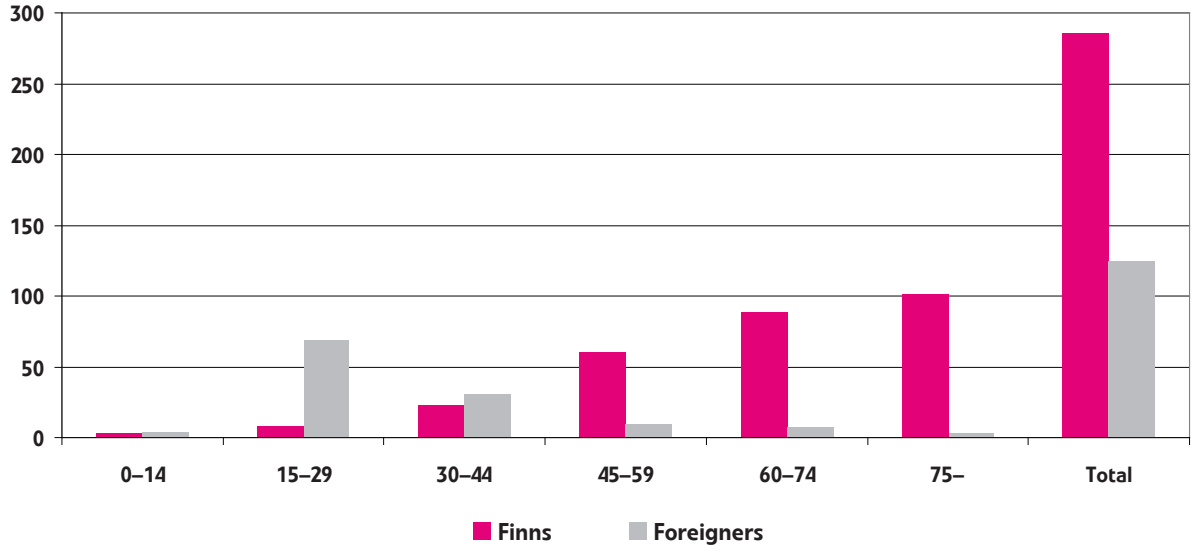


Figure 28. Tuberculosis infections in Finns and persons of foreign origin by age group 2009, number.

strains as part of the strain collection maintained by the National Infectious Diseases Register.

Finland's *M. tuberculosis* strains have been tested systematically by internationally standardised typing methods (IS*6110* RFLP and spoligotyping) since 2000. In early 2008, the complicated RFLP method was replaced with the faster and simplier PCR-based MIRU-VNTR typing. Standardised methods allow results of different laboratories to be compared, and the movements of certain strains can be monitored from one country to another.

Genotyping has been used to trace the source of infections when studying several epidemics. Based on the results, new TB clusters and unexpected connections have been detected between patients. The methods also reveal cross-contamination of samples in laboratories. Typing also helps to find out whether the infection is a case of reactivated tuberculosis previously confirmed by culture, a relapse or a new tuberculosis infection.

Typing has revealed that strains of the so-called Beijing group, common in the nearby regions, are rare in Finland. These *M. tuberculosis* strains spread faster, and they are often MDR strains. About two per cent of Finnish strains belong to the Beijing group, and only a few of them have been MDR strains. So far, there have been no outbreaks caused by an MDR-TB strain in Finland.

Tuberculosis treatment outcome monitoring in 2007

In 2008, Finland launched tuberculosis treatment outcome monitoring based on standardised international definitions. The favourable outcome categories include (1) 'Recovered' = the patient has received full tuberculosis treatment, and the sputum culture is negative at least once in previous sputum tests and at the end of the treatment; and (2) 'Treatment completed' = the patient has received full treatment, but the success of the treatment has not been bacteriologically confirmed. Non-favourable outcomes include (3) 'Treatment failure' = the patient's sputum cultures remain positive or become positive again after five months of treatment; (4) 'Deceased' = the patient passes away before the start of medication or during medication (for any reason); (5) 'Interrupted treatment' = the patient's medical treatment was interrupted for at least two months, or treatment was not started despite a positive TB test.

Table 14. Treatment outcome monitoring of pulmonary tuberculosis in 2007, number and %.

Cases under surveillance	203
TREATMENT OUTCOME	
Favourable	144 (71%)
Cured	85
Treatment completed	59
Non-favourable	44 (22%)
Deceased	41
Treatment failure	1
Interrupted treatment	2
Missing	15 (7%)
Transfer	3
Treatment continues at 12 months	7
Form not returned or treatment outcome was not indicated	5

Definitions for various kinds of missing information on the outcome of the treatment include (6) 'Transfer' = the patient has been transferred to another reporting unit, and the outcome of the treatment is unknown; (7) 'Continuing treatment 12 months after initiation' = the treatment continues 12 months after initiation (and there has been no other outcome during the treatment); (8) 'Unknown' = the outcome of the treatment is unknown, and the patient has not been transferred elsewhere (e.g. the patient has disappeared from the surveillance system).

The first annual outcome surveillance report covers cases registered in 2007. Based on previous register information on cases, all hospital districts received prefilled forms on each case for outcome classification and were requested to classify outcomes at 12 months from the original registration date of the case. Based on the EU definitions, the surveillance included cases of pulmonary tuberculosis where (1) the tuberculosis culture was positive; or (2) both the nucleic acid amplification test from a clinical sample and the mycobacterial staining were positive; or (3) either the mycobacterial staining of a respiratory secrete, or histology or a nucleic acid amplification test for *M. tuberculosis* was positive.

A treatment outcome form was sent in 205 cases. Based on the submitted forms, two cases had originally been erroneously classified as pulmonary tuberculosis. These cases were excluded from further examination. Table 14 shows the treatment outcome distribution. The treatment outcome was favourable in 71% of the cases, which is considerably lower than the WHO international target, 85%. However, the proportion of favourable treatment outcomes in Finland is at the same level as that of most other EU countries. The proportion of missing information is low compared to the other EU countries.

MYCOBACTERIUM BOVIS BCG

The *Mycobacterium bovis* BCG bacterial strain is a strain attenuated for vaccination, derived from the bacterial species *M. bovis* belonging to the *M. tuberculosis* complex. Adverse effects caused by the BCG vaccine in the vaccination programme increased after switching the vaccine manufacturer in August 2002. This was reflected as a rise in the number of *M. bovis* BCG findings in young children notified to the National Infectious Diseases Register. Nearly all findings were obtained from lymph node samples. The number of cases peaked in 2003 (30 cases) and decreased the following year. Similar increases of adverse effects after changing a vaccine have previously been reported.

In 2006, Finland limited the national vaccination programme against BCG to groups of at-risk children only. After this, the number of *M. bovis* BCG findings in young children has varied between one and three cases annually.

ATYPICAL MYCOBACTERIA

Laboratories report the findings of atypical mycobacteria to the National Infectious Diseases Register. Between 1995 and 2009, *M. avium* was clearly the most common finding reported (Table 15). Other common species included *M. gordonae, M. intracellulare, M. fortuitum* and *M. malmoense*. There was no significant annual variation in the distribution of the most common species. The virulence of this group of bacteria varies. Usually they cause so-called 'opportunistic' infections in persons with impaired immunity.

After the restriction of the national vaccination programme against BCG to groups of at-risk children only, the *M. avium* findings in the lymph node samples of small children have increased. Between 1995 and 2007, a total of only three cases was reported, whereas there was a total of 13 *M. avium* findings in young children between 2008 and 2009.

Table 15. Most common findings of atypical mycobacteria 1995–2009, number and %.

	n	Proportion
M. avium	414	23 %
M. gordonae	340	19 %
M. intracellulare	235	13 %
M. fortuitum	148	8 %
M. lentiflavum	111	6 %
M. terrae	69	4 %
M. chelonae	60	3 %
M. bohemicum	47	3 %
M. abscessus	40	2 %
M. peregrinum	38	2 %
M. interjectum	37	2 %
M. malmoense	36	2 %
M. simiae	33	2 %
M. nonchromogenicum	23	1 %
M. kansasii	22	1 %
M. marinum	18	1 %
Other atypical mycobacteria	96	5 %
Total	1767	100%

Other infections

- Sporadic cases of measles are detected each year. They have been imported to Finland by travellers.
- Epidemic nephropathy occurs mainly in December or January, peaking in December 2008.
- The number of tick-borne encephalitis cases has increased nearly everywhere in the Baltic Sea region. The Åland vaccination campaign has efficiently decreased the number of infections.
- The 2009 tularemia epidemic was to be expected, as epidemics occur every three years.
- The expected Pogosta disease outbreak did not occur. Epidemics occur every seven years.
- Borreliosis incidence unprecedented high again.
- Most malaria cases originated in Africa. Immigrants visiting their former home country without malaria prophylaxis are in the risk group.
- Cases of variant Creutzfeldt-Jakob disease, BSE (bovine spongiform encephalopathy) have not been detected in Finland.

HAEMOPHILUS (HAEMOPHILUS INFLUENZAE)

In 2009, there was a total of 47 cases of infections caused by the *Haemophilus influenzae* bacterium, detected from blood or cerebrospinal fluid. *Haemophilus influenzae* type b caused disease in four adults and two children. One of the children was four years old and the other under three months old. The adult patients belonged to an age group which did not receive Hib-vaccination as part of the vaccination programme in their childhood. Children born in 1985 and later have received a Hib vaccine at a child health clinic. From the beginning of 2005 onwards, according to the revised vaccination programme, the Hib vaccination is administered as part of a combination vaccine at the age of three, five and twelve months. The efficacy of the vaccine is monitored closely, and information on vaccinations is investigated among all children who have been diagnosed with Hib.

At the beginning of the 2000s, there were several years when no cases were diagnosed in the vaccinated age groups, while in some years sporadic cases were detected among those who had received a partial or full series of vaccinations.

MENINGOCOCCUS (NEISSERIA MENINGITIDIS)

In 2009, there were a total of 33 meningococcal infections detected from blood or cerebrospinal fluid. This is on a par with the previous year (29) but represents approximately one-fifth less than the average of the preceding ten years. The serogroup distribution was similar to that of the previous years. The majority of cases (73%) were caused by group B meningococci. There were three group C strains, and the group Y meningococcus caused the disease in five persons. Seven of the cases were diagnosed in children between birth and 4 years of age. No temporal or local clusters were detected. (Table 17).

Meningococcal infections slightly on the decrease

The number of meningococcal infections has decreased slightly: between 1997 and 2007, 40 to 58 cases were detected, and between 2008 and 2009, the number of diagnosed cases was 29 to 33 (1.1–0.6/100,000). Between 1995 and 1996, more cases occurred, nearly 80 (1.5/100,000). Most meningococcal infections affected young children (birth-age 4) and young adults (15–19-year-olds). There have been 9–22 cases per year among children under 15. The clusters between 1995 and 1996 increased the

Table 16. Invasive Hi and Hib cases 1995–2009, number.

	Haemophilus influenzae type b cases					All Haemophilus influenzae cases
	Hib cases	Vaccinated cases	0-4 years	5-15 years	> 15 years	
1995	6	2	1	2	3	13
1996	5	-	-	-	5	21
1997	3	1	-	2	1	18
1998	4	-	2	-	2	32
1999	7	3	2	1	4	32
2000	2	2	2	-	-	37
2001	3	-	-	-	3	49
2002	4	-	-	-	4	26
2003	8	4	4	2	2	37
2004	1	-	-	-	1	26
2005	5	-	1	1	3	45
2006	2	1	-	1	1	33
2007	6	-	1	1	4	54
2008	3	1	1	-	2	45
2009	6	1	2	-	4	47

Table 17. Meningococcal infections by serogroup 1995–2009, number.

	Group A	Group B	Group C	Group Y	Group W135	Unknown	Total
1995	-	50	22	-	-	6	78
1996	-	59	15	3	-	2	79
1997	-	36	5	3	-	2	46
1998	-	44	7	2	-	1	54
1999	-	35	9	8	1	5	58
2000	-	30	11	2	3	2	48
2001	-	34	9	4	1	3	51
2002	-	36	6	4	1	2	49
2003	-	28	5	6	-	2	41
2004	-	29	5	4	2	4	44
2005	-	33	1	3	-	3	40
2006	-	38	5	1	-	1	45
2007	-	29	8	5	-	1	43
2008	-	19	8	2	-	-	29
2009	-	24	3	5	-	1	33

incidence in the provinces of Southern Finland and Western Finland (1.3–2.2/100,000). After this, cases have been detected evenly all over the country with the exception of Lapland, where the incidence was high in 1998, 1999 and 2003 (2.01–2.13/100,000).

The strain was sent to the National Institute for Health and Welfare in more than 90% of the cases. The majority of cases were caused by group B meningococci. Fewer than ten group C strains per year were detected between 1997 and 2004, which was also the case with group Y strains. Group W135 strains began to appear after the turn of the millennium. Based on the subtyping results, group B meningococcal strains have been very heterogeneous in Finland.

MMR DISEASES (MEASLES, MUMPS, RUBELLA)

In 2009, two cases of measles were confirmed in Finland. Neither patient had been vaccinated; a one-year-old patient who had not yet been vaccinated and a non-vaccinated young adult. Measles had been contracted on travels to Iraq and Sicily. A sibling of both individuals who contracted measles abroad had been ill with measles already during the trip. The measles cases caused no additional cases in Finland.

There were also only two diagnoses cased of mumps in non-vaccinated adults. In both cases, the source of infection remained unclear.

In 2009, no cases of rubella were reported.

Endemic MMR diseases have been avoided

After the endemic MMR viruses were eradicated from Finland in the mid-1990s, the annual number of laboratory-confirmed cases has varied between zero and eight for each of the diseases (Figure 29). In the 2000s, a total of 11 cases of measles, 35 cases of mumps and 4 cases of rubella have been detected. All cases of measles and rubella have been brought in by Finnish or foreign travellers. For each case, the infection was traced to a European, Asian or African country. The majority of mumps cases were also brought into Finland by travellers, but for some cases, the source of the infection and the place of acquisition have remained unclear. Except for one case, the measles and rubella patients were non-vaccinated, but seven of the mumps patients had received a MMR or monocomponent mumps vaccine. In other parts of the world, in Europe and the United States, individuals vaccinated against MMR diseases have also been reported to have become ill during epidemics, particularly with mumps. Although the MMR vaccination coverage has exceeded 95% in the 1990s and the 2000s, imported MMR diseases may lead to extensive investigations and preventive measures. This occurred in 2008, when a child with measles arriving in Finland exposed a large number of children not yet vaccinated (due to their age). Thanks to a rapid diagnosis, the efficient tracing of exposed individuals and preventive measures, additional cases were avoided.

Currently, the proportion of individuals vaccinated against MMR is approximately half of the Finnish population. The protection provided by two MMR

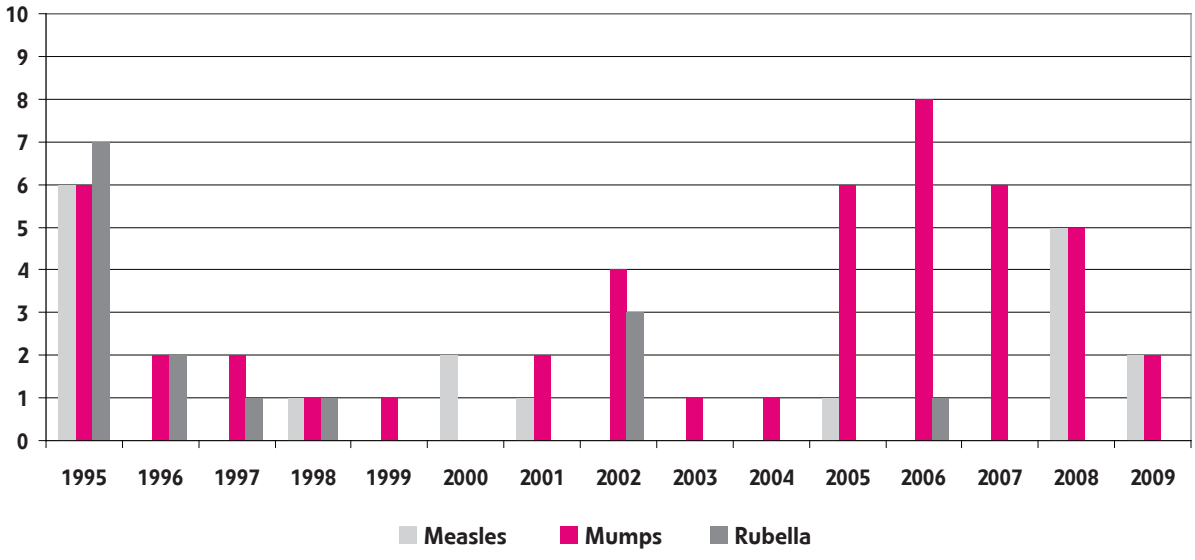


Figure 29. Measles, mumps and rubella cases in Finland 1995–2009, number.

vaccine doses has been sufficient until now. However, both the antibody surveillance study on the vaccinated population and seroepidemiological studies have shown that the level of antibodies produced by the vaccinations decreases significantly over time. The number of MMR cases and antibody levels must be closely monitored, particularly in the vaccinated age groups, in order to determine whether a booster vaccination is needed. MMR still occur widely in the world, including Europe. This is why diseases imported by travellers will continue to challenge the Finnish population's protection against these diseases in the future.

PUUMALA VIRUS

Epidemic nephropathy – Peak incidence from August to December

Between 1995 and 2009, there were nearly 25,000 notified cases of epidemic nephropathy caused by the Puumala virus. Of the patients, 61% were male, and 79% were 25–64 years old. The incidence of epidemic nephropathy among 25–44-year-old men is twice as high as among women in the same age group. Among those over the age of 65, the incidence was equally high among men and women.

There is seasonal variation in the incidence of epidemic nephropathy, with the highest number of cases occurring in December almost every year. Between 2005 and 2009, the highest monthly number occurred each year in December or January, peaking in December 2008, when almost 700 cases of epidemic nephropathy were detected. Between 1995 and 1997 and 2005 and 2008, another incidence peak could be seen in August. In 2008, an unusually high number of cases occurred as early as July. In addition, in the winters of two consecutive years, there are more cases than in the third year. This yearly and seasonal variation has been associated with the three-year cyclical variation of the bank vole population density, and with bank voles seeking their way to houses and sheds early in the winter, which increases the likelihood of Puumala virus exposure for humans.

A particularly high number of cases was diagnosed every three years in 1999, 2002, 2005 and 2008. Between 2005 and 2009, 1,927 to 3,259 annual cases have been detected.

The regions with a high incidence of epidemic nephropathy may vary from year to year depending on the bank vole population density. The incidence proportional to population has almost always been highest in the hospital district of Southern or Eastern Savo (Figure 31). However, in 2006 and 2007, the highest incidence occurred in the hospital districts of Lapland and Kainuu. In 2009, the highest proportional incidence occurred in the hospital district of Southern Savo (182/100,000).

TICK-BORNE ENCEPHALITIS (TBE)

Efficient results for the Åland vaccination campaign

The number of tick-borne encephalitis (TBE) cases has increased since the 1990s almost everywhere in the Baltic Sea region. In Finland, 5 to 42 TBE cases have been detected each year. Since 2005, the number has once more been slightly on the increase. In 2009, 26 TBE antibody findings were reported to the National Infectious Diseases Register. The clinical presentation of 25 cases corresponded to TBE. In 2009, TBE infections occurred between June and November. The patients' age range was 5 to 80.

Before the vaccination campaign that was launched in Åland in 2006, about two-thirds of the patients were from Åland. After this, a greater proportion of the patients have come from other parts of Finland. In 2009, 22 patients came from outside Åland.

In order to identify the place of acquisition, a communicable disease doctor from the National Institute for Health and Welfare interviewed patients with TBE diagnosed in 2009 and/or reviewed their patient records. Two patients had contracted theinfection in Simo, two in the Kokkola region, one in Lappeenranta, one in Imatra, seven in the Turku archipelago, and 9 in Åland.

Based on the systematic investigation of the place of acquisition, Närpiö (in 2007), Varkaus (in 2008), and Simo (2008 and 2009) have been identified as possible endemic TBE regions. This does not change the current vaccination recommendations.

If a patient falls ill with meningitis or encephalitis between May and October, TBE should be suspected even if he or she has not noticed a tick bite and has not been in an identified endemic TBE region.

Along the coast of Gulf of Bothnia the cases typically occur during early summer when the vector species taiga tick lives its most active season. Along the line from Åland to Lappeenranta the prevalent ticktype spreads the virus later and the peak of cases appears during late summer. It is worth remembering that TBE infection can also be imported (endemic areas are among others Central Europe, Sweden, Baltic countries and Russia).

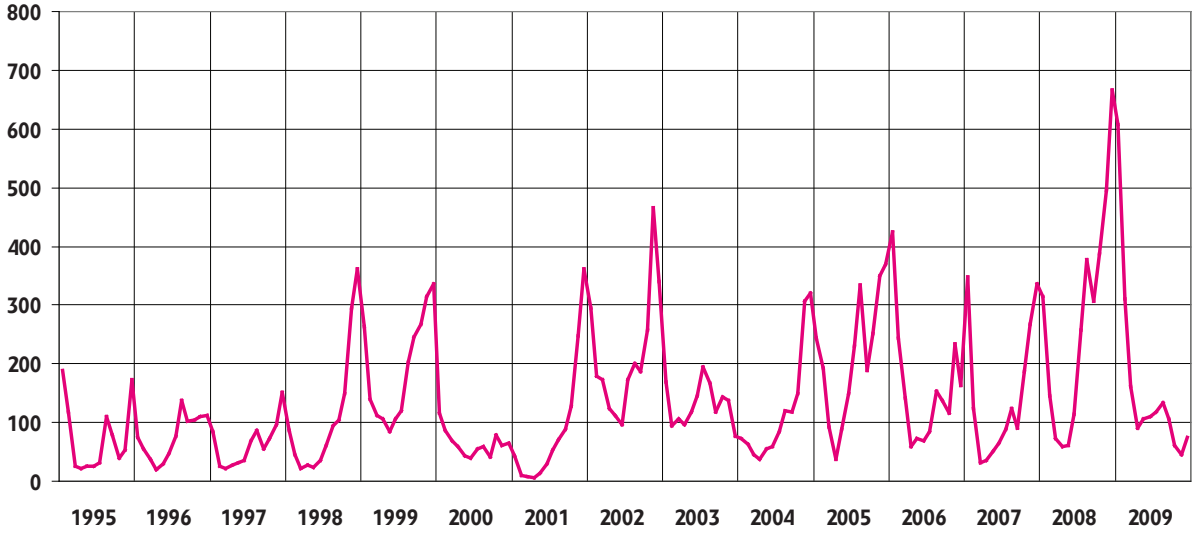


Figure 30. Puumala virus cases by month 1995–2009, number.

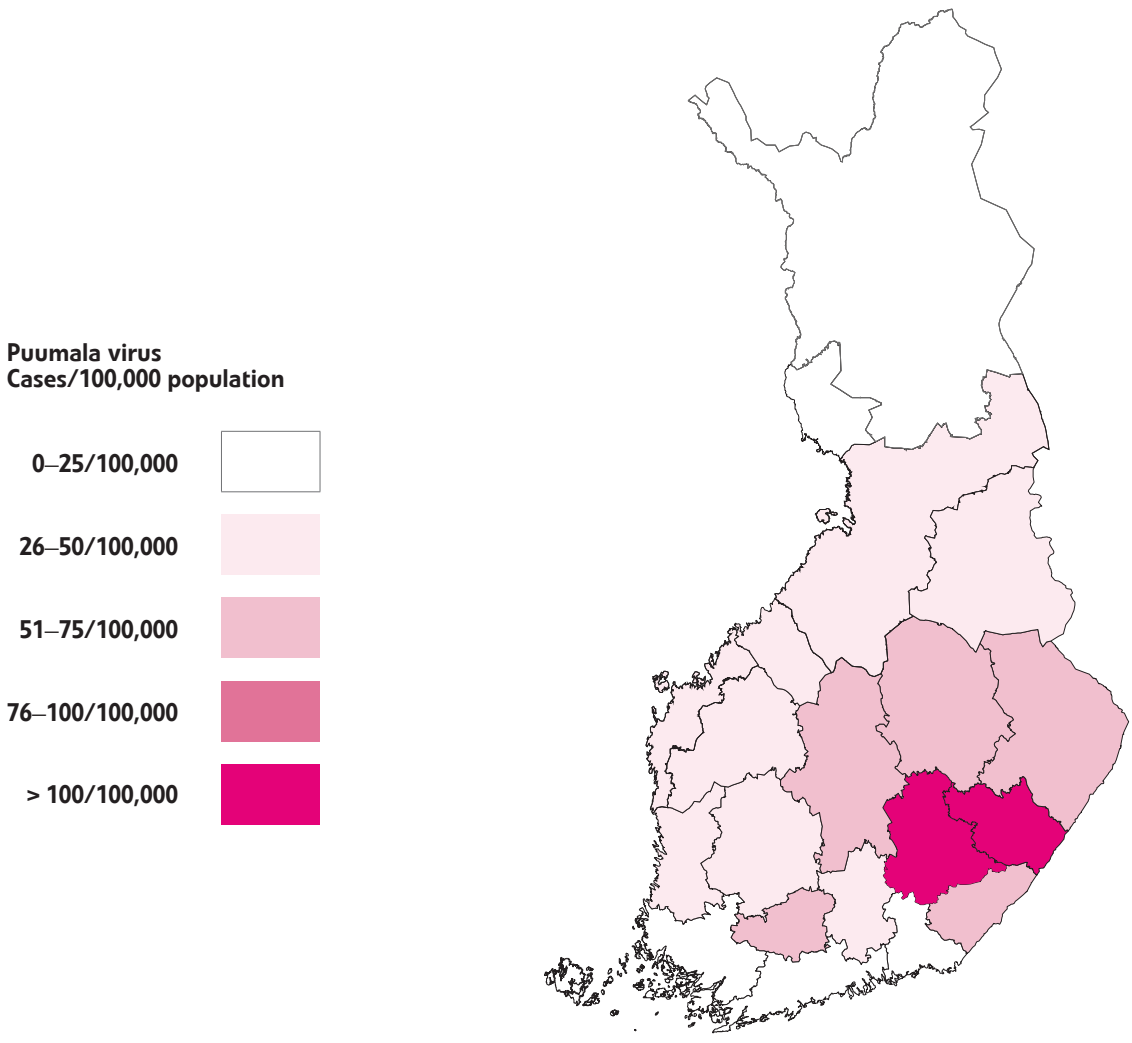


Figure 31. Puumala virus cases by hospital district 2009, cases/100,000 population.

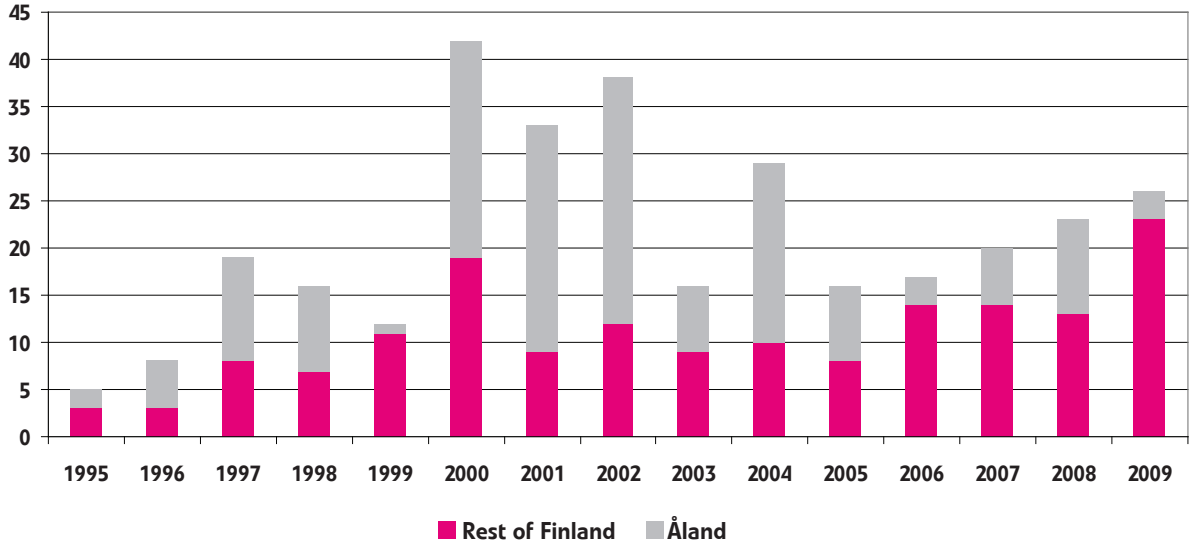


Figure 32. Tick-borne encephalitis, Åland and rest of Finland 1995–2009, number.

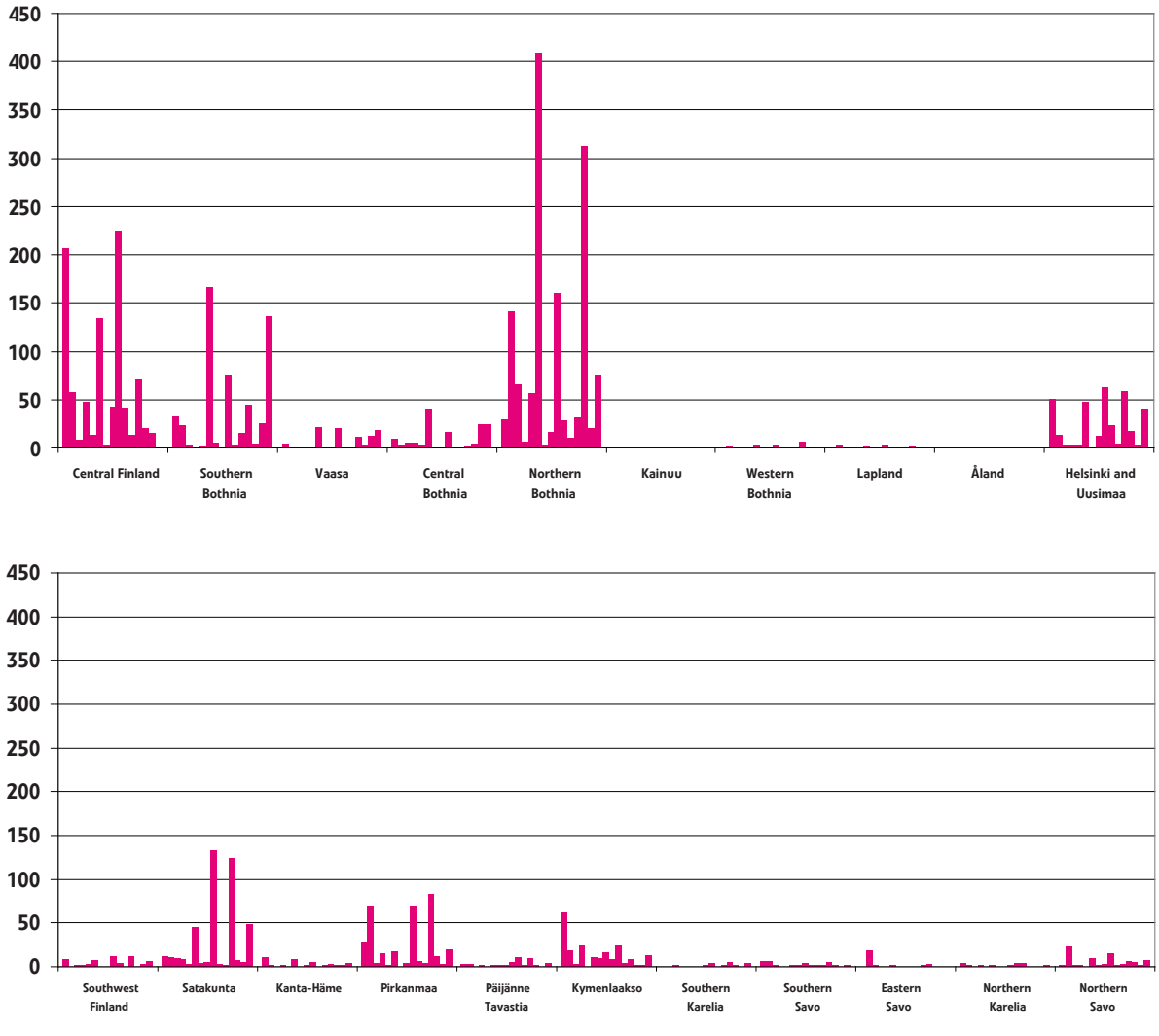


Figure 33a/33b. Tularemia cases by hospital district 1995–2009, number.

TULAREMIA (FRANCISELLA TULARENSIS)

In 2009, 405 microbiologically confirmed tularemia infections (7.6/100,000) were reported to the National Infectious Diseases Register. As in previous years, the majority of cases were detected between August and September, and infections were diagnosed in all age groups, most frequently in 40–65-year-olds. Of the patients, 62% were male.

As extensive tularemia epidemics seem to occur in three-year cycles, the 2009 epidemic was to be expected. The annual tularemia incidence rate varies considerably on the basis of outbreaks (0.5–18/100,000). The previous peak years include 2000 (926 cases), 2003 (823 cases) and 2006 (475 cases).

Endemic tularemia occurs in Northern Bothnia, Southern Bothnia and in Central Finland near flowing bodies of water. In 2009, there was an unexpected geographical distribution of the cases, as the Central Finland hospital district only diagnosed one tularemia case, whereas the corresponding figure was 70 in 2006 and as high as 226 in 2003. In 2009, most cases were reported in Southern Bothnia hospital district, where the incidence was 68.5/100,000. However, in Northern Bothnia hospital district, the incidence (19.5/100,000) was lower than average (in 2000, 111.6/100,000; in 2003, 99.4/100,000; in 2006, 8.12/100,000; and in 2009, 19.5/100,000).

Francisella tularensis is a zoonosis that is probably carried by rodents. Tularemia incidence among wild rodents in Finland is currently under study. In Finland, tularemia is mainly transmitted by insect bites. The site of the bite becomes sore, and it develops into an ulcer. The infection then spreads into local lymph glands (ulcero-glandular form). The disease may also be transmitted through airways. In this case, the disease is mostly manifested as pneumonia associated with severe general symptoms. The pulmonary form caused by inhaling hay dust during harvesting is a farmers' occupational disease.

POGOSTA DISEASE (SINDBIS VIRUS)

The occurrence of outbreaks at seven-year intervals and the clustering of reported cases between late July and September are typical of Pogosta disease. The most recent outbreak was in 2002, when 597 cases were reported. An outbreak was expected to occur again in 2009, but only 106 cases were reported, (2/100,000), Figure 34. The highest number of cases were detected in the hospital districts of Northern Karelia and Central Finland. The patients were mainly middle-aged, and 64 (60%) of them were women. Of the cases, 98 (92%) were detected between July and September.

Since 1974, Pogosta disease has recurred relatively regularly at seven-year intervals, and extensive outbreaks have occurred in 1981, 1995 and 2002. After the incubation period, which is less than one week, the disease causes a fever which may be associated with a rash and joint symptoms which may be long-term and last several years. The Pogosta disease has been found particularly in Eastern Finland. The Sindbis virus is assumed to be transmitted by insect bites, and forest game birds are considered possible animal reservoirs for the disease.

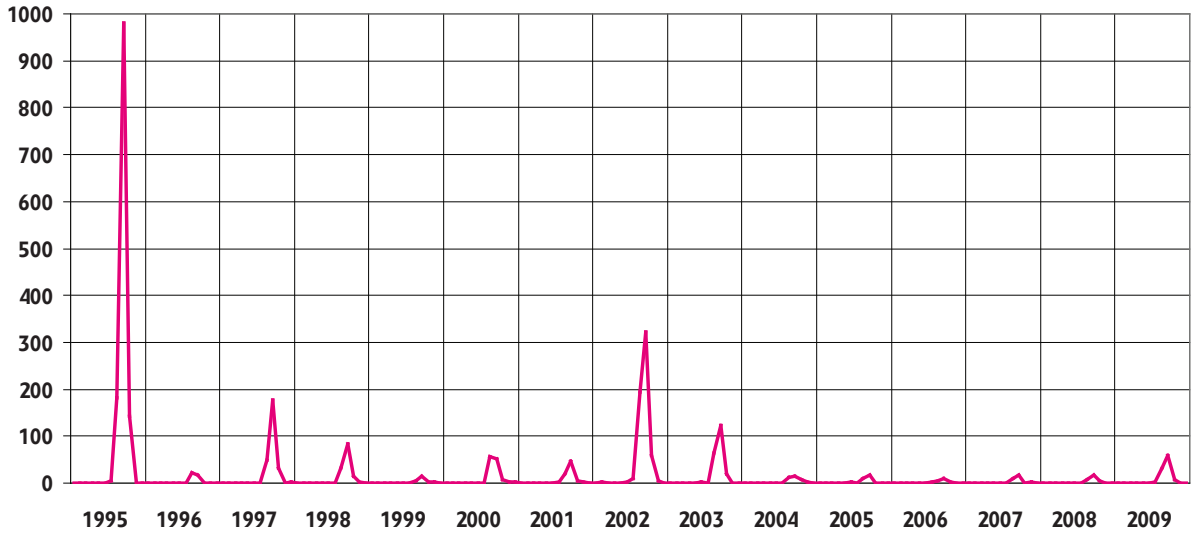


Figure 34. Pogosta disease cases by month 1995–2009, number.

BORRELIA (LYME DISEASE)

In 2009, there was a new record of borreliosis, nearly 1,500 detected cases (28/100,000), whereas the total number was under 350 in 1995. The incidence was by far the highest in Åland (1,064/100,000). The number of borreliosis cases detected in Åland between 2008 and 2009 has slightly decreased from the peak year of 2007 (515–405–292). In mainland Finland, the incidence increased slightly in the province of Western Finland: between 2000 and 2004, the average incidence was 7/100,000 and between 2005 and 2009, 8/100,000. In the province of Southern Finland, both the incidence and the increase were higher: between 2000 and 2004, the average was 14/100,000 and between 2005 and 2009, 29/100,000. In the province of Eastern Finland, the incidence only increased slightly: between 2000 and 2004, the average increase was 13/100,000 and between 2005 and 2009, 15/100,000. In the provinces of Oulu and Lapland, there were generally fewer than 10 annual borreliosis cases.

The highest number of borreliosis cases was detected between August and September, with the exceptions of October 2006 and November 2008. Between 2005 and 2009, 54% of the patients were women, and 73% of the patients were over 45 years old.

The number of borreliosis cases has constantly increased. Borreliosis incidence is affected by humidity which is favourable to the tick, variation in animal reservoir strains and human outdoor activities. The increase has been highest in Åland and in recent years, in Southern Finland. In the Oulu region and in Lapland, where cases only occur sporadically, no obvious increase can be detected. In Eastern and Western Finland, the increase has been lower. It is difficult to determine an exact northern limit for the occurrence of borreliosis (Figure 35).

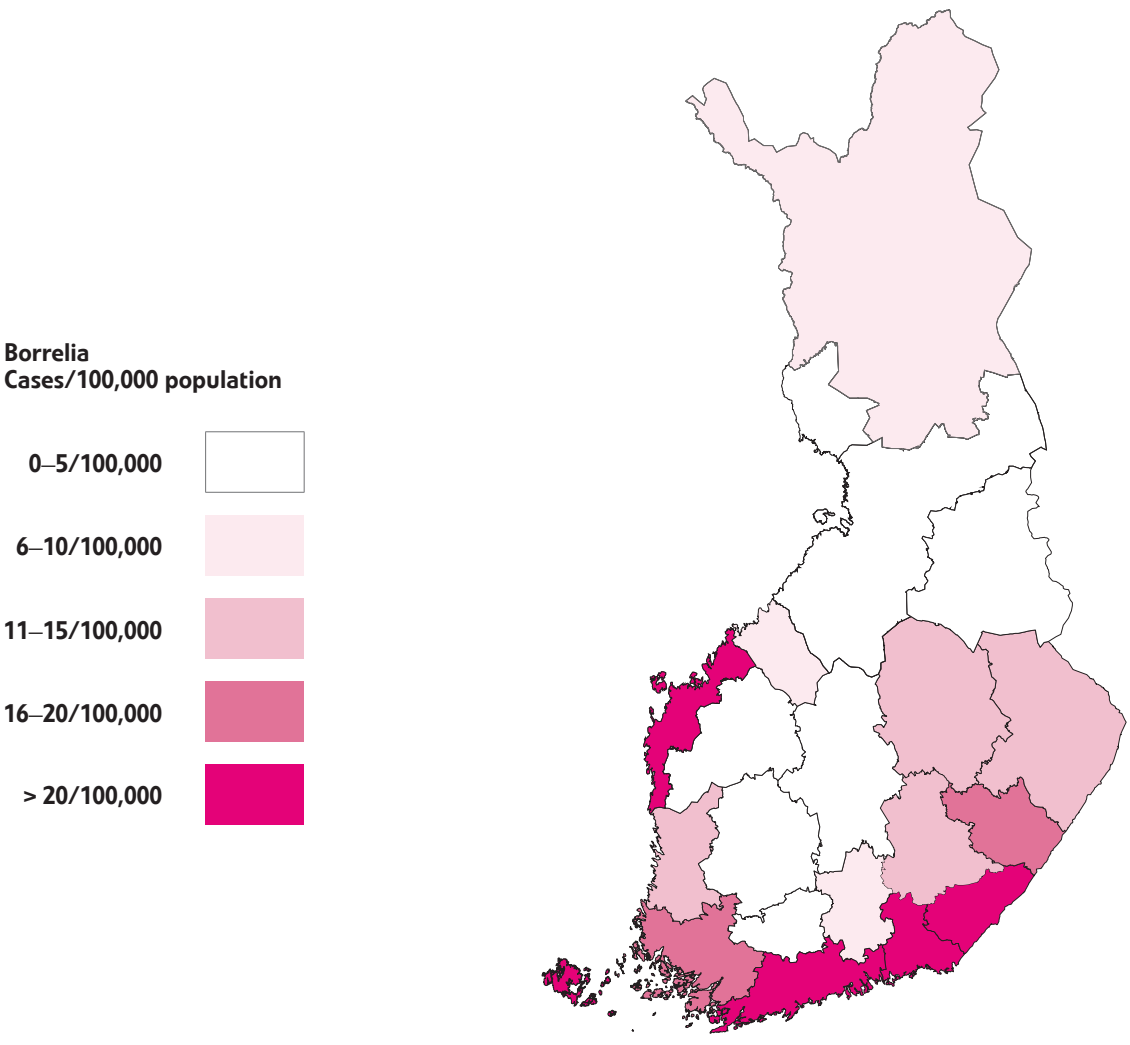


Figure 35. Borreliosis cases by hospital district 2009, cases/100,000 population.

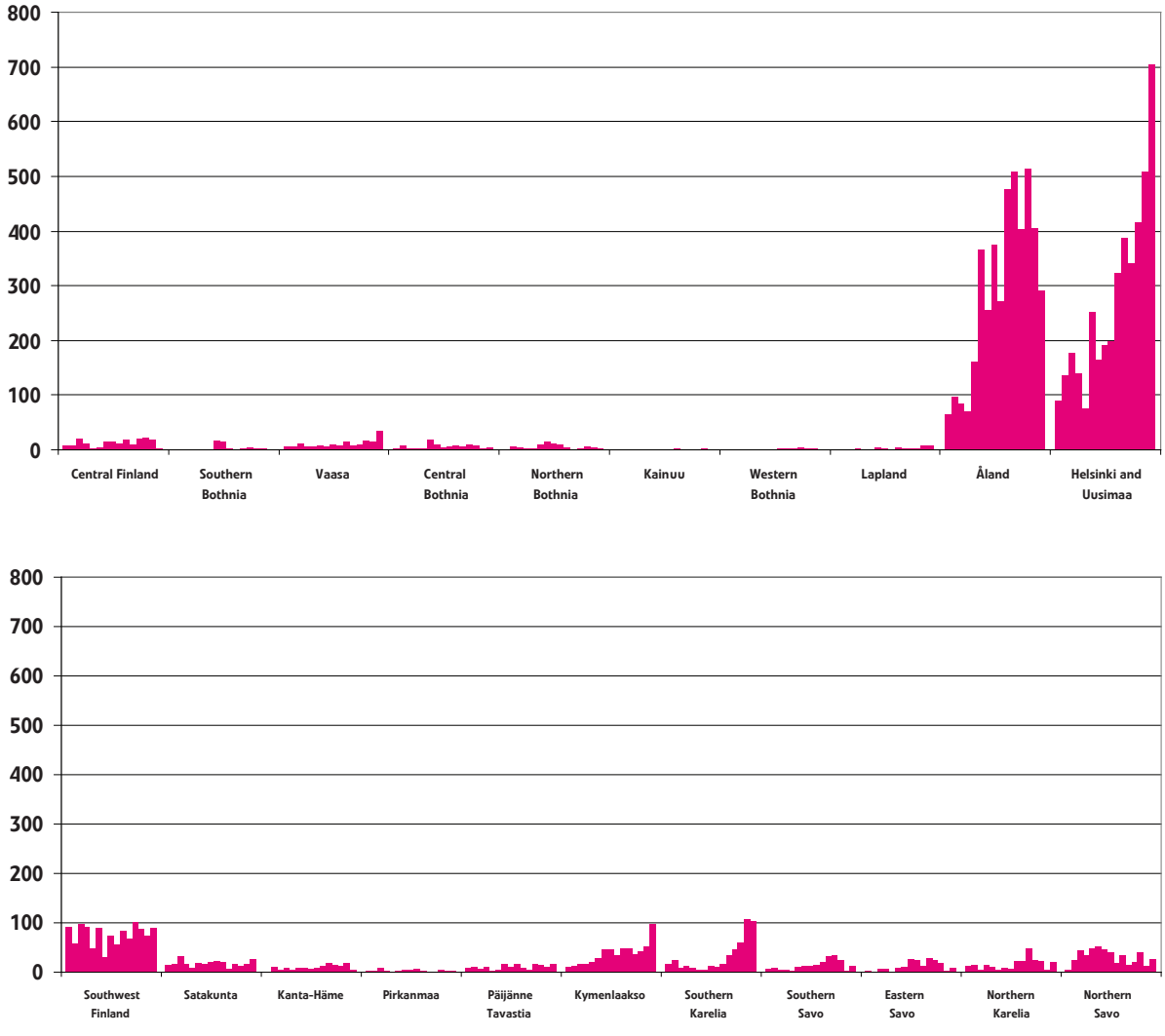


Figure 36a/36b. Borreliosis cases by hospital district 1995–2009, number.

ANTHRAX

Between 1995 and 2009, no human infections caused by the *Bacillus anthracis* bacterium were detected in Finland. Anthrax is a dangerous animal disease occurring mainly in bovines, sheep and goats. Anthrax cases found in cattle are also very rare. In 2008, a *Bacillus anthracis* infection was confirmed in one bovine. The previous case was detected in 2004 in a bovine from the same cattle farm. The disease did not spread elsewhere in either of the cases, and no humans contracted it. It is likely that the soil at the farm is contaminated, since the bacterium forms spores which can be preserved in the soil for decades. Human infections are extremely rare. Humans may contract the infection by contact with an infected animal or contaminated soil, through airways, through the digestive tract or most commonly, through a skin wound. Since the anthrax bacterium spores can also be used for biological terrorism, confirmed or probable anthrax cases are immediately reported to all EU member states via the EU early-warning system.

RABIES

In 2009, 60 notifications of suspected rabies cases were made to the National Infectious Diseases Register. Notifications are made on suspected cases in which postexposure prophylaxis is started based on a risk assessment. The patients were aged 6 to 72 years (median age 31), and 52% were women. During the surveillance period, the greatest number of reports of suspected cases were made in 2007

(72 notifications). In the majority of suspected rabies cases, the exposure occurred while travelling abroad, and the animal causing the exposure has been a dog. The only human rabies infection of the surveillance period was detected in 2007. The infection was contracted from a dog bite in the Philippines. Due to the infection, many members of the nursing staff received postexposure prophylaxis. In addition, a rabies-infected dog puppy imported from India against import requirements caused the exposure of several individuals that same year. During the surveillance period, a rabies infection was detected in a pony imported from Estonia in 2003 and in a Finnish bat in 2009. Individuals exposed by these animals received postexposure prophylaxis.

VARIANT CREUTZFELDT-JAKOB DISEASE (VCJD) AND BSE

Creutzfeldt-Jakob disease in Finland, 1997–2009

The Creutzfeldt-Jakob disease (CJD) is a rare degenerative central nervous system disease which generally leads to death in less than a year. The most common form of the disease is the sporadic CJD which occurs globally with approx. one case per million inhabitants each year. The familial, or genetic, form of the disease usually constitutes 5–15% of the cases. An exceptionally high incidence of the genetic form has been reported in Israel, Slovakia and Hungary.

The Creutzfeldt-Jakob disease (CJD) surveillance group was established by the National Public Health Institute (KTL) in case of the spread of the new disease form, the variant CJD (v-CJD), which was discovered in Britain in the mid-1990s. It is a form of bovine spongiform encephalopathy (BSE) transmitted to humans that affects exceptionally young patients. The clinical and neuropathological presentation of the disease form clearly differs from that of the sporadic CJD. The surveillance consisted of chief neurology physician Jussi Kovanen's register of cases reported to himself and to professor of neuropathology Matti Haltia and from 2004 and 2005 onwards, to docent Anders Paetau, which were then reported to the National Public Health Institute. The neurophysiological expert was docent Tapani Salmi, and the neuroradiological expert was docent Oili Salonen. Finnish neurological and neuropathological units have been aware of this system and have comprehensively reported new cases. A significant proportion of the suspected cases have been reported during the patient's lifetime. The number of cases has been reported with 4–6-month intervals to the EU surveillance unit at Edinburgh, where genetic studies have been carried out if necessary. The unit has also provided expert help, and during its meetings, e.g. diagnostic criteria have been established for different forms of the disease. Efforts have also been made to harmonise the collection of information between different countries.

Between 1997 and 2009, a total of 97 CJD cases were detected. Five of them were genetic. The number of patients varied annually between 4 and 13 (an average of 7.5), approx. 1.4 cases per million inhabitants. The figure is on a par with the figures of most EU countries. The cases were mainly neuropathologically confirmed, and the patients were aged 50 to 75. The cases included a few young patients with sporadic CJD, but no v-CJD patients have been found. No signs of increase or decrease in the number of cases have occurred during the surveillance period.

MALARIA

In 2009, 34 malaria cases were detected in Finland. There were 24 cases of *Plasmodium falciparum*. In addition, five *P. vivax*, three *P. ovale* and two *P. malariae* cases were diagnosed.

Most of the infections (29 cases, 85%) had their origins in Africa. Of these infections, 23 had been acquired in Western Africa and 6 in Eastern Africa. Two infections were acquired on the Indian subcontinent, two in South-East Asia and one in South America. Nine patients were native Finns who had taken a trip of less than six months to a malaria region and six were Finns residing in a malaria region. Twelve patients were immigrants from malaria regions who had visited their former home. Five were refugees who became ill immediately after arriving in Finland. Two were visitors to Finland.

Compared to previous years, the countries of malaria acquisition and the risk groups remained approximately the same. None of the patients who fell ill with falciparum malaria had used appropriate malaria prophylaxis. Four of them required enhanced surveillance or intensive care due to complications. However, no one died.

Majority of cases from Africa between 1995 and 2009

In the past 15-year period, the number of malaria infections was highest in 1997 with 59 diagnosed cases, after which the number has varied on average between 20 and 40 annual cases. In late 2008, the total

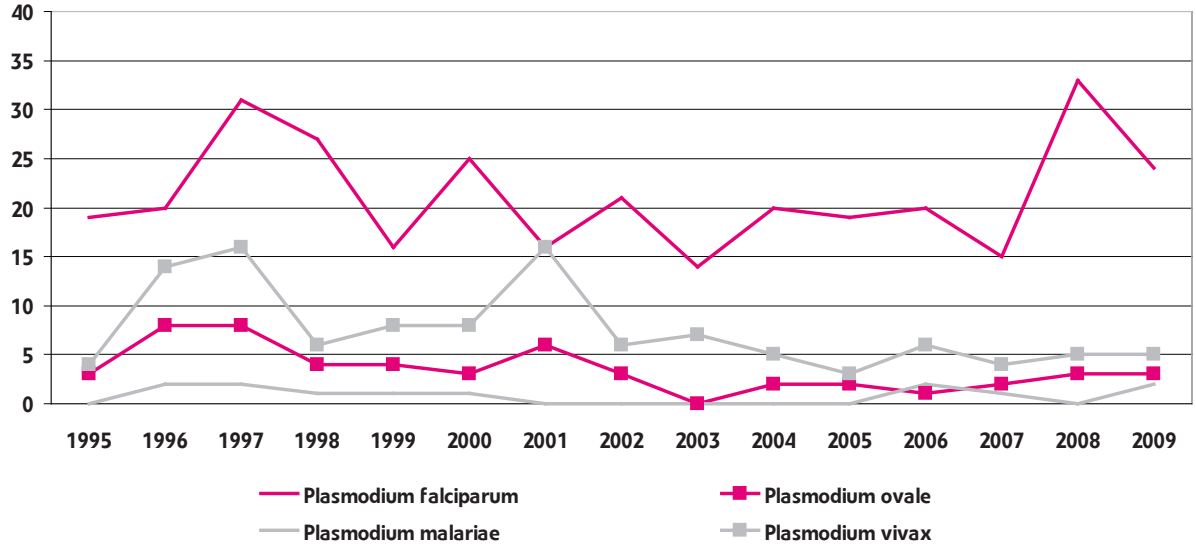


Figure 37. Malaria cases by pathogen type 1995–2009, number.

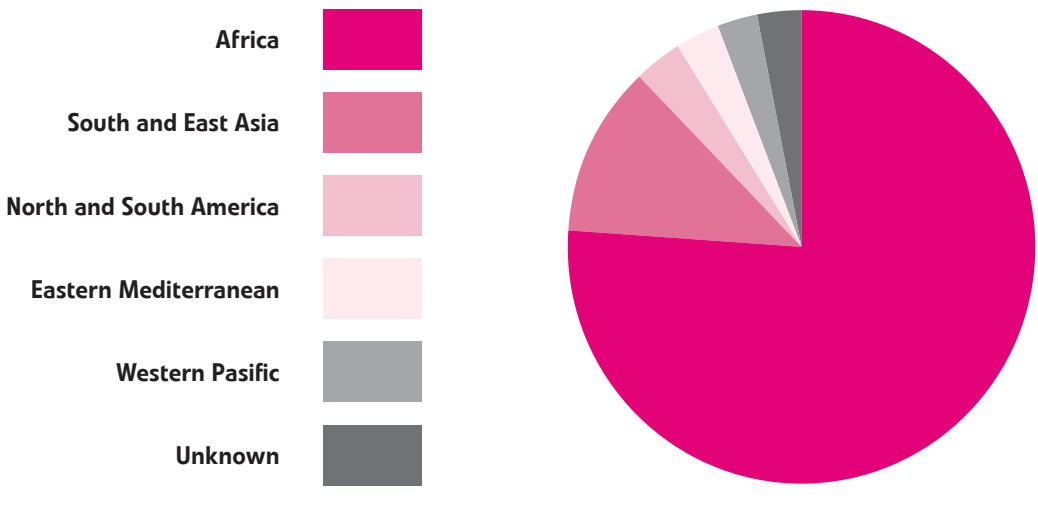


Figure 38. Malaria cases in Finland by continent of origin 1995–2009, %.

number increased due to a malaria cluster of 14 Finns travelling to Gambia. Most of these are falciparum malaria cases, and the majority of all cases were acquired in tropical Africa to the south of Sahara. Most malaria cases are Finns who have been on a short trip to a malaria-endemic region and who have totally ignored prophylaxis or have taken it irregularly or used ineffective prophylaxis. Some of the patients are immigrants from malaria-endemic regions, recently arrived in Finland.

The malaria risk is highest in tropical Africa, where malaria prophylaxis should always be used.

BLOOD AND CSF FINDINGS IN CHILDREN

Blood culture findings in children

There were 683 cases with blood culture positive findings in children under 15 years of age in 2009, which is on a par with previous years. Of the findings, 55% were diagnosed in infants under 12 months old.

Among infants, *Staphylococcus epidermidis* and other coagulase-negative staphylococci caused nearly half of blood culture positive infections. These bacteria,

which are part of the skin's normal flora, typically cause so-called 'late-onset' sepsis in newborns in intensive care. The second most common cause (14% of the findings) was *Streptococcus agalactiae* (Group B streptococcus, GBS). It is typically contracted from the mother's birth canal during labour and causes an infection in the newborn baby during the first days of life (an early-onset sepsis). Other common causes of infection were *Escherichia coli* (10% of the findings), *Streptococcus pneumoniae* (7%), and *Staphylococcus aureus* (6%), as expected. One of the reported *S. aureus* cases was caused by a methicillin-resistant strain (MRSA). The proportion of enterococci in blood findings in infants was low (4%).

S. pneumoniae was the most common finding in 1–14-year-olds, accounting for about 30% of the reported cases in this age group. It was followed by coagulase-negative staphylococci (26% of the findings), *S. aureus* (12%) and the *Streptococcus viridans* group (8%). None of the reported *S. aureus* cases was caused by a methicillin-resistant strain (MRSA).

The number of cases annually reported among children under the age of 15 has varied between 600 and 800 since 1995. No significant changes have occurred in the distribution of microbes causing the infections. A total of 5 to 17 (1–3% of all findings) cases of meningococcal sepsis have been reported annually. The number of GBS findings, which, apart from occasional exceptions, have been found in newborns, has varied annually between 39 and 73 (6–9% of all blood culture findings in children). In the 2000s, the proportion of coagulase-negative staphylococcal findings has stabilised to slightly over one-third of all reported cases. Infections caused by these bacteria are typically healthcare-associated; predisposing factors include a weakened immune system, medical procedures, and foreign devices (e.g. a central venous catheter). During the fifteen-year surveillance period, the proportion of fungi has remained low (0–3%) in all blood culture findings.

Cerebrospinal fluid findings in children

In 2009, there were a total of 44 notified cases of microbial findings related to children's central nervous system infections. Of the cases, 25 were detected in infants under 12 months old.

The most common findings in children under 12 months old were *S. agalactiae* (6 cases), coagulase-negative staphylococci (5 cases), pneumococcus, meningococcus, *S. aureus* and the *S. viridans* group (2 cases each). Other types of findings involved only single cases.

Among 1–14-year-olds, the most common findings included coagulase-negative staphylococcus (5 cases), pneumococcus (4 cases), *S. aureus* (3 cases) and meningococcus (2 cases). Other types of findings involved only single cases.

Since 1995, the number of cerebrospinal fluid findings in under-15-year-olds has varied between 15 and 64. Annual meningococcal findings have totalled 4 to 16. The relative proportion of meningococcal findings has been no more than 20% since 2002, whereas the meningococcus was reported in almost half of the cases in this age group between 1998 and 2001. Central nervous system infections caused by coagulase-negative staphylococci have become more common since 2002. In most years, coagulase-negative staphylococcus has been the most common finding, and its proportion has varied between 15% and 47% (6–28 annual findings). The number of pneumococcal findings has varied between 0 and 16, and its proportion of all findings has been 10–30% in most years. Each year 1 to 10 cases of GBS meningitis in newborns have been reported. The number of findings has varied between 3 and 7 since 2005.

Neonatal GBS disease

Between 1995 and 2009, an average of 35 annual cases of early GBS disease (total blood and/or cerebrospinal fluid findings in under-7-day-olds) (range 28–57 cases/year; incidence 0.5–1.0 cases/1,000 live-births). Between 2008 and 2009, there occurred 29 to 30 cases (0.5 cases/1,000 live births). An average of 14 annual cases of late GBS disease cases detected at the age of more than 7 days have occurred during the 15-year surveillance period (range 6–24 cases/year; incidence 0.1–0.4 cases/1,000 live births). Between 2008 and 2009, there occurred 14 to 20 cases (0.2–0.3 cases/1,000 live births).

Table 18. Blood culture findings 1995–2009, infants (under 1 years of age), number.

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Staphylococcus, other than aureus	45	53	56	58	84	76	99	112	81	146	129	142	131	120	107
Staphylococcus epidermidis	41	48	44	50	63	49	76	76	61	110	98	100	92	87	64
Streptococcus agalactiae	45	50	42	48	42	38	41	46	37	45	73	55	51	49	51
Escherichia coli	52	39	41	48	39	43	39	40	39	37	41	44	42	38	38
Streptococcus pneumoniae	20	11	14	17	16	26	19	17	25	28	26	28	21	26	25
S. aureus	27	22	22	33	29	17	17	24	21	32	32	37	25	23	22
Enterococcus faecalis	9	16	4	11	7	4	6	11	11	9	15	22	8	5	10
Streptococcus viridans group	7	10	9	6	10	6	10	8	13	15	12	10	9	8	9
Klebsiella species	5	12	8	8	10	9	8	7	8	9	9	8	6	8	9
Neisseria meningitidis	3	6	2	5	4	8	3	2	2	5	3	2	3	3	5
Streptococcus pyogenes	2		1	1	2	1	2	1	1	3			3	2	4
Enterobacter species	9	5	7	7	10	6	6	6	6	5	3	13	8	6	3
Streptococcus, other than beta-haemolytic	2		1	5		1		1	1	2		1			3
Haemophilus influenzae		2		3	3	2	3		2	1	2	1	1	2	2
Enterococcus faecium	5		5	1	1	4	1	2	2	3	2	3		1	2
Streptococcus bovis group						1		1	1	1	1				2
Enterococcus, other or unknown	3	3								1					2
Serratia species	1			1		3		5	2	4		2	3	4	1
Acinetobacter species	4	1	1	3	2	1		4	3	1	1	3	2	1	1
Listeria monocytogenes	1	2	1			1	1					2	1		1
Other bacteria	24	13	13	25	26	18	14	19	15	17	10	14	19	17	12
Bacteria, total	305	293	271	330	348	314	345	382	331	474	457	487	425	400	373
Candida albicans	5	3	1	3	11	3	3	10	2	3	4	4	2	3	1
Other candida species	1	1			5	9	8	8	2		1		1	1	
Other fungi													1		
Fungi, total	6	4	1	3	16	12	11	18	4	3	5	4	4	4	1

Table 19. Blood culture findings 1995–2009, children (1–14 years of age), number.

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Streptococcus pneumoniae	72	87	74	60	61	72	76	92	94	88	101	99	115	87	92
Staphylococcus, other than aureus	59	31	41	34	52	63	44	54	46	34	54	48	51	35	48
S. aureus	44	35	54	48	57	42	35	58	47	58	41	37	42	40	36
Staphylococcus epidermidis	52	27	36	24	43	48	26	40	30	25	41	40	33	22	31
Streptococcus viridans group	21	22	27	26	19	18	23	13	13	18	24	24	23	21	25
Escherichia coli	12	12	19	13	14	20	5	13	13	15	10	16	12	14	12
Streptococcus pyogenes	2	8	2	10	11	9	9	10	12	4		9	13	11	11
Enterococcus faecium	1	1	2			2	2	4	1	2	2	3	4	2	7
Other grampositive cocci	2	4	5	5	7	6	6	4	2	8	7	9	6	4	6
Enterococcus faecalis	5	3	1	2	3		2	4	2	2	4	2	6	6	4
Acinetobacter species	3	4	3	3	5	5	5	8	2	1	4	1	2	2	4
Enterobacter species	4	5	3	3	2	2		1	6	3	3	1	2	4	3
Haemophilus influenzae	2	3	2	1	2	2	2	1	5		2	1	2	3	3
Pseudomonas aeruginosa	3	4	4	7	1	6	7	4	6	3	6	3	2	1	3
Pseudomonas, other than aeruginosa	1	2	3	1	1	1	3	1	1		1		1		3
Klebsiella species	4	1	7	3	4	2	2	6	4	5	10	3	6	5	2
Streptococcus, other beta-haemolytic	1			1	1	1	1		3	2	2	4	1		2
Neisseria meningitidis	3	11	8	9	12	9	9	8	6	2	7	5	3	4	
Serratia species	1	1	1					1			1	2	1		
Other bacteria	25	35	33	31	39	36	18	27	27	25	38	26	39	32	17
Bacteria, total	317	296	325	281	334	344	275	349	320	295	358	333	364	293	309
Candida albicans	6	1	2		2	4	1	2	1		1	1		2	
Other candida species	3	2	1	2	4	1				1		2	3	1	
Other fungi			3	1	1			1	2			2	1		
Fungi, total	9	3	6	3	7	5	1	3	3	1	1	5	4	3	0

Table 20. Cerebrospinal fluid culture findings 1995–2009, infants (under 1 years of age), number.

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Streptococcus agalactiae	2	8	2	9	4	4	2	5	1	10	7	7	6	3	6
Staphylococcus, other than aureus	2		3					8	4	5	4	3	2	5	3
Streptococcus pneumoniae	5	2	2	1				3	6	8	3	1	4	3	2
S. aureus	1	1	1	1		1			3	2	1		1	2	2
Staphylococcus epidermidis	2		3					3	3	3	3	3	2	1	2
Neisseria meningitidis	2	3	3	2	2	4	3	1	2	4		1	2	1	2
Streptococcus viridans group	2								1						2
Escherichia coli		1	2	3	1		3	1	1	2		2	1	1	1
Streptococcus pyogenes			1												1
Haemophilus influenzae	1			1			1		1		1				1
Klebsiella species								1		1					1
Enterococcus faecalis			1	1	2				1	1		2	1		
Enterococcus faecium			1									1			
Pseudomonas, other than aeruginosa									1	1					
Other Haemophilus species		1													
Other bacteria	0	1	4	0	0	0	0	3	1	3	0	2	2	0	1
Bacteria, total	17	17	23	18	9	9	9	25	25	40	19	22	21	16	24
Candida albicans															1
Other candida species															
Other fungi															
Fungi, total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

Table 21. Cerebrospinal fluid culture findings 1995–2009, children (1–14 years of age), number.

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Streptococcus pneumoniae	7	6	2		1			2	10	2	1	5	5	2	4
Staphylococcus, other than aureus		8	3					10	3	6	4		1	5	3
S. aureus	2	1	6	2	2	1		1	2	2			2	3	3
Staphylococcus epidermidis		6	2					7	1	4	2		1	5	2
Neisseria meningitidis	8	6	9	14	9	5	4	7	4	4	5	7	5	3	2
Streptococcus pyogenes								1							
Streptococcus viridans group	2		1						1	1		2			
Enterococcus faecalis			2			1				1	1				
Enterococcus faecium								1		1					
Enterococcus, other or unknown		1													
Escherichia coli						1						1			
Klebsiella species						1			1						
Other bacteria	2	4	1	0	2	1	2	8	4	2	7	3	0	8	5
Bacteria, total	21	32	26	16	14	10	6	37	26	23	20	18	14	26	19
Candida albicans										1					
Other candida species															
Other fungi															
Fungi, total	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0

BLOOD AND CSF FINDINGS IN ADULTS

Blood culture findings in adults

In 2009, nearly 11,000 blood culture findings in adults were reported. Gram-positive bacteria were more common in the working-age population (15–64-year-olds) and gram-negative bacteria among those aged 65 or more. Anaerobic bacteria constituted less than 4% and fungi about 2% of all blood culture positive findings in adults.

In the working-age population, the most common 2009 bacterial finding was *Escherichia coli*, constituting about a fifth of all cases. It was followed by coagulase-negative staphylococci (17%), *Staphylococcus aureus* (12%), and *Streptococcus pneumoniae*, (10%). The methicillin-resistant *S. aureus* (MRSA) caused approx. 2% of all *S. aureus* bacteremias.

E. coli was also the most common blood culture finding among patients aged 65 years or more (accounting for a third of all findings). The next most common bacterial findings were coagulase-negative staphylococci (11%), *S. aureus* (11%), *Klebsiella* species (6%), and *S. pneumoniae* (5%).

The total number of blood culture findings in adults doubled between 1995 and 2009, from approx. 5,000 to almost 11,000 cases. The number of reported cases increased more in the group of patients aged 65 years or more than in the working-age population. There were no significant changes in the proportion of gram-positive and gram-negative bacteria during the surveillance period. The proportion of anaerobic bacteria and fungi has remained stable.

Between 1995 and 2009, the number of *E. coli* cases more than doubled. They have increased particularly in the 2000s. *S. aureus* and pneumococcal findings increased slightly less. Enterococcus species, particularly *E. faecium,* increased both among the working-age population and the elderly, but their relative proportion has remained unchanged. *Klebsiella* findings have increased as well, particularly among older people. The increase in the number of reported cases of coagulase-negative staphylococci in the working-age population has stabilised in the 2000s.

The number of notified Candida cases increased to some extent during the 15-year period, but their relative proportion has decreased; the proportion of non-albicans species has remained somewhat the same. The numbers of *Pseudomonas aeruginosa* findings and *Acinetobacter* species remained stable in the working-age population. *Pseudomonas* findings have increased slightly in over-65-year-olds.

Cerebrospinal fluid findings in adults

In 2009, a total of 185 microbial findings in cerebrospinal fluid were reported in over-15-year-olds. Less than a third of the cases were detected in over-65-year-olds.

In the working-age population, coagulase-negative staphylococcus was reported in slightly more than a third of the cases. The most common pathogens were pneumococcus (14%), *S. aureus* (10%), and meningococcus (7%).

In patients aged 65 years or older, coagulase-negative staphylococcus also accounted for slightly less than a third of the culture findings. The most commonly reported pathogens were pneumococcus (19%), *S. aureus* (11%), and *Listeria monocytogenes* (4%). No MRSA findings were reported in either age group in 2009.

The number of cerebrospinal findings in adults has varied between 33 and 234 since 1995. Since 2002, there have been approx. 200 annual reports. Before this, the number of reports was significantly lower (33–130). Since 2002, coagulase-negative staphylococci have been the most common cerebrospinal fluid finding in adults: 61 to 109 annual reports have been made, whereas there were 0 to 24 annual reports between 1995 and 2001. The number of meningococcal reports has remained stable: there have been approx. 20 annual reports, discounting a few exceptional years. Each year, 18 to 33 pneumococcal findings have been made, except between 1998 and 2001, when annual findings totalled 0 to 4.

Table 22. Blood culture findings 1995–2009, working age population (15–64 years), number.

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Escherichia coli	424	442	519	496	547	533	613	580	645	707	780	798	837	871	885
S. aureus	279	288	349	342	390	393	437	458	447	486	457	564	544	526	539
Staphylococcus, other than aureus	247	285	269	319	346	402	406	444	400	420	399	401	406	431	450
Streptococcus pneumoniae	220	251	293	285	298	312	343	333	406	388	377	347	353	479	441
Staphylococcus epidermidis	216	224	222	272	273	274	298	301	286	294	286	281	265	279	313
Klebsiella species	92	93	113	106	114	115	114	134	121	159	184	145	159	198	187
Streptococcus viridans group	75	98	97	91	115	119	118	105	126	141	141	130	118	140	144
Streptococcus pyogenes	34	35	55	63	81	84	60	93	78	93	76	105	133	157	117
Streptococcus, other beta-haemolytic	40	44	58	59	64	59	66	78	79	102	96	127	117	113	113
Enterococcus faecalis	49	73	77	57	76	67	95	99	84	80	100	83	105	83	107
Streptococcus agalactiae	45	43	53	55	60	63	76	78	68	64	99	76	83	96	95
Enterococcus faecium	17	28	38	46	34	39	61	53	51	45	66	69	81	91	89
Enterobacter species	55	65	78	76	58	75	92	53	60	62	49	77	70	69	82
Pseudomonas aeruginosa	80	69	79	70	68	79	72	73	85	58	88	62	72	74	78
Bacteroides fragilis group	60	52	62	65	73	69	64	61	59	67	83	85	82	109	68
Streptococcus milleri group	24	26	35	50	48	48	46	48	48	48	54	62	64	72	57
Other grampositive bacilli	18	10	13	16	15	18	14	20	30	33	32	28	18	31	40
Citrobacter species	18	10	15	10	15	19	18	14	10	21	15	28	19	23	29
Salmonella, other than Typhi	31	17	14	27	39	21	37	12	22	36	30	51	59	48	27
Fusobacterium species	18	14	15	21	21	17	26	15	21	32	31	19	31	31	27
Serratia species	4	7	11	10	12	8	10	12	14	10	16	18	19	24	27
Peptostreptococcus and Peptococcus	26	18	14	23	19	15	20	22	23	15	21	18	11	12	27
Other gramnegative bacilli	3	7	5	1	2	3	2	16	13	10	21	23	18	22	24
Clostridium, other than perfringens	16	13	14	19	8	17	9	7	9	7	19	14	11	13	22
Bacillus	6	15	12	12	8	23	20	18	22	15	18	22	24	25	21
Haemophilus influenzae	5	8	6	11	16	14	14	9	14	12	13	9	26	18	19
Proteus mirabilis	13	9	14	11	8	18	20	15	11	15	12	18	14	14	18
Acinetobacter species	21	23	16	8	17	18	9	13	10	16	16	10	21	13	18
Other grampositive cocci	11	17	12	12	19	21	19	24	19	22	26	24	25	26	17

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Clostridium perfringens	9	6	14	9	10	6	8	6	9	6	16	11	12	10	16
Enterococcus, other or unknown	15	16	13	10	7	6	9	14	11	10	12	6	4	8	14
Prevotella species	10	9	8	9	12	6	11	4	11	11	15	11	8	13	13
Neisseria meningitidis	25	27	9	11	19	13	19	20	18	18	16	20	21	9	13
Corynebacterium species	15	14	10	28	14	28	19	23	9	12	12	9	8	8	13
Stenotrophomonas maltophilia	14	17	10	7	5	11	15	14	6	12	12	7	5	15	12
Capnocytophaga canimorsus	4	4	7	3	8	3	6	6	6	6	8	8	8	8	11
Campylobacter species	9	11	8	10	5	10	14	7	10	13	5	3	8	7	11
Bacteroides, other than fragilis group	4	4	9	3	4	2	6	5		6	2	4	3	5	11
Listeria monocytogenes	11	7	13	24	14	9	7	9	12	7	10	10	9	8	9
Propionibacterium species	3	13	15	20	18	20	19	8	11	6	9	7	5	3	9
Streptococcus, unknown	17	13	8	8	5	6	4	14	5	9	6	8	8	14	8
Morganella morganii	7	5	8	2	4	7	4	3	4	4	3	8	7	14	8
Clostridium, unknown	3	1	11	4	10	7	7	5	5	5	10	11	7	11	7
Pseudomonas, other than aeruginosa	7	4	6	7	3	3	2	3	4	5	4		4	9	7
Other gramnegative cocci	2					1		1	2	2	4	4	4	5	7
Veillonella species	7	3	2	4	6	4	4	2	3	1	6	3	5	3	7
Hafnia alvei		1	5	1	1	4	1	1	5	4	3		1	3	6
Streptococcus bovis group	4	5	3	4	3	4	3	2	2	3	8	5	7	1	6
Proteus vulgaris	2	2	1	1	2	1	3		3	4	3	7	3	2	3
Other enterobacteriaceae species	1	3	3	3	2	1	3		4	1	1	2	5	1	3
Salmonella typhi	6	3	2	3	2		1	1	3	4	3	3	4	1	3
Staphylococcus, unknown	18	26	25	23	12	11	15	17	12	12	5	8	6	3	2
Mycobacterium avium	11	8	1	2		2	3		1		2	2	2	1	2
Other gramnegative anaerobes							3	4	1	2	2	1	5	3	1
Yersinia enterocolitica	1	3	2	3	5		1				1				1
Other Haemophilus species		3	4	3	5	1	8	4	1	5	6	3	3	3	
Mycobacterium, other than avium	2	1		2		1	1	1	4		1	3	4	1	
Yersinia pseudotuberculosis		2	1	1	1	1	2	2	1	1				1	

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Other non-specified bacteria		1	3	1	1	2	1							1	
Mycobacterium, unknown	2	1		1											
Other gramnegative bacteria	10	10	9	13	13	16	10								
Bacteria, total	2366	2507	2768	2853	3035	3129	3388	3364	3424	3627	3790	3858	3951	4259	4284
Candida albicans	18	32	43	35	36	41	44	29	43	45	42	54	55	55	55
Other candida species	11	13	9	16	18	15	27	23	36	24	22	24	27	43	30
Other fungi	3	4	2	9	3			2	1	2	1	2	2	4	5
Fungi, total	32	49	54	60	57	56	71	54	80	71	65	80	84	102	90

Table 23. Blood culture findings 1995–2009, elderly population (65 years and more), number.

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Escherichia coli	887	1000	1034	968	1012	1033	1179	1213	1314	1466	1625	1706	1760	1890	2056
S. aureus	277	322	322	296	337	398	398	449	466	483	483	601	568	672	691
Klebsiella species	143	155	161	177	167	201	241	230	253	341	339	326	338	420	462
Staphylococcus, other than aureus	213	227	234	216	281	349	361	363	344	368	402	394	414	464	425
Streptococcus pneumoniae	165	175	196	183	179	189	216	200	241	239	229	270	294	326	294
Staphylococcus epidermidis	181	199	187	178	206	228	253	224	231	254	284	265	275	299	270
Enterococcus faecalis	100	100	97	117	119	144	142	149	146	192	183	202	220	217	222
Streptococcus, other beta-haemolytic	51	80	93	73	97	88	105	100	123	135	140	174	171	176	220
Pseudomonas aeruginosa	130	120	107	94	116	119	132	148	148	139	151	154	188	191	184
Enterococcus faecium	35	26	39	41	43	61	61	48	76	97	74	108	132	126	175
Bacteroides fragilis group	67	75	90	81	99	96	104	96	118	120	135	119	135	146	164
Streptococcus viridans group	62	57	68	71	74	74	93	83	103	103	106	110	115	140	135
Enterobacter species	39	65	74	83	79	79	97	87	97	92	115	95	105	131	128
Streptococcus agalactiae	20	39	44	46	51	53	61	49	62	76	84	81	77	94	104
Proteus mirabilis	43	39	44	46	48	61	51	57	62	80	57	68	93	99	102
Streptococcus milleri group	15	22	31	29	28	42	30	28	43	45	50	67	54	53	62
Streptococcus pyogenes	20	17	22	31	22	21	28	46	28	30	34	48	58	51	62
Citrobacter species	11	26	18	19	24	26	39	40	44	43	42	42	35	65	59
Clostridium perfringens	30	29	24	24	17	23	31	26	27	32	29	36	39	34	49
Other grampositive cocci	9	11	7	9	6	11	9	13	15	13	13	22	22	34	38
Serratia species	12	14	13	18	11	15	30	15	28	18	33	27	33	50	37
Other grampositive bacilli	9	13	11	13	14	22	14	17	28	34	36	33	27	39	36
Peptostreptococcus and Peptococcus	14	12	11	18	14	15	9	14	20	13	17	22	25	14	29
Streptococcus bovis group	10	7	15	8	13	9	10	7	9	20	12	17	17	15	25
Clostridium, other than perfringens	12	12	13	9	12	17	17	13	7	12	22	19	15	22	24
Enterococcus, other or unknown	26	29	12	13	9	7	22	19	21	17	17	19	16	24	22
Haemophilus influenzae	4	5	7	15	9	17	27	15	13	13	28	21	24	21	22
Other gramnegative bacilli	6	1	5		1			5	10	15	24	18	17	21	21
Listeria monocytogenes	12	16	26	14	23	7	15	11	19	18	20	26	26	26	20

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Morganella morganii	13	9	12	8	7	12	9	13	10	14	21	14	26	11	18
Acinetobacter species	7	10	8	10	7	13	18	17	8	13	10	18	11	12	16
Prevotella species	7	8	8	10	5	5	8	11	4	11	10	10	8	11	15
Clostridium, unknown	9	5	7	3	11	7	9	8	11	14	7	11	18	6	15
Bacteroides, other than fragilis group	6	2	9	4	8	7	5	3	5	8	4	3	5	8	13
Corynebacterium species	6	11	9	16	7	21	16	15	7	11	14	11	13	12	12
Bacillus	8	2	1	6	7	13	17	11	10	10	10	17	9	11	12
Pseudomonas, other than aeruginosa	9	4	5	9	11	9	3	6	6	3	7	10	11	11	11
Other gramnegative cocci		4	1				1	1		2	5	1	3	8	9
Propionibacterium species	5	11	20	12	24	19	12	15	4	8	13	9	4	5	9
Fusobacterium species	5	8	8	13	7	6	6	16	7	13	10	9	15	10	8
Other enterobacteriaceae species		1		3		1	1	3	4		4	3	1	4	8
Hafnia alvei	3	2	3	3	3	3	7	1	1	4	4	3	6	8	7
Salmonella, other than Typhi	9	8	9	4	8	5	4	7	5	6	15	11	8	19	6
Streptococcus, unidentifiable	12	6	12	5	8	8	7	12	9	12	10	15	7	12	6
Neisseria meningitidis	2	3	2	2	3	5	4	4	4	3	2	5	2	6	6
Campylobacter species	3	3	2	1	4	2	3	3	1	5	3	5	3	5	6
Stenotrophomonas maltophilia	6	10	8	1	7	4	8	3	6	10	6	10	8	3	6
Veillonella species		2	1	2		3			1	1	7	2	6	9	5
Staphylococcus, unknown	39	39	22	15	13	23	27	16	21	21	6	4	5	6	5
Proteus vulgaris	3	3	3	2	3	4	8	7	8	7	9	9	9	4	4
Yersinia pseudotuberculosis	1	1	1	4	1		2	1	1	2	2	1	1		3
Capnocytophaga canimorsus		1	3			3	1	1	1	1	1	4	2	3	2
Other gramnegative anaerobes		1						3	1	3	1	1	2	4	1
Other Haemophilus species	1	3	3	1				2	1	3	2	2	1	1	1
Yersinia enterocolitica	1	2		1	1	3	1	1	3	1	1	1	1		1
Mycobacterium, other than avium		1		2		2	2		2	3		5	1	1	
Mycobacterium avium				1				1			1			1	
Salmonella typhi									1		1				

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Other non-specified bacteria			1	4		2		1							
Other gramnegative bacteria	9	15	12	9	12	14	8								
Bacteria, total	2767	3068	3175	3041	3268	3599	3962	3947	4238	4697	4970	5284	5479	6051	6343
Candida albicans	28	31	20	24	34	41	48	39	63	51	39	54	56	66	49
Other candida species	17	4	14	15	17	27	22	31	47	27	25	22	27	25	43
Other fungi	1	1	2	4			1		3		3			2	
Fungi, total	46	36	36	43	51	68	71	70	113	78	67	76	83	93	92

Table 24. Cerebrospinal fluid culture findings 1995–2009, working age population (15–64 years), number.

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Staphylococcus, other than aureus	2	8	8					42	28	40	48	44	24	41	28
Streptococcus pneumoniae	16	18	21		1	1	4	19	26	21	15	17	14	26	19
Staphylococcus epidermidis	1	4	8					27	21	24	34	32	17	27	18
S. aureus		10	5	10	11	11		6	10	17	10	9	16	13	13
Neisseria meningitidis	34	38	20	19	19	9	8	19	15	11	15	20	16	4	9
Pseudomonas aeruginosa			2					5	4	2	4	6	3	4	5
Pseudomonas, other than aeruginosa		1	1					6	6	11	5	5	5	4	4
Escherichia coli	1	1	2	1	4	2		3			7	4	3	3	4
Enterobacter species	1		1					1		3	5	2	2	9	3
Enterococcus faecalis	1		1	2	4	3	3	2	3	5	3	4	5	4	3
Other non-specified bacteria								1	1	1	4	7	5	3	3
Acinetobacter species			2					2	1	1	3	3	5	2	3
Klebsiella species		1	2	1	2	2	2	2	1	1	3	2	1	4	2
Streptococcus pyogenes								1	1			1		2	2
Streptococcus viridans group	1	2	1					6	2	1	4	7	2	1	2
Listeria monocytogenes	6	2	3				1		2	1		2	1	1	2
Other grampositive cocci		2	1					1					1	1	2
Streptococcus, other beta-haemolytic		2						2		1	1			1	2
Haemophilus influenzae		2	2	2	1	1	3	2		1				3	1
Pseudomonas, other									1			1	1	1	1
Other gramnegative cocci									1		1	1		1	1
Enterococcus faecium				2				1		2	1		1		1
Corynebacterium species									1	1	2	1	1		1
Staphylococcus, unidentifiable	3	1		1				3	1		1				1
Peptostreptococcus and Peptococcus									2						1
Capnocytophaga canimorsus															1
Bacillus			1					5			3	6	4	3	
Streptococcus agalactiae	1	4			1			1		2		1	5	2	
Mycobacterium, other than avium						2		2	1				1	2	

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Salmonella, other than Typhi				1			1		1					2	
Enterococcus, other or unknown					1		1	1				1	1	1	
Streptococcus milleri group		1												1	
Serratia species									2	1	1		3		
Citrobacter species									1	1	2		1		
Stenotrophomonas maltophilia	1									1			1		
Other Haemophilus species													1		
Other gramnegative bacilli		1								2		1	1		
Streptococcus, unknown			1		2										
Other grampositive bacilli	1							1				1			
Morganella morganii								1							
Campylobacter species											1				
Fusobacterium species		1													
Prevotella species								1							
Bacteria, total	69	99	82	39	46	31	23	163	132	151	173	178	141	166	132
Candida albicans								1	1	2	1		1		
Other candida species	1							1		4	1	3	4	1	
Other fungi													1		
Fungi, total	1	0	0	0	0	0	0	2	1	6	2	3	6	1	0

Table 25. Cerebrospinal fluid culture findings 1995–2009, elderly population (65 years and more), number.

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Streptococcus pneumoniae	6	6	4					4	5	4	9	10	4	7	10
Staphylococcus, other than aureus	2	5	3				1	12	9	11	15	12	14	13	9
Staphylococcus epidermidis	2	2	3				1	7	5	6	10	9	12	10	6
S. aureus	1	3	4	4	3	2		2	7	7	5	3	2	3	6
Streptococcus viridans group		2	1					1		1		1	1		3
Listeria monocytogenes	3	2	4				1	2	4	2	4	3	2	2	2
Pseudomonas, other than aeruginosa							1	4		1		2		2	2
Haemophilus influenzae			1		2						1	2	2	1	1
Mycobacterium, other than avium	2	1	1	1		2	1	1	4	1	3			1	1
Escherichia coli	1		2			1	1	1	2	2	1	1		1	1
Proteus mirabilis														1	1
Klebsiella species		1	2						1	1				1	1
Enterococcus faecalis		1	3	1		1	1	2	3		2	2	3		1
Other non-specified bacteria								1			1	2	2		1
Streptococcus agalactiae						4	2		1						1
Streptococcus, other beta-haemolytic		2							2		1				1
Streptococcus milleri group															1
Streptococcus bovis group															1
Enterococcus faecium									1						1
Bacteroides fragilis group															1
Pseudomonas aeruginosa			2							1		1		2	
Staphylococcus, unidentifiable			2						1	1	1			1	
Bacillus								3						1	
Neisseria meningitidis	1	2		2	1		1		1	1	2	1		1	
Enterobacter species			1					2		1			1		
Acinetobacter species			1					2	1			1	1		
Streptococcus pyogenes								2							
Streptococcus, unidentifiable								1				1			
Enterococcus, other or unidentifiable								1							

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Peptostreptococcus and Peptococcus									1						
Mycobacterium avium											1				
Corynebacterium species									1						
Other grampositive bacilli	1	1	1						1						
Serratia species										1					
Proteus vulgaris											1				
Morganella morganii			1												
Yersinia enterocolitica					1										
Other enterobacteriaceae species								1							
Pseudomonas, other										1					
Stenotrophomonas maltophilia										1					
Other Haemophilus species			2												
Capnocytophaga canimorsus		1													
Bacteria, total	19	29	38	8	7	10	10	49	50	43	57	51	44	47	51
Candida albicans		1									1			1	
Other candida species		1						2		1		2			2
Other fungi															
Fungi, total	0	2	0	0	0	0	0	2	0	1	1	2	0	1	2

Table 26. Blood culture findings 1995–2009 (all age groups), number.

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Escherichia coli	1375	1493	1613	1525	1612	1629	1836	1846	2011	2225	2456	2564	2651	2813	2991
S. aureus	627	667	747	719	813	850	887	989	981	1059	1013	1239	1179	1261	1288
Staphylococcus, other than aureus	564	596	600	627	763	890	910	973	871	968	984	985	1002	1050	1030
Streptococcus pneumoniae	477	524	577	545	554	599	654	642	766	743	733	744	783	918	852
Staphylococcus epidermidis	490	498	489	524	585	599	653	641	608	683	709	686	665	687	678
Klebsiella species	244	261	289	294	295	327	365	377	386	514	542	482	509	631	660
Enterococcus faecalis	163	192	179	187	205	215	245	263	243	283	302	309	339	311	343
Streptococcus, other beta-haemolytic	94	124	152	138	162	149	172	179	206	241	238	306	289	289	338
Streptococcus viridans group	165	187	201	194	218	217	244	209	255	277	283	274	265	309	313
Enterococcus faecium	58	55	84	88	78	106	125	107	130	147	144	183	217	220	273
Pseudomonas aeruginosa	213	195	193	174	185	204	213	226	240	204	245	219	262	268	265
Streptococcus agalactiae	111	134	140	149	154	155	178	173	169	186	256	212	213	240	250
Bacteroides fragilis group	128	129	153	149	173	169	170	158	177	189	221	204	218	256	233
Enterobacter species	107	140	162	169	149	162	195	147	169	162	170	186	185	210	216
Streptococcus pyogenes	58	60	80	105	116	115	99	150	119	130	110	162	207	221	194
Streptococcus milleri group	42	51	66	79	78	93	77	78	91	93	107	132	118	127	121
Proteus mirabilis	57	49	58	57	57	79	71	72	73	97	69	87	109	113	120
Citrobacter species	32	36	36	31	43	50	60	56	55	64	59	71	56	90	90
Other grampositive bacilli	28	25	26	31	32	42	31	42	64	70	75	62	47	70	80
Clostridium perfringens	40	35	39	34	28	29	39	33	37	38	46	48	53	44	66
Serratia species	18	22	25	29	23	26	40	33	44	32	50	49	56	78	65
Other grampositive cocci	24	33	24	26	36	41	35	44	38	45	48	57	56	67	62
Peptostreptococcus and Peptococcus	40	32	25	43	37	33	31	36	43	28	38	40	36	26	56
Other gramnegative bacilli	11	9	11	1	4	3	2	26	28	27	47	42	38	47	47
Clostridium, other than perfringens	31	26	28	29	20	35	27	20	16	20	42	34	26	35	47
Haemophilus influenzae	11	18	15	30	30	35	46	25	34	26	45	32	53	44	46
Acinetobacter species	35	38	28	24	31	37	32	42	23	31	31	32	36	28	39
Bacillus	19	23	18	20	19	46	41	34	39	29	37	46	37	46	38
Enterococcus, other or unidentifiable	44	48	25	23	17	13	31	33	34	30	29	27	23	35	38

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Fusobacterium species	24	28	27	36	33	27	33	34	28	46	43	31	51	46	36
Salmonella, other than Typhi	42	27	24	34	52	27	42	21	28	43	46	64	72	69	34
Streptococcus bovis group	15	12	18	12	16	14	13	10	12	24	21	23	24	16	33
Listeria monocytogenes	24	25	41	40	37	17	24	20	32	25	30	38	36	34	30
Prevotella species	17	17	16	19	17	11	19	15	15	23	25	21	16	25	28
Corynebacterium species	23	25	20	45	24	53	37	39	18	24	29	24	24	21	27
Morganella morganii	20	14	21	11	12	20	13	16	14	18	24	22	33	25	26
Neisseria meningitidis	33	47	21	27	38	35	35	34	30	28	28	32	29	22	24
Bacteroides, other than fragilisgroup	10	6	18	7	13	10	11	8	5	14	6	7	8	13	24
Stenotrophomonas maltophilia	21	27	24	14	14	17	25	18	14	25	19	18	18	22	22
Clostridium, unidentifiable	12	6	18	9	21	14	16	14	16	19	17	22	26	18	22
Pseudomonas, other than aeruginosa	17	10	14	17	15	13	8	10	11	8	12	10	16	20	21
Propionibacterium species	8	24	38	35	45	40	31	24	16	14	22	16	10	8	18
Other gramnegative cocci	2	5	1			1	1	5	2	8	12	10	12	18	17
Campylobacter species	12	14	10	11	10	14	18	10	11	18	8	8	11	12	17
Streptococcus, unidentifiable	32	19	20	13	15	14	12	27	14	21	16	24	16	26	15
Capnocytophaga canimorsus	4	5	10	3	8	6	7	7	7	7	9	12	10	11	13
Hafnia alvei	3	4	8	4	4	7	8	2	6	8	7	3	7	11	13
Veillonella species	7	5	3	6	6	7	4	2	4	2	13	7	11	12	12
Other enterobacteriaceae species	1	5	3	6	2	2	4	3	8	1	6	5	6	5	11
Staphylococcus, unidentifiable	68	73	52	49	30	36	43	40	38	40	15	12	16	10	7
Proteus vulgaris	5	5	4	3	7	6	11	7	11	11	12	16	12	6	7
Salmonella typhi	7	3	2	3	5		1	2	5	5	6	3	6	1	3
Yersinia pseudotuberculosis	1	3	2	5	2	1	4	3	3	3	2	1	1	1	3
Other gramnegative anaerobes		1					3	7	2	5	3	2	8	7	2
Mycobacterium avium	11	8	1	3		2	3	1	1		3	2	2	2	2
Yersinia enterocolitica	4	5	2	4	6	3	2	1	3	1	2	1	1		2
Other Haemophilus species	1	6	8	5	6	1	8	6	3	8	9	6	4	5	1
Mycobacterium, other than avium	2	2		4		3	3	1	6	3	1	8	5	2	

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Other non-specified bacteria		2	4	5	1	4	1	1						1	
Mycobacterium, unidentifiable	2	1		1											
Other gramnegative bacteria	21	30	26	30	29	33	21								
Bacteria, total	5755	6164	6539	6505	6985	7386	7970	8042	8313	9093	9575	9962	10219	11003	11309
Candida albicans	57	67	66	62	83	89	96	80	109	99	86	113	113	126	105
Other candida species	32	20	24	33	44	52	57	62	85	52	48	48	58	70	73
Other fungi	4	5	7	14	4		1	3	6	2	4	4	4	6	5
Fungi, total	93	92	97	109	131	141	154	145	200	153	138	165	175	202	183

Table 27. Cerebrospinal fluid culture findings 1995–2009 (all age groups), number.

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Staphylococcus, other than aureus	6	21	17				1	72	44	62	71	59	41	64	43
Streptococcus pneumoniae	34	32	29	1	2	1	4	28	47	35	28	33	27	38	35
Staphylococcus epidermidis	5	12	16				1	44	30	37	49	44	32	43	28
S. aureus	4	15	16	17	16	15		9	22	28	16	12	21	21	24
Neisseria meningitidis	45	49	32	37	31	18	16	27	22	20	22	29	23	9	13
Streptococcus agalactiae	3	12	2	9	6	8	5	6	2	12	7	8	11	5	7
Streptococcus viridans group	5	4	3					7	4	3	4	10	3	1	7
Other non-specified bacteria								4	1	1	9	10	7	9	6
Pseudomonas, other than aeruginosa		1	1				1	10	7	13	6	7	5	6	6
Escherichia coli	2	2	6	4	5	4	4	5	3	4	8	8	4	5	6
Pseudomonas aeruginosa			4					5	4	3	4	7	3	6	5
Enterobacter species	1		2					3		6	5	2	3	9	4
Klebsiella species		2	4	1	2	3	2	3	3	3	3	2	1	5	4
Enterococcus faecalis	1	1	7	4	6	5	4	4	7	7	6	8	9	4	4
Listeria monocytogenes	9	5	7				2	2	6	3	4	5	3	3	4
Streptococcus, other beta-haemolytic		4						3	2	1	2			1	4
Haemophilus influenzae	3	2	3	3	4	2	5	2	3	1	2	2	2	4	3
Acinetobacter species			5					6	2	2	4	5	6	2	3
Streptococcus pyogenes			1					4	1			1		2	3
Other grampositive cocci		4	3					5					1	1	3
Enterococcus faecium			1	2				2	1	3	1	1	1		2
Mycobacterium, other than avium	2	1	1	1		4	1	3	6	1	3		1	3	1
Corynebacterium species									2	1	2	1	1	2	1
Pseudomonas, other									1	1		1	1	1	1
Staphylococcus, unidentifiable	3	1	2	1				4	2	1	2			1	1
Streptococcus milleri group		1												1	1
Proteus mirabilis														1	1
Other gramnegative cocci		1							2		2	1		1	1
Other gramnegative bacilli		1								3		1	1		1

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Streptococcus bovis group															1
Peptostreptococcus and Peptococcus									3			1			1
Capnocytophaga canimorsus		1													1
Bacteroides fragilis group												1			1
Bacillus			1					8			3	7	4	4	
Salmonella, other than Typhi				1			1		1					2	
Enterococcus, other or unidentifiable		1			1		1	2				1	1	1	
Serratia species									2	3	1		3		
Citrobacter species			1					1	1	1	2		2		
Stenotrophomonas maltophilia	1	1							1	2			1		
Other Haemophilus species		1	2										1		
Bacteroides, other than fragilisgroup													1		
Streptococcus, unidentifiable			1		2			1				1			
Mycobacterium avium											1				
Other grampositive bacilli	2	1	1					1	1			1			
Proteus vulgaris											1				
Morganella morganii			1					1							
Yersinia enterocolitica					1										
Other enterobacteriaceae species								1							
Campylobacter species											1				
Fusobacterium species		1													
Prevotella species								1							
Bacteria, total	126	177	169	81	76	60	48	274	233	257	269	269	220	255	226
Candida albicans		1						1	1	3	2		1	1	1
Other candida species	1	1						3		5	1	5	4	1	2
Other fungi													1		
Fungi, total	1	2	0	0	0	0	0	4	1	8	3	5	6	2	3

Authors

The use of the National Infectious Diseases Register's statistical database

Terhi Hulkko (National Institute for Health and Welfare, THL)

Respiratory tract infections

Influenza A and B
Niina Ikonen, Thedi Ziegler, Outi Lyytikäinen (THL)
RSV
Timi Martelius, Thedi Ziegler (THL)
Legionella
Jaana Kusnetsov, Timi Martelius, Outi Lyytikäinen (THL)
Whooping cough
Timi Martelius, Qiushui He (THL)
Adenovirus
Timi Martelius, Thedi Ziegler (THL)
Parainfluenza
Timi Martelius, Thedi Ziegler (THL)
Mycoplasma
Timi Martelius (THL)
Chlamydia pneumoniae
Timi Martelius (THL)

Gastrointestinal infections

Salmonella
Anja Siitonen, Ruska Rimhanen-Finne, Taru Kauko (THL)
Campylobacter
Heidi Rossow, Markku Kuusi (THL)
Yersinia
Ruska Rimhanen-Finne, Leila Sihvonen (THL)
Shigella
Heidi Rossow, Markku Kuusi (THL)
Enterohaemorrhagic *Escherichia coli* (EHEC)
Katri Jalava, Susanna Lukinmaa, Anja Siitonen (THL)
Norovirus
Merja Roivainen (THL), Leena Maunula (University of Helsinki)
Rotavirus
Tuija Leino (THL)
Enterovirus
Merja Roivainen (THL)
Listeria
Katri Jalava, Susanna Lukinmaa (THL)
Clostridium difficile
Outi Lyytikäinen, Anni Virolainen-Julkunen (THL)
Giardiasis
Ruska Rimhanen-Finne (THL)
Cryptosporidiosis
Ruska Rimhanen-Finne (THL)
Cholera
Anja Siitonen (THL)
Food- and water-borne epidemics
Markku Kuusi, Ruska Rimhanen-Finne, Susanna Lukinmaa, Anja Siitonen (THL)

Hepatitides

Hepatitis A
Markku Kuusi (THL)
Hepatitis B
Timi Martelius (THL)
Hepatitis C
Timi Martelius (THL)

Sexually transmitted diseases

Chlamydia
Eija Hiltunen-Back (Helsinki and Uusimaa hospital district, HUS)
Gonorrhoea
Eija Hiltunen-Back (HUS)
Syphilis
Eija Hiltunen-Back (HUS)
HIV and AIDS
Kirsi Liitsola, Henrikki Brummer-Korvenkontio (THL)

Antimicrobial resistance

MRSA
Outi Lyytikäinen, Saara Salmenlinna, Jaana Vuopio (THL)
VRE
Outi Lyytikäinen, Saara Salmenlinna, Jaana Vuopio (THL)
ESBL
Outi Lyytikäinen, Jari Jalava (THL)
Invasive pneumococcal disease
Outi Lyytikäinen, Anni Virolainen-Julkunen (THL)
Gastrointestinal infections and antimicrobial resistance
Antti Hakanen, Kaisa Haukka, Mirva Lehtopolku, Susanna Lukinmaa, Leila Sihvonen, Anja Siitonen (THL)
Antimicrobial resistance in Finland, in other Nordic countries and in Europe
Outi Lyytikäinen (THL)

Mycobacterial infections

Tuberculosis
Petri Ruutu, Hanna Soini (THL), Tuula Vasankari (Turku University Hospital TYKS and THL)
Atypical mycobacteria
Petri Ruutu, Hanna Soini (THL), Tuula Vasankari (TYKS and THL)

Other infections

Haemophilus
Anni Virolainen-Julkunen (THL)
Meningococcus
Anni Virolainen-Julkunen, Maija Toropainen, Outi Lyytikäinen (THL)
MMR diseases (measles, mumps, rubella)
Irja Davidkin (THL)
Puumala virus
Timi Martelius (THL), Olli Vapalahti (HUS)
Tick-borne encephalitis (TBE)
Timi Martelius (THL), Olli Vapalahti (HUS)
Tularemia
Heidi Rossow (THL)
Pogosta disease
Katri Jalava (THL), Jussi Sane (University of Helsinki)
Borrelia
Timi Martelius, Outi Lyytikäinen (THL), Jarmo Oksi (University of Turku)
Anthrax
Heidi Rossow (THL)
Rabies
Ruska Rimhanen-Finne (THL)
Variant Creutzfeldt-Jakob disease (vCJD) and BSE
Jussi Kovanen (HUS), Outi Lyytikäinen (THL), Auli Verkkoniemi (HUS)
Malaria
Heli Siikamäki (HUS), Sandra Guedes, Outi Lyytikäinen (THL)
Blood and cerebrospinal fluid findings in children
Emmi Sarvikivi (THL)
Blood and cerebrospinal fluid findings in adults
Timi Martelius, Emmi Sarvikivi (THL)