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Communicable Diseases Surveilance in Singapore 2013

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We would like to thank all medical practitioners, laboratory personnel, nurses, public health professionals, as well as partners from public and private healthcare institutions and other government agencies, who have, in one way or another, contributed to the data and information published in this report. We acknowledge their invaluable contributions towards our national efforts in communicable diseases surveillance, prevention and control, and look forward to their continued support and cooperation in our work.

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FOREWORD

I am pleased to present the Ministry of Health's "Communicable Diseases Surveillance in Singapore 2013" Annual Report.

2013 was an eventful year on both the global and local fronts for communicable diseases. At the end of March 2013, cases of human infection with avian influenza A(H7N9) virus were notified in China. This was the first time that this virus was found to have infected humans resulting in severe illness. As of 31 December 2013, 149 laboratory-confirmed cases including 48 deaths were reported from 13 provinces/municipalities in eastern mainland China, Hong Kong SAR, China, and the Taipei Centers for Disease Control. Around the same time, the Middle East Respiratory Syndrome coronavirus (MERS-CoV), which was first reported to cause severe pneumonia in humans in September 2012, resurged with a total of 176 laboratory-confirmed cases including 74 deaths as of 31 December 2013. The ever-changing situation underscores the importance of constant vigilance and preparedness for new and emerging infectious diseases, which the Ministry of Health (MOH) will continue to do.

On the home front, vector-borne diseases, namely dengue fever (DF)/dengue haemorrhagic fever (DHF) and chikungunya fever, contributed significantly to the burden of communicable diseases in 2013. A record high of 22,170 laboratory-confirmed DF/DHF cases was notified in 2013, which is more than four times of the 4,632 cases notified in 2012. Eight deaths due to dengue were reported in 2013. The majority of the cases were infected locally (98.6%). The upsurge in the number of cases was associated with the serotype switch from DENV-2, the predominant serotype circulating in Singapore from 2007 to 2012, to DENV-1, the predominant circulating serotype in 2013, as well as the greater fitness of the new DENV-1 strain.

The total number of laboratory-confirmed chikungunya fever cases rose from 22 cases in 2012 to 1,059 in 2013. Forty-eight of these cases were imported while 1,011 cases were acquired locally. As a self-limiting disease, no deaths due to chikungunya were reported. The majority of cases were detected in Kranji/Sungei Kadut and Bukit Timah. This unprecedented outbreak of chikungunya fever demonstrated Singapore's vulnerability towards the importation of infections such as chikungunya fever, especially when the vectors required for transmission are present locally. The control of vector-borne diseases emphasizes the need for a coordinated multi-agency response especially by MOH and the National Environmental Agency (NEA). This is in addition to community involvement, for intensive vector control has been the mainstay of prevention and control strategies for vector-borne diseases in Singapore.

In 2013, the incidence of tuberculosis (TB) among Singapore Citizens and Permanent Residents declined to 36.9 per 100,000 population from 40.9 per 100,000 population in 2012. Measures to strengthen case detection and treatment have been rolled out progressively to enhance the Singapore TB Elimination Programme (STEP) following a review in 2012, which addressed key challenges for TB control: the delayed diagnosis of infectious TB cases and the non-compliance with the complete treatment regimen until a full cure. Infection with human immunodeficiency virus (HIV) is known to increase a person's susceptibility to TB. The number of newly reported HIV infections also decreased from 469 in 2012 to 454 in 2013. The National HIV/AIDS Control Programme adopts a multi-pronged approach, which comprises education of the general public and high-risk groups, protection of the national blood supply through screening of blood and blood products, management of cases and contact tracing, epidemiological surveillance, scaling up the prevention and control of sexually-transmitted infections (STIs), and legislation.

This report was published from the compilation of epidemiological information on communicable diseases collated through our close working relationship with the community of health professionals and our partner agencies. We thank all healthcare professionals and our partner agencies for their unwavering support and dedication in combating and minimising the threats of communicable diseases, for the common goal of safeguarding public health.

I hope that you will find this report useful. I look forward to your continued support and cooperation in the national surveillance of communicable diseases.

A/PROF BENJAMIN ONG
DIRECTOR OF MEDICAL SERVICES
MINISTRY OF HEALTH, SINGAPORE

POPULATION PROFILE

In 2013, Singapore had an estimated population of 5.39 million, with a resident population of 3.84 million. The female-to-male ratio in the resident population was 1.03. The ethnic distribution in the resident population showed a Chinese majority of 74.2%, followed by Malays and Indians at 13.3% and 9.2% respectively.

The aging pattern of Singapore's population is shown in the age pyramid below. The proportion of residents aged 15 to 64 years has increased from 71.0% in 1990 to 73.5% in 2013 while the proportion of children under 15 years has steadily declined from 23.0% in 1990 to 16.0% in 2013. Currently 10.5% of Singapore residents are aged 65 years and above, compared to 6.0% in 1990.

Demographic profile (mid-year estimates), 2013

	2013
Total population	5,399,162
Resident population	3,844,751
Gender ratio (female to male)	1.03
Ethnic distribution (%)	
Chinese	74.2
Malay	13.3
Indian	9.2
Others	3.3

(Source: Singapore Department of Statistics)

Age Distribution of resident population, 2013

(Source: Singapore Department of Statistics)

OVERVIEW OF COMMUNICABLE DISEASES SITUATION

In this issue of the Communicable Diseases Surveillance report, all notifications of infectious diseases received during the year 2013 have been included. However, notifications of cases seeking medical treatment in Singapore for infectious diseases have been excluded from selected morbidity statistics which reflect the status in Singapore citizens, Singapore permanent residents and foreigners residing in Singapore (i.e. non-citizens who have not been granted permanent residence status).

AIR-/DROPLET-BORNE DISEASES

In 2013, hand, foot and mouth disease (HFMD) continued to contribute significantly to the burden of air-/droplet-borne diseases. There were 31,741 notified cases (587.9 per 100,000 population) of HFMD, a decrease of 14.5% from 37,125 cases in 2012.

A total of 46 measles cases were notified in 2013 compared to 38 cases in 2012.

A total of 48 rubella cases (0.9 per 100,000 population) were notified compared with 64 cases in 2012. There was one case of congenital rubella reported in an infant who had been brought to Singapore for medical treatment. There were two reported termination of pregnancy resulting from acquired maternal rubella infection.

There were 495 notified cases of mumps (9.2 per 100,000 population) in 2013 compared to 521 cases (9.8 per 100,000 population) in 2012.

VECTOR-BORNE/ZOONOTIC DISEASES

In 2013, dengue fever (DF)/dengue haemorrhagic fever (DHF) and chikungunya contributed significantly to the burden of vector borne diseases. A record high of 22,170 dengue fever (DF)/dengue haemorrhagic fever (DHF) cases were notified compared with 4,632 cases in Year 2012. The majority of the cases were infected locally. DEN-1 was the predominant circulating strain in 2013.

A total of 1059 chikungunya fever cases were notified in 2013 compared with 22 cases in Year 2012.

In addition, there were 111 notified cases of malaria in 2013, all except one were acquired overseas. All vector-borne diseases were thoroughly investigated on notification, followed by a multi-agency response. Intensive vector control remained the main strategy for the prevention and control of vector-borne diseases.

FOOD-/WATER-BORNE DISEASES

There were 88 cases of Hepatitis A notified in 2013, a decrease of 18.5% compared to 108 cases in 2012. The incidence of enteric fevers (typhoid and paratyphoid fevers) showed a 24.1% decrease from 141 cases in 2012 to 107 cases in 2013. Campylobacteriosis and non-typhoidal salmonellosis contributed significantly to foodborne disease morbidity. There were 397 cases of campylobacteriosis and 1,735 cases of salmonellosis reported in 2013. Although most cases were sporadic in nature, strict measures were implemented to ensure that a high standard of food and environmental hygiene was maintained. These measures were carried out by the Ministry of Health (MOH), in close collaboration with the National Environment Agency (NEA) and the Agri-Food and Veterinary Authority (AVA).

ENVIRONMENT-RELATED DISEASES

In 2013, 24 cases of legionellosis and 36 cases of melioidosis were notified. Eight patients died of melioidosis and melioidosis-related conditions giving an overall case fatality rate of 23.5%, higher than that reported in 2012 (6.5%).

HIV/AIDS, STIs, TUBERCULOSIS & LEPROSY

The number of HIV/AIDS infection notifications decreased by 3.2% from 469 in 2012 to 454 in 2013.

The three main sexually transmitted infections (STIs) notified in Singapore in 2013 were chlamydia, gonorrhoea and syphilis. The overall incidence rate for STIs was 192 cases per 100,000 population. Chlamydia was the most common STI with an incidence rate of 43 cases per 100,000 population.

In 2013, a total of 2,028 new cases of TB were reported (1,420 residents and 608 long staying foreigners), a decrease of 7.9% from 2012.

In 2013, a total of 7 cases of leprosy were notified (4 residents and 3 non-residents). The resident incidence rate was 0.1 per 100,000 population.

The annual statistics on infectious disease notifications and deaths are presented in the following table. Detailed updates on individual diseases are provided in the respective chapters of the report.

Infectious disease notifications and deaths in 2013

Diseases	No. of notified cases	No. of Deaths+	Morbidity rate*	Mortality rate*
Air-/Droplet-Borne Diseases				
Hand, Foot and Mouth Disease	31,741	0	587.9	0.0
Measles	46	0	0.9	0.0
Meningococcal Infection	3	0	0.1	0.0
Mumps	495	0	9.2	0.0
Rubella	48	0	0.9	0.0
Vector-Borne/Zoonotic Diseases				
Chikungunya Fever	1,059	0	19.6	0.0
Dengue Fever/Dengue Haemorrhagic Fever	22,170	8	410.6	0.1
Malaria	111	0	2.1	0.0
Food-/Water-Borne Diseases				
Campylobacteriosis	397	0	7.4	0.0
Cholera	2	0	0.0	0.0
Hepatitis A	88	0	1.6	0.0
Hepatitis E	55	0	1.0	0.0
Paratyphoid	23	0	0.4	0.0
Salmonellosis	1,735	0	32.1	0.0
Typhoid	84	0	1.6	0.0
Blood-Borne Diseases				
Hepatitis B	57	0	1.1	0.0
Hepatitis C	2	0	0.04	0.0
Environmental-Related Diseases				
Legionellosis	24	0	0.4	0.0
Melioidosis	36	3	0.7	0.1
HIV/AIDS, STIs, TB & Leprosy				
HIV/AIDS**	454	89	11.8	2.3
STIs	10,347	0	191.6	0.0
Tuberculosis***	2,028	46	37.6	1.2
Leprosy	7	0	0.1	0.0

+Source: Registry of Births & Deaths
*Rates per 100,000 population, based on estimated mid-year total population, 2013 (Source: Singapore Department of Statistics)
** Refers to Singaporeans/PR cases
*** Refers to Singaporeans/PR cases & long staying foreigners

SPECIAL FEATURE
INDIGENOUS CASES OF CHIKUNGUNYA FEVER IN SINGAPORE, 2013

Introduction

This special feature describes the 2013 experience of indigenous chikungunya virus infection in Singapore.

Epidemiological findings

A total of 1,059 laboratory-confirmed cases of chikungunya fever were reported in 2013, of which 48 were imported cases, involving 19 Singapore residents and 29 foreigners including work permit holders. The remaining 1,011 cases were indigenous cases, bringing the overall incidence rate of chikungunya fever to 18.7 per 100,000 population. 63 (6.2%) of the 1,011 indigenous chikungunya fever cases in 2013 were detected through active case detection carried out as part of epidemiological investigations.

The first indigenous case of chikungunya fever in 2013 was reported on 8 Feb 2013 involving a 41-year-old male Indian national working and living in Kranji who developed onset of symptoms on 4 Feb 2013. This was followed by the notification of the second case of chikungunya fever on 25 Feb 2013, which involved a 41-year-old Indian national crane operator living and working in Sungei Kadut who developed onset of symptoms on 18 Feb 2013. Cases of chikungunya fever were initially confined to the Kranji/Sungei Kadut area, however, on 27 Mar 2013, the first indigenous case of chikungunya fever outside of Kranji/Sungei Kadut was detected in a 37-year-old British housewife residing in Bukit Timah. Indigenous cases of chikungunya fever were subsequently reported in other parts of Singapore such as Jalan Papan, Jalan Lekar, Seletar West Farmway and Tanjong Kling Road, with the highest concentration of cases in Kranji/Sungei Kadut and Bukit Timah.

Figure 1
Time distribution of 1,011 indigenous chikungunya fever cases in Singapore by location, 2013

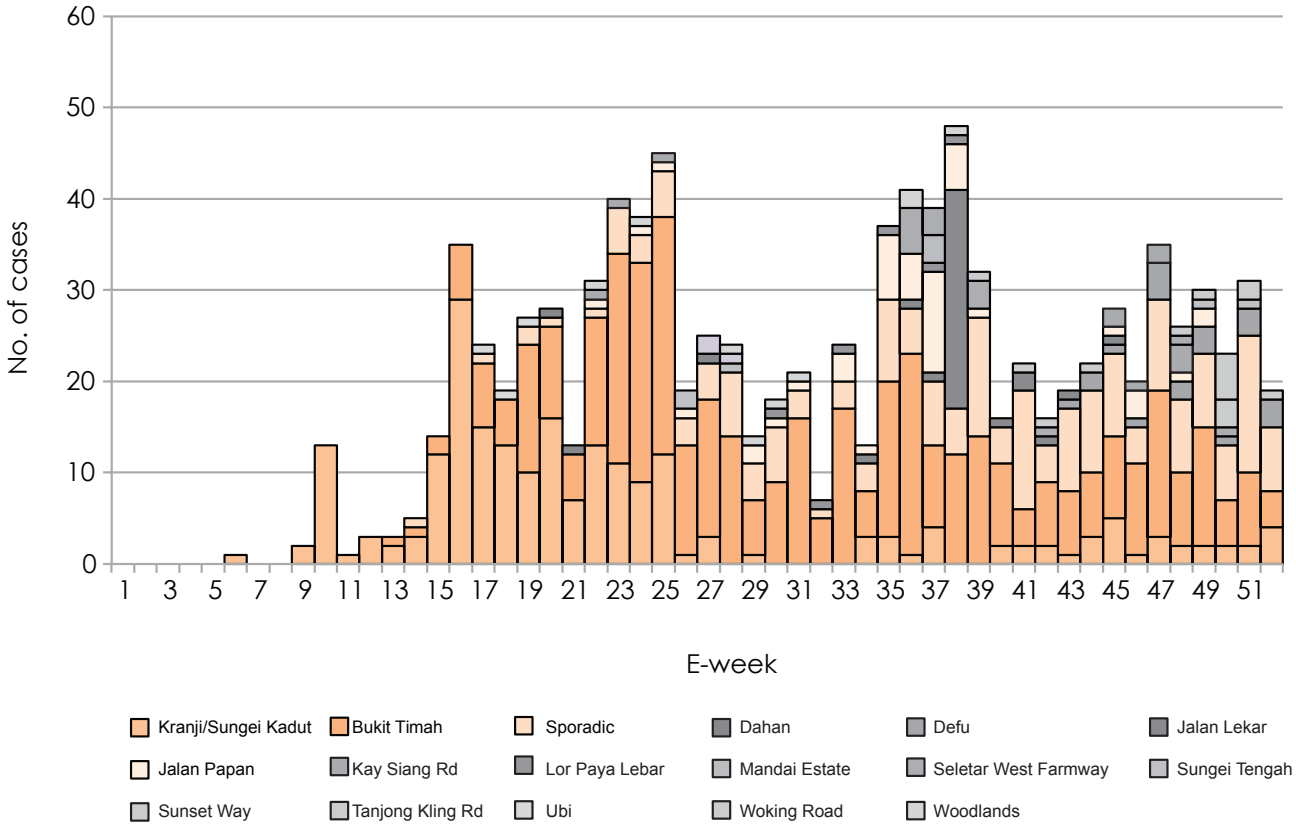


Table 1

Table 1

Distribution of indigenous chikungunya fever cases^ in Singapore by location, 2013

Area with indigenous cases of chikungunya fever	Number of cases	Percentage of cases
Bukit Timah	418	41.3%
Kranji/Sungei Kadut	219	21.7%
Jalan Papan	48	4.7%
Jalan Lekar	33	3.3%
Defu	21	2.1%
Seletar West Farmway	14	1.4%
Kay Siang Road	11	1.1%
Tanjong Kling Road	10	1.0%
Woodlands	9	0.9%
Sunset Way	7	0.7%
Lor Paya Lebar	6	0.6%
Sungei Tengah	5	0.5%
Dahan Road	3	0.3%
Mandai Estate	3	0.3%
Ubi	3	0.3%
Woking Road	3	0.3%
Sporadic	198	19.6%
Grand Total	**1011**	**100.0%**

^Cases acquired locally among Singaporeans, permanent and temporary residents.

Of the 1,011 indigenous chikungunya fever cases reported in 2013, 219 (21.7%) were linked through epidemiological investigations to the Kranji/Sungei Kadut area. As part of epidemiological investigations, active case detection was performed and detected 16.4% (36) of the 219 cases linked to the Kranji/Sungei Kadut area. Of the cases detected through active case detection, 11(30.6%) were positive by polymerase chain reaction (PCR) and were viraemic at the point of testing. Majority of the cases in the Kranji/Sungei Kadut area involved males aged between 25 and 34 years of age (41.6%). 85.4% of cases linked to the Kranji/Sungei Kadut area were foreigners living and/or working in the area.

Cases linked to the Kranji/Sungei Kadut area were reported beginning from E-week 6 and was increasing significantly before peaking in in E-week 16. The number of cases reported then declined sharply for the rest of the year.

Figure 2

Time distribution of 219 indigenous chikungunya fever cases in Kranji/Sungei Kadut, 2013

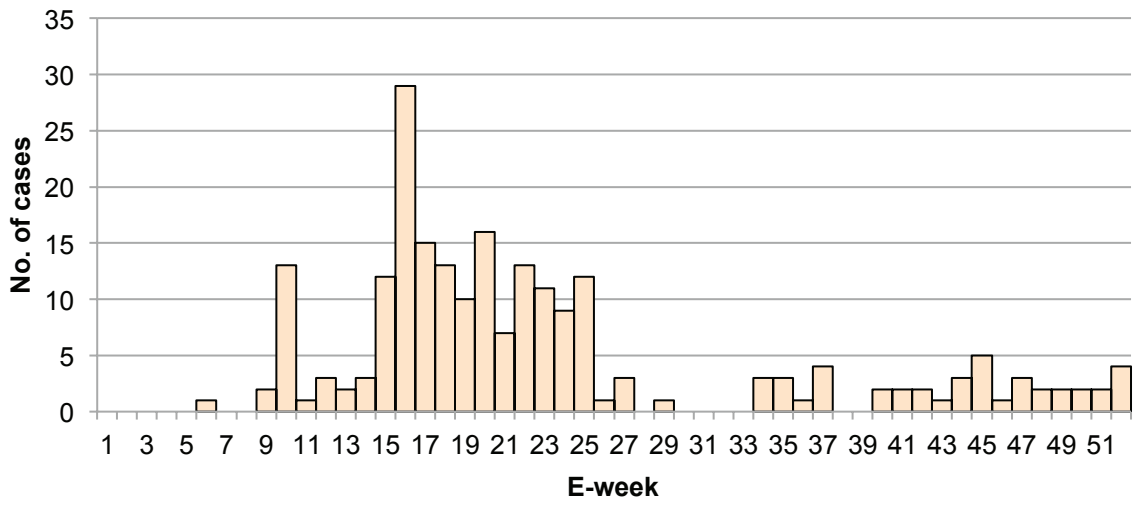


Table 2
Age-gender distribution and age-specific incidence rate of indigenous chikungunya fever cases^ in Kranji/Sungei Kadut, 2013

Age (Yrs)	Male	Female	Total (%)
0 – 4	0	0	0 (0.0)
5 – 14	0	0	0 (0.0)
15 – 24	21	0	21 (9.6)
25 – 34	91	0	91 (41.6)
35 – 44	2	73	75 (34.2)
45 – 54	19	0	19 (8.7)
55+	13	0	13 (5.9)
Total	**146**	**73**	**219 (100.0)**

^Cases acquired locally among Singaporeans, permanent and temporary residents.

Table 3
Ethnic-gender distribution and ethnic-specific incidence rate of indigenous chikungunya fever cases^ in Kranji/Sungei Kadut, 2013

	Male	Female	Total (%)
Singapore Resident			
Chinese	28	1	29 (13.2)
Malay	1	0	1 (0.5)
Indian	2	0	2 (0.9)
Others	0	0	0 (0.0)
Foreigner	186	1	187 (85.4)
Total	**217**	**2**	**219 (100.0)**

^Cases acquired locally among Singaporeans, permanent and temporary residents.

Of the 1,011 indigenous chikungunya fever cases reported in 2013, 418 (41.3%) were linked through epidemiological investigations to the Bukit Timah area, of which 4 (1.0%) were detected through active case detection. None of the cases detected through active case detection were viraemic at the point of testing. Majority of these cases involved were aged between 35 and 34 years of age (41.6%). Residents and foreign domestic helpers constituted 63.2% (264) and 28.2% (118) of the cases reported in Bukit Timah respectively.

Cases linked to Bukit Timah were first reported in E-week 13 and gradually increased. At its peak during E-week 26, 25 cases were reported before the number of cases reported for subsequent weeks was observed to decrease, but was maintained at a higher level than what was seen after the cases linked to Kranji/Sungei Kadut peaked in E-week 16.

Figure 3
Time distribution of 418 indigenous chikungunya fever cases in Bukit Timah, 2013

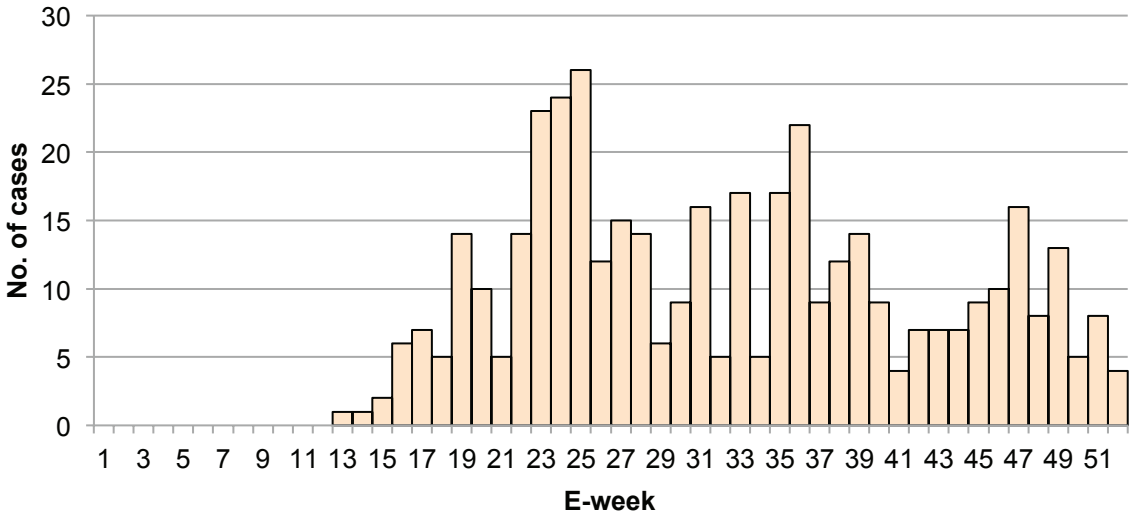


Table 4
Age-gender distribution and age-specific incidence rate of indigenous chikungunya fever cases^ in Bukit Timah, 2013

Age (Yrs)	Male	Female	Total (%)
0 – 4	2	1	3 (0.7)
5 – 14	15	6	21 (5.0)
15 – 24	16	9	25 (6.0)
25 – 34	31	50	81 (19.4)
35 – 44	36	98	134 (32.0)
45 – 54	22	36	58 (13.9)
55+	47	49	96 (23.0)
Total	**169**	**249**	**418 (100.0)**

^Cases acquired locally among Singaporeans, permanent and temporary residents.

Table 5
Ethnic-gender distribution and ethnic-specific incidence rate of indigenous chikungunya fever cases^ in Bukit Timah, 2013

	Male	Female	Total (%)
Singapore Resident			
Chinese	63	67	130 (31.1)
Malay	7	0	7 (1.7)
Indian	3	2	5 (1.2)
Others	12	11	23 (5.5)
Foreigner	84	169	253 (60.5)
Total	**169**	**249**	**418 (100.0)**

^Cases acquired locally among Singaporeans, permanent and temporary residents.

Although most cases were found to be associated with clusters of indigenous chikungunya fever cases, 19.6% of the indigenous cases reported in 2013 were sporadic and could not be linked to any of the other known clusters. The demographics of sporadic cases was also observed to be more diverse than those seen in Kranji/Sungei Kadut and Bukit Timah, and involved more Singapore residents (49.0% compared to 14.6% and 39.5% in Kranji/Sungei Kadut and Bukit Timah respectively).

Sporadic cases were first reported in E-week 14 but was noted to pick up towards E-week 23, gradually increasing and peaking in E-week 51. Despite extensive investigations to elucidate possible links to other known clusters of cases, cases were reported having no recent movement history to other clusters.

Figure 4
Time distribution of 198 sporadic indigenous chikungunya fever cases, 2013

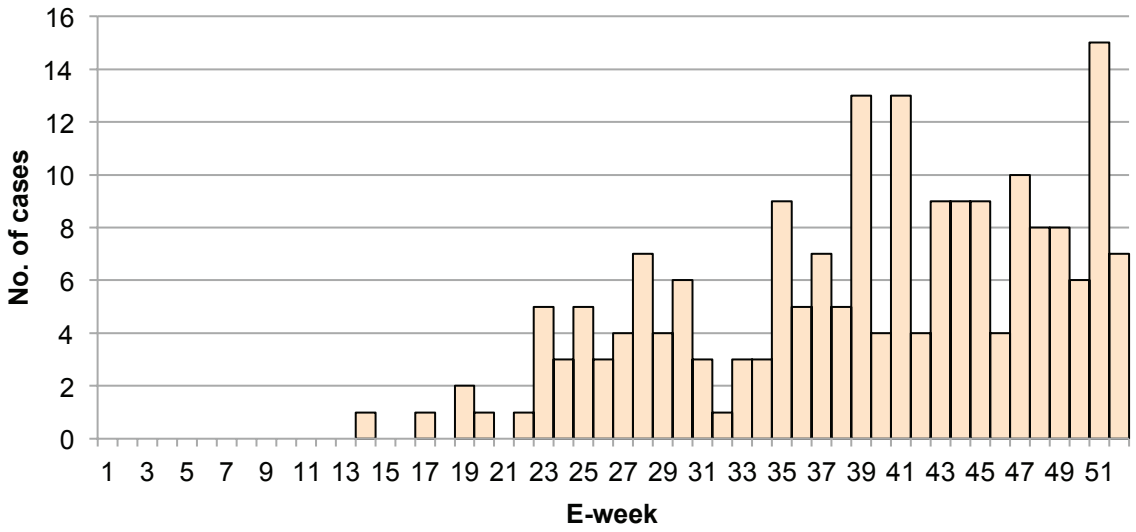


Table 6
Age-gender distribution and age-specific incidence rate of sporadic indigenous chikungunya fever cases^, 2013

Age (Yrs)	Male	Female	Total (%)
0 – 4	0	1	1 (0.5)
5 – 14	3	2	5 (2.5)
15 – 24	11	3	14 (7.1)
25 – 34	42	12	54 (27.3)
35 – 44	33	9	42 (21.2)
45 – 54	27	12	39 (19.7)
55+	28	15	43 (21.7)
Total	**144**	**54**	**198 (100.0)**

^Cases acquired locally among Singaporeans, permanent and temporary residents.

Table 7
Ethnic-gender distribution and ethnic-specific incidence rate of sporadic indigenous chikungunya fever cases^, 2013

	Male	Female	Total (%)
Singapore Resident			
Chinese	57	22	79 (39.9)
Malay	6	1	7 (3.5)
Indian	2	1	3 (1.5)
Others	3	5	8 (4.1)
Foreigner	76	25	101 (51.0)
Total	**144**	**54**	**198 (100.0)**

^Cases acquired locally among Singaporeans, permanent and temporary residents.

Virological and entomological findings

The genetic analysis of envelope 1 (E1) gene of Chikungunya virus (CHIKV) included virus strains obtained from 487 indigenous and eight imported cases. In addition, three virus strains isolated from adult *Aedes albopictus* mosquitoes in two clusters during the early phase of the outbreak were also included in the analysis. Mosquito-derived E1 gene sequences were identical to those of human viruses from the two clusters, indicating the role of *Ae. albopictus* in virus transmission. The same finding confirmed establishment of indigenous transmission of outbreak strains. Furthermore, adult mosquito surveillance in clusters captured only *Ae. albopictus* further strengthening its role in CHIKV transmission during the outbreak.

Phylogenetic analysis revealed that all locally-transmitted CHIKV strains clustered into a monophyletic group within the East, Central and South African (ECSA) genotype. They shared an Indian sub-continent ancestry.

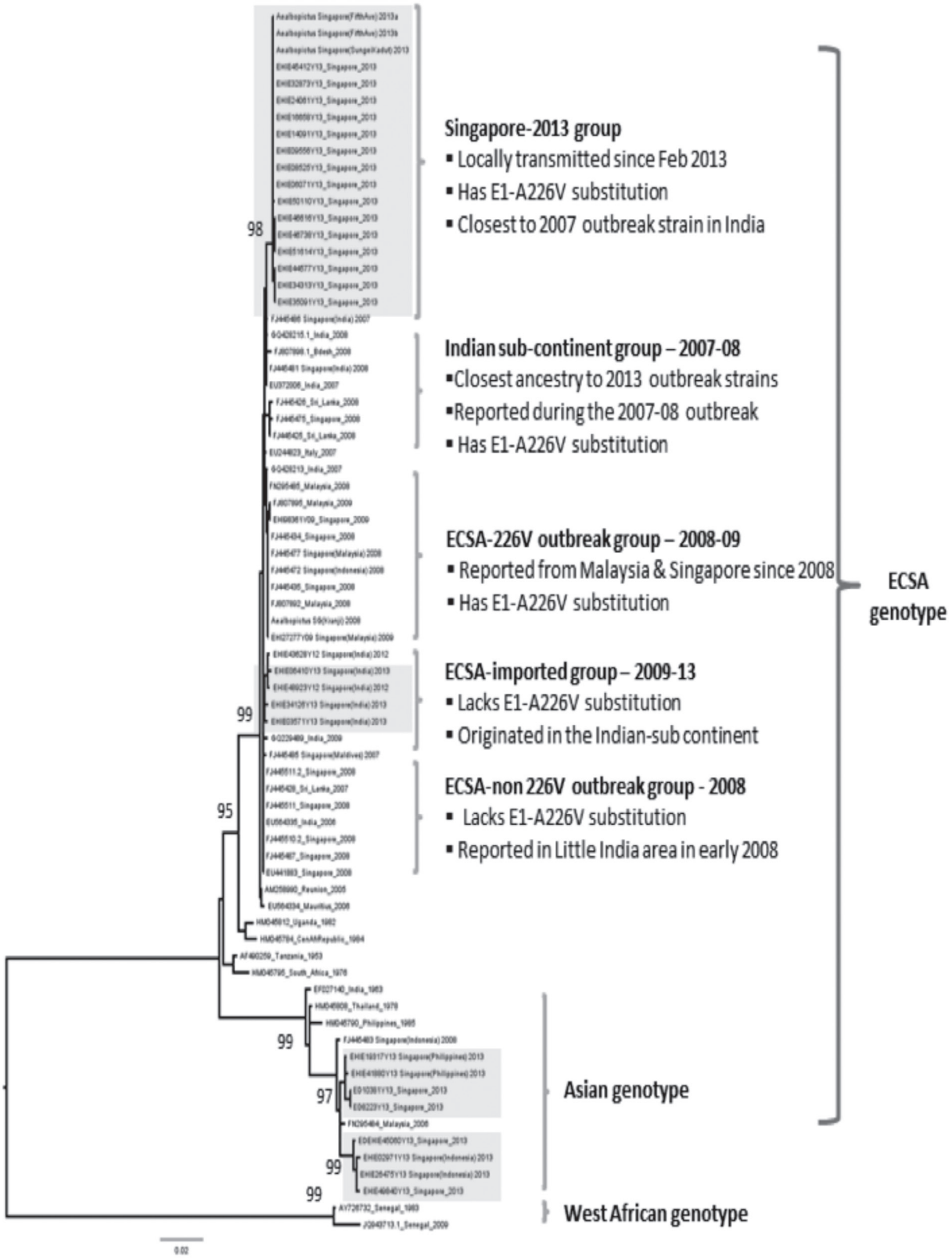
Imported virus strains in 2013 belonged to the ECSA and Asian genotypes. Both groups of viruses did not possess E1-A226V substitution. Imported ECSA strains shared an Indian sub-continent ancestry,

but clustered separately from outbreak strains and were repeatedly detected as sporadic cases during 2009-2013 periods. On the other hand, Asian genotype strains were imported from Philippines and Indonesia. As shown in Figure 5, high bootstrap support indicated that virus strains from those two countries were genetically distinct. Those that belonged to Philippines lineage established local transmission for a brief period, causing a cluster of six cases in Lorong Paya Lebar in October 2013.

Table 8
Summary of entomological surveillance findings in 2013

Year	Location	Type	Adult mosquito collection		CHIKV infected
			Aedes aegypti	*Aedes albopictus*	
2013	Sungei Kadut	Rural/sub-urban	0	6	1
2013	Sixth Avenue	Sub-urban	0	32	0
2013	Fifth Avenue	Sub-urban	0	82	2

Figure 5
Phylogenetic analysis of CHIKV envelope 1 (E1) gene sequences.



The maximum likelihood tree was constructed using MEGA 6.06 software [86] based on the general time reversible (GTR) model with gamma distribution and invariant sites. The robustness of the original tree was tested with 1000 bootstrap replications. Sequences of outbreak strain in 2013 are shaded. Figures on branches are bootstrap support values and only those on major nodes are shown. All GenBank-derived sequences are named with accession number, country of origin and year of isolation.

Discussion

Chikungunya fever is a new emerging disease to Singapore, with the first outbreak of chikungunya fever in Singapore having occurred in 2008, where there were two episodes of indigenous transmission. During the 2008 outbreak, there was an initial wave of cases that occurred in Little India (Jan – Feb 08) while the second episode was initiated by a wave of imported cases from Malaysia.

In 2013, cases were first detected in the semi-rural, industrial area of Kranji/Sungei Kadut and were largely confined to foreigners living and working there. It was hypothesized that the movement of human traffic in and out of the Kranji/Sungei Kadut area eventually resulted in the introduction of cases in the Bukit Timah area almost 2 months later. This hypothesis was further strengthened through virological findings where analysis of the E1 genetic sequences obtained from CHIKV virus strains from of cases in both Kranji/Sungei Kadut and Bukit Timah were found to be closely related. This eventually resulted in the introduction of cases in other parts of Singapore, resulting in smaller clusters of cases as well as the reporting of sporadic cases of chikungunya fever which could not be linked to clusters despite extensive investigations. All samples from indigenous cases of chikungunya fever in 2013 were of the ECSA genotype and were closely related to the 2007 outbreak strain in India. Evidence of local transmission was further observed through the capture of mosquitoes carrying the CHIKV virus, which were found to be identical to what was isolated from human cases.

Despite belonging to the same genotype as virus strains involved in the first chikungunya outbreak in Singapore in 2008, indigenous strains in 2013 possessed a signature of two synonymous substitutions (C639T + C816A) in E1 gene, making them a genetically distinct group. These observations, together with the long-term absence of CHIKV transmission in the country at an outbreak scale, supported a viral introduction event prior to the establishment of indigenous transmission during the CHIKV outbreak in 2013. Outbreak strains possessed E1-A226V substitution, an adaptive substitution to *Ae. albopictus*, further supporting the potential role of *Ae. albopictus* in transmitting chikungunya fever in 2013.

The 2013 experience of indigenous cases of chikungunya fever demonstrates Singapore's vulnerability towards the importation of infections such as chikungunya fever due to our open borders as well as the presence of the vectors required for transmission. Close cooperation between the relevant authorities as well as the community is required for prompt identification of cases and clusters, leading to the implementation of measures such as employing effective vector control measures to stop the chain of transmission.

OUTBREAK OF GASTROENTERITITIS CAUSED BY *SALMONELLA* ENTERIDITIS ASSOCIATED WITH THE CONSUMPTION OF FOOD FROM A RESTAURANT IN SINGAPORE

Introduction

Salmonellosis is one of the commonest food-borne infections worldwide[1]. An estimated 1.4 million cases of Salmonella infections are reported in the US yearly[2], while 1374 cases of salmonellosis were reported in Singapore in 2011[3].

Salmonella Enteritidis is one of the most common serotypes worldwide, particularly in developed countries[4,5]. In Asia it has also emerged as the most common serotype in Japan, the Republic of Korea, Thailand[1] and Singapore[3].

Two incidents of gastroenteritis linked to consumption of food in a restaurant were notified to the Ministry of Health (MOH) on 12 May 2013. We report the findings of our epidemiological, microbiological and environmental investigations, and highlight the importance of molecular typing in establishing the source of infection.

Notification

The first incident involved 2 adults who developed diarrhoea and fever after their meal at the restaurant on 10 May 2013 at 1800 hrs. The second incident involved 4 adults who developed diarrhoea, fever and nausea after consuming food at the same restaurant on 10 May 2013 at 2030hrs.

Methods

A case was defined as a previously well individual who developed watery diarrhoea (two or more episodes in 24 hours) with/without fever, after consuming food from the restaurant from 10-13 May 2013. All the cases were interviewed and relevant clinical and epidemiological data such as age, sex, ethnicity, clinical symptoms, date of onset of symptoms, food items eaten and medical treatment sought were obtained.

A site visit was immediately made to the implicated restaurant to identify the source of infection and mode of transmission. The food preparation process was also reviewed with the management. Stool from the cases as well as food and environmental samples were taken for microbiological analysis *(Campylobacter, Salmonella, Staphylococcus aureus, Clostridium perfingens, Escherichia coli, rotavirus and norovirus)*. All implicated food handlers were referred to the Communicable Disease Centre and screened for enteropathogens.

Genotyping of *Salmonella* cultured from stool samples (determined by multiple-locus vari¬able number of tandem repeat analysis, MLVA), was performed by the National Public Health Laboratory (NPHL). Seven variable-number tandem repeats (VNTR) loci selected for MLVA were amplified in a single multiplex PCR[6]. The PCR products obtained were then directly analysed using the QIAxcel High Resolution Kit, in combination with QIAxcel instruments.

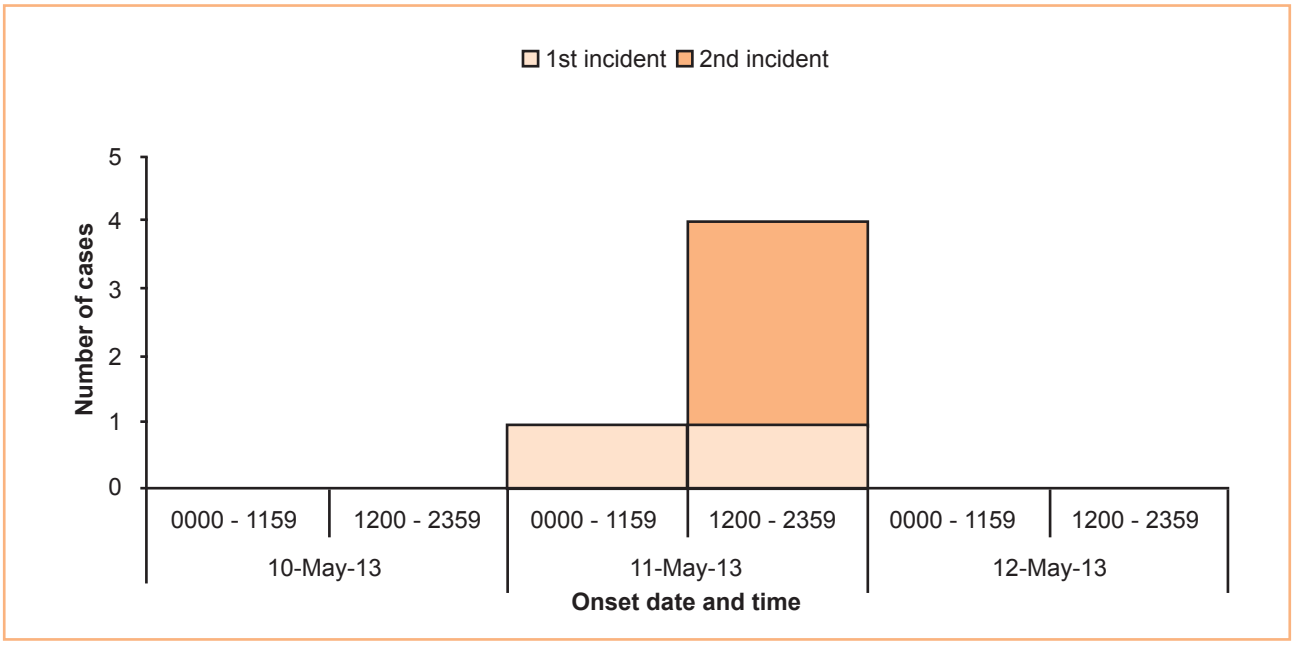
Results

A total of five cases that met the case definition were identified. Two of these cases were from the first incident and the remaining cases were from the second incident. All of them had consumed tiramisu and roast chicken for dinner on 10 may 2013 prior to their onset of symptoms.

All the cases were Singaporean Chinese and 60% were males. The presenting symptoms were watery diarrhoea (100%), fever (100%) and nausea (20%). Of the five cases, one was hospitalised (20%) while the rest sought outpatient treatment (80%). The hospitalised case was admitted on 11 May 2013 and discharged on 14 May 2013.

The onset of illness was from 0200 to 2100 hrs on 11 May 2013 (Figure 1). The mean and median incubation periods were 16.2 hours and 16 hours respectively, with a range of 8-23 hours.

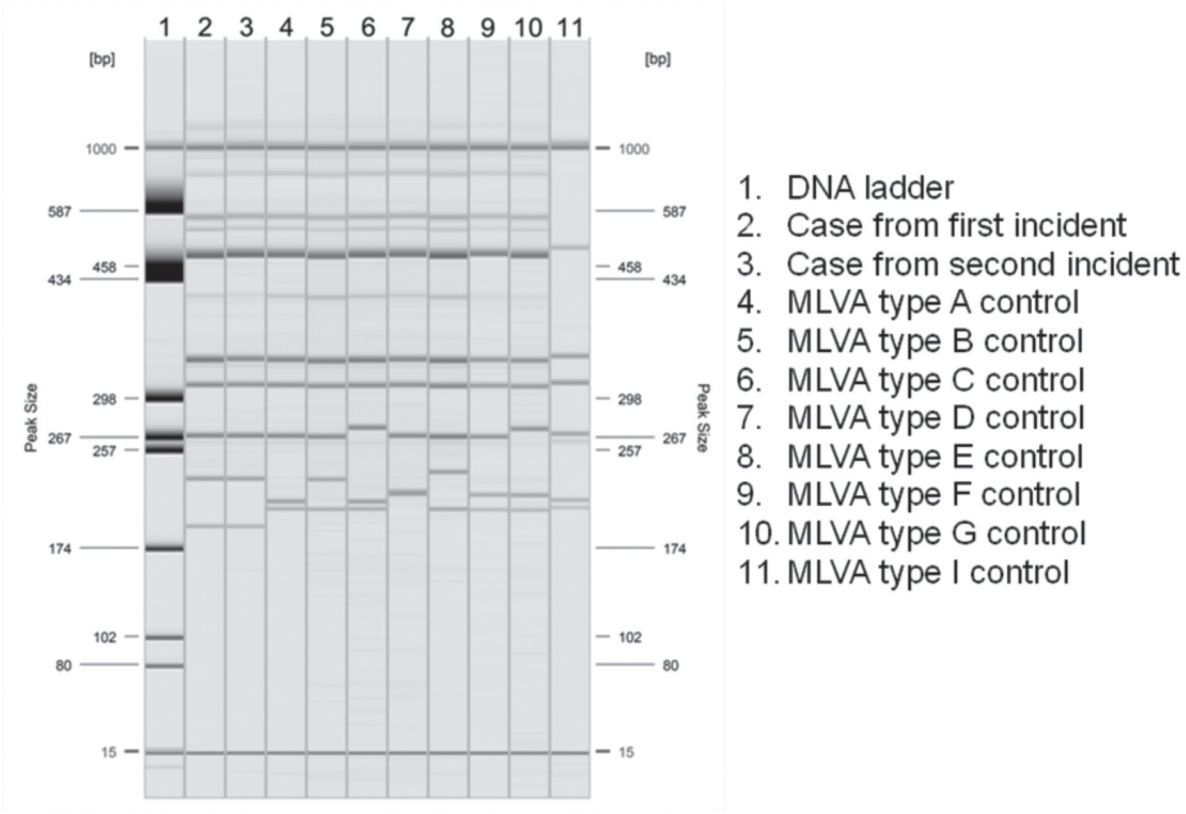
Figure 1
Onset of Illness of 5 reported food poisoning cases who consumed food at a restaurant on 10 May 2013



Two of four stool samples obtained from the cases were positive for *Salmonella* Enteriditis, MLVA type J (Figure 2). All the four food handlers from the implicated restaurant tested negative for food-borne pathogens, including norovirus and rotavirus.

Of the two food samples collected (tiramisu and poached eggs) for microbial analysis, tiramisu was found to have high total plate count (2,900,000 CFU/g; limit <100,000 CFU/g) and high total coliform count (1100 MPN/g; limit <50 MPN/g). An environmental swab of the chopping board for roasted chickens tested negative for bacterial food poisoning pathogens.

Figure 2
MLVA typing of two *Salmonella*-positive cases

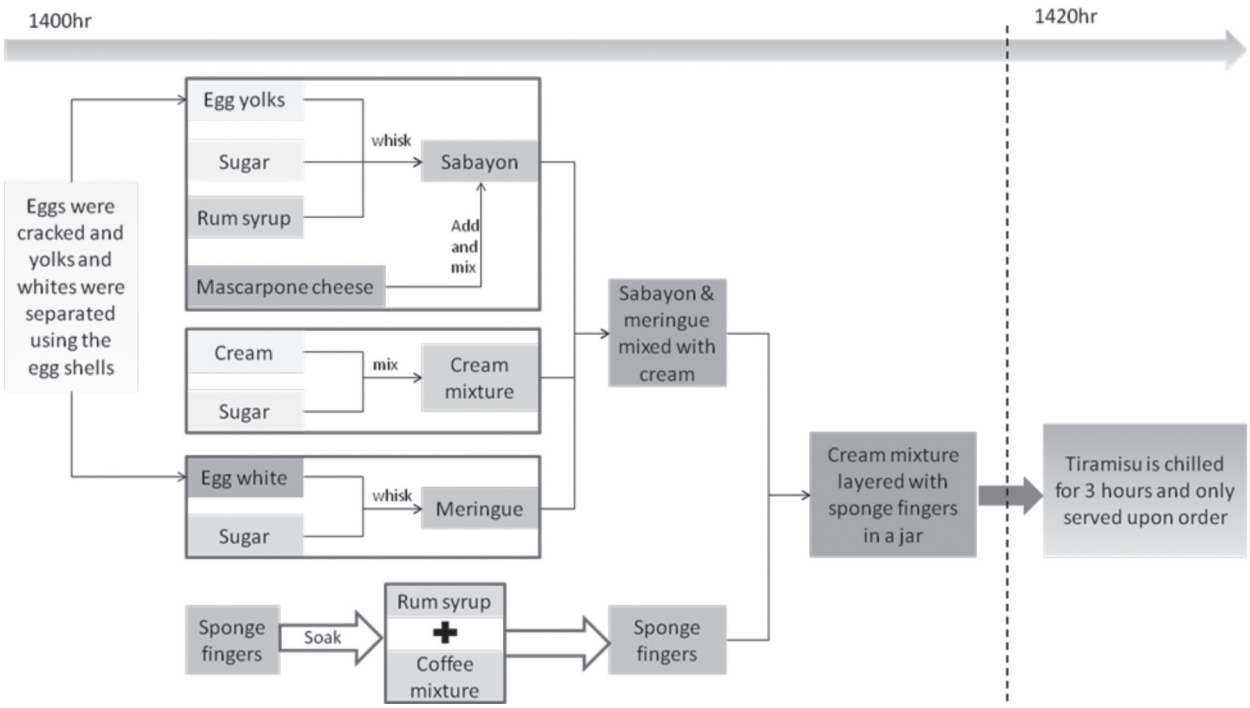


Food preparation process

Two batches of chickens were cooked each day at 0900hrs and 1500hrs. Preparations for roast chickens began at 0900hrs when fresh chickens were delivered to the restaurant. The chickens were marinated in brine with salt and sugar. The first batch of chickens was seared before cooking in the combination oven. The remaining chickens were kept in the refrigerator to be cooked at 1500hrs. After cooking in the combination oven, the chickens were then transferred to the rolling oven for further roasting. The roast chickens were then transferred to the warmer before serving. Sauces were added to the chickens just before serving to the customers. Precautionary measures were taken throughout the food preparation process to prevent cross-contamination between raw and cooked chickens

The tiramisu was prepared by the food handlers daily at 1400hrs and it took 20 minutes to complete. There were no specific personnel-in-charge of making the tiramisu. Eggs were a key ingredient used to make the tiramisu. These were supplied daily to the restaurant at 0900hrs. The egg whites and eggs yolks were manually separated from whole eggs into 2 bowls. Sugar was added to 18 of these pooled egg yolks to be whisked together with rum syrup to make a mousse (sabayon). Mascarpone cheese was then added to the sabayon and this was subsequently chilled in the refrigerator. Similarly, sugar was added to the pooled egg whites and whisked to become a meringue. Fresh cream was mixed with sugar to make a cream mixture. Sponge fingers were separately soaked in rum syrup and coffee mixture. Finally, the meringue, sabayon and cream were mixed together and then layered onto the sponge fingers to make 60 jars of tiramisu. The tiramisu was then chilled for 3 hours before serving. This batch of tiramisu would be served on the same day as well as for lunch on the following day. The preparation process of the tiramisu is depicted in Figure 3.

Figure 3
Preparation process of tiramisu



The restaurant was found to be satisfactorily maintained. However, two hygiene lapses were observed. These included uncovered food items in the refrigerator and a refuse bin without a functional pedal. None of the staff reported being unwell one week prior to the two incidents and the establishment had not received any other complaints of food-borne illness.

Discussion

The epidemiological and clinical findings suggest that this is an outbreak of salmonellosis. The reported symptoms (fever and diarrhoea) with a mean incubation period of 16.2 hours (range 8 to 23 hours) are compatible with the symptoms and known incubation period for *Salmonella* infection. This is further supported by the isolation of *Salmonella* Enteriditis from the stool samples of two cases, one from the first incident and the other from the second incident. The common source of infection from the implicated restaurant was confirmed by the same genetic sequence (MLVA type type J).

There were no common meals among the cases other than the dinner at the restaurant on 10 May 2013. Tiramisu and roast chicken were the two common food items consumed by the cases in the 2 incidents.

Salmonellosis is a bacterial disease characterized by acute enterocolitis, with sudden onset of abdominal pain, diarrhoea, nausea and vomiting. The incubation period is usually between 12 and 36 hours but it can range from 6 to 72 hours. Infection can arise from ingestion of the salmonella bacteria in food derived from infected animals or food that is contaminated by faeces of infected animals or humans[7].

Common implicated food items include raw or inadequately cooked poultry and eggs and dairy products, as well as processed meat products[7,8]. Its increasing incidence in the United Kingdom and the United States of America in the 1980s was mainly attributed to consumption of raw or undercooked contaminated poultry, hen eggs and egg-containing products[5,9]. In Singapore, food-borne outbreaks of Salmonella Enteritidis have been reported in cream cakes[10], bread[11], and an egg-based pancake[12].

Outbreaks of *Salmonella* Enteritidis associated with eggs and desserts are not uncommon. In 2010, Wright Country Egg of Galt, Iowa, conducted a nationwide voluntary recall of shell eggs due to Salmonella Enteritidis contaminated egg shells. 1,939 reported cases of salmonellosis were associated with this outbreak[8]. In the United States, eggs or egg-containing foods were implicated in

77% of the outbreaks of *Salmonella* Enteritidis infection in which a food vehicle was identified[5]. In the United Kingdom, desserts were implicated in 19% of outbreaks and eggs were used as an ingredient in 70% of these desserts[9]. The high number of eggs-associated outbreaks may be due to the fact that eggs are often eaten raw or undercooked. Foods that contain eggs, such as tiramisu or ice-creams, are often lightly cooked or uncooked. The practice of pooling a large number of eggs for use in commercial settings may also increase the risk of salmonella-associated outbreaks as one or a few contaminated eggs can accelerate and increase the exposure of consumers to *Salmonella* Enteritidis contamination.

In this outbreak, tiramisu was prepared from unpasteurised raw eggs without further heating or reheating. Any contamination in a single batch of eggs could potentially present a risk to consumers. It is likely that the tiramisu served during the dinner on 10 May 2013 could have been contaminated during its preparation. We noted that the egg shell had been used to manually separate the egg yolk and egg whites during the preparation process. This could have resulted in contamination of the tiramisu if the surface of the egg shells was contaminated with the faeces of an infected animal or after oviposition. Eggs can also be contaminated by direct penetration through the eggshell from the colonised gut of an infected poultry or by direct contamination of the internal contents of the eggs by infected ovaries and oviducts[13].

The other food item that was common in this outbreak was roasted chicken. However, we believe that it is an unlikely vehicle of transmission as it was cooked at temperatures above 100oC (the temperature settings were checked during the inspection). In addition, as roast chickens accounted for half of the sales, we would have expected more cases linked to this premises.

Other possible sources of contamination included the cross-contamination of utensils, equipments and work surfaces. Our investigations uncovered hygiene lapses such as ready-to-serve food items that were not properly stored and covered rubbish bin with faulty pedal. *Salmonella* can survive in the environment for several days[14]. Therefore, when personal and food hygiene practices are insufficiently observed, there is a possibility that *Salmonella* Enteritidis can be transferred from the contaminated food to other ready-to-serve food through unwashed hands or food preparation surfaces.

Currently, there is no regulation on using pasteurised eggs in the preparation of food in Singapore. Nevertheless, we have advised the management of the implicated restaurant to use pasteurised eggs and to use an egg strainer to separate the yolks from the whites to minimize the risk of contamination. The restaurant was also reminded to ensure that proper personal and food hygiene practices are observed at all times.

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- Haemophilus Influenza Type B Disease
- Hand, Foot and Mouth Disease
- Influenza
- Measles
- Meningococcal Infection
- Mumps
- Pertussis
- Pneumococcal Disease (invasive)
- Rubella
- Viral Conjunctivitis
- Severe Illness & Death from Possibly Infectious Causes (SIDPIC)
- Chickenpox (Varicella)

I
AIR-/DROPLET-BORNE DISEASES

Airborne transmission occurs by dissemination of droplet nuclei which are small particle residues 5 micrometers or smaller in diameter, which can remain suspended in the air for long periods of time. Droplets can be formed when a person coughs, sneezes or talks. Droplets can also be formed during administration of drugs via nebuliser or invasive procedures such as suctioning and bronchoscopy. Transmission occurs when droplets containing microorganisms generated from infected persons are propelled a short distance (within a meter) through air and deposited on the host's mucous membranes (such as conjunctiva, nasal mucosa, mouth or respiratory tract).

HAEMOPHILUS INFLUENZA TYPE B DISEASE

Haemophilus influenza type b (Hib) disease is a serious disease caused by bacteria. The most common severe types of *Haemophilus influenzae* disease are: pneumonia (lung infection); bacteremia (bloodstream infection); and meningitis (infection of the covering of the brain and spinal cord). The causative agent is *Haemophilus Influenza* type b (gram-negative coccobacillus). The mode of transmission is by inhalation of respiratory droplets or direct contact with respiratory tract secretions of infected persons. Hib disease is vaccine-preventable.

In 2013, there were ten cases of *Haemophilus influenza* type b disease reported compared to one case in 2012 (Figure 1.1). All the cases were laboratory confirmed with positive blood or cerebral spinal fluids culture. The incidence rate was highest in those aged 55 years and above. Among the major ethnic groups, Malays had the highest incidence rate and followed by Chinese (Table 1.1 and 1.2).

Figure 1.1
E-weekly distribution of reported Hib cases, 2012 – 2013

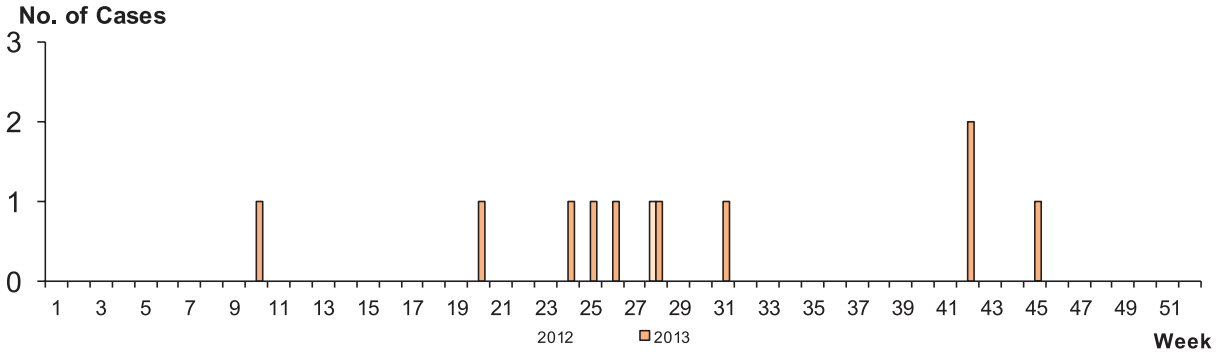


Table 1.1
Age-gender distribution and age-specific incidence rates of reported Hib cases, 2013

Age (Yrs)	Male	Female	Total (%)	Incidence rate per 100,000 population*
0 - 4	0	0	0 (0.0)	0.0
5 – 14	0	0	0 (0.0)	0.0
15 – 24	0	0	0 (0.0)	0.0
25 – 34	0	0	0 (0.0)	0.0
35 – 44	0	0	0 (0.0)	0.0
45 – 54	0	2	2 (20.0)	0.3
55 - 64	2	2	4 (40.0)	0.7
65+	4	0	4 (40.0)	0.9
Total	**6**	**4**	**10 (100.0)**	**0.2**

*Rates are based on 2013 estimated mid-year population.
(Source: Singapore Department of Statistics)

Table 1.2
Ethnic-gender distribution and ethnic-specific incidence rate of reported Hib cases, 2013

	Male	Female	Total (%)	Incidence rate per 100,000 population*
Singapore Resident				
Chinese	4	2	6 (60.0)	0.2
Malay	1	1	2 (20.0)	0.4
Indian	0	0	0 (0.0)	0.0
Others	1	0	1 (10.0)	0.8
Foreigner	0	1	1 (10.0)	0.1
Total	**6**	**4**	**10 (100.0)**	**0.2**

*Rates are based on 2013 estimated mid-year population.
(Source: Singapore Department of Statistics)

HAND, FOOT AND MOUTH DISEASE (HFMD)

Hand, foot and mouth disease (HFMD) is a common childhood viral disease characterised by brief prodromal fever, followed by pharyngitis, mouth ulcers and rash on the hands and feet. Children may have reduced appetite due to painful oral ulcers erupting on the tongue, gums or inside of the cheeks. A non-pruritic vesicular rash or red spots typically appears on the hands and feet, most commonly on the palms and soles. The common causative agents for HFMD are the *coxsackieviruses type A (CA), echovirus (EC) and enterovirus 71 (EV71)*. HFMD can be transmitted from person to person through the faecal-oral or respiratory route.

A total of 31,741 cases of HFMD were reported in 2013, a decrease of 14.5% compared to 37,125 cases reported in 2012 (Figure 1.2). There were no local cases with severe complications due to HFMD reported in 2013.

The incidence rate was highest in the 0 - 4 years age group, with an overall male to female ratio of 1.3:1 (Table 1.3). Among the three major ethnic groups, Malays had the highest incidence rate, followed by Chinese and Indians (Table 1.4). No HFMD deaths were reported in 2013.

Viral isolation and PCR of *enterovirus* 71 (EV 71) and other *enteroviruses* was carried out on samples collected at the KK Women's and Children's Hospital (KKH), National University Hospital (NUH) and

sentinel GP clinics. Of the isolates that were tested positive, the majority was *coxsackieviruses* type A (CA) (54.0%), followed by EV 71 (0.3%). Among the *coxsackieviruses*, CA6 (72.0%) was the predominant serotype, followed by CA16 (12.2%).

Figure 1.2
E-weekly distribution of reported hand, foot and mouth cases, 2012 – 2013

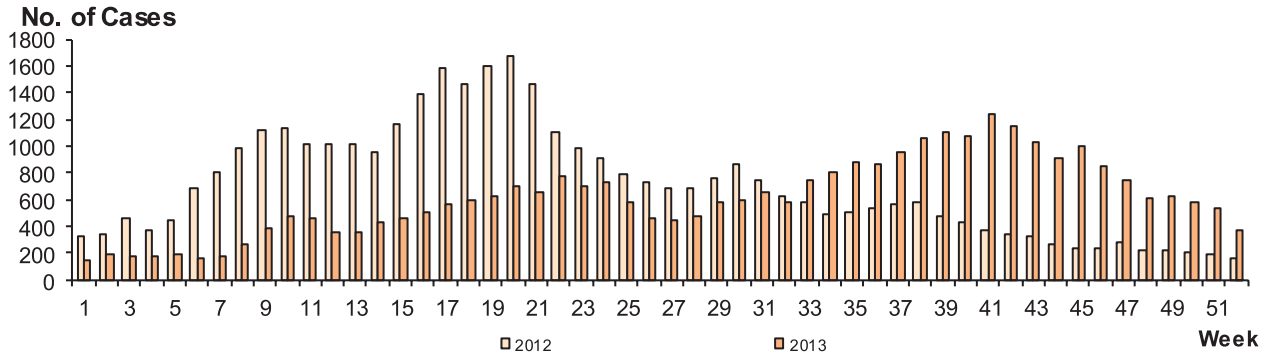


Table 1.3
Age-gender distribution and age-specific incidence rate of reported hand, foot and mouth cases^, 2013

Age (Yrs)	Male	Female	Total (%)	Incidence rate per 100,000 population*
0 - 4	11,273	8,843	20,116 (63.4)	8,979.9
5 – 14	4,189	3,345	7,534 (23.8)	1,570.3
15 – 24	642	532	1,174 (3.7)	150.3
25 – 34	782	781	1,563 (4.9)	128.0
35 – 44	645	446	1,091 (3.4)	114.2
45 – 54	104	63	167 (0.5)	22.7
55+	41	36	77 (0.3)	7.7
Total	**17,676**	**14,046**	**31,722 (100.0)**	**587.5**

^Excluding 19 tourists.
*Rates are based on 2013 estimated mid-year population.
(Source: Singapore Department of Statistics)

Table 1.4
Ethnic-gender distribution and ethnic-specific incidence rate of reported hand, foot and mouth cases^, 2013

	Male	Female	Total (%)	Incidence rate per 100,000 population*
Singapore Resident				
Chinese	11,870	9,551	21,421 (67.5)	750.6
Malay	2,235	1,773	4,008 (12.6)	781.5
Indian	500	466	966 (3.1)	274.7
Others	1,102	865	1,967 (6.2)	1,555.0
Foreigner	1,969	1,391	3,360 (10.6)	216.2
Total	**17,676**	**14,046**	**31,722 (100.0)**	**587.5**

^Excluding 19 tourists.
*Rates are based on 2013 estimated mid-year population.
(Source: Singapore Department of Statistics)

Institutional Outbreaks of HMFD

There were 2,418 reported outbreaks of HFMD in year 2013, each involving two or more cases. Table 1.5 gives a breakdown of HFMD outbreaks at various educational institutions by attack rate. Two HFMD clusters are discussed below.

Since 2010, additional measures were introduced to curb the HFMD transmission in educational institutions. These included weekly hygiene spot checks on randomly selected childcare centres or kindergartens which have outbreaks of HFMD but had not hit any specific triggers for follow-up action. Childcare centres or kindergartens with prolonged HFMD transmission had their names published on the MOH website and were subsequently closed for ten days if the transmission was further prolonged. These measures continued to be enforced in 2013 with public education enhanced.

Table 1.5
Outbreaks of hand, foot and mouth disease in childcare centres/ kindergartens/schools, 2013

Attack rate (%)	Childcare Centres	Kindergartens	Primary Schools	Enrichment Centres	Other Institutions*
< 10	1,041	354	499	22	162
10 - 20	239	7	-	15	2
21 - 30	44	-	-	3	-
31 - 40	13	-	-	3	-
41 - 50	5	-	-	5	-
>50	2	-	-	2	-
Total	**1,344**	**361**	**499**	**50**	**164**

*96 from secondary schools, 46 from international schools, 10 from special schools, nine from polytechnics, two from private schools and one from junior college.

Cluster 1: Childcare centre at Punggol

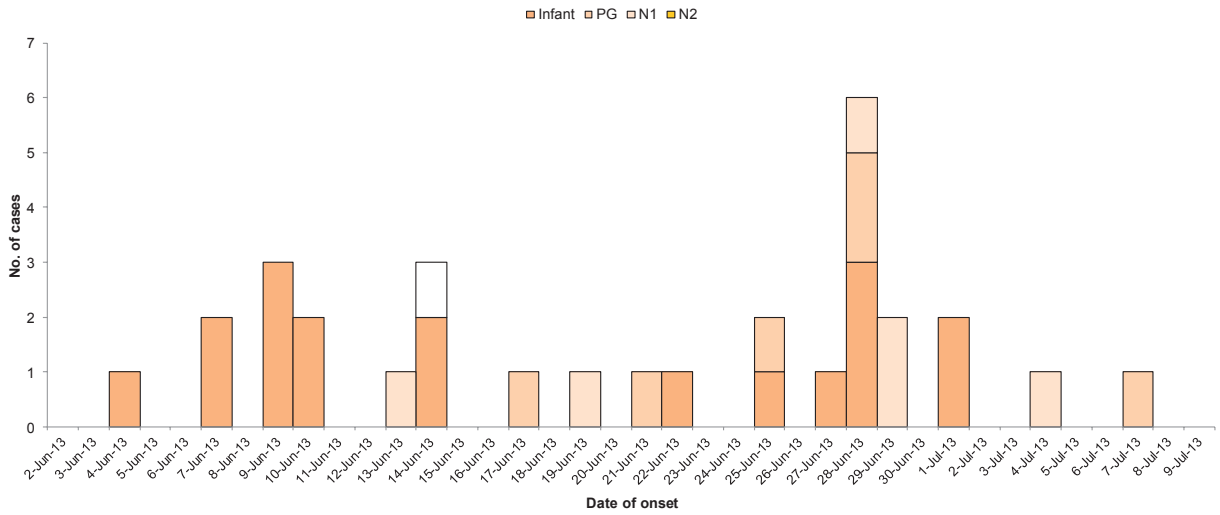
An outbreak of HFMD involving 31 children aged between 0 and 4 years occurred between 4 Jun and 7 Jul 2013 in a childcare centre at Punggol. At the time of the outbreak, the centre had 27 full-time staff and 88 children in four classes; Infant, Playgroup (PG), Nursery 1 (N1) and Nursery 2 (N2).

The class-specific attack rates ranged from 4.5% to 64.3%, with an overall attack rate of 35.2% (Table 1.6). The index case, an infant, presented with symptoms on 4 Jun 2013. The infection subsequently spread amongst other children. The last reported case was on 7 Jul 2013 (Figure 1.2). The centre was mandatorily closed for ten days from 3 to 12 Jul 2013 due to the high number of cases and the prolonged disease transmission period.

Table 1.6
Attack rates of hand, foot and mouth disease (HFMD) in a childcare centre at Punggol, 4 Jun –7 Jul 2013

Class Category	No. Enrolled			No. Affected and Attack Rates					
	Male	Female	Total	Male	%	Female	%	Total	%
Infant	14	14	28	7	50.0	11	78.6	18	64.3
PG	7	13	20	2	28.6	4	30.8	6	30.0
N1	6	12	18	3	50.0	3	25.0	6	33.3
N2	12	10	22	1	8.3	0	0.0	1	4.5
Total	**39**	**49**	**88**	**13**	**33.3**	**18**	**36.7**	**31**	**35.2**

Figure 1.3
Time distribution of 31 cases of hand, foot and mouth disease in a childcare centre at Punggol, 4 Jun –7 Jul 2013



Cluster 2: Kindergarten at Outram

An outbreak of HFMD involving 11 children aged between 3 and 6 years occurred between 6 July and 5 August 2013 in a kindergarten at Outram. At the time of the outbreak, the centre had 17 full-time staff and 232 children in four levels: Nursery 1 (N1), Nursery 2 (N2), Kindergarten 1 (K1) and Kindergarten 2 (K2).

The class-specific attack rates ranged from 2.0% to 7.4%, with an overall attack rate of 4.7% (Table 1.7).

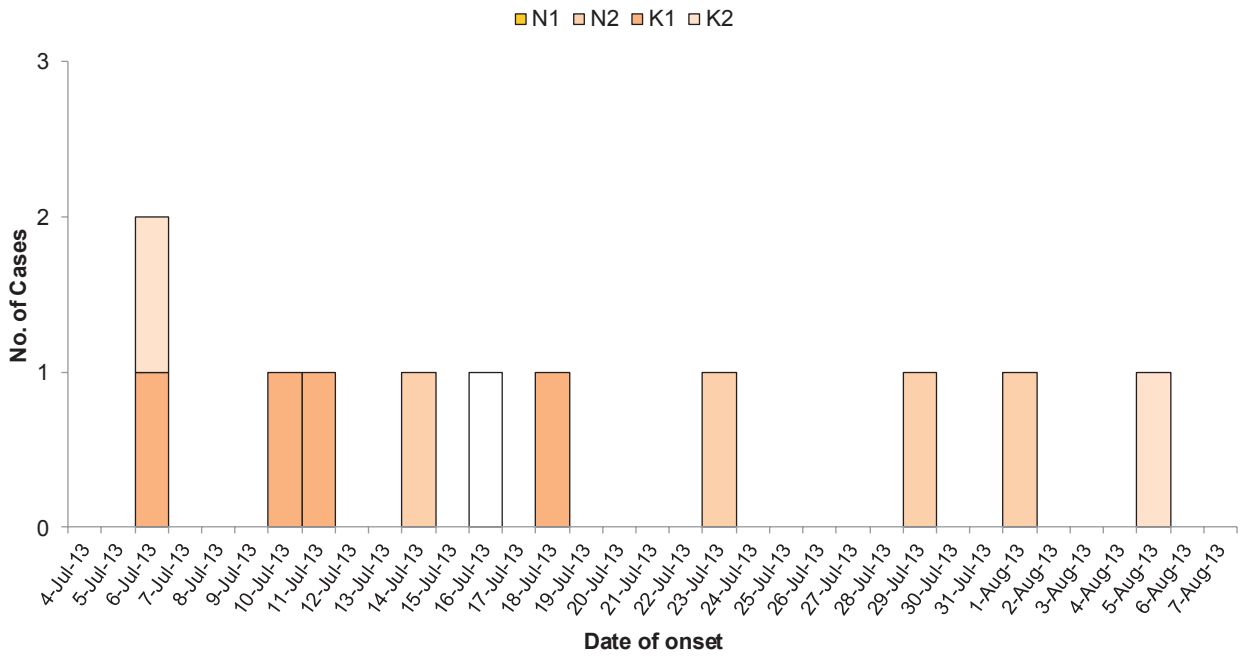
The outbreak started with two children attending the K1 or K2 class who developed symptoms on 6 July 2013. The infection subsequently spread amongst other children. The last reported case was on 5 August 2013 (Figure 1.4).

The centre's name was published on the Ministry of Health's website due to the prolonged disease transmission period.

Table 1.7
Attack rates of hand, foot and mouth disease in a kindergarten at Outram, 6 July - 5 August 2013

Class Category	No. Enrolled			No. Affected and Attack Rates					
	Male	Female	Total	Male	%	Female	%	Total	%
N1	26	24	50	0	0.0	1	4.2	1	2.0
N2	31	23	54	3	9.7	1	4.3	4	7.4
K1	34	30	64	2	5.9	2	6.7	4	6.3
K2	41	23	64	1	2.4	1	4.3	2	3.1
Total	**132**	**100**	**232**	**6**	**4.5**	**5**	**5.0**	**11**	**4.7**

Figure 1.4
Time distribution of 11 cases of hand, foot and mouth disease in a kindergarten at Outram, 6 July – 5 August 2013



INFLUENZA

Influenza is an acute viral disease of the respiratory tract characterised by fever and symptoms such as sore throat, cough, coryza, headache and myalgia. It is spread from person to person mainly through infectious respiratory secretions released during coughing and sneezing.

The causative agent is the influenza virus and three types of influenza virus (influenza A, B and C) are recognised. The Influenza type A viruses include two subtypes (H1N1 and H3N2) that infect humans and have been associated with pandemics and widespread epidemics. Influenza type B is occasionally associated with regional epidemics, and influenza type C is usually associated with sporadic cases and minor localised outbreaks. Diagnosis is based on the clinical recognition of influenza-like illness with or without laboratory confirmation and strain characterisation.

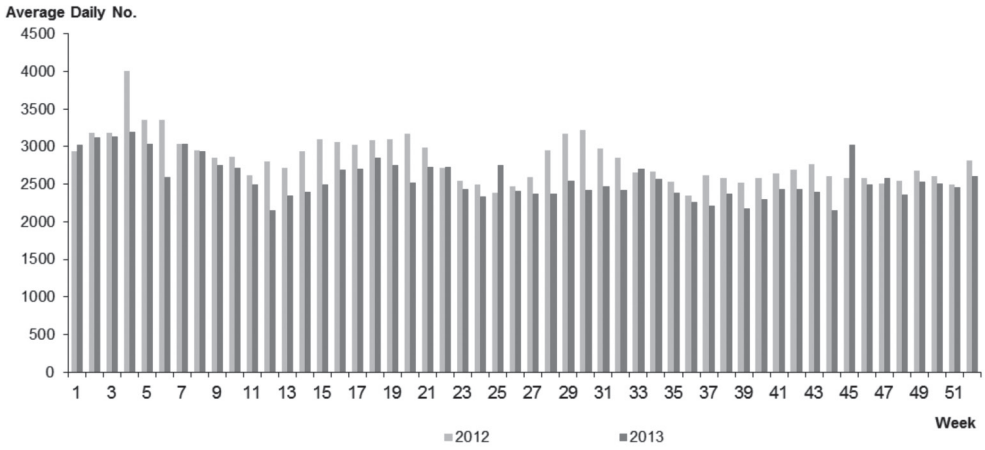
In temperate and cold climates, influenza reaches peak incidence in winter. As the Northern and Southern Hemispheres have winter at different times of the year, there are two flu seasons each year: December-March in the Northern Hemisphere; and June-September in the Southern Hemisphere.

In tropical and subtropical areas, influenza epidemics can occur either twice a year or even throughout the year. In Singapore, influenza viruses circulate year round, with a bimodal increase in incidence observed in April–July and November–January.

The weekly attendance for acute respiratory infections (ARI) at polyclinics and public hospital emergency departments (ED) is routinely monitored as a proxy indicator for influenza activity (Note: ARI represents a mixture of respiratory illnesses and the proportion of influenza cases presenting with ARI varies with the level of influenza activity.) The weekly number of admissions due to ARI at public hospitals is also monitored.

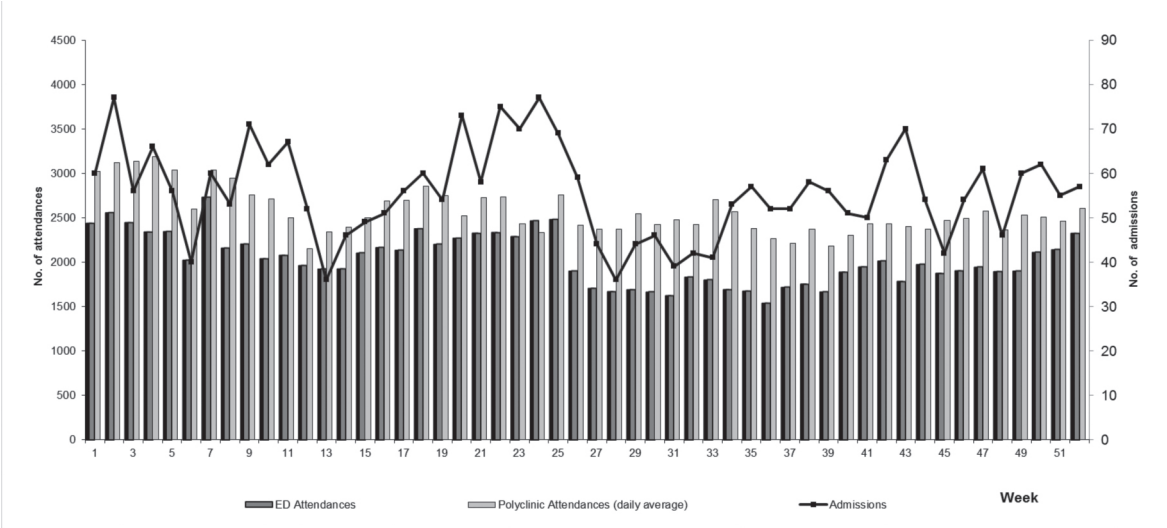
There were a total of 703,527 attendances at polyclinics for ARI in 2013, a decrease of 9.0% compared to 773,139 seen in 2012. No clear seasonal pattern for ARI was observed although higher average daily numbers of ARI attendances were observed from Epidemiological week (E-week) 1 to 7, with the exception of E-week 6. The average daily number of polyclinics attendances for ARI peaked at 3,190 in E-week 4 (Figure 1.5).

Figure 1.5
E-weekly distribution of acute respiratory infection attendance at polyclinics 2012 – 2013



An annual total of 106,086 ARI cases were seen at the emergency departments (ED) of public hospitals in 2013, an increase of 0.1% compared to 105,930 cases reported in 2012. The average weekly ARI attendance at ED was 2,040 with higher attendances observed in E-weeks 7. In addition, ARI admissions peaked at 77 cases in E-week 2 and 24 (Figure 1.6).

Figure 1.6
Weekly polyclinic attendance, emergency department (ED) attendances and admissions for ARI, 2013

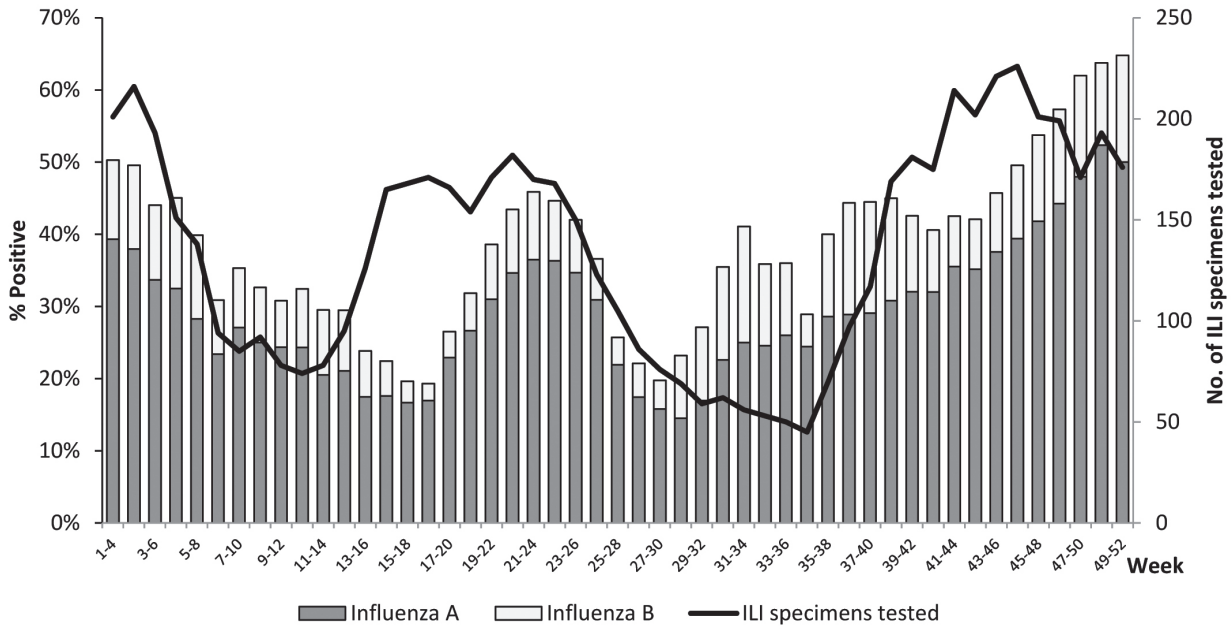


Virological surveillance of influenza viruses was carried out on throat and/or nasopharyngeal specimens obtained from polyclinics, hospitals and sentinel private clinics throughout the year. The typing, subtyping and isolation of influenza viruses was carried out at the National Public Health Laboratory (NPHL) and at designated hospital laboratories. Further genetic analysis and antigenic characterisation of selected samples was also done by NPHL and the WHO Collaborating Centre for Reference and Research on Influenza, Melbourne, Australia.

The 4-weekly moving average of the proportion of samples from patients in polyclinics and sentinel private clinics with influenza-like illness (ILI) which were positive for influenza viruses is shown in

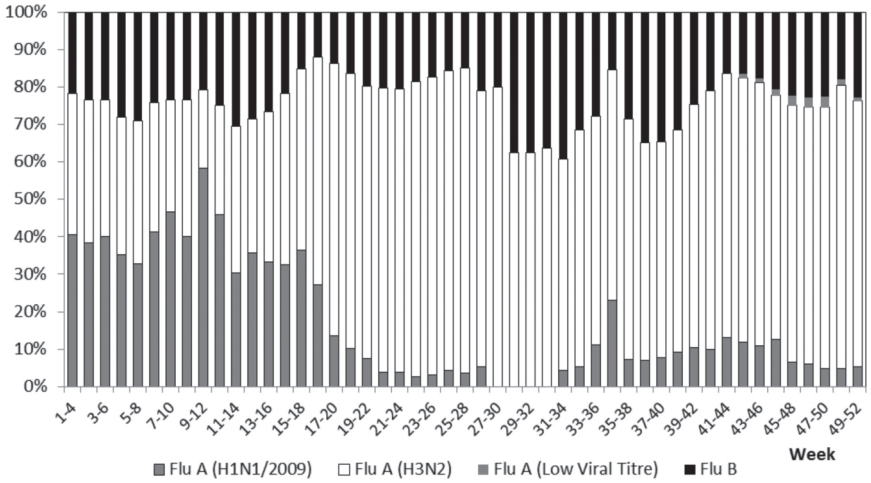
Figure 1.7. Higher levels of influenza activity were observed for the 4-weekly moving average between E-weeks 45-48 and 49-52, with a range of 52.2% to 64.2%. Influenza activity peaked in E-weeks 49-52 with 64.2% of ILI samples testing positive for influenza viruses. 77.0% of the positive samples in E-weeks 22-25 were influenza A viruses. Of these, 71.7% were of the H3N2 subtype. In 2013, 42.2% of all ILI samples tested positive for influenza viruses. Of the positive samples, 77.1% tested positive for influenza A viruses, of which 78.6% were of the influenza A(H3N2) subtype.

Figure 1.7
4-Week Moving Virological Surveillance of Influenza A & B, 2013



Between E-weeks 1-4 and 11-14 in 2013, influenza A viruses (A(H1N1)pdm09 and A(H3N2)) were the predominant subtypes in Singapore, co-circulating with low levels of seasonal influenza B viruses. This is followed by influenza A(H3N2) virus gaining strong predominance in Singapore for the remainder of 2013 (Figure 1.8).

Figure 1.8
4-Week moving influenza typing results, 2013



Based on sequencing and haemagglutination inhibition results, circulating A(H1N1)pdm09 and A(H3N2) viruses of 2013 were antigenically similar to current vaccine viruses, A/California/07/2009 and A/Victoria/361/2011 (cell-grown virus), respectively. Oseltamivir-resistance A(H1N1)pdm09, due to the H275Y mutation, was not detected in 284 samples screened.

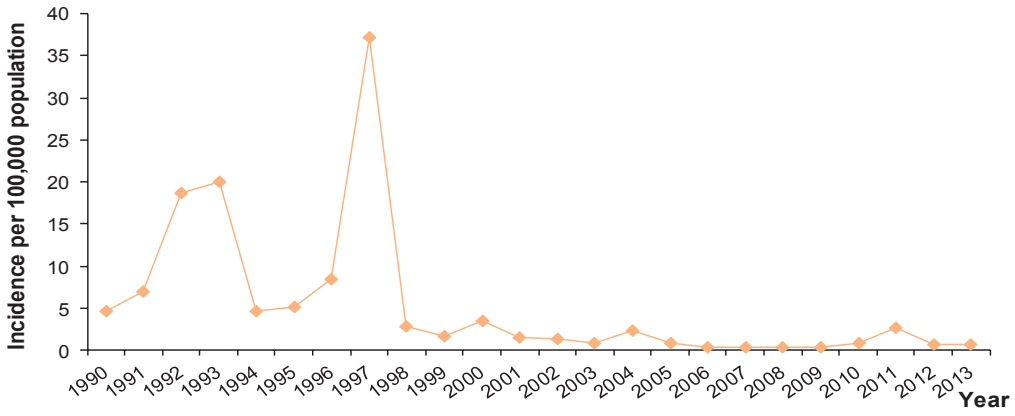
Viruses of both B/Yamagata and B/Victoria lineages co-circulated in Singapore throughout the year. Although majority of Influenza B viruses during November 2012 to March 2013 were of B/Victoria lineage, viruses of B/Yamagata lineage predominated over those of B/Victoria lineage since May 2013 until December 2013. Majority of viruses of B/Yamagata lineage were antigenically similar to B/Massachusetts/2/2012, a vaccine strain recommended for northern hemisphere 2013-14 influenza season, although low reactors had been detected. Those of the B/Victoria lineage were B/Brisbane/60/2008-like viruses.

MEASLES

Measles is an acute, highly communicable viral disease caused by the measles virus, a member of the genus *Morbillivirus* of the family Paramyxoviridae. The mode of transmission is airborne by droplet spread, or direct contact with the nasal or throat secretions of an infected person.

In Singapore, the number of reported measles cases has rapidly declined with the introduction of compulsory measles vaccination in August 1985. In 1992 and 1997, there was an increase in the number of reported cases (Figure 1.9). All age groups were affected and as a result, the "catch-up" immunisation initiative was implemented in July – November 1997 and the two-dose MMR vaccination regime was implemented in January 1998. The incidence of measles has remained at a low level since then.

Figure 1.9
Incidence of reported measles cases, 1990 – 2013



A total of 46 laboratory confirmed cases of measles were reported in 2013 compared to 38 cases reported in 2012 (Figure 1.10). The highest incidence rate was observed in children under the age of 1 year (Table 1.8). Among the three major ethnic groups, Malays had the highest incidence rate, followed by Chinese and Indian (Table 1.9). Three cases had at least one dose of MMR vaccination prior to onset of illness (Source: National Immunisation Registry).

Figure 1.10
E-weekly distribution of reported measles cases, 2012 – 2013

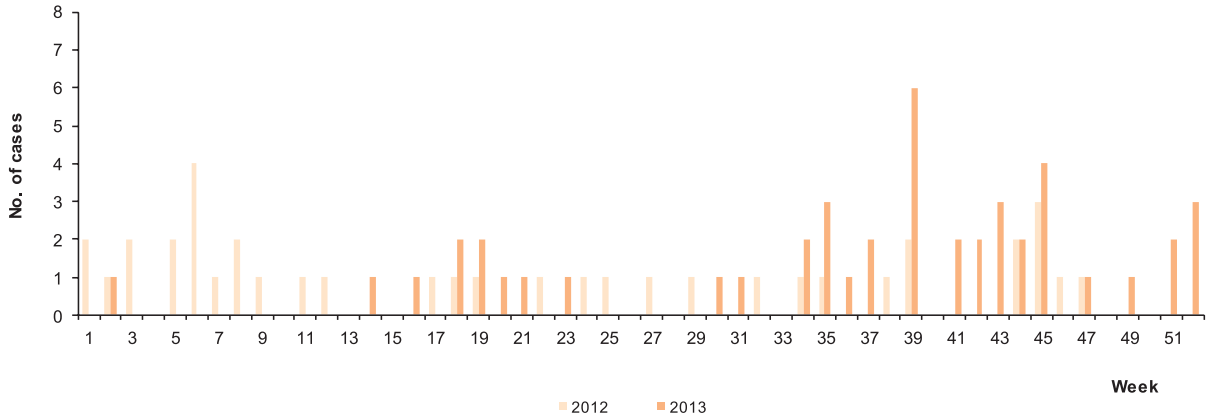


Table 1.8
Age-gender distribution and age-specific incidence rate of reported measles cases^, 2013

Age (Yrs)	Male	Female	Total (%)	Incidence rate per 100,000 population*
< 6 mths	1	2	3 (7.9)	39.8
6 mths – < 1yr	11	2	13 (34.2)	
1 – 4 yrs	8	4	12 (31.6)	6.5
5 – 9 yrs	0	0	0 (0.0)	0.0
10 – 14 yrs	0	1	1 (2.6)	0.4
15 – 24 yrs	1	0	1 (2.6)	0.1
25 – 34 yrs	1	3	4 (10.5)	0.3
35 – 44 yrs	2	2	4 (10.5)	0.4
45 – 54 yrs	0	0	0 (0.0)	0.0
55+	0	0	0 (0.0)	0.0
Total	**24**	**14**	**38 (100.0)**	**0.7**

^Excluding eight foreigners seeking medical treatment in Singapore
*Rates are based on 2013 estimated mid-year population.
(Source: Singapore Department of Statistics)

Table 1.9
Ethnic-gender distribution and ethnic-specific incidence rate of reported measles cases^, 2013

	Male	Female	Total (%)	Incidence rate per 100,000 population*
Singapore Resident				
Chinese	13	5	18 (7.4)	0.6
Malay	3	2	5 (13.2)	1.0
Indian	1	1	2 (5.3)	0.6
Others	2	2	4 (10.5)	3.2
Foreigner	5	4	9 (23.7)	0.6
Total	**24**	**14**	**38 (100.0)**	**0.7**

^Excluding eight foreigners seeking medical treatment in Singapore
*Rates are based on 2013 estimated mid-year population.
(Source: Singapore Department of Statistics)

MENINGOCOCCAL INFECTION

Meningococcal meningitis is an acute bacterial disease, characterised by sudden onset of fever, intense headache, nausea and often vomiting and stiff neck. Frequently there is a petechial rash with pink macules or very rarely, vesicles. The causative agent is *Neisseria meningitidis* with serotype groups, namely, A, B, C, Y, W-135, X and Z. The mode of transmission is via direct contact, including respiratory droplets from nose and throat of infected persons.

In 2013, there were three cases of meningococcal infection reported compared to zero case in 2012 (Table 1.10). All the cases were laboratory confirmed with positive blood or cerebral spinal fluids culture (Table 1.11).

Table 1.10
Age-gender distribution and age-specific incidence rates of reported meningococcal infection cases, 2013

Age (Yrs)	Male	Female	Total (%)	Incidence rate per 100,000 population*
0 - 4	1	0	1	0.4
5 – 14	0	0	0	0
15 – 24	0	0	0	0
25 – 34	0	0	0	0
35 – 44	1	0	1	0.1
45 – 54	0	0	0	0
55+	1	0	1	0.2
Total	**3**	**0**	**3 (100.0)**	**0.1**

*Rates are based on 2013 estimated mid-year population.
(Source: Singapore Department of Statistics)

Table 1.11
Epidemiological data of three reported meningococcal infection cases, 2013

Case particulars				
Gender	Age	Ethnic group	Causative agent	Status
M	6 months	Chinese	*Neisseria meningitides Grp B*	Recovered
M	41 years	Chinese	*Neisseria meningitides Grp C*	Died
M	58 years	Chinese	*Neisseria meningitides Grp C (non-groupable)*	Died

MUMPS

Mumps or infectious parotitis is an acute viral disease characterised by fever, swelling and tenderness of one or more salivary glands. The mumps virus, a member of the genus Paramyxovirus, is antigenically related to the parainfluenza viruses. The mode of transmission is airborne spread via infected respiratory droplets or by direct contact with the saliva of an infected person.

The incidence of mumps in Singapore increased five-fold between 1998 and 1999, from 1,183 cases (30.2 per 100,000 population) to 6,384 cases (161.6 per 100,000 population). Children below age 15 were the most affected age group. This increase was due to the low protective efficacy of vaccines containing the Rubini strain, which had been used between the years 1993 – 1995. Following this resurgence, a more efficacious vaccine replaced the Rubini strain-containing vaccine. Since then, the annual incidence of mumps has declined rapidly (Figure 1.11).

Figure 1.11
Incidence of reported mumps cases, 1990 – 2013

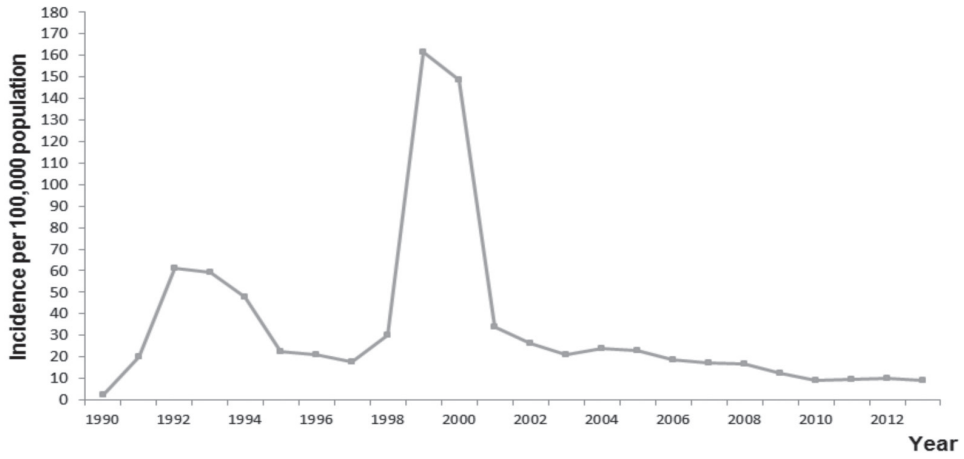
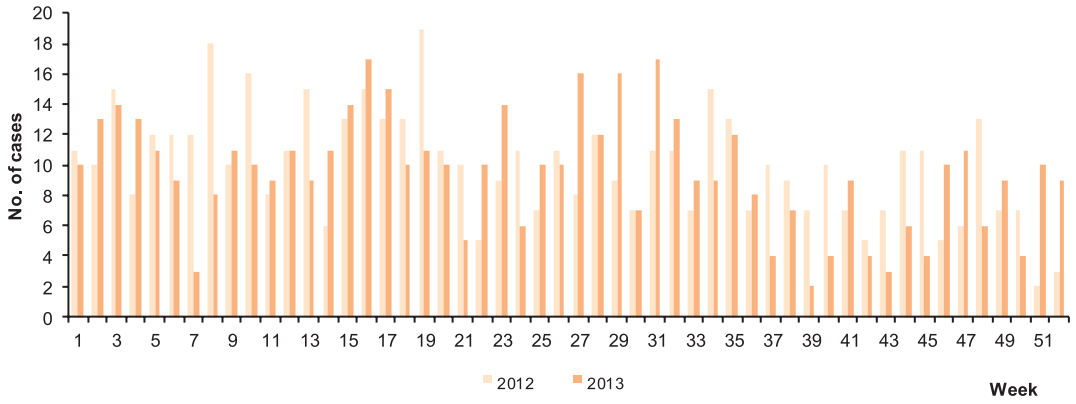


Figure 1.12
E-weekly distribution of reported mumps cases, 2012 – 2013



A total of 495 cases (9.2 per 100,000 population) were reported in 2013 as compared to 521 cases in 2012 (Figure 1.12). The incidence rate was highest in the 5 – 14 years age group (Table 1.12). Among the three major ethnic groups, Malays had the highest incidence rate, followed by Chinese. Foreigners comprised 26.5% of cases (Table 1.13).

Table 1.12
Age-gender distribution and age-specific incidence rate of reported mumps cases, 2013

Age (Yrs)	Male	Female	Total (%)	Incidence rate per 100,000 population*
0 - 4	39	25	65 (12.9)	28.6
5 – 14	95	50	145 (29.3)	30.2
15 – 24	20	27	47 (9.5)	6.0
25 – 34	46	40	86 (17.4)	7.0
35 – 44	53	23	76 (15.4)	8.0
45 – 54	24	18	42 (8.5)	5.7
55+	20	15	35 (7.1)	6.3
Total	**297**	**198**	**495 (100.0)**	**9.2**

*Rates are based on 2013 estimated mid-year population.
(Source: Singapore Department of Statistics)

Table 1.13
Ethnic-gender distribution and ethnic-specific incidence rate of reported mumps cases, 2013

	Male	Female	Total (%)	Incidence rate per 100,000 population*
Singapore Resident				
Chinese	140	120	260 (52.5)	9.1
Malay	45	18	63 (12.7)	12.3
Indian	4	6	10 (2.0)	2.8
Others	21	10	31 (6.3)	24.5
Foreigner	87	44	131 (26.5)	8.4
Total	**297**	**198**	**495 (100.0)**	**9.2**

*Rates are based on 2013 estimated mid-year population.
(Source: Singapore Department of Statistics)

PERTUSSIS

Pertussis is an acute bacterial infection of the respiratory tract caused by *Bordetella pertussis*. The mode of transmission is via respiratory droplets or direct contact with the nasal or throat secretions of an infected person.

A total of 17 laboratory confirmed cases of pertussis were reported in 2013 compared to 24 in 2012 (Figure 1.13). Of the cases, 15 were aged below 1 year, and the rest were young adults aged 15-34 years. Among the three major ethnic groups, Malays had the highest incidence rate, followed by Indians (Table 1.10 and 1.11). None of the cases received DPT vaccination prior to onset of illness (Source: National Immunisation Registry).

Figure 1.13
E-weekly distribution of reported pertussis cases, 2012 – 2013

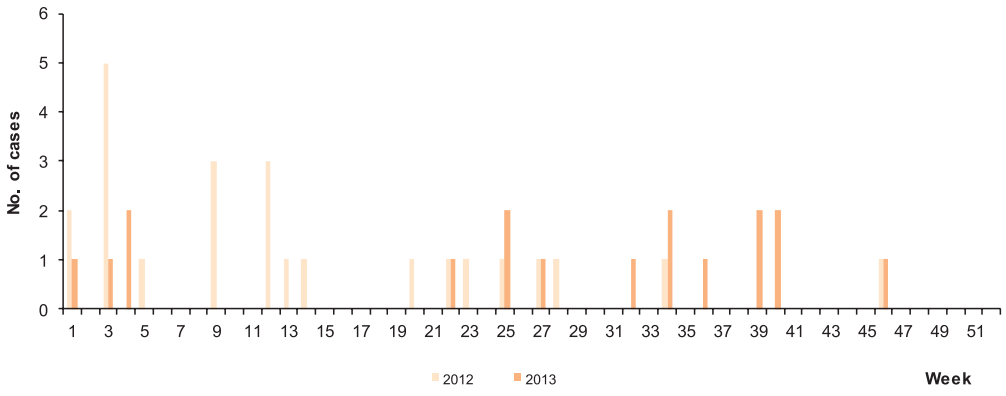


Table 1.14
Age-gender distribution and age-specific incidence rate of reported pertussis cases, 2013

Age (Yrs)	Male	Female	Total (%)	Incidence rate per 100,000 population*
0 – < 1yr	5	10	15 (88.2)	37.3
1 – 4 yrs	0	0	0 (0.0)	0.0
5 – 9 yrs	0	0	0 (0.0)	0.0
10 – 14 yrs	0	0	0 (0.0)	0.0
15 – 24 yrs	1	0	1 (5.9)	0.1
25 – 34 yrs	0	1	1 (5.9)	0.1
35 – 44 yrs	0	0	0 (0.0)	0.0
45 – 54 yrs	0	0	0 (0.0)	0.0
55+	0	0	0 (0.0)	0.0
Total	**16**	**4**	**17 (100.0)**	**0.3**

*Rates are based on 2013 estimated mid-year population.
(Source: Singapore Department of Statistics)

Table 1.15
Ethnic-gender distribution and ethnic-specific incidence rate of reported pertussis cases, 2013

	Male	Female	Total (%)	Incidence rate per 100,000 population*
Singapore Resident				
Chinese	1	7	8 (47.1)	0.3
Malay	4	2	6 (35.3)	1.2
Indian	1	1	2 (11.8)	0.6
Others	0	0	0 (0.0)	0.0
Foreigner	0	1	1 (5.9)	0.1
Total	**6**	**11**	**17 (100.0)**	**0.3**

*Rates are based on 2013 estimated mid-year population.
(Source: Singapore Department of Statistics)

PNEUMOCOCCAL DISEASE (INVASIVE)

Invasive pneumococcal disease (IPD) is an acute bacterial infection of the respiratory tract, brain or blood stream caused by *Streptococcus pneumoniae*. The mode of transmission is by droplets or close contact with the nasopharyngeal secretions of an infected person.

A total of 166 laboratory confirmed cases of invasive pneumococcal infection were reported in 2013, an increase of 1.8% compared to 163 cases reported in 2012 (Figure 1.14). The incidence rate was highest in those aged 55 years and above. Among the three major ethnic groups, Malays had the highest incidence rate, followed by Indians and Chinese (Tables 1.16 and 1.17). Of these 166 laboratory confirmed IPD cases, the number of serotyped cases was 132, which correspond to 79.5% of laboratory confirmed IPD cases. The predominant pneumococcal type for children cases was 19A and for adult cases was 6B. (Tables 1.18 and 1.19). Six cases had received at least one dose of pneumococcal vaccines prior to onset of illness (Source: National Immunisation Registry).

Figure 1.14
E-weekly distribution of reported invasive pneumococcal cases, 2012 – 2013

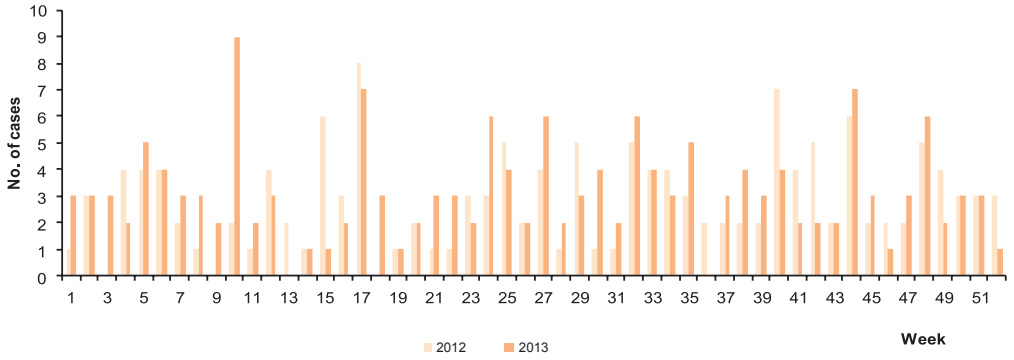


Table 1.16
Age-gender distribution and age-specific incidence rate of reported invasive pneumococcal cases, 2013

Age (Yrs)	Male	Female	Total (%)	Incidence rate per 100,000 population*
0 - 4	6	3	9 (5.4)	4.0
5 – 14	7	2	9 (5.4)	1.9
15 – 24	2	0	2 (1.2)	0.3
25 – 34	11	5	16 (9.6)	1.3
35 – 44	4	7	11 (6.6)	1.2
45 – 54	16	2	18 (10.9)	2.4
55+	73	28	101 (60.9)	18.2
Total	**119**	**47**	**166 (100.0)**	**3.1**

*Rates are based on 2013 estimated mid-year population.
(Source: Singapore Department of Statistics)

Table 1.17
Ethnic-gender distribution and ethnic-specific incidence rate of reported invasive pneumococcal cases, 2013

	Male	Female	Total (%)	Incidence rate per 100,000 population*
Singapore Resident				
Chinese	69	32	101 (60.8)	3.5
Malay	24	7	31 (18.7)	6.0
Indian	10	4	14 (8.4)	4.0
Others	2	1	3 (1.8)	2.4
Foreigner	14	3	17 (10.3)	1.1
Total	**119**	**47**	**166 (100.0)**	**3.1**

*Rates are based on 2013 estimated mid-year population.
(Source: Singapore Department of Statistics)

Table 1.18
Distribution of pneumococcal serotypes among children cases, 2013

Pneumococcal Type/ Group	Number of isolates (n = 18) (%)
Type 14 *§	2 (11.1)
Group 15	1 (5.6)
Group 17	1 (5.6)
Type 19A §	7 (38.9)
Type 23F *§	3 (16.6)
Type 6B *§	3 (16.6)
Type 6C	1 (5.6)

* Serotype included in PCV7, § serotype included in PCV13

Table 1.19
Distribution of pneumococcal serotypes among adult cases, 2013

Pneumococcal Type/ Group	Number of isolates (n = 144) (%)
Type 1 *§	1 (0.9)
Type 3 *§	10 (8.8)
Type 4 *§	9 (7.9)
Type 5 *§	1 (0.9)
Type 8	4 (3.4)
Group 10	1 (0.9)
Group 11	2 (1.8)
Group 12	1 (0.9)
Type 14 *§	9 (7.9)
Group 17	2 (1.8)
Type 20	2 (1.8)
Group 33	2 (1.8)
Type 15A	1 (0.9)
Type 15F	1 (0.9)
Type 18C *§	1 (0.9)
Type 18F	2 (1.8)
Type 19A §	10 (8.8)
Type 19F *§	3 (2.5)
Type 23A	5 (4.4)
Type 23F *§	8 (7.0)
Type 6A §	3 (2.5)
Type 6B *§	12 (10.5)
Type 6C	8 (7.0)
Type 7F §	7 (6.1)
Type 9V *§	2 (1.8)
Non-groupable	7 6.1)

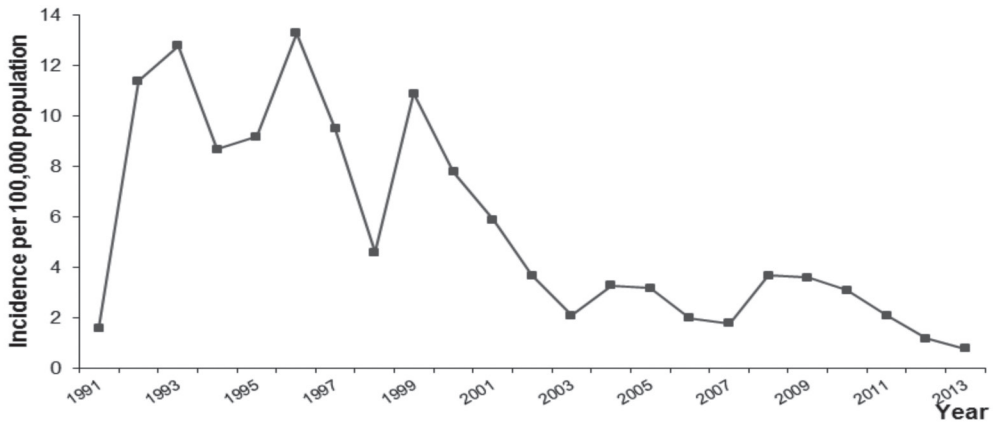
* Serotype included in PCV7, § serotype included in PCV13

RUBELLA

Rubella is a generally mild febrile viral disease with a diffuse punctate and maculopapular rash sometimes resembling that of measles or scarlet fever. It is also commonly known as German measles. The causative agent is the rubella virus (genus *Rubivirus*) from the Togaviridae family and it is spread through droplets or by close contact with the nasopharyngeal secretions of an infected person.

Rubella incidence fluctuated during 1991 – 1999. This was followed by a steady decline from 1999 (10.9 per 100,000 population) to 2013 (0.8 per 100,000 population) (Figure 1.15).

Figure 1.15
Incidence of reported rubella cases, 1991 – 2013



A total of 48 cases of rubella were reported in 2013, a decrease of 25.0% compared to 64 cases reported in 2012 (Figure 1.16). The incidence rate was highest in the 0 - 4 year age group (Table 1.20). Of the 7 female cases, 24.1% (0.5 per 100,000 female population) were in the reproductive age group of 15 – 44 years. Among the three major ethnic groups, Chinese had the highest incidence rate, followed by Indian. Foreigners comprised 59.1% of cases (Table 1.21).

There was one case of congenital rubella reported in an infant who had been brought to Singapore for medical treatment. There were two reported termination of pregnancy resulting from acquired maternal rubella infection.

Figure 1.16
E-weekly distribution of reported rubella cases, 2012 – 2013

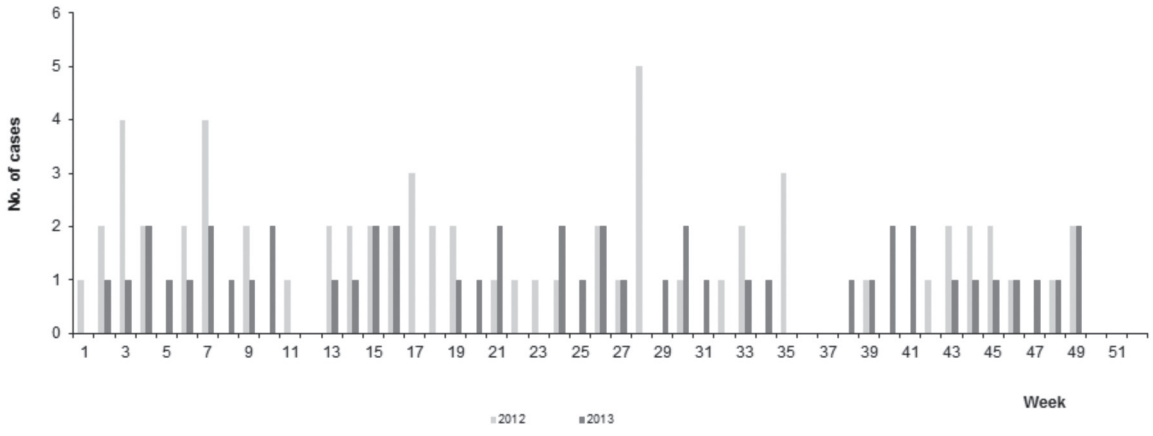


Table 1.20
Age-gender distribution and age-specific incidence rate of reported rubella cases^, 2013

Age (Yrs)	Male	Female	Total (%)	Incidence rate per 100,000 population*
0 - 4	3	2	5 (11.4)	2.2
5 – 14	0	0	0 (0.0)	0.0
15 – 24	2	0	2 (4.5)	0.3
25 – 34	8	3	11 (25.0)	0.9
35 – 44	10	4	14 (31.8)	1.5
45 – 54	4	3	7 (15.9)	1.0
55+	2	3	5 (11.4)	0.5
Total	**29**	**15**	**44 (100.0)**	**0.8**

^Excluding four foreigners seeking medical treatment in Singapore
*Rates are based on 2013 estimated mid-year population.
(Source: Singapore Department of Statistics)

Table 1.21
Ethnic-gender distribution and ethnic-specific incidence rate of reported rubella cases^, 2013

	Male	Female	Total (%)	Incidence rate per 100,000 population*
Singapore Resident				
Chinese	6	8	14 (31.8)	0.5
Malay	1	0	1 (2.3)	0.2
Indian	0	1	1 (2.3)	0.3
Others	1	1	2 (4.5)	1.6
Foreigner	21	5	26 (59.1)	1.7
Total	**29**	**15**	**44 (100.0)**	**0.8**

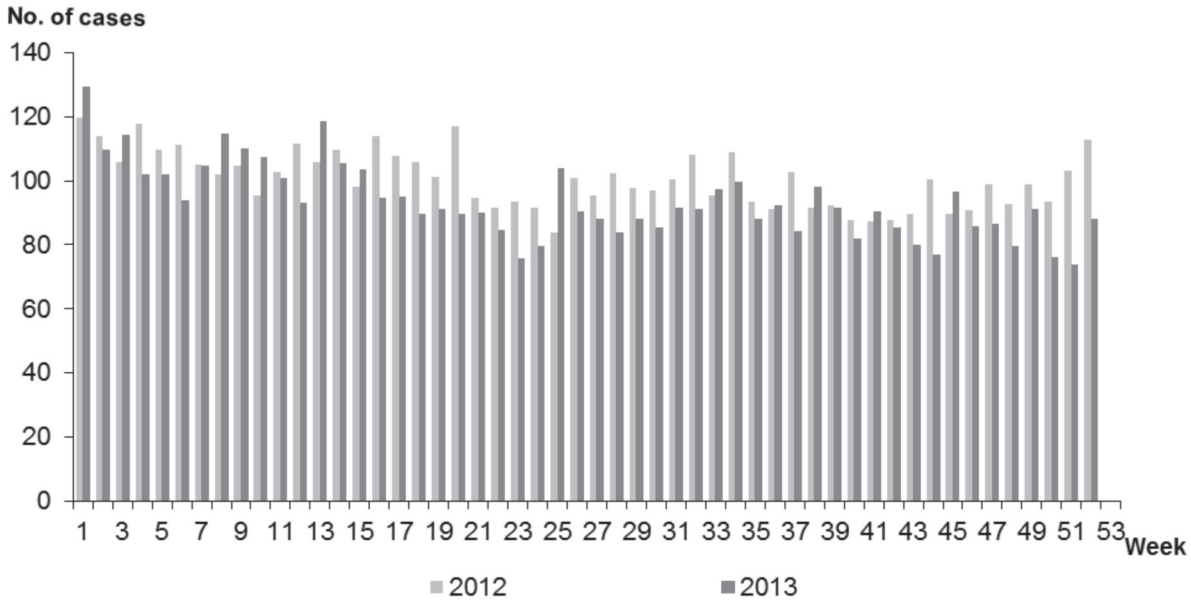
^Excluding four foreigners seeking medical treatment in Singapore
*Rates are based on 2013 estimated mid-year population.
(Source: Singapore Department of Statistics)

VIRAL CONJUNCTIVITIS

Viral conjunctivitis is a clinical syndrome characterised by inflammation of the conjunctiva of the eyes beginning with lacrimation, irritation and hyperemia of the palpebral and bulbar conjunctivae. The common causative agents are the adenoviruses and the enteroviruses.

In 2013, the polyclinics reported 25,563 attendances for conjunctivitis, an increase of 5.37% compared to 24,261 attendances reported in 2012 (Figure 1.17). There were no institutional outbreaks of viral conjunctivitis reported in 2013.

Figure 1.17
E-weekly distribution of reported conjunctivitis cases, 2012 – 2013



SEVERE ILLNESS AND DEATH FROM POSSIBLY INFECTIOUS CAUSES (SIDPIC) PROGRAMME

The SIDPIC programme is a hospital-based sentinel surveillance programme which reviews cases of unexplained deaths and critical illness to identify possible emerging infections caused by novel pathogens. It aims to reduce delays in recognising emerging infections of public health importance. The project is presently operational in four public hospitals (TTSH, NUH, SGH and KKH). In year 2013, a total of 3,416 hospital patients were screened by SIDPIC project coordinators in participating hospitals (Table 1.22). Of these, 194 SIDPIC cases that fulfilled the inclusion criteria[1] were identified. The majority of SIDPIC cases (33%) had illnesses with respiratory syndromes (Table 1.23). Of the 194 cases identified in 2013, 85 were found to have alternate aetiologies. 51 of these 85 cases had causative pathogens found. The top three causative pathogens were respiratory viruses (37.35%), *Escherichia coli (13.73%)* and *Streptococcus pneumoniae (11.76%)*. The remaining cases had clinical presentations that were consistent with the clinical diagnosis, e.g. auto-immune disorders. Despite extensive laboratory testing, the aetiology in 105 (54.12%) cases remained unknown. Table 1.24 lists the pathogens which may be tested for under the SIDPIC programme.

[1] Inclusion criteria of SIDPIC programme:
- Age 1 to 49 years.
- Previously healthy. Exclusion criteria:
  - Immunosuppression (e.g. HIV/ AIDS, cancers, and immune disorders)
  - Chronic diseases (e.g. cardiac, lung, renal and hepatic)
- Clinical presentation suggestive of infection
- Death or critically ill cases
- Routine testing has not identified a known cause

Table 1.22
SIDPIC Performance Indicators 2013

Surveillance Indicators	NUH	TTSH	SGH	KKH	TOTAL
No. of cases screened	886	963	1138	429	3416
Death	208	186	207	3	604
Non-death	678	777	931	426	2812
No. of SIDPIC cases	113	31	9	41	194
Aetiology Found	52	10	4	19	85
Unknown Aetiology	59	21	3	22	105
Co-morbidity found	2	0	2	0	4

Table 1.23
Distribution of cases based on syndrome[2] classification, 2013

Syndrome	Aetiology Found*	Unknown Aetiology	Total (%)
Neurological	16	18	34 (17.53)
Cardiac	11	14	25 (12.88)
Respiratory	26	38	64 (32.99)
Gastrointestinal	1	10	11 (5.67)
Multisystem	35	25	60 (30.93)
Total	**89***	**105**	**194 (100.0)**

*Included 4 cases with co-morbidity found.

[2] Syndrome Classification:
i. Neurological – meningitis or encephalitis
ii. Cardiac – myocarditis, pericarditis, endocarditis
iii. Respiratory – pneumonia, acute respiratory distress syndrome (ARDS), respiratory failure
iv. Gastrointestinal – hepatitis, hepatic failure, severe diarrhoea
v. Multisystem – sepsis, haemorrhagic fever, rash, shock

Table 1.24
SIDPIC Lab Test Panels

	Pneumonia	Encephalitis	Viral Haemorrhagic Fever
First line panel*	**Respiratory Samples** • Multiplex PCR • Influenza PCR • H5N1 PCR • SARS CoV-PCR • MERS-CoV PCR • TB PCR **Blood** • Bacterial culture • Mycoplasma serology • Legionella serology • Chlamydia serology • H5N1 PCR • SARS CoV-PCR **Urine** • Urine culture • Pneumococcal Ag • Legionella Ag **Other samples (e.g. lung tissue)** • PCP stain • Fungal stain	**Cerebrospinal Fluid** • Bacterial culture • AFB PCR, culture • Fungal culture • Enterovirus PCR • HSV/ CMV/ VZV/ EBV PCR • Dengue PCR • JE IgM, PCR • WNV PCR • Nipah PCR **Respiratory Samples** • EV PCR • Nipah PCR **Stool** • Enterovirus PCR • Poliovirus PCR **Other samples (e.g. Brain tissue)** • Histopathology	**Blood & Respiratory Samples** • Dengue PCR, serology • Chikungunya PCR, serology • Yellow fever PCR, serology • Lassa, Ebola, Marburg fever
Second line panel#	**Blood** • Brucella serology **Respiratory Samples** • Viral isolation • Hantaan virus PCR • Nipah PCR • Zikavirus (Micronesia area)	**Cerebrospinal Fluid** • Viral isolation, also consider lymphocytic choriomeningitis virus • Rickettsial isolation • Kunjin • Chandipura • Measles • Polio • Rabies, and other viral encephalitides dependent on travel history, e.g. WEE, SLE, VEE, Kyasanur forest disease (India) • Toscana (from Europe/ Spain) • Sindbis virus (Europe/ Australia/ Asia) **Stool** • Viral isolation **Other samples (e.g. Brain tissue)** • EM	**Blood & Respiratory Sanples** • VEE, CCHF, RVF and other South American arenaviruses, e.g. Junin, Machupo, Guanarito and Sabia viruses, depending on travel history • HFRS • Virus isolation • EM

Table 1.24
SIDPIC Lab Test Panels

	Myocarditis	Gastrointestinal
First line panel*	**Blood** • EV71 PCR **Stool** • Enterovirus PCR **Other samples (e.g. Cardiac tissue)** • Histopathology	**Stool** • Vibrio Cholera • E. coli O157:H7 **Other samples (e.g. Liver/ intestinal tissue)** • Histopathology • Special stains **Blood** • Bacterial culture • Yellow fever PCR, serology
Second line panel#	**Blood** • Virus isolation **Other samples (e.g. Cardiac tissue)** • EM, special stains	**Stool** • Rotavirus, astrovirus, sapovirus, adenovirus 40.41, Norovirus PCR • Viral isolation **Other samples (e.g. Liver/ intestinal tissue)** • EM, special stains

*** First line panel:** These are the first-line tests which may be conducted after a check has been made to ensure that these pathogens have not already been tested for, as part of the patient's clinical management.

 # Second line panel: These tests may be conducted after the SIDPIC physician and the laboratory have evaluated the epidemiological and clinical features of the case.

Abbreviations:

AFB = Acid-fast bacillus
Ag = Antigen
CCHF =Crimean-Congo haemorrhagic fever
CMV = Cytomegalovirus
E. coli O157:H7 = Escherichia coli serotype O157:H7
EBV = Epstein-Barr virus
EM = Electron microscopy
EV = Enterovirus
EV71 = Enterovirus Type 71
H5N1 = Influenza A virus subtype H5N1
HFRS = Haemorrhagic fever with renal syndrome
HSV = Herpes simplex virus
JE IgM = Japanese encephalitis immunoglobulin M
MERS-CoV = Middle East respiratory syndrome coronavirus
PCP = Pneumocystis carinii pneumonia
PCR = Polymerase chain reaction
RVF = Rift Valley fever
SARS-CoV = Severe acute respiratory syndrome coronavirus
SLE = St Louis encephalitis
TB = Tuberculosis
VEE = Venezuelan equine encephalitis
VZV = Varicella zoster virus
WEE = Western equine encephalitis
WNV = West Nile Virus

CHICKENPOX (VARICELLA)

There were a total of 4,282 attendances in polyclinics for chickenpox in 2013 compared with 4,766 attendances in 2012. 86.7% of the attendances were by Singaporeans and Permanent Residents. Persons below the age of 20 years represented 64.9% of attendances for chickenpox (Table 1.25).

Table 1.25
Profile of chickenpox (varicella) polyclinic attendances by age group and nationality, 2013

	Singaporeans/PRs			Foreigners			Total
Age (Yrs)	Total	Male	Female	Total	Male	Female	Total (%)
0 - 9	1,731	899	832	36	26	10	1,767 (41.3)
10 - 19	1,050	616	434	30	23	7	1,080 (25.2)
20 - 29	375	209	166	332	274	58	707 (16.5)
30 - 39	204	106	98	140	119	21	344 (8.0)
40 - 49	178	124	54	30	20	10	208 (4.9)
50 - 59	90	53	37	2	2	0	92 (2.1)
60+	83	46	37	1	0	1	84 (2.0)
Total	**3,711**	**2,053**	**1,658**	**571**	**464**	**107**	**4,282 (100.0)**

- Chikungunya Fever
- Dengue Fever/Dengue Haemorrhagic Fever (DF/DHF)
- Malaria

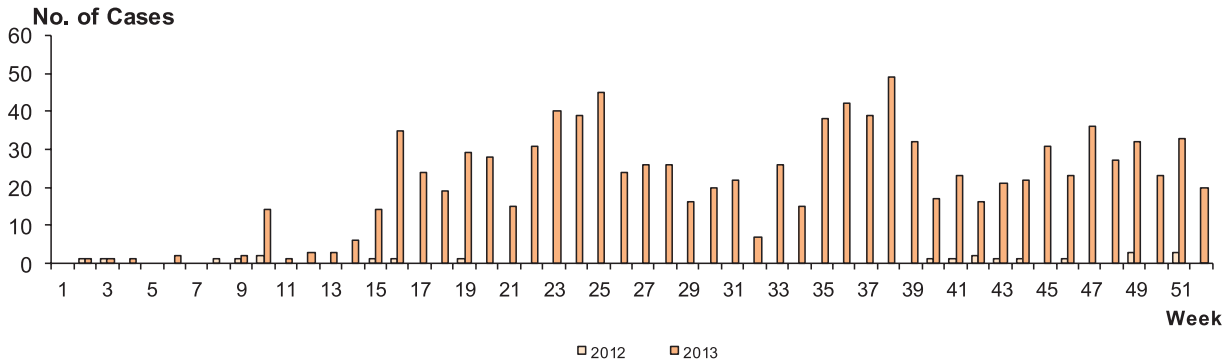
II
VECTOR-BORNE DISEASES

CHIKUNGUNYA FEVER

Chikungunya fever is an acute febrile disease caused by the chikungunya virus. The disease is characterised by fever, joint pain with or without swelling, headache, fatigue, nausea and vomiting. Some patients may develop a rash affecting the trunk and limbs. The disease is usually self-limiting. Most symptoms last for 3 -10 days although the joint pain may last for weeks to months. The main vector in Singapore is the *Aedes albopictus* mosquito.

A total of 1,059 laboratory-confirmed cases of chikungunya fever were reported in 2013, compared to 22 cases in 2012 (Figure 2.1). Out of the 1,059 cases, 48 were imported cases, involving 19 Singapore residents and 29 foreigners including work permit holders. The remaining 1,011 cases were indigenous cases. No deaths due to chikungunya were reported in 2013.

Figure 2.1
E-weekly distribution of Chikungunya fever cases, 2012 – 2013



The incidence rate among indigenous cases was highest in the 35 – 44 years age group with a male to female ratio of 1.4:1 (Table 2.1). Among the three major ethnic groups, Chinese had the highest incidence followed by Indians and Malays. Foreigners comprised 66.7% of the indigenous cases (Table 2.2).

Table 2.1
Age-gender distribution and age-specific incidence rate of indigenous chikungunya fever cases^, 2013

Age (Yrs)	Male	Female	Total (%)	Incidence rate per 100,000 population*
0 - 4	2	2	4 (0.4)	1.8
5 – 14	21	9	30 (3.0)	6.3
15 – 24	70	12	82 (8.1)	10.5
25 – 34	227	67	294 (29.1)	24.1
35 – 44	172	122	294 (29.1)	30.8
45 – 54	88	53	141 (13.9)	19.1
55+	99	67	166 (16.4)	16.6
Total	**679**	**332**	**1,011 (100.0)**	**18.7**

^Cases acquired locally among Singaporeans, permanent and temporary residents.
*Rates are based on 2013 estimated mid-year population.
(Source: Singapore Department of Statistics)

Table 2.2
Ethnic-gender distribution and ethnic-specific incidence rate of indigenous chikungunya fever cases^, 2013

	Male	Female	Total (%)	Incidence rate per 100,000 population*
Singapore Resident				
Chinese	160	108	268 (26.5)	9.4
Malay	17	2	19 (1.9)	3.7
Indian	12	4	16 (1.6)	4.5
Others	19	15	34 (3.3)	26.9
Foreigner	471	203	674 (66.7)	43.4
Total	**679**	**332**	**1,011 (100.0)**	**18.7**

^Cases acquired locally among Singaporeans, permanent and temporary residents.
*Rates are based on 2013 estimated mid-year population.
(Source: Singapore Department of Statistics)

There were 48 (4.5%) imported cases, defined as residents and non-residents with a history of travel to chikungunya-endemic countries within twelve days prior to the onset of illness. 18 (37.5%), 15 (31.3%) and 7 (14.6%) had travelled to India, Indonesia and Philippines respectively (Table 2.3).

Table 2.3
Imported chikungunya fever cases, 2009 – 2013

	Year				
	2009	2010	2011	2012	2013
Southeast Asia					
Thailand	2	0	0	0	2
Myanmar	2	0	0	0	0
Malaysia	26	2	4	0	5
Indonesia	4	6	1	5	15
Philippines	0	1	0	2	7
South Asia					
Bangladesh	0	0	0	0	1
India	30	11	3	12	18
Maldives	2	0	0	0	0
Other Regions	0	0	1	0	0
Total	**66**	**20**	**9**	**19**	**48**

The geographical distribution of indigenous chikungunya fever cases and *Aedes albopictus* is as follows (Figure 2.2).

Figure 2.2
Geographical distribution of indigenous chikungunya fever cases and *Aedes albopictus*, 2013

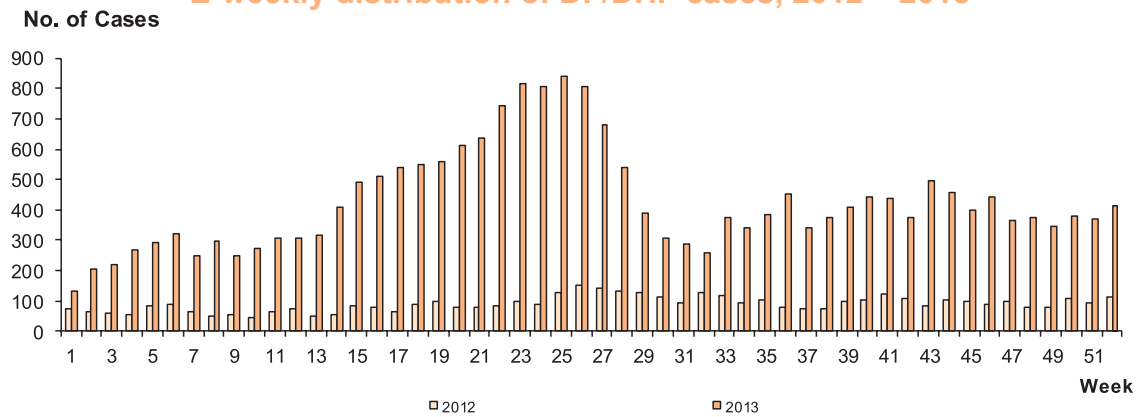
(Source: National Environment Agency)

DENGUE FEVER/DENGUE HAEMORRHAGIC FEVER (DF/DHF)

Dengue fever is an acute febrile viral disease characterised by sudden onset of fever for 3 – 5 days, intense headache, myalgia, arthralgia, retro-orbital pain, anorexia, gastrointestinal disturbances and rash. Early generalised erythema may occur in some cases. The infectious agents are flaviviruses comprising four serotypes (dengue-1, 2, 3 and 4) and are transmitted by the *Aedes* mosquito. In some cases, dengue haemorrhagic fever - a potentially fatal complication characterised by high fever, thrombocytopaenia, haemorrhagic manifestations, and evidence of plasma leakage may develop.

A total of 22,170 laboratory confirmed cases of DF/DHF [comprising 22,077 cases of dengue fever (DF) and 93 cases of dengue haemorrhagic fever (DHF)] were reported in 2013, more than four times of the 4,632 dengue fever cases reported in 2012. Of these, 13,592 were Singapore residents, with 78 imported and 13,514 indigenous cases. The remaining 8,578 cases were foreigners, of which 8,349 cases were infected locally and 229 cases acquired the infection overseas. Majority of those who acquired the infection overseas were foreigners who came to Singapore for medical treatment. The incidence increased from E-week 2 and peaked in E-week 25, and decreased from E-weeks 26 to 32, after-which the incidence fluctuated for the rest of the year. (Figure 2.3).

Figure 2.3
E-weekly distribution of DF/DHF cases, 2012 – 2013



The incidence rate among indigenous cases was highest in the age group of 15-24 with a male to female ratio of 1.9:1 (Table 2.4). Among the three major ethnic groups, Chinese had the highest incidence rate, followed by Malays and Indians. Foreigners comprised 38.2% of the indigenous cases (Table 2.5).

Table 2.4
Age-gender distribution and age-specific incidence rates of indigenous^ DF/DHF cases, 2013

Age (Yrs)	Male	Female	Total	(%)	Incidence rate per 100,000 population*
0 - 4	83	74	157	(0.7%)	70.1
5 – 14	733	524	1,257	(5.7%)	262.0
15 – 24	2,697	1,421	4,118	(18.8%)	527.2
25 – 34	4,135	1,772	5,907	(27.0%)	483.8
35 – 44	3,065	1,487	4,552	(20.8%)	476.4
45 – 54	1,751	1,138	2,889	(13.2%)	392.2
55+	1,504	1,479	2,983	(13.6%)	297.9
Total	**13,968**	**7,895**	**21,863**	**(100.0%)**	**404.9**

^Cases acquired locally among Singaporeans, permanent and temporary residents.
*Rates are based on 2013 estimated mid-year population.
(Source: Singapore Department of Statistics)

Table 2.5
Ethnic-gender distribution and ethnic-specific incidence rates of indigenous^ DF/DHF cases, 2013

	Male	Female	Total	(%)	Incidence rate per 100,000 population*
Singapore Resident					
Chinese	5,682	4,644	10,326	(47.2%)	361.8
Malay	1,021	699	1,720	(7.9%)	335.4
Indian	408	278	686	(3.1%)	195.1
Others	451	331	782	(3.6%)	618.2
Foreigner	6,406	1,943	8,349	(38.2%)	537.1
Total	**13,968**	**7,895**	**21,863**	**(100.0%)**	**404.9**

^Cases acquired locally among Singaporeans, permanent and temporary residents.
*Rates are based on 2013 estimated mid-year population.
(Source: Singapore Department of Statistics)

There were 78(0.4%) imported cases, defined as local residents with a history of travel to endemic areas seven days prior to the onset of illness. The majority of these cases (79.5%) were from Southeast Asian countries: 35 from Malaysia, 16 from Indonesia, 5 from Thailand, 3 from Philippines, 2 from Myanmar, 1 from Vietnam and the rest are from other regions (Table 2.6).

Table 2.6
Imported DF/DHF cases, 2008 – 2013

	Year					
	2008	**2009**	**2010**	**2011**	**2012**	**2013**
Southeast Asia						
Brunei	0	1	0	0	0	0
Cambodia	4	3	0	2	4	0
East Timor	1	1	1	1	3	0
Indonesia	40	19	42	17	25	16
Laos	0	1	0	0	0	0
Malaysia	42	32	34	7	17	35
Myanmar	1	1	0	0	0	2
Philippines	4	3	9	6	4	3
Thailand	15	2	11	8	10	5
Viet Nam	8	4	6	3	1	1
South Asia						
Bangladesh	2	0	0	0	0	0
China	0	0	0	0	2	3
India	13	9	26	8	9	5
Maldives	1	0	0	0	4	1
Nepal	0	1	0	0	0	0
Pakistan	0	0	0	0	0	0
Sri Lanka	1	0	1	0	1	0
Other Regions	11	6	6	2	4	7
Total	**143**	**83**	**136**	**54**	**84**	**78**

Residents in Housing & Development Board (HDB) flats, condominiums and compound houses constituted 85.4%, 8.1% and 4.2% of the cases respectively. Compared to previous year, the incidence rate of residents of compound houses (6,845.0 per 100,000) was more than five times of residents in HDB flats (1,222.5 per 100,000). (Table 2.7).

Table 2.7
Incidence rates of reported indigenous DF/DHF cases by housing type for Singapore residents, 2013

Housing Type	No.	%	Incidence rate per 100,000 population*
Compound houses (including shophouses)	568	6.3	6845.0
HDB Flats	11539	85.4	1222.5
Condominiums	1098	6.0	852.1
Others	309	2.3	476.1
Total	**13514**	**100.0**	**1179.3**

*Rates are based on census of population 2010.
(Source: Singapore Department of Statistics)

A total of 1,475 clusters involving 10,256 epidemiologically linked cases were identified in 2013, of which 188 clusters (12.8%) had 10 or more cases. Areas with more than 50 cases are listed in Table 2.9. The median number of cases in these 188 clusters was 17 (range 10 to 233) and the median duration of transmission was 27 days (range 2 to 142) (Table 2.8). The number of clusters increased almost five times more compared to the previous year.

Table 2.8
Dengue clusters identified, 1990 – 2013

Year	No. of indigenous cases	No. of clusters*	No. of cases in cluster area (% total cases)	No. of clusters with >=10 cases (% total clusters	Median no. of cases per cluster	Median duration of transmission (days)
1990	1,640	40	270 (16.5)	11 (27.5)	4.5	10
1991	2,062	74	414 (20.1)	9 (12.2)	3.5	6
1992	2,741	134	733 (26.7)	13 (9.7)	3	5
1993	794	33	183 (23.0)	4 (12.1)	3	8
1994	1,084	75	424 (39.1)	8 (10.7)	3	7
1995	1,756	118	679 (38.7)	16 (13.6)	3	7
1996	2,877	143	1,088 (37.8)	27 (18.9)	3	6
1997	4,039	198	1,124 (27.8)	24 (12.1)	3	5
1998	5,105	239	1,197 (23.4)	23 (9.6)	2	7
1999	1,138	54	230 (20.2)	6 (11.1)	3	11
2000	402	9	40 (10.0)	1 (11.1)	4	15
2001	2,064	93	531 (25.7)	15 (16.1)	3	8
2002	3,560	73	725 (20.4)	30 (41.1)	7	20
2003	4,542	180	1,405 (30.9)	38 (21.1)	4.5	12
2004	9,297	559	2,434 (26.2)	34 (6.1)	3	4
2005	14,032	1,190	5,362 (37.7)	93 (7.8)	3	5
2006	2,844	172	871 (30.6)	19 (11.0)	3	5
2007	8,287	949	3,877 (46.8)	58 (6.1)	3	10
2008	6,631	576	2,267 (34.2)	34 (5.9)	2	7
2009	4,187	392	1,456 (34.8)	17 (4.3)	3	7
2010	4,978	406	1,858 (37.3)	29 (7.1)	3	7
2011	5,099	433	1,904 (37.3)	32 (7.4)	3	7
2012	4,632	328	1,403 (30.9)	21 (6.4)	3	6
2013	22,170	1,475	10,256 (46.3)	188 (12.8)	17	27

*A cluster is defined as two or more cases epidemiologically linked by place [within 150m (200m till 2002)] and time (within 14 days)

Table 2.9
Dengue clusters identified, 2013 (50 or more cases)

S/No.	LOCALITY	No. of cases	Month
1	Tampines Ave 5 (Blk858,860,860B,861) / Tampines St 71 (Blk707,724,725,731,732,734) / Tampines St 82 (Blk830,832,836,840,842,856,856B) / Tampines St 83 (Blk833,835,839,841,843,847,849,851,853,855,857,862,863B,864,867A,868,885) / Tampines St 84 (Blk871,871A,872,874,882,883)	233	Mar - Jul
2	Bedok Nth Rd (Blk 705, 706, 707, 708) / Bedok Reservoir Rd (Blk 701, 702, 703, 704, 705, 709, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 740) / Construction Site @ Bedok Reservoir Rd / Construction Site @ Bedok Reservoir Cres	158	Sep - Nov
3	Tampines St 12 (Blk 158, 161, 162, 163, 164, 166) / Tampines St 21 (Blk 245, 246, 247, 248, 249, 250, 251, 253, 254, 266, 267, 268, 269, 270, 271) / Tampines St 22 (Blk 272, 273, 274, 275,277)	141	Feb - May
4	Tamp Ctr 1 / Tampines St 21(Blk 236, 238, 239, 240, 243, 244) / Tampines St 41 (Blk 401, 402, 404, 405, 406, 407, 408, 410, 415, 411,418, 419, 421, 422, 423, 424, 426,428,429,430) / Tampines St 43 (Blk 433,434)	134	Mar - Jul
5	Pasir Ris Dr 4 (232,233,234,477,478,479,480,481,482,483,484,485,486,487) / Pasir Ris Dr 6 (453,469,470,472,473,474,475,476,477) / Pasir Ris St 21 (225.226.227,229,230,236,235,237,238,239,241) / Pasir Ris St 41 (463,464)	134	Jun - Aug
6	Yishun Ave 6 (Blk 283, 286, 288) / Yishun Ave 9 (Blk 245,246,247,248,249,250,255) / Yishun Ring Rd (Blk 225,237,244,252,253,254,255,256,257) / Yishun St 21 (Blk 222,227) / Yishun St 22 (Blk 258,260,263,262,264,265,269,270,271,272,273,274,275,276,277 ,279,291,293)	128	Apr - Jul
7	Jurong West St 74 (Blk 759, 760, 761, 764, 765, 766) / Westwood Ave, Walk, Rd, Cres, Ter, Dr, Walk	112	May - Aug
8	Construction Site @ Orchard Rd (near Somerset MRT Stn) / Orchard Rd / Emerald Hill Rd / Saunder	107	Oct - Dec
9	Tampines St 71 (Blk 710, 712, 713, 714, 715, 716, 726, 728, 730, 731, 733, 734, 735) / Tampines St 72 (Blk 717, 718, 719, 720, 722, 723, 735, 736, 737, 738, 740, 741) / Tampines St 73	105	Aug - Nov
10	Pasir Ris Dr 1 (Blk 531, 533, 534, 535, 536) / Construction Site @ Pasir Ris St 51 / Pasir Ris St 51 (Blk 537, 538, 540, 541, 543, 547, 552, 553, 555, 557, 558, 560, 561, 562, 564, 565, 566, 567, 568, 569)	102	May - Jul
11	Joo Chiat Ln, Pl, Rd, Ter / Lor 101, 102, 104, 105, 106 Changi / Changi Rd / Langsat Rd / Everitt Rd, Rd Nth / Geylang Serai (Blk 3A) / Sims Ave (Blk 826, 830, 832, 838, 840, 842, 846)/Tembeling Rd	99	Apr - May
12	Choa Chu Kang St 51 (Blk 515, 517, 523, 525, 526, 527, 528, 529, 531) / Choa Chu Kang St 52 (Blk 540, 541, 542, 543, 544, 545, 547, 548, 549, 550, 551, 552)	94	May - Aug
13	Construction Site @ Yishun Ind St 1 / Yishun St 23	92	Apr - May
14	Choa Chu Kang St 53 (Blk 701, 702, 703, 704, 705, 706, 707, 708) / Choa Chu Kang Nth 5 (Blk 751, 753, 754, 755, 756, 757, 758, 759, 761)/ Choa Chu Kang Dr (Blk 784, 785, 786)/Choa Chu Kang Nth 6 (Blk 787, 633, 634, 788, 792)/ Choa Chu Kang Nth 6	88	Apr - Jul
15	Ava Rd / Balestier Rd / Jln Ampas / Jln Kemaman / Kim Keat Cl, Ln, Rd / Lor Ampas / Lor Limau (Blk 76, 77) / Lor Limau / Mandalay Rd / Minbu Rd / Pegu Rd / Prome Rd / Whampoa Dr (Blk 82)	84	Nov - Jan 14

S/No.	LOCALITY	No. of cases	Month
16	Construction Site @ Boon Lay Way / Corporation Rd, Rise, Walk / Lakepoint Dr / Lakeside Dr	82	May - Jul
17	Jurong West St 52 (Blk 514, 515, 516, 517, 517A, 517C, 517D, 517E, 518, 520, 521) / Corporation Rd	82	May - Jul
18	Geylang Rd / Guillemard Rd / Lor 4, 6, 8, 14, 16, 18, 20, 22 Geylang	80	Nov - Jan 14
19	Berwick Dr / Bishops Pl / Bridport Ave / Cowdray Ave / Farleigh Ave / Huddington Ave / Portchester Ave / Kingswear Ave / Hemsley Ave / Tavistock Ave / S'goon Gdn Way	79	Mar - May
20	Da Silva Ln / Flower Rd / Glasgow Rd / Highland Cl, Rd, Walk / Kovan Rd / Lowland Rd / Palm Grove Ave / Phillips Ave / Richards Ave, Pl / Rosyth Rd / Simon Pl / Teow Hock Ave / Upp Serangoon Rd	74	Sep - Dec
21	Parry Ter / Park Villas Green, Rise, Ter / Poh Huat Cres, Dr, Rd, Rd West, Ter / Construction Site @ Terrasse Ln / Robey Cres / Limbok Ter	72	Jan - Feb
22	Bartley Rd / Eden Grove / Jln Labu Ayer / Jln Labu Manis / Jln Labu Merah / Lor Gambir / Serangoon Ave 1 (Blk 401, 402, 403, 405, 406, 407) / Sunshine Ter / Upp Sgn Rd	72	Nov - Jan 14
23	Jurong East St 21 (Blk 201, 202, 203, 204, 205, 206, 207, 208, 287A, 287B, 287C, 287D, 288A, 288C, 288D) / Toh Guan Rd (Blk 285A, 285B, 286A, 286C, 286D)	71	Sep - Oct
24	Compassvale Bow (Blk 266A) / Compassvale Link (Blk 267A) / Construction Site @ Sengkang East Ave / Construction Site @ Rivervale Link / Rivervale Walk (Blk 101, 102, 103, 109, 110)	69	Aug - Sep
25	Changi Rd / Jln Eunos / Kampong Eunos / Lor 110 Changi / Lor Sarina / Lor G, H Telok Kurau / Telok Kurau Rd/Lor Marzuki/ Sims Ave East	68	May - Jun
26	Lor 2 Toa Payoh (Blk 86) / Lor 3 Toa Payoh / Lor 4 Toa Payoh (Blk 56, 58, 60, 80, 80A, 81A, 81B, 82, 82A, 82B, 85, 85B) / Lor 5 Toa Payoh (Blk 48, 49, 50, 53, 54, 55, 57, 61) / Lor 6 Toa Payoh (Blk 47, 51) / Toa Payoh Central (Blk 79B, 79D, 79E)	67	Sep - Oct
27	Construction Site @ Tampines Ave 8 (Blk 868C) /.St 71 (Blk 704,7 24,725,727,729,730,731,732) /St 82 (Blk 850) /St 83 (Blk 853,855, 857,865,866,867,867A,868,869)/ St 84 (Blk 871,871A,872,874)/ Tampines Central (Blk 518A)	66	Feb - May
28	Corporation Rd / Construction Site @ Lakeside Dr / Lakeside Dr	66	Dec - Jan 14
29	Hougang St 51 (Blk 533, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 566, 567) / Hougang St 52 (Blk 534, 537, 538, 539, 699A) / Hougang Ave 6 (Blk 531) / Hougang Ave 8 (Blk 544, 545, 699)	65	Jan - Mar
30	Jln Belibas / Jln Chegar / Jln Chempah / Jln Hari Raya / Jln Keli / Jln Khamis / Jln Ikan Merah / Jln Isnin / Jln Minggu / Jln Pintau / Jln Sembilang / Jln Terubok / Shunfu Rd (Blk 311, 314, 315, 317) / Sin Ming Rd (Blk 23, 24, 25)	65	Aug - Dec
31	Hougang Ave 8 (Blk 626, 628, 629, 631, 632, 633, 634, 635, 636, 637, 638, 639, 641, 642, 647, 648)	60	Jan - Feb
32	Construction Site @ Pasir Ris Link	57	Jun - Jul
33	Construction Site @ Canberra Dr / Yishun Ave 7 (Blk 170, 172, 173, 175) / Yishun Ring Rd (Blk 165, 166, 167) / Yishun St 11 (Blk 122, 123, 125, 127, 128, 130)	57	Oct - Jan 14
34	Yishun Central (Blk 304, 306, 320, 321, 322, 323, 324, 325) / Yishun Ring Rd (Blk 308, 326, 327, 328, 329, 330, 331, 332)	52	May - Aug

Dengue Deaths

A total of eight fatal cases were reported in 2013. Of these, seven fatal cases were classified as indigenous infections among local residents. The remaining fatal case was a non-resident foreigner seeking treatment in Singapore who had acquired the infection overseas.

Laboratory Surveillance

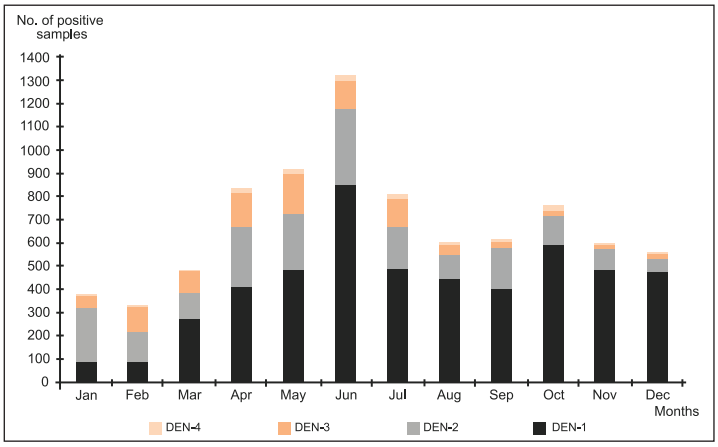
All reported cases of DF/DHF were confirmed by one or more laboratory tests; viz. anti-dengue IgM antibody, enzyme linked immunosorbent assay (ELISA), and polymerase chain reaction (PCR).

A total of 8,203 blood samples obtained from both inpatients and outpatients tested positive for dengue virus by PCR at the Singapore General Hospital Department of Pathology, Environmental Health Institute, Tan Tock Seng Hospital Department of Pathology and Laboratory Medicine, National University Hospital Laboratory, Changi General Hospital, KK Women's and Children's Hospital Laboratory and Khoo Teck Puat Hospital Laboratory.

All four dengue serotypes were detected, comprising DENV1 (61.8%), DENV2 (24.6%), DENV3 (11.6%) and DENV4 (2.0%) (Figures 2.4 & 2.5).

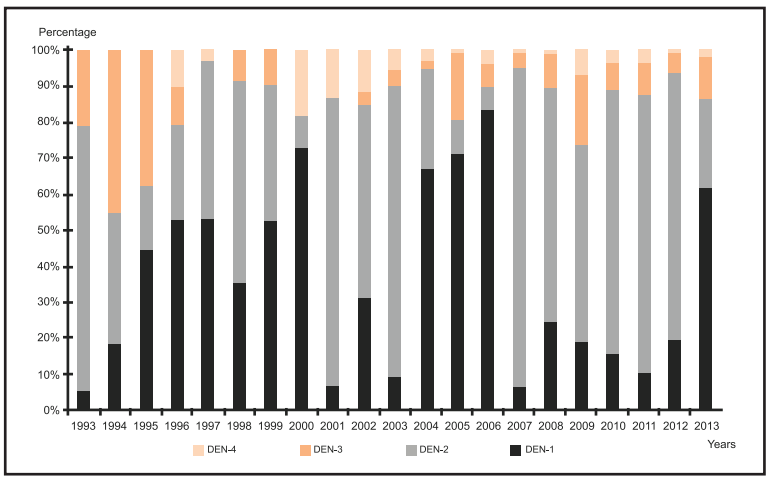
DENV2 was the predominant circulating serotype from 2007 to 2012. DENV1 was found to be the predominant circulating serotype in 2013 (Figure 2.5).

Figure 2.4
Surveillance of dengue virus serotypes, 2013



(Source: Singapore General Hospital Department of Pathology, Environmental Health Institute, Tan Tock Seng Hospital Department of Pathology and Laboratory Medicine, National University Hospital Laboratory, Changi General Hospital, KK Women's and Children's Hospital Laboratory and Khoo Teck Puat Hospital Laboratory)

Figure 2.5
Surveillance of dengue virus serotypes, 1993 – 2013



(Source: Singapore General Hospital Department of Pathology, Environmental Health Institute, Tan Tock Seng Hospital Department of Pathology and Laboratory Medicine, National University Hospital Laboratory, Changi General Hospital, KK Women's and Children's Hospital Laboratory and Khoo Teck Puat Hospital Laboratory)

Aedes mosquito vectors surveillance and control

Suppressing the Aedes mosquito vector population is the key to dengue control in the absence of an effective vaccine. The National Environment Agency (NEA) adopts an evidence-based approach for the surveillance and control of Aedes vectors.

Surveillance builds on the current regime of inspecting premises for mosquito breeding. It is complemented by adult mosquito sentinel surveillance using Gravitraps, which capture gravid mosquitoes. Vector surveillance is integrated with epidemiological surveillance and laboratory-based virus surveillance, to generate risk maps that are used to guide vector control efforts, and to communicate risk to the community.

Source reduction by the community is central to Singapore's dengue vector control efforts. NEA actively engages the community to do their part to prevent mosquito breeding in their premises. Through the Inter-Agency Dengue Taskforce, NEA coordinates source reduction efforts in partnership with stakeholders in the public, private and people sectors. Since 2006, this has been augmented by Intensive Source Reduction Exercise (ISRE) that takes place at the start of the year. This systematic searching and destroying of potential breeding habitats in outdoor areas helps to reduce the vector population to a low level before the onset of the peak season for dengue transmission, which typically falls between May and October.

To control the vector population in clusters, NEA carries out space and residual spraying of insecticides to kill adult mosquitoes, complemented by searching and destroying of mosquito breeding sources. Apart from surveillance, Gravitraps are also used to supplement these measures and to monitor the extent of control efforts.

A total of 22,170 cases were reported in 2013. This was 50% higher than the previously largest epidemic in 2005. Against the backdrop of the low population immunity and the continued presence of Aedes mosquito vectors, the increase in cases was associated with the switch of predominant serotype from DENV-2 to DENV-1 and the emergence of a new strain of DENV-1 virus with apparently greater fitness. DENV-1 was the predominant virus serotype in 2013.

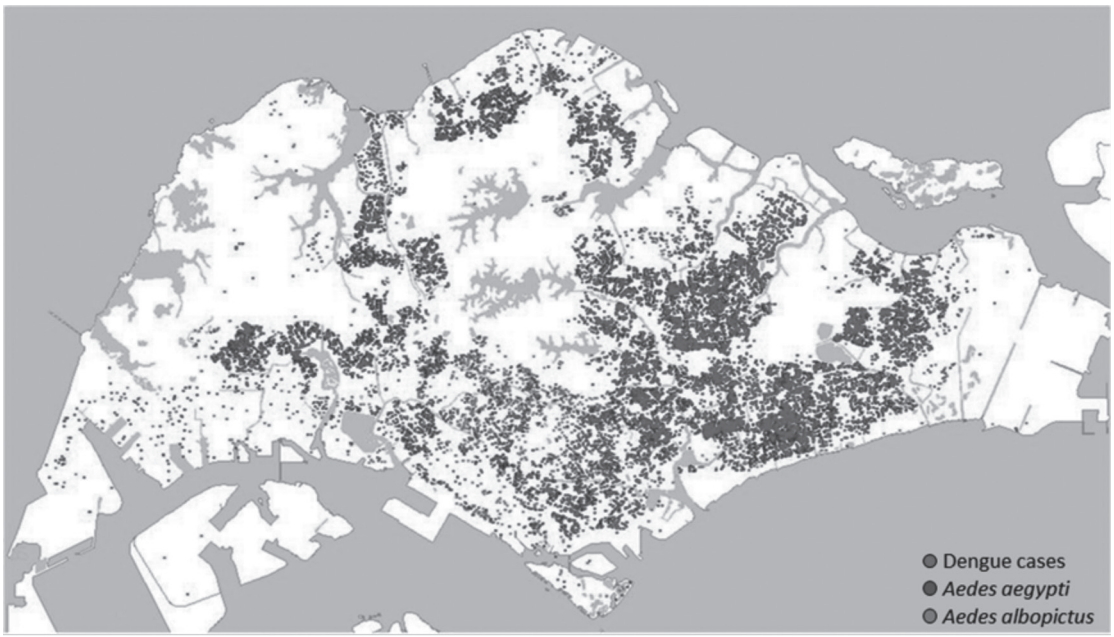
In the absence of an effective vaccine, Singapore's dengue control programme focuses on controlling the Aedes mosquito vector. To this end, NEA piloted a sentinel surveillance system whereby 2,900 gravitraps were deployed in HDB housing estates at 34 locations around Singapore to monitor the Aedes mosquito population. The map (Figure 2.6) shows the distribution of the 34 sentinel sites. Another 1,300 gravitraps were also rolled out in two constituencies – Bukit Panjang and Clementi. Data provides information on mosquito population and distribution, which could serve as basis for guiding operational deployment.

In 2013, NEA inspected some 6 million premises and surveyed over 112,000 outdoor areas. These include residential premises, as well as construction sites, schools and factories. The distribution of dengue cases and Aedes mosquito breeding are shown in Figure 2.7 (Note: Aedes aegypti and Aedes albopictus are now known as Stegomyia aegypti and Stegomyia albopictus, respectively). The overall Aedes House Index (HI) was 0.30%, with compound houses showing the highest HI among the residential premises (Figure 2.8). The top breeding habitats for Ae. aegypti were domestic containers (32.9%), ornamental containers (10.9%), flower pot plate/tray (9.7%), puddle/ground depression (2.8%), and discarded receptacles (2.4%) (Figure 2.9). As for Ae. albopictus, the most common breeding habitats were discarded receptacles (13.2%), domestic containers (10.1%), flower pot plate/tray (9.7%), canvas/plastic sheets (6.2%), and plants such as hardened soil and plant axils) (3.9%) (Figure 2.10).

Figure 2.6
Distribution of sentinel sites, 2013

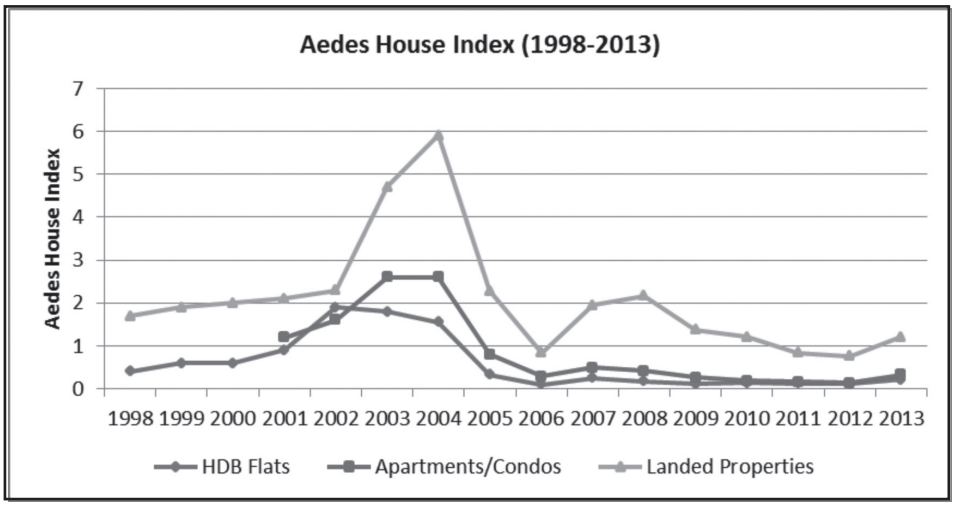
(Source: National Environment Agency)

Figure 2.7
Geographical distribution of *Ae. albopictus*, *Ae. aegypti* and dengue cases



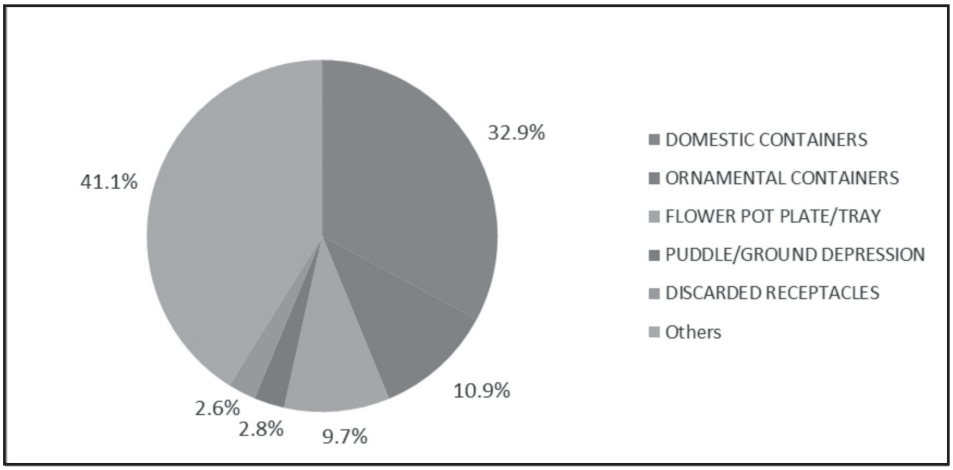
(Source: National Environment Agency)

Figure 2.8
Percentage of premises breeding *Aedes* mosquitoes, 1998-2013



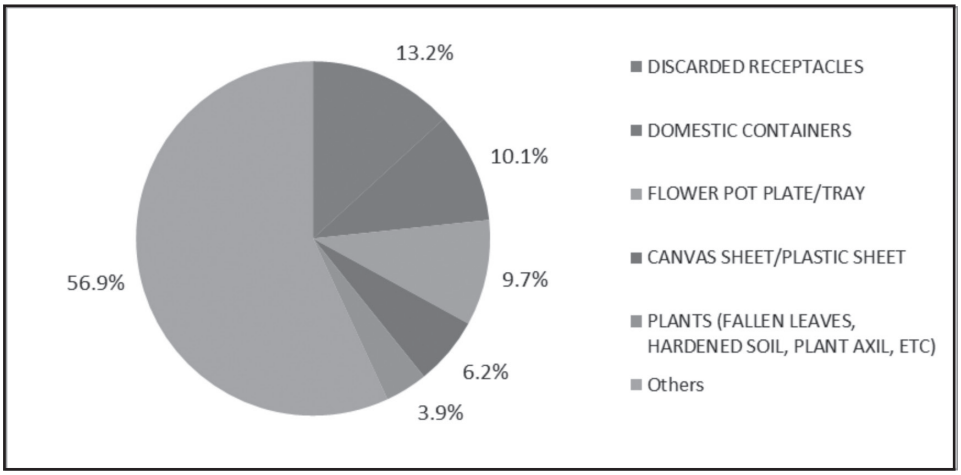
(Source: National Environment Agency)

Figure 2.9
Distribution (%) of *Aedes aegypti* by top 5 breeding habitats, 2013



(Source: National Environment Agency)

Figure 2.10
Distribution (%) of *Aedes albopictus* by top 5 breeding habitats, 2013



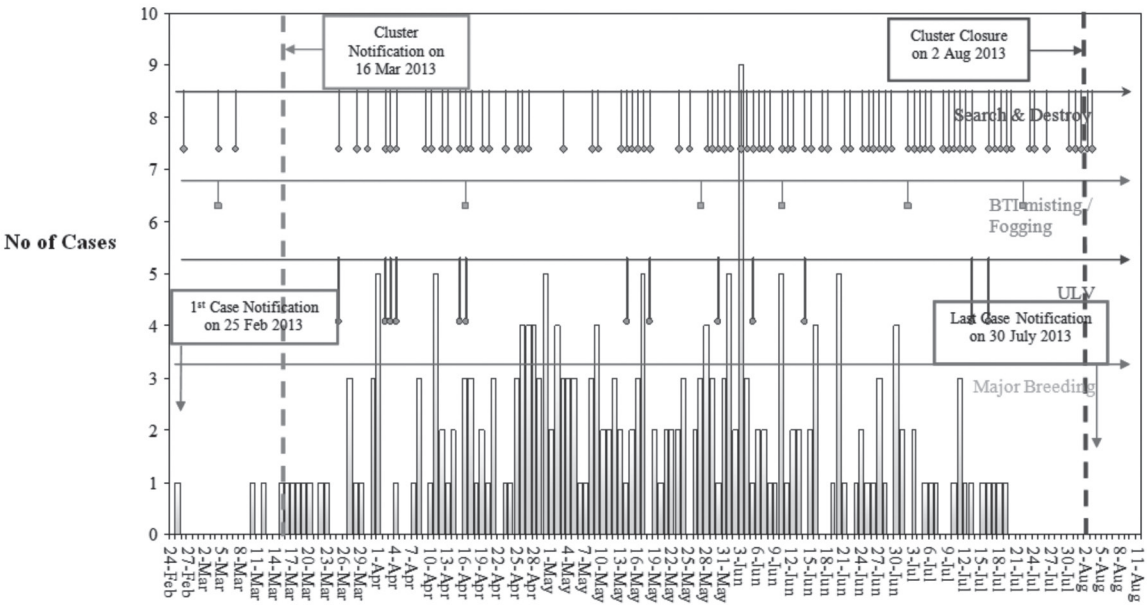
(Source: National Environment Agency)

There were 1,475 clusters in 2013. The two largest clusters were in Tampines Ave 5, Ave 8, St 71, St 81, St 82, St 83, St 84, and Bedok Reservoir Road (Blk 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 740) / Construction Site) with 233 and 158 cases, respectively.

Outbreak of Dengue Fever at Tampines Ave 5, Ave 8, St 71, St 81, St 82, St 83, St 84

On 25 February 2013, the Ministry of Health was notified of a Dengue case residing in Blk 860 Tampines Ave 5. Within two weeks, two additional cases were reported in the vicinity. Epidemiological investigation and vector control were carried out. A total of 233 cases were reported in the outbreak, with onset dates spanning 25 February 2013 and 19 July 2013. The epidemic curve is shown in Figure 2.11.

Figure 2.11
Time distribution of 233 DF/DHF cases in Tampines Ave 5, Ave 8, St 71, St 81, St 82, St 83, St 84

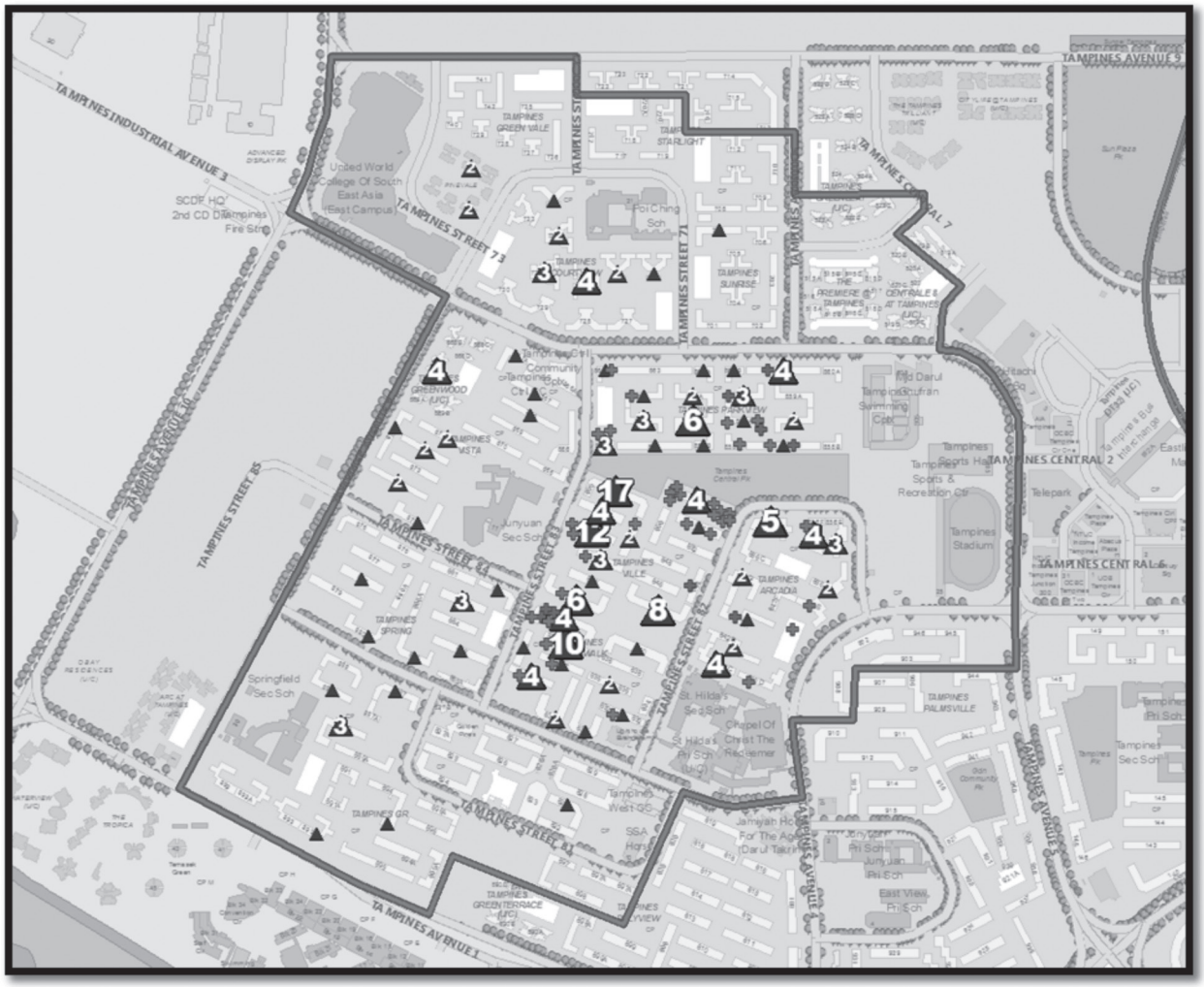


(Source: National Environment Agency)

Of the 233 cases, 209 (89.7%) were Singapore residents. Majority of the cases (68.2%) were in the 15-50 years age group. The female to male ratio was 1:1.3. Based on the reported occupations, the cases comprised 44 students, 26 housewives, 8 workers in construction-related trade, 7 unemployed, 6 retirees, 3 domestic helpers and 71 working adults. Information was not available for 68 cases.

Figure 2.12 shows the geographical distribution of cases in the cluster. 83 mosquito breeding habitats were identified and destroyed. 32.5% of the breeding habitats found in the cluster were domestic containers (containers and pails), and 16.9% were ornamental containers (flower vase and pots). 73.5% of the breeding habitats were detected in residential premises, with the remainder on outdoor grounds. Aedes aegypti accounted for 76% of the breeding. There were three profuse breeding – one in a plastic pail within residential premises (400pH), and two in concrete gutters in outdoor areas (200pH and 300pH, respectively).

Figure 2.12
Geographical distribution of 233 DF/DHF cases in Tampines Ave 5, Ave 8, St 71, St 81, St 82, St 83, St 84

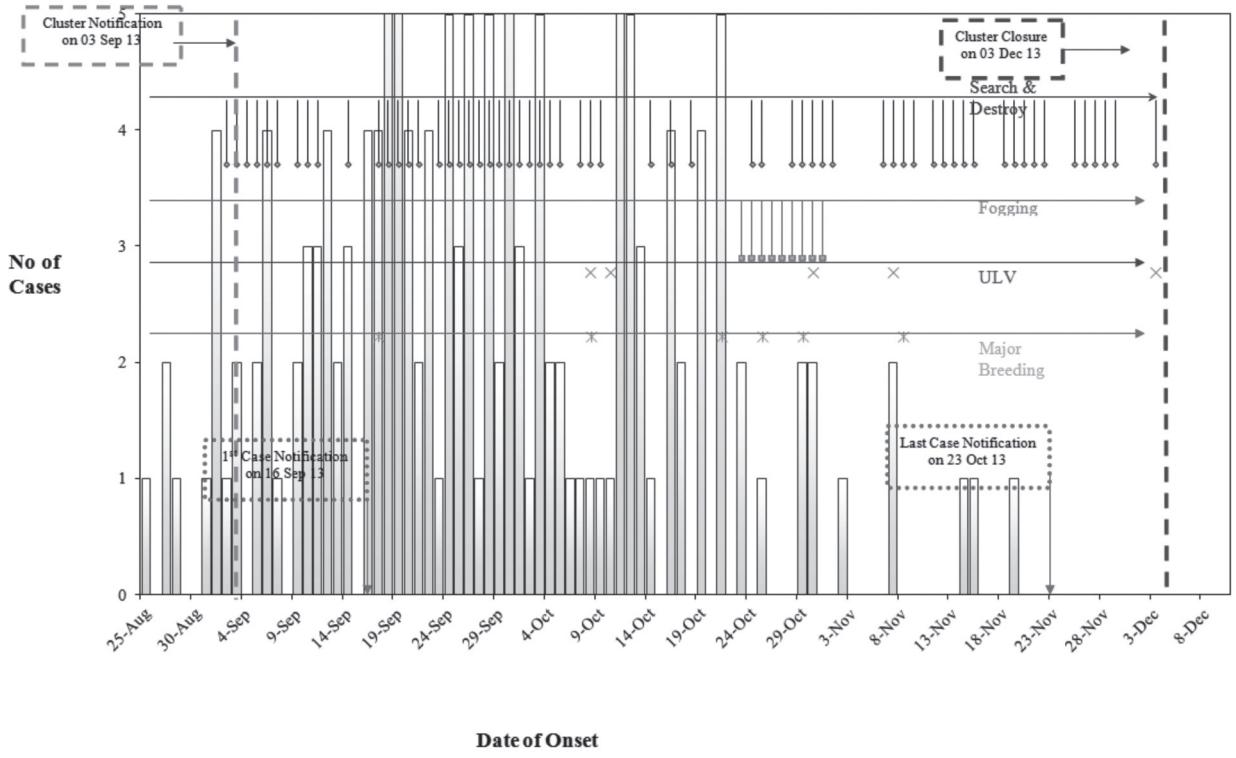


(Source: National Environment Agency)

Outbreak of Dengue Fever at Bedok Reservoir Road (Blk 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 740) / Construction Site)

On 29 August 2013, the Ministry of Health was notified of a Dengue case residing in Bedok Reservoir Road. Another case was reported in the same area in the next few days. Epidemiological investigation and vector control were carried out. A total of 158 cases were reported in the outbreak, with onset dates spanning 25 August 2013 and 15 November 2013. The epidemic curve is shown in Figure 2.13.

Figure 2.13
Time distribution of 158 DF/DHF cases in Bedok Reservoir Road (Blk 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 740) / Construction Site)

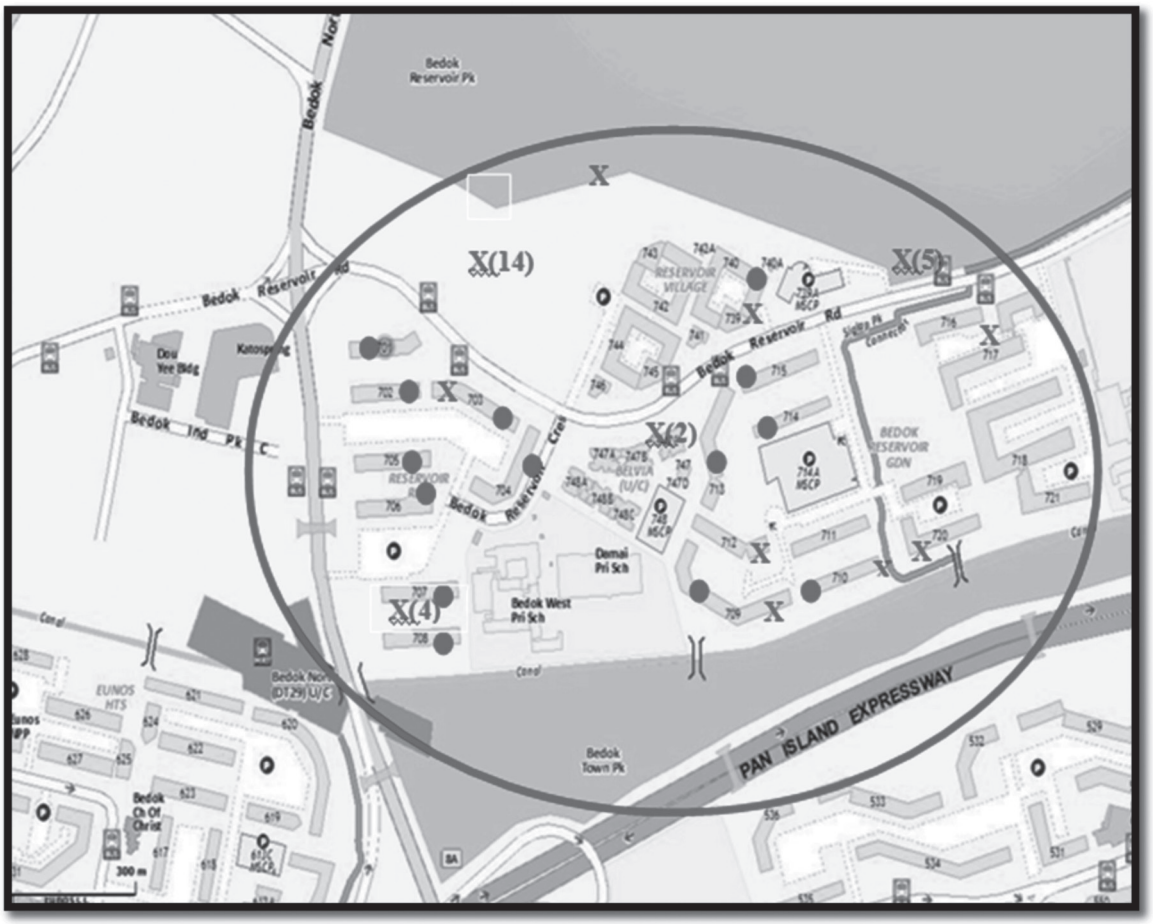


(Source: National Environment Agency)

Of these 158 cases, 100 (63.3%) were non-Singapore residents. Majority of the cases (82.3%) were in the 15-50 years age group. The female to male ratio was 1:2.2. Based on the reported occupations, the cases comprised 23 workers in construction-related trade, 19 students, 3 retirees, 2 housewives and 22 working adults. Information was not available for 89 cases.

Figure 2.14 shows the geographical distribution of cases in the cluster. 38 mosquito breeding habitats were identified and destroyed during the vector control operation in the cluster. 39.5% of the breeding habitats found in the cluster were found in construction sites (drain holes, unattended construction materials), 34.2% of the habitats were found in outdoor areas (drains, tree holes and lighting covers) and 26.3% in residential premises (domestic containers, flower pots/vases and hardened soil). Aedes aegypti accounted for 70% of the breeding habitat.

Figure 2.14
Geographical distribution of 158 DF/DHF cases in Bedok Reservoir Road (Blk 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 740) / Construction Site)



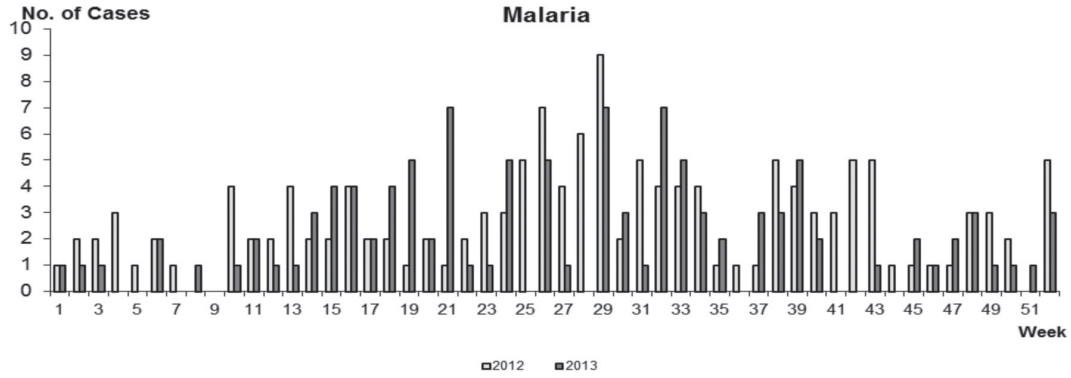
(Source: National Environment Agency)

MALARIA

Malaria is a disease caused by a protozoan parasite, *Plasmodium*. The disease is transmitted via the bite of an infective female *Anopheles* mosquito. There are four species that cause disease in humans, namely *P. vivax, P.malariae, P. falciparum and P. ovale*. In recent years, *P. knowlesi* – a species that causes malaria among monkeys and occurs in certain forested areas of South-East Asia – has also caused several human cases of malaria. Symptoms of malaria include fever, headache, chills and vomiting.

In 2013, a total of 111 laboratory-confirmed cases were reported, a decrease of 22% compared to the 143 cases reported in 2012 (Figure 2.15). 110 cases were imported.

Figure 2.15
E-weekly distribution of reported malaria cases, 2012-2013



The incidence rate was highest in the 15 - 24 years age group, with an overall male to female ratio of 7.8:1 (Table 2.10). Among the three major ethnic groups, Indians had the highest incidence rate, followed by Malays and Chinese (Table 2.11).

Table 2.10
Age-gender distribution and age-specific incidence rate of reported malaria cases^, 2013

Age (Yrs)	Male	Female	Total (%)	Incidence rate per 100,000 population*
0 - 4	0	0	0 (0.0)	0.0
5 – 14	0	1	1 (1.2)	0.2
15 – 24	27	1	28 (31.8)	3.6
25 – 34	35	4	39 (44.3)	3.2
35 – 44	10	2	12 (13.6)	1.3
45 – 54	3	0	3 (3.4)	0.4
55+	3	2	5 (5.7)	0.5
Total	**78**	**10**	**88 (100.0)**	**1.6**

^Excluding 9 foreigners seeking medical treatment in Singapore and 14 tourists.
*Rates are based on 2013 estimated mid-year population.
(Source: Singapore Department of Statistics)

Table 2.11
Ethnic-gender distribution and ethnic-specific incidence rate of reported malaria cases^, 2013

	Male	Female	Total (%)	Incidence rate per 100,000 population*
Singapore Resident				
Chinese	4	1	5 (5.7)	0.2
Malay	2	0	2 (2.2)	0.4
Indian	4	1	5 (5.7)	1.4
Others	5	0	5 (5.7)	4.0
Foreigner	63	8	71 (80.7)	4.6
Total	**80**	**18**	**88 (100.0)**	**1.6**

^ Excluding 9 foreigners seeking medical treatment in Singapore and 14 tourists.
*Rates are based on 2013 estimated mid-year population.
(Source: Singapore Department of Statistics)

Malaria parasite species

The distribution of the cases by parasite species was *P. vivax (75.7%)*, *P. falciparum (18.9%)*, *P. knowlesi (3.6%)* and *P. ovale (1.8%)* (Table 2.12).

Table 2.12
Classification of reported malaria cases by parasite species, 2013

Classification	Parasite species					Total (%)
	P.v.	P.f.	P.o.	P.m.	P.k.	
Imported**	84	21	2	0	3	110 (99.1)
Introduced	0	0	0	0	0	0 (0.0)
Indigenous	0	0	0	0	1	1 (0.9)
Cryptic	0	0	0	0	0	0 (0.0)
Induced	0	0	0	0	0	0 (0.0)
Total	**84**	**21**	**2**	**0**	**4**	**111 (100.0)**

P.v. - *Plasmodium vivax* P.f. - *Plasmodium falciparum* P.o. - *Plasmodium ovale*

P.m. - *Plasmodium malariae* P.k. - *Plasmodium knowlesi*

**Including relapsed cases that were imported.

Imported malaria cases

The majority of cases who had acquired malaria overseas were infected in India (71.8%) and Indonesia (8.2%). *P. vivax* accounted for 91.1% and 44.4% of the infections acquired in India and Indonesia respectively and *P. falciparum* accounted for 75.0% and 44.4% of the infections acquired in the African region and Indonesia respectively (Table 2.13).

Table 2.13
Imported malaria cases by country of origin and by parasite species, 2013

Classification	Parasite species					Total (%)
	P.v.	P.f.	P.o.	P.m.	P.k.	
Southeast Asia						
Brunei Darussalam	0	0	0	0	1	1 (0.9)
Indonesia	4	4	1	0	0	9 (8.2)
Malaysia	0	0	0	0	1	1 (0.9)
Myanmar	2	0	0	0	0	2 (1.8)
Thailand	1	0	0	0	1	2 (1.8)
South Asia						
India	72	7	0	0	0	79 (71.8)
Pakistan	1	0	0	0	0	1 (0.9)
Africa						
Angola	0	1	0	0	0	1 (0.9)
Cameroon	1	0	0	0	0	1 (0.9)
Ghana	0	1	0	0	0	1 (0.9)
Guinea	0	1	0	0	0	1 (0.9)
Libya	0	0	1	0	0	1 (0.9)
Mali	0	1	0	0	0	1 (0.9)
Niger	0	1	0	0	0	1 (0.9)
Nigeria	0	2	0	0	0	2 (1.8)
South Africa	1	0	0	0	0	1 (0.9)
Tanzania	0	1	0	0	0	1 (0.9)
Uganda	0	1	0	0	0	1 (0.9)

Other countries						
British Indian Ocean Territory	0	1	0	0	0	1 (0.9)
Papua New Guinea	2	0	0	0	0	2 (1.8)
Total	**84**	**21**	**2**	**0**	**3**	**110 (100.0)**

P.v. - *Plasmodium vivax* P.f. - *Plasmodium falciparum* P.o. - *Plasmodium ovale*
P.m. - *Plasmodium malariae* P.k. - *Plasmodium knowlesi*

Most of the cases (69.9%) had onset of fever within three weeks of entry into Singapore (Table 2.14). For *P. vivax* malaria, 31.8% of cases did not develop symptoms until more than six weeks after entry.

Table 2.14
Imported malaria cases by interval between period of entry and onset of illness and by parasite species, 2013

Interval in weeks	Parasite species					Total (%)
	P.v.	P.f.	P.o.	P.m.	P.k.	
<2	32	18	0	0	2	52 (47.3)
2 – 3	11	3	0	0	1	15 (13.7)
4 – 5	3	0	1	0	0	4 (3.6)
6 - 7	6	0	0	0	0	6 (5.5)
8 – 9	5	0	0	0	0	5 (4.6)
10 – 11	5	0	0	0	0	5 (4.6)
12 – 13	2	0	0	0	0	2 (1.8)
14 – 15	2	0	0	0	0	2 (1.8)
16 – 17	0	0	1	0	0	1 (0.9)
18 – 19	3	0	0	0	0	3 (2.7)
20 – 23	4	0	0	0	0	4 (3.6)
24 – 27	2	0	0	0	0	2 (1.8)
28 – 31	1	0	0	0	0	1 (0.9)
32 – 35	2	0	0	0	0	2 (1.8)
36 – 39	2	0	0	0	0	2 (1.8)
40+	4	0	0	0	0	4 (3.6)
Total	**84**	**21**	**2**	**0**	**3**	**110 (100.0)**

P.v. - *Plasmodium vivax* P.f. - *Plasmodium falciparum* P.o. - *Plasmodium ovale*
P.m. - *Plasmodium malariae* P.k. - *Plasmodium knowlesi*

The 110 imported cases comprised 16 Singapore residents (14.6%), 58 work permit/employment pass holders (52.7%), 2 student pass holders (1.8%), 11 foreigners residing in Singapore (10.0%), 9 foreigners seeking medical treatment in Singapore (8.2%) and 14 tourists (12.7%) (Table 2.15).

Table 2.15
Classification of imported malaria cases by population group, 2012-2013

Classification	2012		2013	
	Cases	%	Cases	%
Local Residents				
Singapore residents	29	20.3	16	14.6
Work permit/Employment pass holders	61	42.6	58	52.7
Student pass holders	3	2.1	2	1.8
Other foreigners	5	3.5	11	10.0
Foreigners seeking medical treatment	21	14.7	9	8.2
Tourists	24	16.8	14	12.7
Total	**143**	**100.0**	**110**	**100.0**

The majority of Singapore residents who contracted malaria whilst travelling overseas were on holiday. All of the cases admitted that they did not take/complete chemoprophylaxis (Table 2.16 and 2.17).

Table 2.16
Purpose of travel for Singapore residents who contracted malaria overseas, 2009-2013

	2009	2010	2011	2012	2013
Purpose of Travel					
Social visits/holidays	14	26	10	24	10
Business	5	6	4	1	3
Military service	0	0	1	1	0
Volunteer/Missionary work	1	0	0	1	2
Employment	2	3	1	2	1
Total	**22**	**35**	**16**	**29**	**16**

Table 2.17
History of chemoprophylaxis for Singapore residents who contracted malaria overseas, 2009 - 2013

	2009	2010	2011	2012	2013
Chemoprophylaxis					
Took complete chemoprophylaxis	0	0	0	1	0
No chemoprophylaxis	22	35	15	27	16
Irregular/incomplete chemoprophylaxis	0	0	1	1	0
Total	**22**	**35**	**16**	**29**	**16**

- Acute Diarrhoeal Illness
- Campylobacteriosis
- Cholera
- Enteric Fevers (Typhoid and Paratyphoid)
- Hepatitis A
- Hepatitis E
- Salmonellosis
- Food Poisoning

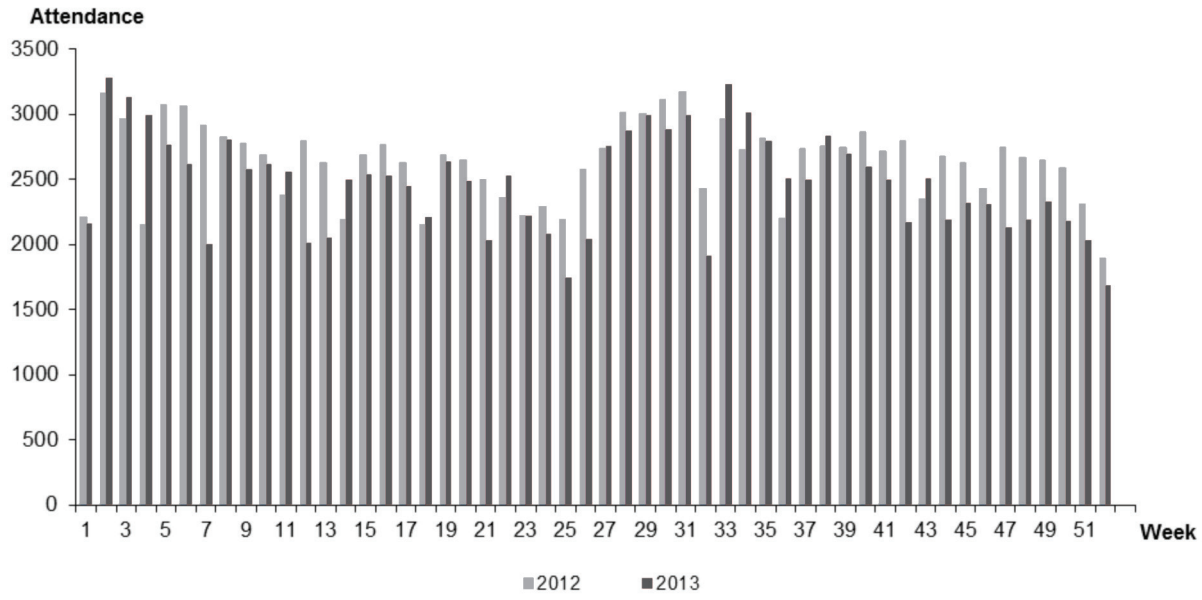
III
FOOD-/WATER-BORNE DISEASES

Food-borne diseases are caused by the ingestion of foodstuffs or water contaminated by toxins associated with bacterial growth in the food, bacterial, viral or parasitic agents, toxins produced by harmful algal species or present in specific fish species or heavy metals and other organic compounds.

ACUTE DIARRHOEAL ILLNESSES

There were a total of 137,079 attendances at polyclinics for acute diarrhoeal illnesses in 2013 – an increase of 7.6% over the 127,402 seen in 2012. The weekly surveillance of acute diarrhoeal attendances showed a similar pattern to that of the previous year (Figure 3.1).

Figure 3.1
Weekly attendances of diarrhoeal illnesses at polyclinics, 2012 – 2013



CAMPYLOBACTERIOSIS

Campylobacter enteritis is an acute bacterial enteric disease of variable severity characterised by diarrhoea, abdominal pain, malaise, fever, nausea and vomiting. *Campylobacter jejuni* and less commonly, *Campylobacter coli* are the usual causes of *Campylobacter* enteritis in humans. The mode of transmission is by ingestion of the organism in undercooked chicken and pork, contaminated food and water or unpasteurised milk.

A total of 397 cases of *Campylobacter* enteritis were reported in 2013, a decrease of 10.4% compared to 443 cases reported in 2012. *Campylobacter jejuni* was isolated in majority of the cases (Table 3.1). Of the 397 reported cases, 35 were imported cases and 356 were indigenous cases. The other 6 cases were two foreigners who came to Singapore to seek medical treatment for infections acquired overseas and four tourists.

The incidence rate among indigenous cases was highest in the 0-4 years age group, with an overall male to female ratio of 1.2:1 (Table 3.2). Among the three major ethnic groups, the Malays had the highest incidence followed by Chinese and Indians (Table 3.3).

Table 3.1
Incidence of reported *Campylobacter* enteritis, 2002 – 2013

Year	No. of cases caused by					Incidence rate per 100,000 population*
	C. jejuni	*C. coli*	*C. laridis*	Other species	Total	
2002	50	0	0	0	50	1.2
2003	140	1	0	3	144	3.4
2004	122	2	0	7	131	3.1
2005	241	0	0	0	241	5.5
2006	227	0	0	9	236	5.3
2007	161^	1^	0	9	170	3.7
2008	158	0	0	19	177	3.7
2009	240	0	0	21	261	5.2
2010	292	0	0	28	320	6.3
2011	340	2	0	30	372	7.2
2012	388#	12	1#	43	443	8.3
2013	335	14	0	48	397	7.4

^One case had a concurrent infection of both *C.jejuni* and *C.coli*
#One case had a concurrent infection of both *C. jejuni* and *C. laridis*
*Rates are based on 2013 estimated mid-year population.
(Source: Singapore Department of Statistics)

Table 3.2
Age-gender distribution and age-specific incidence rates of reported *Campylobacter* enteritis cases^, 2013

Age (Yrs)	Male	Female	Total (%)	Incidence rate per 100,000 population*
0 – 4	102	76	178 (45.5)	79.5
5 – 14	47	36	83 (21.2)	17.3
15 – 24	9	6	15 (3.8)	1.9
25 – 34	11	10	21 (5.5)	1.7
35 – 44	8	1	9 (2.3)	0.9
45 – 54	7	4	11 (2.8)	1.5
55+	32	42	74 (18.9)	13.4
Total	**216**	**175**	**391 (100)**	**7.2**

^Excluding two foreigners seeking medical treatment in Singapore and four tourists.
*Rates are based on 2013 estimated mid-year population.
(Source: Singapore Department of Statistics)

Table 3.3
Ethnic-gender distribution and ethnic-specific incidence rates of reported *Campylobacter* enteritis cases^, 2013

	Male	Female	Total (%)	Incidence rate per 100,000 population*
Singapore Resident				
Chinese	134	96	230 (58.8)	8.1
Malay	24	26	50(12.8)	9.7
Indian	11	5	16 (4.1)	4.5
Others	15	17	32 (8.2)	25.3
Foreigner	32	31	63 (16.1)	4.1
Total	**216**	**175**	**391 (100)**	**7.2**

^Excluding two foreigners seeking medical treatment in Singapore and four tourists.
*Rates are based on 2013 estimated mid-year population.
(Source: Singapore Department of Statistics)

CHOLERA

Cholera is an acute bacterial enteric disease characterised in its severe form by sudden onset, profuse painless watery stools, nausea and vomiting. Untreated cases proceed rapidly to dehydration, acidosis, hypoglycaemia, circulatory collapse and renal failure. The usual causative agent in Singapore is *Vibrio cholerae* serogroup O1 which includes two biotypes, Classical and El Tor. Each of these biotypes can be further classified into serotypes Inaba, Ogawa and Hikojima. Other serogroups in addition to O1 are O139 and Non O. The mode of transmission is through ingestion of food or water contaminated with faeces or vomitus of infected persons.

In 2013, two imported cases of cholera were reported (Figure 3.2), one is a Singapore citizen and the other is a permanent resident. Both cases were positive for *V. cholerae* O1 El Tor biotypes. The overall incidence rate was 0.04 per 100,000 population (Table 3.4 and 3.5).

Figure 3.2
E-weekly distribution of reported cholera cases, 2012 - 2013

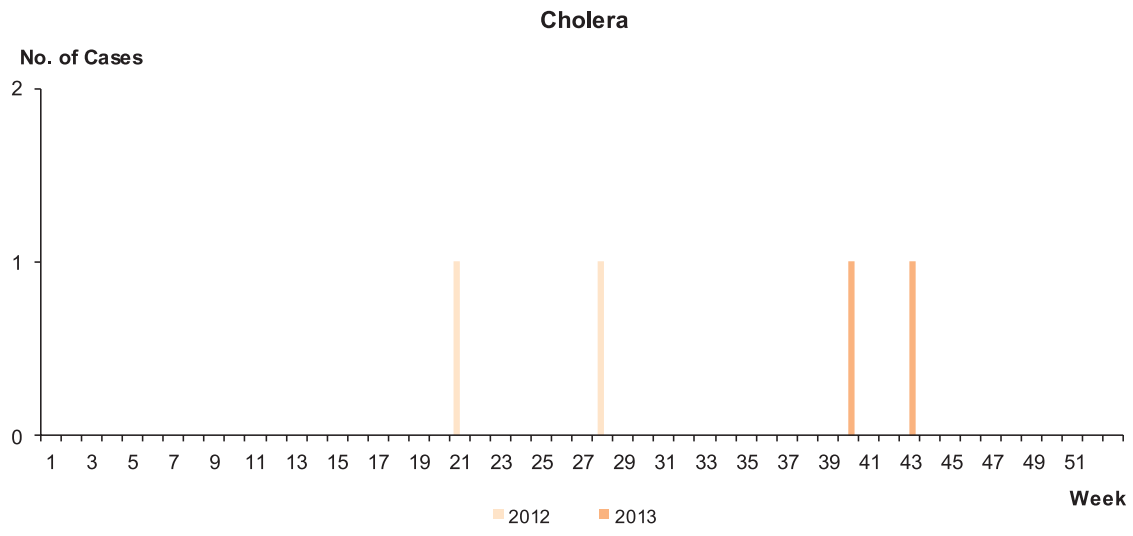


Table 3.4
Age-gender distribution and age-specific incidence rate of reported cholera cases, 2013

Age (Yrs)	Male	Female	Total (%)	Incidence rate per 100,000 population*
0 – 4	0	0	0 (0.0)	0.00
5 – 14	0	0	0 (0.0)	0.00
15 – 24	0	0	0 (0.0)	0.00
25 – 34	0	0	0 (0.0)	0.00
35 – 44	0	2	2 (100.0)	0.21
45 – 54	0	0	0 (0.0)	0.00
55 – 64	0	0	0 (0.0)	0.00
65 +	0	0	0 (0.0)	0.00
Total	**0**	**2**	**2 (100.0)**	**0.04**

*Rates are based on 2013 estimated mid-year population.
(Source: Singapore Department of Statistics)

Table 3.5
Ethnic-gender distribution and ethnic-specific incidence rate of reported cholera cases, 2013

	Male	Female	Total (%)	Incidence rate per 100,000 population*
Singapore Resident				
Chinese	0	0	0 (0.0)	0.00
Malay	0	0	0 (0.0)	0.00
Indian	1	0	1 (50.0)	0.28
Others	1	0	1 (50.0)	0.79
Foreigner	0	0	0 (0.0)	0.00
Total	**2**	**0**	**2 (100.0)**	**0.04**

*Rates are based on 2013 estimated mid-year population
(Source: Singapore Department of Statistics)

ENTERIC FEVERS

Enteric fevers are systemic, bacterial diseases characterised by insidious onset of sustained fever, severe headache, malaise, anorexia. Other features may include a relative bradycardia, splenomegaly and non-productive cough (in the early stage of the illness). Constipation is more common than diarrhoea in adults. It is important to appreciate the difference between Salmonellosis food poisoning, and typhoid or paratyphoid fever, commonly known as enteric fevers. Causative organisms for the enteric fevers are *Salmonella typhi* and *Salmonella paratyphi* (types A or B) and infections are usually associated with travel to countries where these diseases are endemic.

During the period 2009 to 2013, a total of 569 cases of enteric fever were reported, of which 390 (68.5%) cases were typhoid and 179 (31.5%) cases were paratyphoid. The majority (91.9%) were imported cases (Table 3.6).

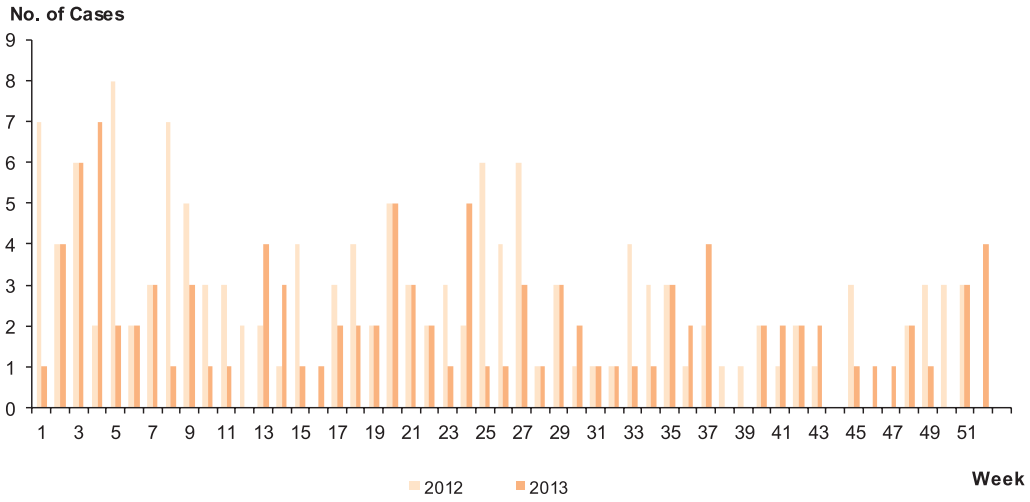
Table 3.6
Classification of reported enteric fever cases, 2009 – 2013

Year	Typhi	Paratyphi		Total
		A	B	
2009	69 (62)	21 (19)	7 (3)	97 (84)
2010	82 (77)	37 (35)	1 (1)	120 (113)
2011	71 (69)	32 (31)	1 (0)	104 (100)
2012	84 (82)	57 (46)	0 (0)	141 (128)
2013	84 (75)	23 (23)	0 (0)	107 (98)
Total	**390 (365)**	**170 (154)**	**9 (4)**	**569 (523)**

( ) imported cases

In 2013, a total of 107 cases of enteric fevers, comprising 84 cases of typhoid, and 23 cases of paratyphoid A, a decrease of 24.1% compared to 141 cases reported in 2012 (Figure 3.3).

Figure 3.3
E-weekly distribution of reported enteric fever cases, 2012 – 2013



Typhoid Fever

Of the 84 reported cases of typhoid, 75 were imported. Of the 75 imported cases, 24 were Singapore residents, 35 were work permit or employment pass holders, nine were tourists, four were foreigners seeking treatment in Singapore, two were student pass holders, and one was a dependent pass holder (Table 3.7). Of the nine local cases, five were Singapore residents, three were foreigners working in Singapore and one was a dependant pass holder.

Table 3.7
Classification of reported typhoid and paratyphoid cases, 2013

Population Group	Typhoid No. (%)	Paratyphoid No. (%)
Local residents	29 (34.5)	11 (47.8)
Foreigners seeking medical treatment in Singapore	4 (4.8)	6 (26.1)
Tourists	9 (10.7)	0 (0.0)
Other categories of foreigners	42 (50.0)	6 (26.1)
Total	**84 (100.0)**	**23 (100.0)**

The overall incidence rate of typhoid fever among local residents was 1.3 per 100,000 population and was highest in the 0 – 4 years and 15 – 24 age group (Table 3.8).

Table 3.8
Age-gender distribution and age-specific incidence rate of reported typhoid cases^, 2013

Age (Yrs)	Male	Female	Total (%)	Incidence rate per 100,000 population*
0 – 4	2	3	5 (7.0)	2.2
5 – 14	6	4	10 (14.1)	2.1
15 – 24	15	2	17 (24.0)	2.2
25 – 34	15	7	22 (31.0)	1.8
35 – 44	5	5	10 (14.1)	1.0
45 – 54	2	2	4 (5.6)	0.5
55 – 64	2	0	2 (2.8)	0.4
65+	0	1	1 (1.4)	0.2
Total	**47**	**24**	**71 (100.0)**	**1.3**

^ Excluding four foreigners seeking medical treatment in Singapore and nine tourists
*Rates are based on 2013 estimated mid-year population.
(Source: Singapore Department of Statistics)

Among the three major ethnic groups, the other ethnic group had the highest incidence rate (Table 3.9). Foreigners comprised 59.2% of the cases.

Table 3.9
Ethnic-gender distribution and ethnic-specific incidence rate of reported typhoid cases^, 2013

	Male	Female	Total (%)	Incidence rate per 100,000 population*
Singapore Resident				
Chinese	1	3	4 (5.6)	0.1
Malay	4	0	4 (5.6)	0.8
Indian	6	7	13 (18.3)	3.7
Others	2	6	8 (11.3)	6.3
Foreigner	34	8	42 (59.2)	2.7
Total	**47**	**24**	**71 (100.0)**	**1.3**

^ Excluding four foreigners seeking medical treatment in Singapore and nine tourists
*Rates are based on 2013 estimated mid-year population.
(Source: Singapore Department of Statistics)

Of the 24 Singapore residents who acquired the infection overseas, the majority contracted the disease from India (Table 3.10). Most cases were overseas on vacation (95.8%) (Table 3.11).

Table 3.10
Singapore residents who contracted typhoid overseas by country of origin, 2009 – 2013

Classification	2009 No. (%)	2010 No. (%)	2011 No. (%)	2012 No. (%)	2013 No. (%)
Country visited					
Bangladesh	0 (0.0)	1 (4.8)	0 (0.0)	1 (3.6)	1 (4.2)
Cambodia	2(18.2)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
China	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Germany	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (4.2)
India	3(27.3)	10 (47.5)	20 (76.9)	16 (57.1)	17 (70.8)
Indonesia	3(27.3)	5 (23.7)	6 (23.1)	4 (14.2)	2 (8.3)
Malaysia	1(9.1)	2 (9.6)	0 (0.0)	1 (3.6)	3 (12.5)
Nepal	0 (0.0)	1 (4.8)	0 (0.0)	0 (0.0)	0 (0.0)
Pakistan	0 (0.0)	1 (4.8)	0 (0.0)	1 (3.6)	0 (0.0)
Qatar	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Thailand	2 (18.2)	0 (0.0)	0 (0.0)	1 (3.6)	0 (0.0)
Myanmar	0 (0.0)	0 (0.0)	0 (0.0)	3 (10.7)	0 (0.0)
Maldives	0 (0.0)	0 (0.0)	0 (0.0)	1 (3.6)	0 (0.0)
Vietnam	0 (0.0)	1 (4.8)	0 (0.0)	0 (0.0)	0 (0.0)
Total	**11 (100.0)**	**21 (100.0)**	**26 (100.0)**	**28 (100.0)**	**24 (100.0)**

Table 3.11
Singapore residents who contracted typhoid overseas by purpose of travel, 2009 – 2013

	2009 No. (%)	2010 No. (%)	2011 No. (%)	2012 No. (%)	2013 No. (%)
Purpose of travel					
Vacation	9 (81.2)	19 (90.5)	25 (96.2)	26 (92.9)	23 (95.8)
Business/employment	2 (18.2)	2 (9.5)	1 (3.8)	2 (7.1)	1 (4.2)
Others	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Total	**11 (100.0)**	**21 (100.0)**	**26 (100.0)**	**28 (100.0)**	**24 (100.0)**

Paratyphoid Fever

Of the 23 reported cases of paratyphoid, all were imported cases. Of the 23 imported cases, 11 were Singapore residents, six were foreigners seeking treatment in Singapore, three were work permit or employment pass holders, two were student pass holders and a dependant pass holder. The overall incidence rate of paratyphoid fever among local residents was 0.3 per 100,000 population (Table 3.12) and was highest in the 5 – 14 years age group.

Table 3.12
Age-gender distribution and age-specific incidence rate of reported paratyphoid cases^, 2013

Age (Yrs)	Male	Female	Total (%)	Incidence rate per 100,000 population*
0 – 4	0	0	0 (0.0)	0.0
5 – 14	3	0	3 (17.7)	0.6
15 – 24	1	1	2 (11.8)	0.3
25 – 34	4	2	6 (35.2)	0.5
35 – 44	0	2	2 (11.8)	0.2
45 – 54	3	0	3 (17.7))	0.4
55 - 64	1	0	1 (5.8)	0.2
65 +	0	0	0 (0.0)	0.0
Total	**12**	**5**	**17 (100.0)**	**0.3**

^ Excluding six foreigners seeking medical treatment in Singapore.
*Rates are based on 2013 estimated mid-year population.
(Source: Singapore Department of Statistics)

Among the three major ethnic groups, other ethnic groups had the highest incidence rate (Table 3.13). Foreigners comprised 35.3% of the cases.

Table 3.13
Ethnic-gender distribution and ethnic-specific incidence rate of reported paratyphoid cases^, 2013

	Male	Female	Total (%)	Incidence rate per 100,000 population*
Singapore Resident				
Chinese	3	3	6 (35.3)	0.2
Malay	0	0	0 (0.0)	0.0
Indian	1	0	1 (5.9)	0.3
Others	3	1	4 (23.5)	3.2
Foreigner	5	1	6 (35.3)	0.4
Total	**12**	**5**	**17 (100.0)**	**0.3**

^ Excluding six foreigners seeking medical treatment in Singapore.
*Rates are based on 2013 estimated mid-year population.
(Source: Singapore Department of Statistics)

Of the 11 Singapore residents who acquired the infection overseas, 8 (53.3%) acquired the infection from India, Indonesia and Cambodia (Table 3.14). Most cases were overseas on vacation (54.6%) (Table 3.15).

Table 3.14
Singapore residents who contracted paratyphoid overseas by country of origin, 2009 – 2013

	2009 No. (%)	2010 No. (%)	2011 No. (%)	2012 No. (%)	2013 No. (%)
Country visited					
Bangladesh	0 (0.0)	1 (6.7)	1 (7.7)	0 (0.0)	0 (0.0)
Cambodia	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (18.1)
China	1 (9.1)	0 (0.0)	0 (0.0)	2 (7.1)	1 (9.1)
India	4 (36.4)	8 (53.3)	4 (30.8)	3 (10.7)	3 (27.3)
Indonesia	3 (27.3)	3 (20.0)	4 (30.8)	7 (25.0)	3 (27.3)
Malaysia	1 (9.1)	0 (0.0)	2 (15.4)	2 (7.1)	1 (9.1)
Myanmar	1 (9.1)	0 (0.0)	1 (7.7)	5 (17.9)	1 (9.1)
Nepal	0 (0.0)	3 (20.0)	1 (7.7)	1 (3.6)	0 (0.0)
Hong Kong SAR	0 (0.0)	0 (0.0)	0 (0.0)	1 (3.6)	0 (0.0)
South Korea	0 (0.0)	0 (0.0)	0 (0.0)	1 (3.6)	0 (0.0)
Switzerland	0 (0.0)	0 (0.0)	0 (0.0)	1 (3.6)	0 (0.0)
Pakistan	1 (9.1)	0 (0.0)	0 (0.0)	2 (7.1)	0 (0.0)
Vietnam	0 (0.0)	0 (0.0)	0 (0.0)	1 (3.6)	0 (0.0)
Thailand	0 (0.0)	0 (0.0)	0 (0.0)	2 (7.1)	0 (0.0)
Total	**11 (100.0)**	**15 (100.0)**	**13 (100.0)**	**28 (100.0)**	**11 (100.0)**

Table 3.15
Singapore residents who contracted paratyphoid overseas by purposes of travel, 2009 – 2013

Classification	2009 No. (%)	2010 No. (%)	2011 No. (%)	2012 No. (%)	2013 No. (%)
Purpose of travel					
Vacation	9 (81.8)	14 (93.3)	11 (84.6)	18 (64.3)	6 (54.6)
Business/employment	2(18.2)	1(6.7)	2 (15.4)	10 (35.7)	5 (45.4)
Seminar	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0 (0.0)
Total	**11 (100.0)**	**15 (100.0)**	**13 (100.0)**	**28 (100.0)**	**11 (100.0)**

HEPATITIS A

Hepatitis A is a viral infection spread from person to person by the faecal-oral route. Foods that are eaten raw or partially cooked, prepared with contaminated water or by an infected food handler are common sources of infection. Clinical features include jaundice, fever, nausea and vomiting, loss of appetite, abdominal pain and tenderness, dark urine and pale stools.

There were 88 cases of serologically confirmed acute hepatitis A as compared to 108 cases in 2012 (Figures 3.4). 11 of the 88 cases involved 9 foreigners seeking medical treatment in Singapore and 2 tourists (Table 3.16).

Figure 3.4
E-weekly distribution of reported acute hepatitis A cases, 2012 – 2013

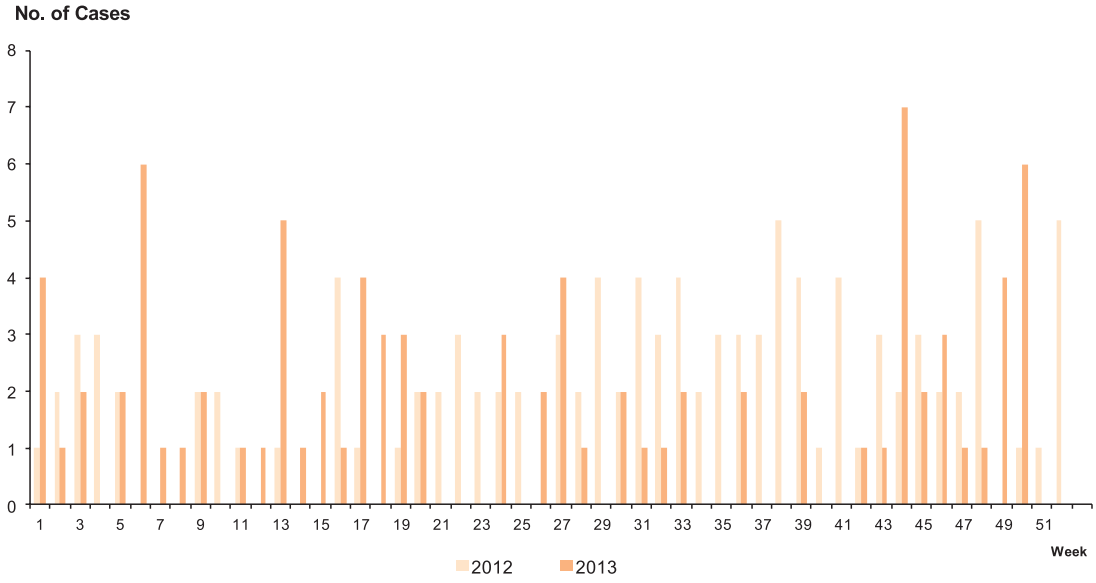


Table 3.16
Classification of reported acute hepatitis A cases, 2013

Population Group	No. of cases (%)
Singapore residents	54 (61.4)
Work permit holders/other foreigners	23 (26.1)
Foreigners seeking medical treatment in Singapore and tourists	11 (12.5)
Total	**88 (100.0)**

Among local residents, the age-specific incidence rate of acute hepatitis A (2.2 per 100,000 population) was highest in the 45 - 54 years age group. The overall male to female ratio was 3:1 (Table 3.17).

Table 3.17
Age-gender distribution and age-specific incidence rate of acute hepatitis A cases^, 2013

Age (Yrs)	Male	Female	Total (%)	Incidence rate per 100,000 population*
0 – 4	0	0	0 (0)	0.0
5 – 14	3	4	7 (9.1)	1.5
15 – 24	6	3	9 (11.7)	1.2
25 – 34	14	5	19 (24.6)	1.6
35 – 44	14	1	15 (19.5)	1.6
45 – 54	13	3	16 (20.8)	2.2
55 – 64	5	2	7 (9.1)	1.3
65+	3	1	4 (5.2)	0.9
Total	**58**	**19**	**77 (100.0)**	**1.4**

^Excluding 9 foreigners seeking medical treatment in Singapore and 2 tourists
*Rates are based on 2013 estimated mid-year population.
(Source: Singapore Department of Statistics)

Among the three major ethnic groups, Malay and Indian had similar incidence rate while Chinese had lower incidence rate. (Table 3.18).

Table 3.18
Ethnic-gender distribution and ethnic-specific incidence rate of acute hepatitis A cases^, 2013

	Male	Female	Total (%)	Incidence rate per 100,000 population*
Singapore Resident				
Chinese	29	9	38 (49.3)	1.3
Malay	4	3	7 (9.1)	1.4
Indian	4	1	5 (6.5)	1.4
Others	1	3	4 (5.2)	3.2
Foreigner	20	3	23 (29.9)	1.5
Total	**58**	**19**	**77(100.0)**	**1.4**

^Excluding 9 foreigners seeking medical treatment in Singapore and 2 tourists
*Rates are based on 2013 estimated mid-year population.
(Source: Singapore Department of Statistics)

Imported acute hepatitis A

Of the 88 cases of acute hepatitis A, 57 (64.8%) cases were acquired overseas (Table 3.19). The majority of the cases acquired the infection from Southeast Asia (65%) and the Indian subcontinent (24.6%) (Table 3.20).

Table 3.19
Imported acute hepatitis A by population group, 2013

Population Group	No. of cases (%)
Local Residents	
Residents who contracted the disease overseas	27 (47.4)
Workpermit/employment/dependent pass holders	19 (33.3)
Foreigners seeking medical treatment and tourist	11 (19.3)
Total	**57 (100.0)**

Table 3.20
Imported acute hepatitis A by country of origin, 2013

Country visited	No. of cases (%)
Southeast Asia	
Indonesia	12 (21.2)
Malaysia	14 (24.6)
Myanmar	2 (3.5)
Philippines	7 (12.3)
Thailand	1 (1.7)
Vietnam	1 (1.7)
Indian Subcontinent	
India	12 (21.2)
Nepal	1 (1.7)
Pakistan	1 (1.7)
Other Countries	
China	3 (5.3)
Russia	1(1.7)
Taiwan	1(1.7)
Vanuata	1(1.7)
Total	**57 (100.0)**

HEPATITIS E

Similar to hepatitis A, hepatitis E is also a viral infection spread from person to person by the faecal-oral route. The most common documented mechanism of transmission is via faecal-contaminated drinking water. Clinical features include jaundice, fever, nausea and vomiting, loss of appetite, abdominal pain and tenderness, dark urine and pale stools.

There were 55 reported cases of serologically confirmed acute hepatitis E compared to 104 cases in 2012 (Figure 3.5). 2 of the 55 cases involved foreigners seeking medical treatment in Singapore (Table 3.21).

Figure 3.5
E-weekly distribution of reported acute hepatitis E cases, 2012 – 2013

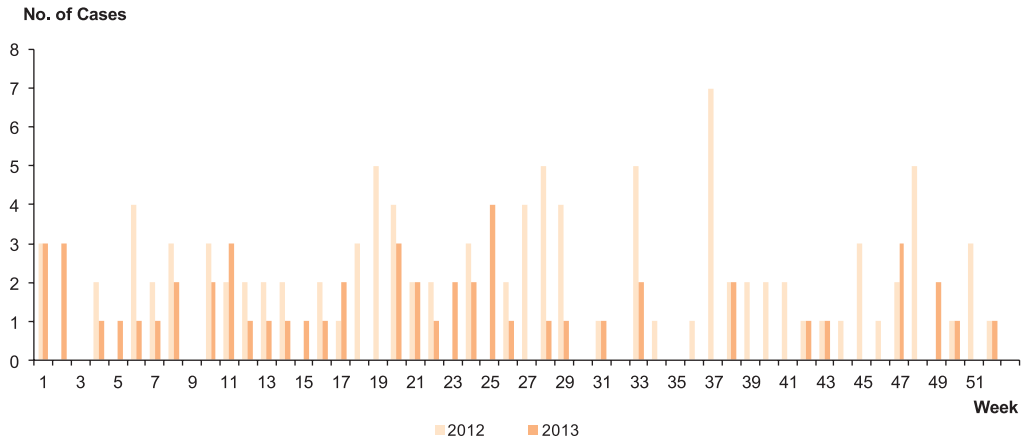


Table 3.21
Classification of reported acute hepatitis E cases, 2013

Population Group	No. of cases (%)
Singapore residents	34 (61.8)
Work permit holders/other foreigners	19 (34.6)
Foreigners seeking medical treatment in Singapore	2 (3.6)
Total	**55 (100.0)**

Among local residents, the age-specific incidence rate of acute hepatitis E was highest in the 65+ years age group (2.7 per 100,000 population). The overall male to female ratio was 3.1:1 (Table 3.22).

Table 3.22
Age-gender distribution and age-specific incidence rate of acute hepatitis E cases^, 2013

Age (Yrs)	Male	Female	Total (%)	Incidence rate per 100,000 population*
0 – 4	0	0	0 (0.0)	0.0
5 – 14	0	0	0 (0.0)	0.0
15 – 24	7	1	8 (15.1)	1.0
25 – 34	9	2	11 (20.8)	0.9
35 – 44	6	2	8 (15.1)	0.8
45 – 54	4	0	4 (7.5)	0.5
55 – 64	5	5	10 (18.9)	1.8
65+	9	3	12 (22.6)	2.7
Total	**40**	**13**	**53 (100.0)**	**1.0**

^ Excluding 2 foreigners seeking medical treatment in Singapore
*Rates are based on 2013 estimated mid-year population.
(Source: Singapore Department of Statistics)

Of the three main ethnic groups, Chinese and Indian had similar incidence rate (Table 3.23).

Table 3.23
Ethnic-gender distribution and ethnic-specific incidence rate of acute hepatitis E cases^, 2013

	Male	Female	Total (%)	Incidence rate per 100,000 population*
Singapore Resident				
Chinese	19	11	30 (56.6)	1.1
Malay	0	0	0 (0.0)	0.0
Indian	3	1	4 (7.5)	1.1
Others	0	0	0 (0.0)	0.0
Foreigner	18	1	19 (35.9)	1.2
Total	**40**	**13**	**53 (100.0)**	**1.0**

^ Excluding 2 foreigners seeking medical treatment in Singapore
*Rates are based on 2013 estimated mid-year population.
(Source: Singapore Department of Statistics)

Imported acute hepatitis E

Of the 55 cases of hepatitis E, 36 (65.5%) cases were acquired overseas (Table 3.24). The majority of the cases acquired the infection from the Indian subcontinent (78.9%) and Southeast Asia (15.8%) (Table 3.25).

Table 3.24
Imported acute hepatitis E by population group, 2013

Population Group	No. of cases (%)
Local Residents	
Residents who contracted the disease overseas	19 (52.8)
Work permit/employment/dependent pass holders	15 (41.7)
Foreigners seeking medical treatment	2 (5.5)
Total	**36 (100.0)**

Table 3.25
Imported acute hepatitis E by country of origin, 2013

Country visited	No. of cases (%)
Southeast Asia	
Cambodia	1 (2.8)
Indonesia	1 (2.8)
Malaysia	8 (22.1)
Philippines	2 (5.6)
Thailand	3 (8.3)
Indian Subcontinent	
Bangladesh	9 (25.0)
India	5 (13.9)
Other Countries	
China	3 (8.3)
Hong Kong SAR	1 (2.8)
Taiwan	2 (5.6)
Vanuatu	1 (2.8)
Total	**36 (100.0)**

SALMONELLOSIS

Salmonellosis is a bacterial disease commonly presenting as acute enterocolitis, with sudden onset of fever, headache, abdominal pain, diarrhoea, nausea and sometimes vomiting. Dehydration, especially among infants or in the elderly, may be severe. The causative pathogen, *Salmonella* is a genus of gram-negative, facultative anaerobic motile rod-shape bacteria. It is divided into two species, *Salmonella enterica* and *Salmonella bongori*. *Salmonella enterica* is further subdivided into subspecies and serotypes based on biochemical and antigenic reactions. The majority (59%) of *Salmonella* serotypes belong to *S. enterica* subsp. *enterica*. Within *S. enterica* subsp. enterica, the most common O-antigen serogroups identified are from A to E. Numerous serotypes of *Salmonella* are pathogenic for both animals and human; that includes the most commonly reported *Salmonella enterica* serovar Typhimurium *(S. Typhimurium)* and *Salmonella enterica* serovar Enteritidis *(S. Enteritidis)*.

Poultry is the commonest source of human salmonellosis. Consumption of contaminated meat and eggs is also a frequent cause. A wide range of domestic and wild animals including poultry, swine, cattle, rodents and pets may act as reservoirs for salmonellosis.

A total of 1,735 laboratory-confirmed cases of non-typhoidal salmonellosis were reported in 2013, an increase of 15.7% compared to 1,499 cases reported in 2012 (Figure 3.6). Of these, 540 cases were caused by S. Enteritidis (Table 3.26).

Figure 3.6
E-weekly distribution of reported Salmonellosis cases, 2012 – 2013

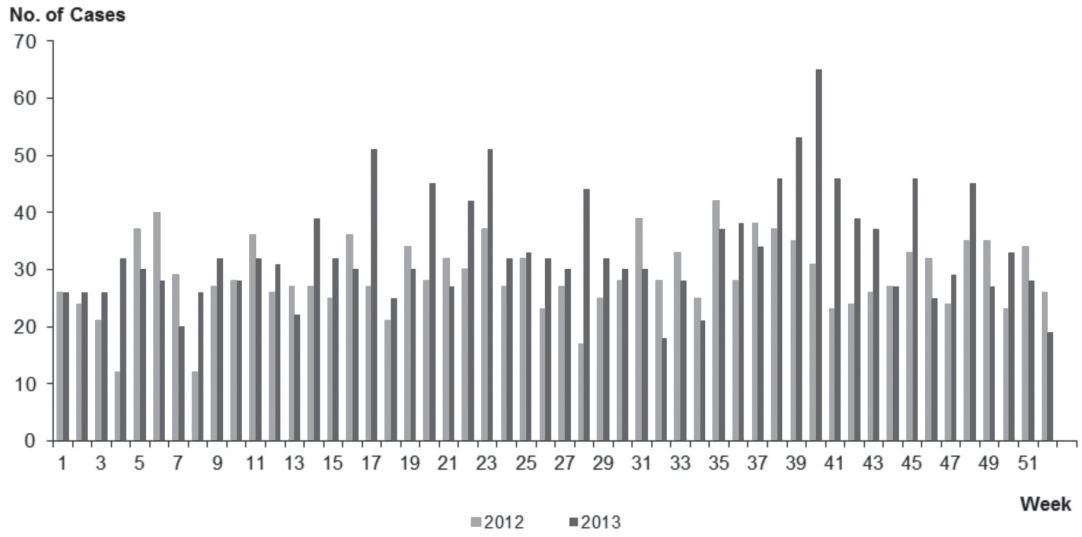


Table 3.26
Incidence of reported non-typhoidal salmonellosis, 2013

Salmonella serotypes	No. of cases (%)	Incidence rate per 100,000 population*
Group A		
Paratyphi A	2 (0.1)	0.04
Untyped	1 (0.1)	0.02
Group B		
Stanley	101 (5.8)	1.87
Agona	3 (0.2)	0.06
Brandenburg	1 (0.1)	0.02
Chester	2 (0.1)	0.04
Serovar 4,5,12:b: - (dT+)	43 (2.5)	0.8
Serovar 4,5,12:b: -	1 (0.1)	0.02
Serovar 4,5,12:d: -	1 (0.1)	0.02

Salmonella serotypes	No. of cases (%)	Incidence rate per 100,000 population*
Serovar 4,12:i: -	1 (0.1)	0.02
Serovar 4,5,12:i: -	10 (0.6)	0.18
Serovar 4,5,12 : - : 1,2	1 (0.1)	0.02
Stanleyville	1 (0.1)	0.02
Saintpaul	5 (0.3)	0.09
Indiana	1 (0.1)	0.02
Reading	1 (0.1)	0.02
Schwarzengrund	1 (0.1)	0.02
Paratyphi B dT+ (var Java)	18 (1.0)	0.33
Typhimurium	47 (2.7)	0.87
Non-Typhimurium	9 (0.5)	0.17
Untyped	183 (10.5)	3.39
Group B / C	1 (0.1)	0.02
Group C		
Albany	14 (0.8)	0.26
Augustenborg	1 (0.1)	0.02
Bardo	1 (0.1)	0.02
Bareilly	21 (0.8)	0.39
Bovismorbificans	13 (0.7)	0.24
Braenderup	15 (0.9)	0.28
Corvallis	10 (0.6)	0.18
Newport	4 (0.2)	0.07
Potsdam	3 (0.2)	0.06
Livingstone	2 (0.1)	0.04
Hadar	1 (0.1)	0.02
Hindmarsh	2 (0.1)	0.04
Infantis	1 (0.1)	0.02
Mbandaka	6 (0.3)	0.11
Molade	2 (0.1)	0.04
Montevideo	1 (0.1)	0.02
Muenchen	1 (0.1)	0.02
Ohio	1 (0.1)	0.02
Oslo	1 (0.1)	0.02
Richmond	1 (0.1)	0.02
Rissen	3 (0.2)	0.06
Serovar 6,7 : - : -	1 (0.1)	0.02
Serovar 6,7 : y : -	1 (0.1)	0.02
Serovar 8 : - : -	1 (0.1)	0.02
Serovar 8,20 : - : -	1 (0.1)	0.02
Singapore	3 (0.2)	0.06
Untyped	116 (6.7)	2.15
Group C / D	4 (0.2)	0.07
Group D		
Enteritidis	540 (31.1)	10
Javiana	21 (1.21)	0.39
Serovar 9,12:-:15	1 (0.1)	0.02
Panama	1 (0.1)	0.02
Eastbourne	1 (0.1)	0.02

Salmonella serotypes	No. of cases (%)	Incidence rate per 100,000 population*
Non-Enteritidis	30 (1.73)	0.55
Untyped	313 (18.0)	5.8
Group E		
Weltevreden	66 (3.8)	1.22
Senftenberg	4 (0.2)	0.07
Orion	1 (0.1)	0.02
Give	2 (0.1)	0.04
Untyped	28 (1.6)	0.52
Group F		
Rubislaw	1 (0.1)	0.02
Group E / G	19 (1.1)	0.35
Group G		
Okatie	4 (0.2)	0.07
Untyped	4 (0.2)	0.07
Group I		
Hvittingfoss	6 (0.3)	0.11
Group M		
Pomona	1 (0.1)	0.02
Group O		
Alachua	1 (0.1)	0.02
Group P		
Mgulani	1 (0.1)	0.02
Serovar 38 : i : -	1 (0.1)	0.02
Untyped	24 (1.4)	0.44
Total	**1,735 (100.0)**	**32.1**

*Rates are based on 2013 estimated mid-year population.
(Source: Singapore Department of Statistics)

S. Enteritidis

Of the 540 cases reported in 2013, 530 were local residents comprising 8 imported and 522 indigenous cases. Two cases of S. Enteritidis were seamen who went through medical screening and eight cases were foreigners seeking medical treatment in Singapore.

The notifications of S. Enteritidis among local residents had increased by 52.7% as compared to 347 cases in 2012. The incidence rate was highest in the 65 + years age group (Table 3.27).

Table 3.27
Age-gender distribution and age-specific incidence rate of reported S. Enteritidis cases^, 2013

Age (Yrs)	Male	Female	Total (%)	Incidence rate per 100,000 population*
0 – 4	76	51	127 (24.0)	56.7
5 – 14	17	19	36 (6.8)	7.5
15 – 24	18	4	22 (4.2)	2.8
25 – 34	61	20	81 (15.3)	6.6
35 – 44	20	11	31 (5.8)	3.2
45 – 54	18	15	33 (6.2)	4.5
55 - 64	31	28	59 (11.1)	10.7
65 +	76	65	141 (26.6)	31.5
Total	**317**	**213**	**530 (100.0)**	**9.8**

Among the three major ethnic groups, Malays had the highest incidence rate, followed by Chinese and Indians (Table 3.28).

Table 3.28
Ethnic-gender distribution and ethnic-specific incidence rate of reported S. Enteritidis cases^, 2013

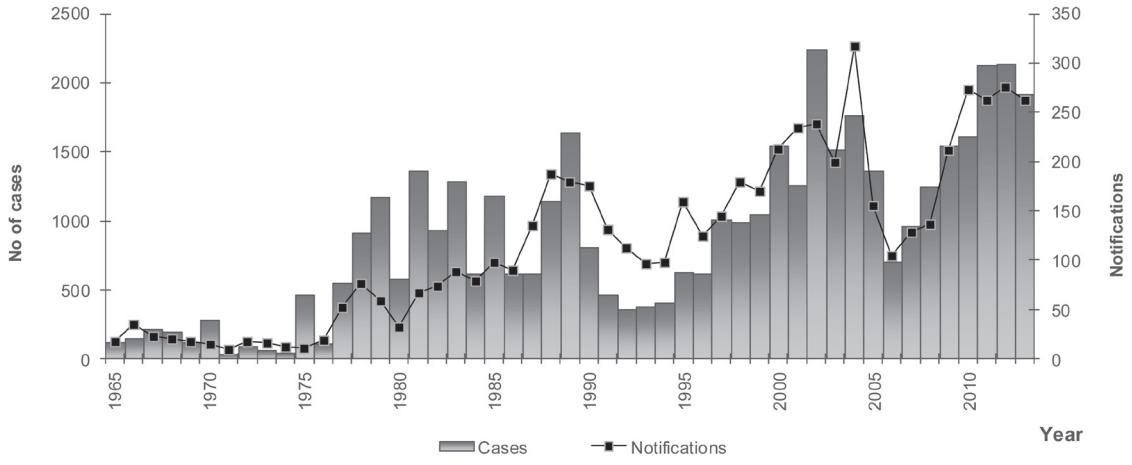
	Male	Female	Total (%)	Incidence rate per 100,000 population*
Singapore Resident				
Chinese	170	131	301 (56.8)	10.5
Malay	46	33	79 (14.9)	15.4
Indian	11	16	27 (5.1)	7.7
Others	7	9	16 (3.0)	12.6
Foreigner	83	24	107 (20.2)	6.9
Total	**317**	**213**	**530 (100.0)**	**9.8**

^ Excluding two seamen who went through medical screening and eight foreigners who sought medical treatment in Singapore
*Rates are based on 2013 estimated mid-year population.
(Source: Singapore Department of Statistics)

FOOD POISONING

There were 262 notifications of food poisoning involving 1,922 cases in 2013, compared with 276 notifications involving 2,137 cases in 2012 (Figure 3.7). Of these, 249 notifications were classified as outbreaks involving two or more cases epidemiologically linked to a common source, as compared to 270 notifications in 2012.

Figure 3.7
Notifications of food poisoning in Singapore, 1965 – 2013



The majority (64.7%) of the outbreaks occurred in restaurants and eating houses (Table 3.29).

Table 3.29
Food poisoning notifications by type of food establishment, 2013

Type of food establishments	No. of notifications	Notification classified as outbreak*	No. of food establishments involved	No. of cases
General outlets				
Bakery	7	7	7	44
Canteens				
School	4	4	4	107
Others	6	6	6	141
Caterer (licensed)	10	10	10	323
Eating house	28	25	25	80
Fair(food fair)	0	0	0	0
Fair (Others)	2	2	2	4
Food court	13	12	12	30
Food Factory	1	1	1	2
Foodshop (takeaway)	3	3	3	6
Hawker centre	16	16	16	44
Other licensed premises	2	2	2	16
Restaurants				
In Hotel	13	12	12	147
Fast Food	6	6	6	13
Others	125	118	108	489
Supermarket	2	2	2	5
Snackbar	14	13	13	38
Unapproved catering by licensed premises	0	0	0	0
Sub-total (General outlets)	**252**	**239**	**229**	**1,489**
In house kitchen				
Army	1	1	1	250
Childcare centre	1	1	1	26
Nursing home	0	0	0	0
Workers dormitory	1	1	1	7
Others	4	4	4	108
Unlicensed premises	3	3	3	42
Sub-total (Others)	**10**	**10**	**10**	**433**
Total	**262**	**249**	**239**	**1,922**

*two or more epidemiologically linked cases involved

Microbiological investigations of 201 food samples and 55 environmental swabs were conducted. Of the food samples, seven were positive for *Bacillus cereus*, five were positive for *Staphylococcus aureus*, two were positive for *Salmonella* Enteritidis, one was positive for *Escherichia coli*, and one was positive for Norovirus. Two environmental samples were positive for *Staphylococcus aureus*.

Of 449 food handlers sent for screening, 36 were positive for Norovirus, 12 were positive for *Aeromonas*, 8 were positive for *Salmonella*, three were positive for *Salmonella* Enteritidis, three were positive for Rotavirus, two were positive for *Campylobacter,* three were positive for *Vibrio parahaemolyticus*, one was positive for *Vibrio furnissii* and one was positive for *Vibrio cholerae*.

- Hepatitis B
- Hepatitis C

IV
BLOOD-BORNE DISEASES

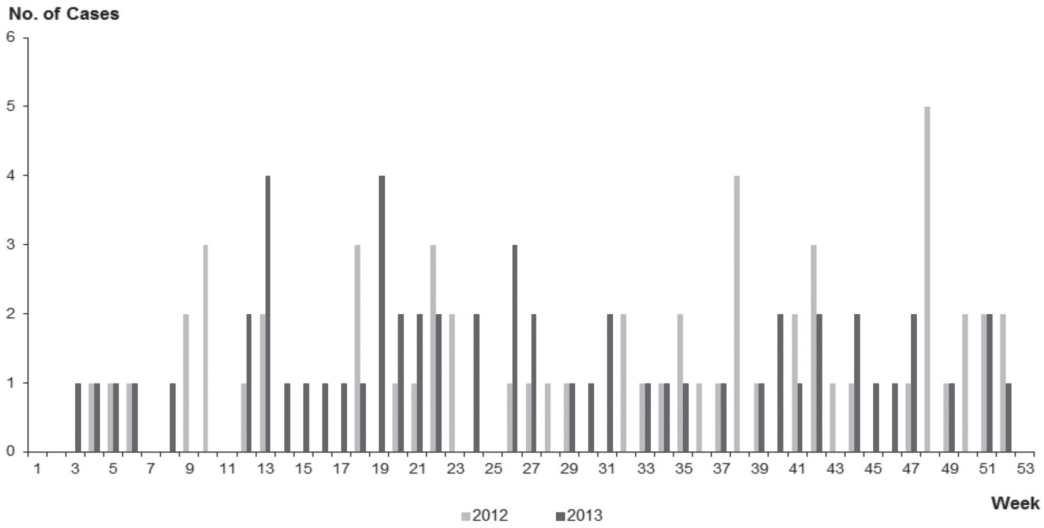
Blood-borne pathogens are microorganisms such as viruses or bacteria that are carried in blood and can cause disease in humans. There are many different blood-borne diseases. We focus on hepatitis B (HBV) and hepatitis C (HCV) in this chapter. The mode of transmission is via infected human blood and body fluids. The mechanism of infection commonly includes transfusion of blood or blood products, sexual contact, contaminated IV drug use paraphernalia or accidental occupational exposure.

HEPATITIS B

Hepatitis B virus is a small DNA virus that belongs to the Hepadnaviridae family of viruses. Common symptoms of hepatitis B infection include fever, fatigue, muscle or joint pain, loss of appetite, nausea and vomiting. More severe cases may present with jaundice and ascites.

A total of 57 cases of acute hepatitis B were reported in 2013, compared to 58 cases reported in 2012 (Figure 4.1). All cases were serologically confirmed with the presence of hepatitis B surface antigen (HBsAg) and anti-HBc IgM antibody which are both associated with acute clinical presentation.

Figure 4.1
E-weekly distribution of reported lab confirmed Hepatitis B cases, 2012 - 2013



The incidence rate was highest in the 25 - 44 years age group, with an overall male to female ratio of 5.2:1 (Table 4.1). Among the three major ethnic groups, Chinese had the highest incidence rate. (Table 4.2).

Table 4.1
Age-gender distribution and age-specific incidence rate of acute hepatitis B cases^, 2013

Age (Yrs)	Male	Female	Total (%)	Incidence rate per 100,000 population*
0 – 4	0	0	0 (0.0)	0.0
5 – 14	0	0	0 (0.0)	0.0
15 – 24	2	0	2 (3.6)	0.3
25 – 34	17	4	21 (38.2)	1.7
35 – 44	14	2	16 (29.1)	1.7
45 – 54	7	2	9 (16.4)	1.2
55-64	3	0	3 (5.4)	0.5
65+	2	2	4 (7.3)	0.9
Total	**45**	**10**	**55 (100.0)**	**1.0**

^Excludes two foreigners seeking medical treatment in Singapore.
*Rates are based on 2013 estimated mid-year population.
(Source: Singapore Department of Statistics)

Table 4.2
Ethnic-gender distribution and ethnic-specific incidence rate of acute hepatitis B cases^, 2013

	Male	Female	Total (%)	Incidence rate per 100,000 population*
Singapore Resident				
Chinese	24	4	28 (35.1)	1.0
Malay	0	2	2 (3.6)	0.4
Indian	0	0	0 (0.0)	0.0
Others	1	0	1 (1.8)	0.8
Foreigner	20	4	24 (43.7)	1.5
Total	**45**	**10**	**55 (100.0)**	**1.0**

^Excludes two foreigners seeking medical treatment in Singapore.
*Rates are based on 2013 estimated mid-year population.
(Source: Singapore Department of Statistics)

The cases comprised people from a wide spectrum of occupational groups. Construction labourers and related workers made up 16.4% of total notifications in 2013 (Table 4.3).

Table 4.3
Distribution of acute hepatitis B cases by occupation, 2013

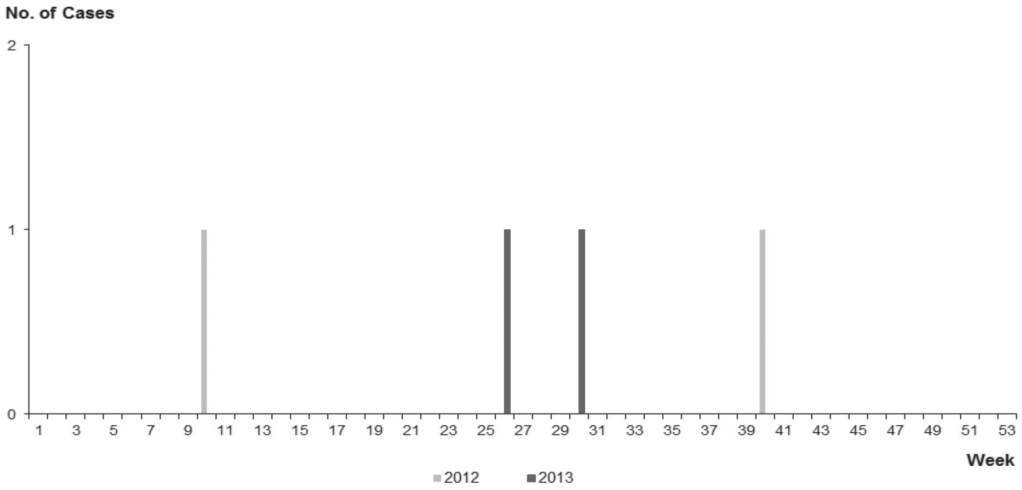
Occupation	Total	%
Cleaners, Labourers and Related Workers		
Construction labourers and related workers	9	16.4%
Domestic helpers & cleaners	3	5.5%
Labourers & Related Workers Not Classified	6	10.9%
Legislator, Senior Officials and Manager		
Manager	7	12.7%
Self-employed/Businessmen	3	5.5%
Professionals		
Company director	1	1.8%
Clerks/secretaries	1	1.8%
Architects	1	1.8%
Healthcare workers	1	1.8%
Policeman/Fireman/Security guard	1	1.8%
Associate Professionals and Technicians		
Technicians/Asst Engineers	3	5.5%
Service Workers and Shop/Market Sales Workers		
Driver	2	3.6%
Hawker/ Food Handler	1	1.8%
Shop Sales & Related Workers	3	5.5%
Production craftsmen & workers not classified		
Ship deck crew, sailors & related workers	1	1.8%
Unclassified		
Housewife	5	9.1%
Retiree	2	3.6%
Students	1	1.8%
Unemployed	3	5.5%
Prisoner/Illegal immigrant	1	1.8%
Total	**55**	**100%**

HEPATITIS C

Hepatitis C virus (HCV) is an enveloped RNA virus in the flaviviridae family which appears to have a narrow host range. HCV is a major cause of acute hepatitis and chronic liver disease, including cirrhosis and liver cancer. It is most efficiently transmitted by direct percutaneous exposure to infected blood or intravenous drug use.

A total of two cases of acute hepatitis C were reported in 2013, similar to two cases reported in 2012 (Figure 4.2). Both cases had positive HCV recombinant immunoblot assay (RIBA) results. Both cases presented with acute clinical symptoms such as fever, jaundice, dark urine and pale stools.

Figure 4.2
E-weekly distribution of reported hepatitis C cases*, 2012 – 2013



Both cases were 45-years and above (Table 4.4) and were males (Table 4.5).

Table 4.4
Age-gender distribution and age-specific incidence rate of reported acute hepatitis C cases, 2013

Age (Yrs)	Male	Female	Total (%)	Incidence rate per 100,000 population*
0 – 4	0	0	0 (0.0)	0.00
5 – 14	0	0	0 (0.0)	0.00
15 – 24	0	0	0 (0.0)	0.00
25 – 34	0	0	0 (0.0)	0.00
35 – 44	0	0	0 (0.0)	0.00
45 – 54	1	0	1 (50.0)	0.14
55 - 64	1	0	1 (50.0)	0.18
65+	0	0	0 (0.0)	0.00
Total	**2**	**0**	**2 (100.0)**	**0.04**

*Rates are based on 2013 estimated mid-year population.
(Source: Singapore Department of Statistics)

Table 4.5
Ethnic-gender distribution and ethnic-specific incidence rate of reported acute hepatitis C cases, 2013

	Male	Female	Total (%)	Incidence rate per 100,000 population*
Singapore Resident				
Chinese	0	0	0 (0.0)	0.00
Malay	1	0	1 (50.0)	0.19
Indian	1	0	1 (50.0)	0.28
Others	0	0	0 (0.0)	0.00
Foreigner	0	0	0 (0.0)	0.00
Total	**2**	**0**	**2 (100.0)**	**0.04**

*Rates are based on 2013 estimated mid-year population.
(Source: Singapore Department of Statistics)

- Legionellosis
- Melioidosis

V
ENVIRONMENT- RELATED DISEASES

Environment-related diseases are illnesses caused by exposure to disease-causing agents in the environment.

LEGIONELLOSIS

Legionellosis is an acute bacterial disease caused by the bacterium *Legionella pneumophila*. It has two recognised distinct clinical and epidemiological manifestations: Legionnaires disease and Pontiac fever. Both conditions are characterised by fever, chills, anorexia, malaise, myalgia and headache. However, Pontiac fever is not associated with pneumonia. The mode of transmission is airborne and includes aspiration of aerosolised water containing the bacteria. Chest X-ray in a Legionnaires' disease patient may reveal patchy or focal areas of consolidation.

A total of 24 cases of laboratory-confirmed legionellosis were reported, compared with 31 cases in 2012 (Figure 5.1). 19 of these 24 cases were local residents. The other five cases comprised foreigners who came to Singapore to seek medical treatment for infections acquired overseas. Of the 19 local residents, four cases had confirmed Legionnaires' disease, 13 cases had presumptive Legionnaires' disease and two cases had presumptive Pontiac fever (Table 5.1). Four of the 19 cases had acquired their infections overseas. All the diagnoses were based on an indirect fluorescent antibody titre of ≥1:1,024 in a single blood specimen or a positive urinary antigen detection.

Figure 5.1
E-weekly distribution of reported legionellosis, 2012 – 2013

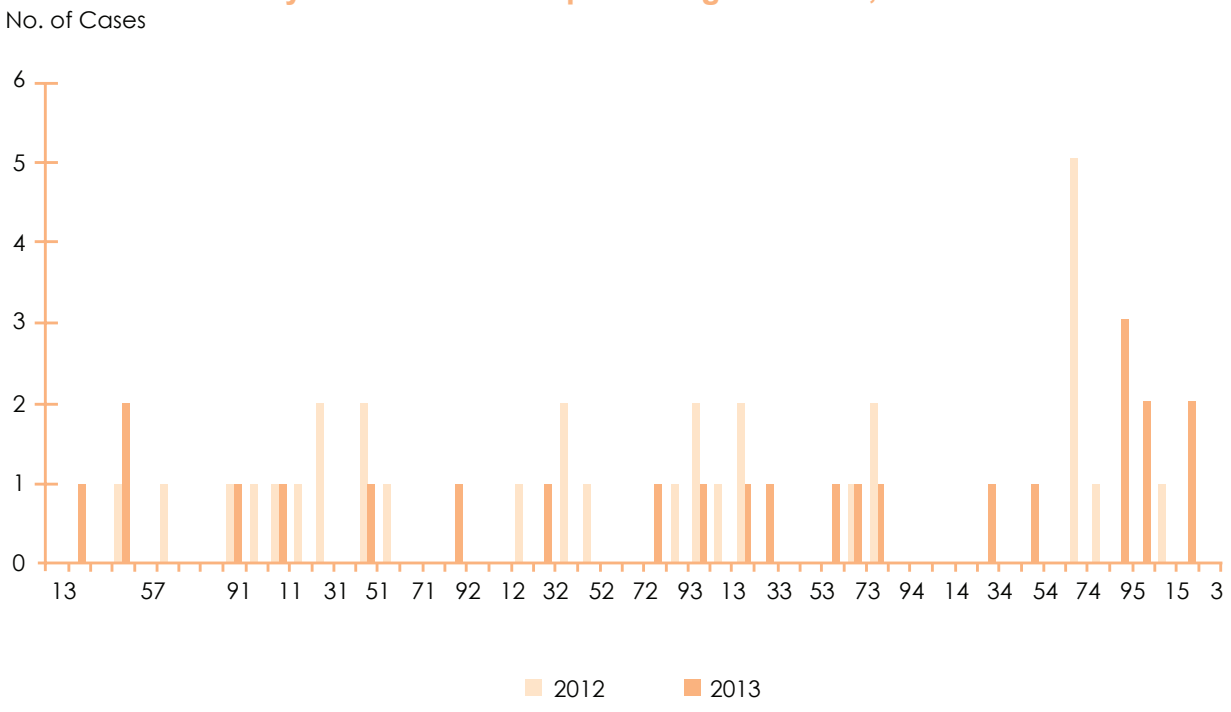


Table 5.1
Classification of reported cases of legionellosis in local residents^, 2013

	Pontiac fever	Legionnaires' disease	Total
Confirmed cases	0	4	4
Presumptive cases	2	13	15
Total	**2**	**17**	**19**

^Excluding five foreigners seeking medical treatment in Singapore

The incidence rate was highest in the 55-64 years age group (42.1%) (Table 5.2).

Table 5.2
Age-gender distribution and age-specific incidence rate of reported legionellosis cases^, 2013

Age (Yrs)	Male	Female	Total (%)	Incidence rate per 100,000 population*
0 – 4	0	0	0 (0.0)	0.0
5 – 14	0	0	0 (0.0)	0.0
15 – 24	0	0	0 (0.0)	0.0
25 – 34	1	0	1 (5.3)	0.1
35 – 44	0	1	1 (5.3)	0.1
45 – 54	2	1	3 (15.8)	0.4
55-64	6	2	8 (42.1)	1.4
65+	4	2	6 (31.6)	1.3
Total	**13**	**6**	**19 (100.0)**	**0.4**

^Excluding five foreigners seeking medical treatment in Singapore
*Rates are based on 2013 estimated mid-year population.
(Source: Singapore Department of Statistics)

Among the three major ethnic groups, Chinese had the highest incidence rate of 0.5 per 100,000 population (Table 5.3). Various occupational groups were involved (Table 5.4).

Table 5.3
Ethnic-gender distribution and ethnic-specific incidence rate of legionellosis cases^, 2013

Singapore Resident	Male	Female	Total (%)	Incidence rate per 100,000 population*
Chinese	11	4	15 (78.9)	0.5
Malay	2	0	2 (10.5)	0.4
Indian	0	0	0 (0.0)	0.0
Others	0	1	1 (5.3)	0.8
Foreigner	0	1	1 (5.3)	0.1
Total	**13**	**6**	**19 (100.0)**	**0.4**

^ Excluding five foreigners seeking medical treatment in Singapore
*Rates are based on 2013 estimated mid-year population.
(Source: Singapore Department of Statistics)

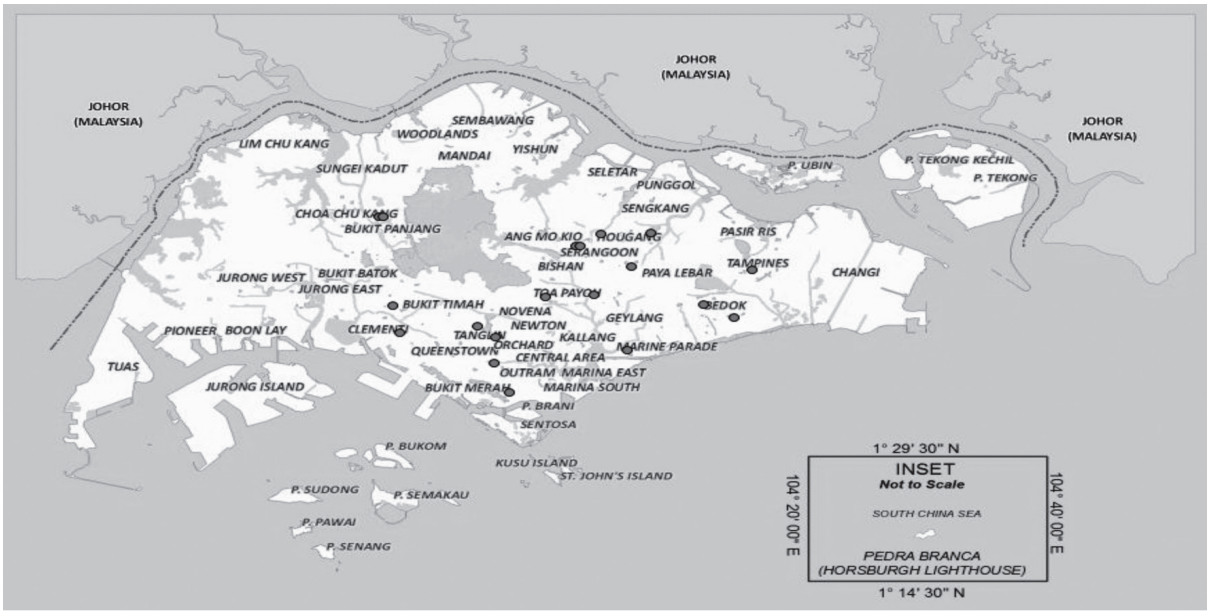
Table 5.4
Occupation of reported legionellosis cases*, 1989 – 2013

Occupation	1989 – 2012 n=749	2013 n=19	Total n=768
Cleaners, labourers & related workers			
Construction labourer	54	1	55
Domestic maid	3	0	3
Other cleaners, labourers & related workers	23	1	24
Armed Forces personnel	27	1	28
Clerical workers	17	0	17
Service & shop/market sales workers	30	0	30
Professionals, Self-employed & Managers	80	4	84
Teachers, Lecturers	3	0	3
Accountants, auditors	1	0	1
Drivers	13	1	14
Production craftsmen & technicians	22	0	22
Others			
Retiree	251	5	256
Housewife	154	5	159
Unemployed	22	0	22
Student	11	0	11
Seaman	6	0	6
Prisoner	2	0	2
No record / Not applicable	30	1	31

*According to Singapore Standard Occupational Classification 2000 (Department of Statistics)

Geographical distribution of the local sporadic cases is presented in Figure 5.2.

Figure 5.2
Geographical distribution of local sporadic legionellosis cases, 2013



Key presenting symptoms of the 19 legionellosis cases include fever and cough (Table 5.5).

Table 5.5
Clinical presentation* of reported legionellosis cases, 2013

Clinical presentation	No. of cases n=19
Fever (with/without chills and rigors)	**11**
Respiratory symptoms	
Cough (productive and non-productive)	10
Shortness of breath	8
Runny nose	1
Chest pain and discomfort	2
Sore throat	1
Other signs and symptoms	
Chills	10
Myalgia	5
Loss of Appetite	1
Nausea	1
Giddiness	2
Epigastric pain	1
Generalised weakness	3
Jaundice	1

*Cases may have one or more clinical presentations

11 (57.9%) of the reported cases had co-morbid medical illnesses such as hypertension, ischaemic heart disease and diabetes (Table 5.6). Two legionellosis-related deaths were reported (Table 5.7).

Table 5.6
Concurrent medical conditions* of reported legionellosis cases, 1989 – 2013

Concurrent medical condition	1989 – 2012 n=749	2013 n=19	Total n=768
Diseases of the circulatory system			
Cardiomegaly	1	0	1
Hypertensive disease	173	5	178
Ischaemic heart disease	104	1	105
Heart failure	27	0	27
Cerebrovascular disease	36	0	36
Peripheral vascular disease	1	0	1
Moyamoya disease	1	0	1
Atrial fibrillation	4	0	4
Hyperlipidemia	0	3	3
Metabolic diseases			
Diabetes mellitus	131	4	135
Gout	5	2	7

Concurrent medical condition	1989 – 2012 n=749	2013 n=19	Total n=768
Thyrotoxicosis	2	0	2
Diseases of the respiratory system			
Chronic obstructive pulmonary disease	50	2	52
Asthma	65	2	67
Bronchiectasis	25	1	26
Bronchitis	7	0	7
Dyspnoea	3	0	3
Fibrosing alveolitis	1	0	1
Pneumonia	1	1	2
Interstitial lung disease	1	0	1
Pulmonary fibrosis	0	1	1
Infectious diseases			
Pulmonary tuberculosis	44	1	45
epticaemia	4	0	4
Melioidosis	2	0	2
Hepatitis	1	0	1
Dengue fever	2	0	2
Leprosy	1	0	1
Neoplasms	23	2	25
Disease of the digestive system			
Cholecystitis, cholangitis, cholelithiasis	7	0	7
Peptic ulcer	9	0	9
Alcoholic liver disease	3	0	3
Liver cirrhosis	6	0	6
Duodenitis	1	0	1
Diseases of blood			
Anaemia	21	0	21
Thalassaemia minor	2	0	2
Mental disorders			
Schizophrenia	6	0	6
Dementia	2	0	2
Diseases of musculoskeletal system and connective tissue			
Arthritis	6	0	6
Systemic lupus erythematosus	2	0	2
Diseases of genitourinary system			
Renal failure	46	1	47
Pyelonephritis	1	0	1
Urinary tract infection	7	0	7
Benign prostatic hypertrophy	0	1	1
Diseases of nervous system			
Parkinson's disease	3	1	4

*Patients may have one or more concurrent medical conditions

Table 5.7
Case-fatality rate of reported legionellosis by history of medical conditions, 1989 – 2013

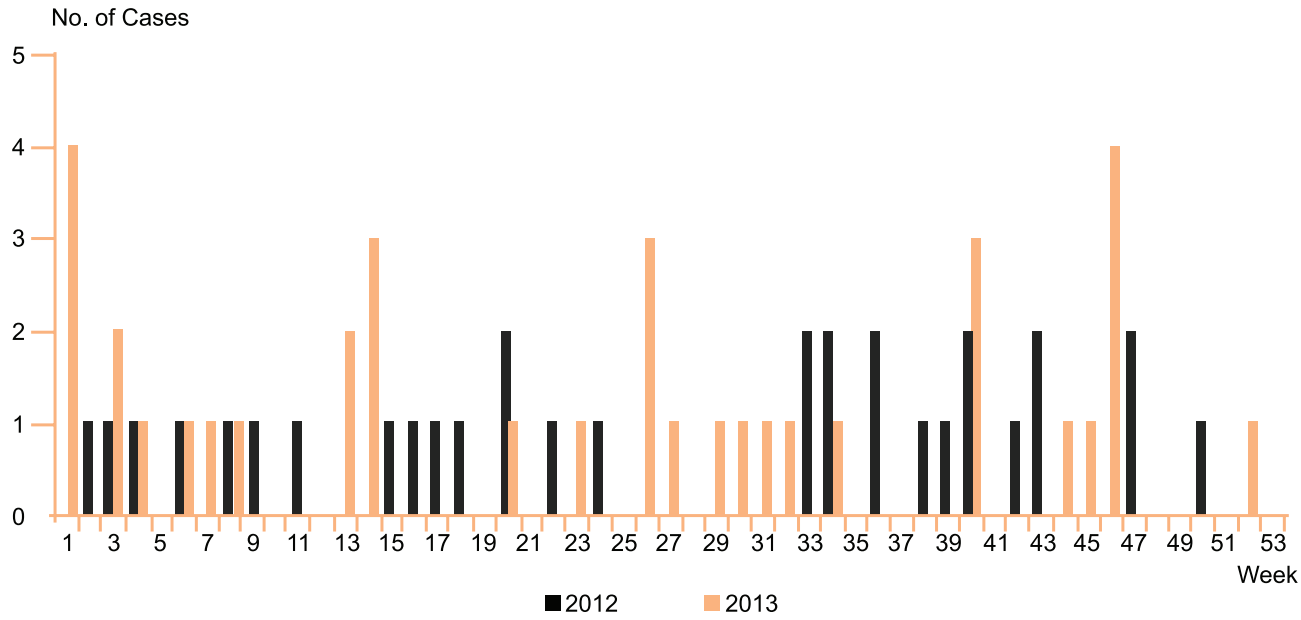
Year	Concurrent medical conditions					
	Present		Absent		Total	
	Cases	Death	Cases	Death	Cases	Death
1989	16	4	17	0	33	4(12.1)
1990	18	3	14	0	32	3(9.4)
1991	11	2	3	0	14	2(14.3)
1992	37	5	21	1	58	6(10.4)
1993	15	4	2	0	17	4(23.5)
1994	19	8	14	1	33	9(27.3)
1995	11	2	11	0	22	2(9.1)
1996	23	4	9	0	32	4(12.5)
1997	40	4	3	0	43	4(9.3)
1998	28	5	9	0	37	5(13.5)
1999	60	5	19	0	79	5(13.5)
2000	45	3	20	0	65	3(4.6)
2001	32	1	20	0	52	1(1.9)
2002	26	1	14	0	40	1(2.5)
2003	26	0	20	0	46	0(0.0)
2004	10	0	7	0	17	0(0.0)
2005	6	0	12	0	18	0(0.0)
2006	3	0	10	0	13	0(0.0)
2007	3	0	9	0	12	0(0.0)
2008	3	0	12	0	15	0(0.0)
2009	4	1	15	0	19	1(5.3)
2010	6	0	8	0	14	0(0.0)
2011	7	0	9	0	16	0(0.0)
2012	13	0	9	0	22	0(0.0)
2013	11	2	8	0	19	2(10.5)
Total	**473**	**54**	**295**	**2**	**768**	**56 (7.3)**

MELIOIDOSIS

Melioidosis is a bacterial infection with a wide spectrum of clinical manifestations, ranging from pulmonary consolidation to localised cutaneous or visceral abscesses, necrotising pneumonia with or without fulminant septicaemia. The infectious agent is Burkholderia pseudomallei. The mode of transmission is usually by contact with contaminated soil or water through overt or inapparent skin lesions. It could also be transmitted by aspiration or ingestion of contaminated water or inhalation of dust from contaminated soil.

In 2013, there were 36 cases of laboratory confirmed melioidosis, compared with 31 cases in 2012 (Figure 5.3). 34 of these 36 cases were local residents, of which two were imported cases who contracted their infections overseas. The remaining two cases comprised foreigners who came to Singapore to seek medical treatment for infections acquired overseas.

Figure 5.3
E-weekly distribution of reported melioidosis cases, 2012 - 2013



The mean age of the reported cases was 53.7 years (range 9 – 88 years). The overall incidence rate for local residents was 0.6 per 100,000 population, with the highest incidence rate in the 55-64 years age group (Table 5.8).

Table 5.8
Age-gender distribution and age-specific incidence rate of melioidosis cases^, 2013

Age (Yrs)	Male	Female	Total (%)	Incidence rate per 100,000 population*
0 – 4	0	0	0 (0.0)	0.0
5 – 14	0	1	1 (2.9)	0.2
15 – 24	3	0	3 (8.8)	0.4
25 – 34	0	0	0 (0.0)	0.0
35 – 44	3	1	4 (11.8)	0.4
45 – 54	5	1	6 (17.6)	0.8
55 – 64	10	4	14 (41.2)	2.5
65+	3	3	6 (17.6)	1.3
Total	**24**	**10**	**34 (100.0)**	**0.6**

^Excluding two foreigners seeking medical treatment in Singapore
*Rates are based on 2013 estimated mid-year population.
(Source: Singapore Department of Statistics)

Among the three major ethnic groups, the incidence rate was highest in Malays (Table 5.9).

Table 5.9
Ethnic distribution and ethnic-specific incidence rate of melioidosis cases^, 2013

	Male	Female	Total (%)	Incidence rate per 100,000 population*
Singapore Resident				
Chinese	7	7	14 (41.2)	0.5
Malay	10	2	12 (35.3)	2.3
Indian	3	1	4 (11.8)	1.1
Others	0	0	0 (0.0)	0.0
Foreigner	4	0	4 (11.8)	0.3
Total	**24**	**10**	**34 (100.0)**	**0.6**

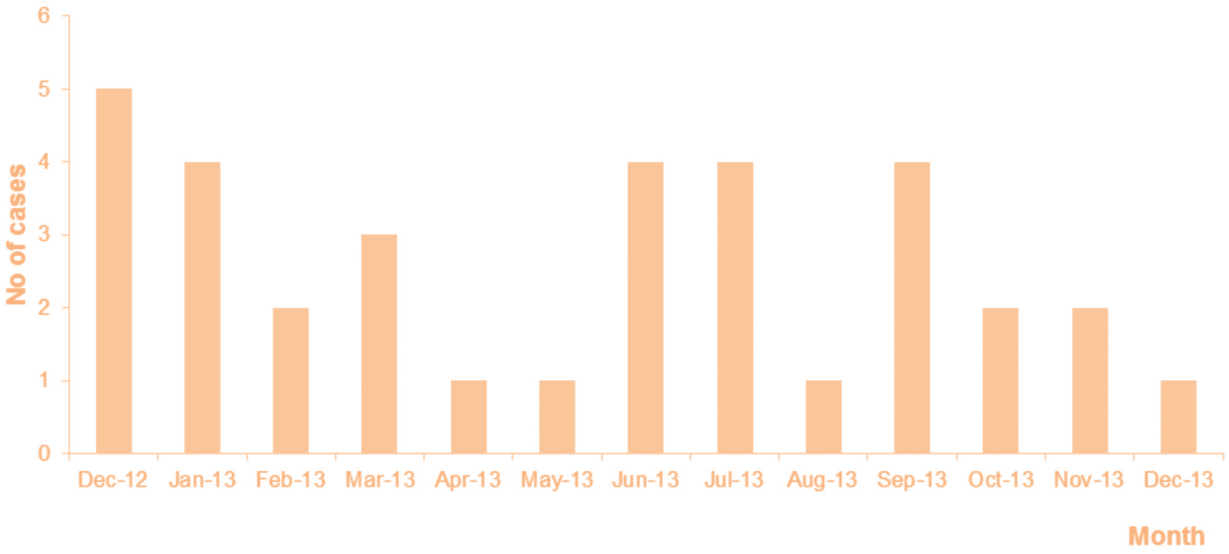
^Excluding two foreigners seeking medical treatment in Singapore
* Rates are based on 2013 estimated mid-year population
(Source: Singapore Department of Statistics)

The geographical distribution and monthly distribution of the local cases are presented in Figures 5.4 and 5.5 respectively.

Figure 5.4
Distribution of local sporadic melioidosis cases#, 2013

Postal codes of 1 case unavailable

Figure 5.5
Monthly distribution of reported melioidosis cases by onset date, 2013



Among the 34 cases, *Burkholderia pseudomallei* were isolated from blood culture in 67.6% of the cases. See Table 5.10 for other laboratory diagnostic sources.

Table 5.10
Laboratory diagnosis of melioidosis cases^, 2013

Method of diagnosis	No. of cases (%)
Culture	
Blood	23 (67.6)
Pus	4 (11.8)
Tissue	1 (2.9)
Abscess fluid	3 (8.8)
Lower respiratory culture	2 (5.9)
Swabs	3 (9.7)
Total	**34 (100.0)**

^Excluding two foreigners seeking medical treatment in Singapore

The predominant signs and symptoms were abscesses and fever (Table 5.11). 41.9% of the cases presented with localised or multiple abscesses. Those who presented with bacteraemia comprised 41.2% of the cases in 2013 (Table 5.12).

Table 5.11
Main presenting signs and symptoms* of reported melioidosis cases, 1994 – 2013

SIGNS AND SYMPTOMS	1994 – 2012 (n=1163)		2013 (n=34)	
	No.	%	No.	%
Fever (with/without chills and rigors)	886	76.2	24	70.6
Myalgia	10	0.9	0	0.0
Ulcers	3	0.3	0	0.0
Respiratory symptoms				
Cough (productive and non-productive)	507	43.6	12	35.3
Dyspnoea	273	23.5	7	20.6
Chest pain	127	10.9	2	5.9
Runny Nose	5	0.4	0	0.0
Gastrointestinal symptoms				
Abdominal pain/discomfort/epigastric pain	108	9.3	0	0.0
Vomiting	86	7.4	2	5.9
Diarrhoea	77	6.6	2	5.9
Constipation	3	0.3	0	0.0
Jaundice	8	0.7	0	0.0
Urinary symptoms (dysuria, haematuria)	41	3.5	2	5.9
Abscesses (localised, multiple)	357	30.7	15	44.1

*Cases may have one or more presenting signs and symptoms

Table 5.12
Cases of melioidosis presenting with bacteraemia and abscesses, 1990 – 2013

Year	Cases	Bacteraemia		Abscesses			
				All Abscesses		Cutaneous	
		No.	(%)	No	(%)	No.	(%)
1990	22	20	90.9	5	22.7	3	13.6
1991	43	29	67.4	12	27.9	7	16.3
1992	46	25	54.3	13	28.3	6	13.0
1993	56	40	71.4	15	26.8	10	17.9
1994	40	25	62.5	14	35	9	22.5
1995	90	50	55.6	17	18.9	13	14.4
1996	70	30	42.9	24	34.3	17	24.3
1997	58	24	41.4	14	24.1	4	6.9
1998	114	42	36.8	18	15.8	5	4.4
1999	81	21	25.9	16	19.8	6	7.4
2000	77	28	36.4	18	23.4	11	14.3
2001	59	29	49.2	17	28.8	12	20.3
2002	36	23	63.9	19	52.8	13	36.1
2003	44	26	59.1	14	31.8	12	27.3

Year	Cases	Bacteraemia		Abscesses			
				All Abscesses		Cutaneous	
		No.	(%)	No	(%)	No.	(%)
2004	96	55	57.3	40	41.7	18	18.8
2005	74	47	63.5	33	44.6	21	28.4
2006	59	40	67.8	29	49.2	13	22.0
2007	57	38	66.7	21	36.8	7	12.3
2008	53	35	66.0	18	34.0	6	11.3
2009	35	21	60.0	11	31.4	2	5.7
2010	55	35	63.6	24	43.6	9	16.4
2011	34	20	58.8	16	47.1	3	8.8
2012	31	19	61.3	13	41.9	6	19.4
2013	34	14	41.2	20	58.8	6	17.6
Total	**1,364**	**736**	**54.0**	**441**	**32.3**	**219**	**16.1**

Overall, 73.5% of cases had co-morbid medical conditions. The most common was diabetes mellitus (72.0%), followed by hypertension (52.0 %) (Table 5.13).

Table 5.13
Concurrent medical conditions* of 1,337 melioidosis cases, 1989 – 2013

Concurrent medical condition	1989 – 2012 n=1,312 (288)		2013 n=25 (5)		Total n=1,337 (293)	
Metabolic/nutritional diseases						
Diabetes mellitus	682	(171)	18	(4)	700	(175)
Disorders of the thyroid gland	7	(4)	1		8	(4)
Gout	15	(5)			15	(5)
Dyslipidemia	5		1		6	
Hyperlipidemia	44	(14)	7	(2)	51	(16)
Panhypopituitarism	1	(1)			1	(1)
Others	7	(3)			7	(3)
Diseases of the circulatory system						
Acute Myocardiac Infarction	5	(3)	1	(1)	6	(4)
Cerebrovascular disease	23	(5)	1	(1)	24	(6)
Coronary Artery Bypass Graft	3				3	
Heart failure	26	(14)			26	(14)
Heart disease	32	(7)	3	(1)	35	(8)
Hypertensive disease	324	(84)	13	(3)	337	(87)
Ischaemic heart disease	139	(55)	3	(3)	142	(58)
Pulmonary/arterial embolism and thrombosis	7	(2)	1	(1)	8	(3)
Rheumatic heart disease	1				1	
Others	7	(3)	1		8	(13)
Diseases of the respiratory system						
Asthma	62	(18)			62	(18)
Bronchiectasis	13	(5)			13	(5)
Chronic obstructive pulmonary disease	29	(13)			29	(13)
Pneumonia	198	(58)	1		199	(58)

Concurrent medical condition	1989 – 2012 n=1,312 (288)		2013 n=25 (5)		Total n=1,337 (293)	
Pulmonary edema	1				1	
Respiratory failure	5	(4)			5	(4)
Others	28	(6)			28	(6)
Diseases of the genitourinary system						
Benign prostatic hypertrophy	5	(2)			5	(2)
Renal failure/impairment	139	(66)	3		142	(66)
Nephrosis	14	(2)			14	(2)
Urinary Tract Infection	9	(2)			9	(2)
Others	9	(1)	1		10	(1)
Diseases of the digestive system						
Cholecystitis	4	(2)			4	(2)
Chronic liver disease and cirrhosis	26	(12)			26	(12)
Colon cancer	3				3	
Colonic polyp	1				1	
Hepatocellular disease	5	(2)			5	(2)
Hepatomegaly	2	(2)			2	(2)
Pancreas cancer	2				2	
Pancreatitis	2				2	
Ulcer of stomach and duodenum	18	(2)			18	(2)
Infectious diseases						
Dengue Fever	10	(3)			10	(3)
Hepatitis B	1				1	
Hepatitis C	1				1	
HIV infection	3	(2)			3	(2)
MRSA	2	(1)			2	(1)
Salmonellosis	1				1	
Tuberculosis	77	(20)	1	(1)	78	(21)
Neoplasms	40	(17)			40	(17)
Mental disorders						
Alcohol dependence syndrome	4	(2)			4	(2)
Drug dependence	4	(4)			4	(4)
Psychosis	8	(4)			8	(4)
Depression	1				1	
Disease of the eye						
Cataract	5				5	
Retinopathy	2				2	
Diseases of the blood	0				0	
Anaemia	24	(6)	1		25	(6)
α-thalassaemia	1				1	
ß-thalassaemia	5				5	
Disseminated intravascular coagulation	1	(1)			1	(1)
Pancytopenia	1				1	
Sepsis	27	(8)	1		28	(8)
Thrombocytopenia	2	(1)			2	(1)
Diseases of the nervous system						
Alzheimer's disease	2				2	

Concurrent medical condition	1989 – 2012 n=1,312 (288)		2013 n=25 (5)		Total n=1,337 (293)	
Dementia	3	(1)	1	(1)	4	(2)
Neuropathy	3	(1)			3	(1)
Parkinson's disease	3				3	
Stroke	6	(1)			6	(1)
Immune-mediated Diseases	6	(1)			6	(1)
Diseases of Ear, Nose, and Throat						
Otitis media	2				2	
Diseases of the musculoskeletal system/ connective tissue						
Cellulitis	4				4	
Chondromalacia patellae	1				1	
Myopathy	1				1	
Mixed connective tissue disease	1				1	
Osteoarthritis	6	(3)			6	(3)
Osteomyelitis	1				1	
Osteoporosis	1	(1)			1	(1)
Rheumatoid arthritis	3	(1)			3	(1)

( ) Deaths
* Patients may have one or more concurrent medical condition

In 2013, there were three melioidosis deaths and five melioidosis-related deaths, giving a case-fatality rate of 23.5% (Table 5.14). Higher case-fatality rates were observed among those without co-morbid medical conditions (33.3%) and with bacteraemia (5.7%). Please refer to Table 5.14 and 5.15.

Table 5.14
Case-fatality rate of reported melioidosis cases by history of concurrent medical condition, 1990 – 2013

Year	Concurrent medical conditions					
	Present		Absent		Total	
	Cases	Death	Cases	Death	Cases	Death
1990	17	9 (52.9)	5	4 (80.0)	22	13 (59.1)
1991	39	18 (46.2)	4	1 (25.0)	43	19 (44.2)
1992	39	22 (56.4)	7	2 (28.6)	46	24 (52.2)
1993	40	22 (55.0)	16	7 (43.8)	56	29 (51.8)
1994	32	11 (34.4)	8	1 (12.5)	40	12 (30.0)
1995	73	20 (27.4)	17	8 (47.1)	90	28 (31.1)
1996	53	14 (26.4)	17	5 (29.4)	70	19 (27.1)
1997	41	9 (21.9)	17	0 (0.0)	58	9 (15.5)
1998	92	18 (19.6)	22	1 (4.5)	114	19 (16.7)
1999	61	8 (13.1)	20	1 (5.0)	81	9 (11.1)
2000	51	9 (17.6)	26	0 (0.0)	77	9 (11.7)
2001	33	5 (15.2)	26	2 (7.7)	59	7 (11.9)
2002	19	2 (10.5)	16	0 (0.0)	36*	2 (5.6)
2003	26	3 (11.5)	16	1 (6.3)	44*	6* (13.6)
2004	81	25 (30.8)	15	0 (0.0)	96	26 (27.1)
2005	61	12 (19.7)	13	0 (0.0)	74	12 (16.2)
2006	51	9 (17.6)	8	0 (0.0)	59	9 (15.3)

Year	Concurrent medical conditions					
	Present		Absent		Total	
	Cases	Death	Cases	Death	Cases	Death
2007	48	12 (25.0)	9	0 (0.0)	57	12 (21.1)
2008	52	12 (23.1)	8	0 (0.0)	60	12 (20.0)
2009	30	5 (16.7)	7	0 (0.0)	37	5 (13.5)
2010	46	13 (28.3)	12	1 (8.3)	58	14 (24.1)
2011	23	4 (17.4)	11	2 (18.2)	34	6 (17.6)
2012	19	0 (0.0)	12	2(16.7)	31	2 (6.5)
2013	25	5 (20.0)	9	3 (33.3)	34	8 (23.5)
Total	**1,052**	**266 (25.3)**	**321**	**41 (12.8)**	**1,376***	**311 (22.6)**

*One case in 2002 and two cases in 2003 – information were not available

Table 5.15
Case-fatality rate of bacteraemic and non-bacteraemic melioidosis in Singapore, 1990 – 2013

Year	Bacteraemia					
	Present		Absent		Total	
	Cases	Deaths (%)	Cases	Deaths (%)	Cases	Deaths (%)
1990	20	10 (50.0)	6	2 (100)	22	12 (54.5)
1991	29	17 (58.6)	14	3 (21.4)	43	20 (46.5)
1992	25	18 (72.0)	21	6 (28.6)	46	24 (52.2)
1993	40	26 (65.0)	16	3 (18.8)	56	29 (51.8)
1994	25	11 (44.0)	15	1 (6.7)	40	12 (30.0)
1995	50	23 (46.0)	40	5 (12.5)	90	28 (31.1)
1996	30	15 (50.0)	40	4 (10.0)	70	19 (27.1)
1997	24	7 (29.2)	34	2 (5.9)	58	9 (15.5)
1998	42	17 (40.5)	72	2 (2.8)	114	19 (16.7)
1999	21	7 (33.3)	60	2 (3.3)	81	9 (11.1)
2000	28	5 (17.8)	49	4 (8.2)	77	9 (11.7)
2001	29	5 (17.2)	30	2 (6.7)	59	7 (11.9)
2002	23	2 (8.7)	12	0 (0.0)	36*	2 (5.6)
2003	26	4 (15.4)	16	0 (0.0)	44*	6* (13.6)
2004	55	24 (43.6)	41	2 (4.9)	96	26 (27.1)
2005	47	11 (23.4)	27	1 (3.7)	74	12 (16.2)
2006	40	7 (17.5)	19	2 (10.5)	59	9 (15.3)
2007	38	8 (21.1)	19	4 (21.1)	57	12 (21.1)
2008	40	11 (27.5)	20	1 (5.0)	60	12 (20.0)
2009	22	2 (9.1)	15	3 (20.0)	37	5 (13.5)
2010	34	14 (41.2)	24	0 (0.0)	58	14 (24.1)
2011	20	6 (30.0)	14	0 (0.0)	34	6 (17.6)
2012	19	2 (10.5)	12	0 (0.0)	31	2 (6.5)
2013	14	8 (5.7)	20	0 (0.0)	34	8 (23.5)
Total	**741**	**260 (35.1)**	**632**	**49 (7.8)**	**1,376***	**311 (22.6)**

*One case in 2002 and two cases in 2003 – information were not available

- Human Immunodeficiency Virus Infection and Acquired Immunodeficiency Syndrome
- Sexually Transmitted Infections
- Tuberculosis
- Leprosy

VI
HIV/AIDS, STIs, TUBERCULOSIS & LEPROSY

HUMAN IMMUNODEFICIENCY VIRUS INFECTION AND ACQUIRED IMMUNODEFICIENCY SYNDROME

Human immunodeficiency virus (HIV) belongs to the lentivirus group of the retrovirus family. HIV, the cause of the Acquired Immunodeficiency Syndrome (AIDS), continues to spread. Since the disease first appeared in 1981, almost 75 million people have been infected with the virus and about 36 million have died of AIDS worldwide. Globally, 35.3 million [32.2–38.8 million] people were living with HIV at the end of 2012.

HIV can be transmitted from person to person through unprotected sexual intercourse, the use of HIV contaminated needles including the sharing of needles among intravenous drug users, transfusion of infected blood or blood products, mucosal exposures with infected body fluid and the transplantation of HIV-infected tissues or organs. Mother-to-child or vertical transmission is the most common route of HIV infection in children.

AIDS is the advanced stage of HIV infection, when a person's immune system is severely damaged and vulnerable to opportunistic infections. Previously, people with HIV could progress to AIDS in eight to ten years. However, since the introduction of Highly Active Anti-Retroviral Therapy (HAART) in the mid 1990s, the lifespan of a HIV infected individual on treatment has become comparable to someone without HIV infection.

Singapore's multi-pronged National HIV/AIDS Control Programme comprises education of the general public and high-risk groups, protection of the national blood supply through screening of blood and blood products, management of cases and contact tracing, epidemiological surveillance, scaling up the prevention and control of sexually-transmitted infections (STIs), and legislation.

The National HIV/AIDS Policy Committee, which comprises representatives from seven ministries (Health; Defence; Home Affairs; Social and Family Development; Manpower; Education; Communications and Information), the Communicable Disease Centre, the National Skin Centre, the Health Promotion Board, the AIDS Business Alliance, Action for AIDS and the Singapore National Employers Federation, provides guidance on all policy matters related to HIV infection/AIDS, including public health, legal, ethical, social and economic issues, and coordinates a broad-based multi-sectoral approach to the prevention and control of HIV infection/AIDS in Singapore.

In 2013, a total of 454 Singapore residents were newly reported to have HIV infection, a decrease of 3.2% from 469 cases in 2012 (Table 6.1). This brings the cumulative total number of HIV/AIDS infections among residents since the first case was diagnosed in 1985 to 6,229, of whom 3,108 persons are asymptomatic carriers, 1,450 have or have had AIDS-related illnesses and 1,671 have died.

During 2013, 116 cases of AIDS were reported (Table 6.2), including 109 with AIDS at diagnosis of HIV infection and seven previously diagnosed asymptomatic HIV-infected patients who progressed to AIDS. These 109 cases with AIDS at diagnosis comprised 24% of the newly reported cases. 41% of the newly reported patients presented with late-stage [1] HIV infection.

The notification rate of HIV/AIDS in 2013 was 118.1 per million population, compared to 122.8 per million population in 2012 (Figure 6.1). The AIDS morbidity rate was 30.2 per million population in 2013, compared to 40.9 per million population in 2012. In 2013, 89 deaths in HIV/AIDS patients were reported, giving a mortality rate of 23.1 per million population. Table 6.1

[1] As defined by CD4+ cell count of less than 200 per cu mm or AIDS-defining opportunistic infections or both.

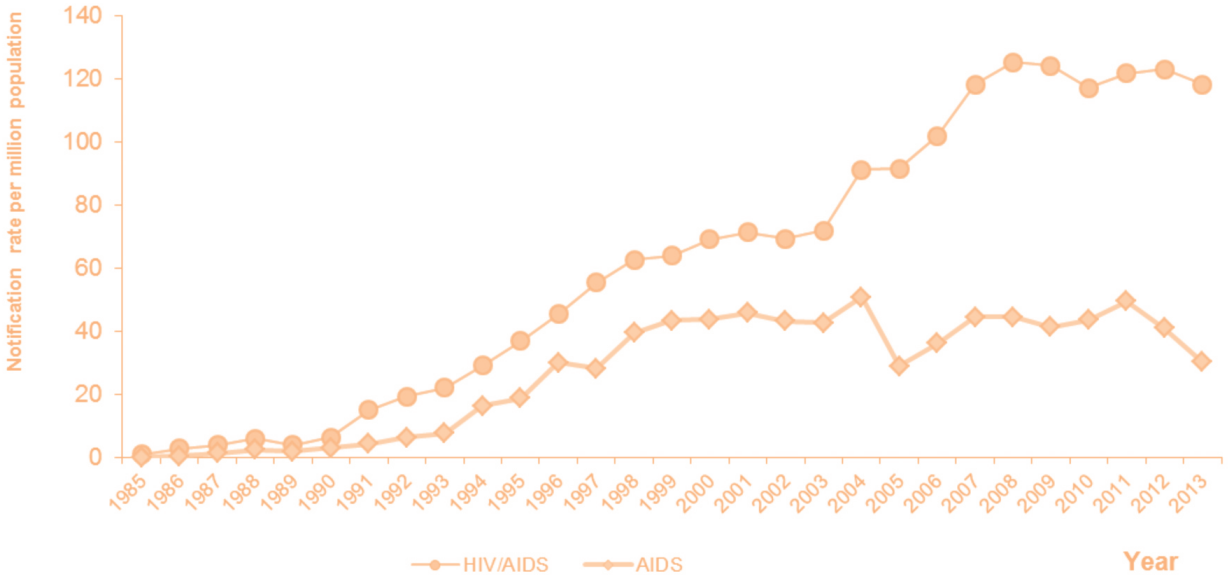
Table 6.1
Distribution of Singapore residents with HIV/AIDS by gender, 1985 – 2013

Year	Male	Female	Total	No. of cases per million population
1985	2	0	2	0.8
1986	6	1	7	2.8
1987	10	0	10	3.9
1988	15	0	15	5.8
1989	9	1	10	3.8
1990	17	0	17	6.2
1991	39	3	42	15.0
1992	49	6	55	19.3
1993	58	6	64	22.0
1994	76	10	86	29.1
1995	102	9	111	36.8
1996	123	16	139	45.3
1997	157	16	173	55.4
1998	167	32	199	62.6
1999	171	35	206	63.8
2000	193	33	226	69.0
2001	204	33	237	71.3
2002	206	28	234	69.2
2003	212	30	242	71.9
2004	290	21	311	91.1
2005	287	30	317	91.4
2006	327	32	359	101.8
2007	392	31	423	118.1
2008	426	30	456	125.2
2009	418	45	463	124.0
2009	418	45	463	124.0
2010	403	38	441	116.9
2011	430	31	461	121.7
2012	437	32	469	122.8
2013	428	26	454	118.1
Total	**5,654**	**575**	**6,229**	**-**

Table 6.2
Distribution of Singapore residents with AIDS by gender, 1985 – 2013

Year	Male	Female	Total	No. of cases per million population
1985	0	0	0	0.0
1986	1	0	1	0.4
1987	3	0	3	1.2
1988	6	0	6	2.3
1989	5	0	5	1.9
1990	8	0	8	2.9
1991	12	0	12	4.3
1992	17	1	18	6.3
1993	19	3	22	7.6
1994	44	4	48	16.2
1995	51	5	56	18.6
1996	89	3	92	30.0
1997	80	8	88	28.2
1998	112	13	125	39.3
1999	125	15	140	43.3
2000	128	15	143	43.7
2001	136	16	152	45.7
2002	133	13	146	43.2
2003	130	13	143	42.5
2004	162	11	173	50.7
2005	91	9	100	28.8
2006	118	9	127	36.0
2007	153	6	159	44.4
2008	157	5	162	44.5
2009	142	12	154	41.2
2010	151	13	164	43.5
2011	174	13	187	49.3
2012	145	11	156	40.9
2013	110	6	116	30.2
Total	**2,502**	**204**	**2,706**	**-**

Figure 6.1
Notification rate of HIV/AIDS among Singapore residents, 1985 – 2013



Distribution by age and gender

As in previous years, HIV/AIDS cases were predominantly male with a male to female ratio of 16:1. In 2013, the highest notification rates were observed for both males and females in the 30 - 39 years age group (Table 6.3).

Table 6.3
Age-gender distribution and age-specific notification rates of HIV/AIDS among Singapore residents, 2013

					Notification rate per million population*		
Age	**Male**	**Female**	**Total**	**(%)**	**Male**	**Female**	**Total**
0 - 14	0	0	0	0%	0.0	0.0	0.0
15-19	2	1	3	1%	15.4	8.0	11.8
20-29	86	5	91	20%	333.3	18.9	174.2
30-39	102	8	110	24%	353.3	25.5	182.6
40-49	108	6	114	25%	347.3	18.9	181.3
50-59	86	4	90	20%	288.0	13.5	151.5
60 & above	44	2	46	10%	151.2	6.0	73.4
Total	**428**	**26**	**454**	**100%**	**226.3**	**13.3**	**118.1**

*Rates are based on 2013 mid-year population.
(Source: Singapore Department of Statistics)

Ethnic Distribution

Among the three major ethnic groups, the Malays had the highest HIV notification rate at 183.3 per million population, followed by the Chinese and the Indians (Table 6.4).

Table 6.4
Ethnic-gender distribution and ethnic-specific notification rates of HIV/AIDS among Singapore residents, 2013

					Notification rate per million population*		
Ethnic group	**Male**	**Female**	**Total**	**(%)**	**Male**	**Female**	**Total**
Chinese	310	13	323	71%	222.2	8.9	113.2
Malay	81	13	94	21%	317.4	50.5	183.3
Indian	22		22	5%	121.6	0.0	62.6
Others	15		15	3%	248.9	0.0	118.6
Total	**428**	**26**	**454**	**100%**	**22.6**	**1.3**	**11.8**

*Rates are based on 2013 mid-year population
(Source: Singapore Department of Statistics)

Biographic profile of HIV/AIDS patients

Of the 454 new cases in 2013, 66% were single, while 23% were married, 9% were divorced/separated and 2% were widowed at the time of diagnosis (Table 6.5).

Among the male cases, 68% were single at the point of diagnosis. For the females, however, the majority (54%) were married.

Table 6.5
Distribution of Singapore residents with HIV/AIDS by marital status, 2013

Marital status	**Male**	**Female**	**Total**	**(%)**
Single	292	8	300	66%
Married	92	14	106	23%
Divorced	38	3	41	9%
Widowed	6	1	7	2%
Total	**428**	**26**	**454**	**100%**

Mode of HIV/AIDS transmission

The main mode of HIV transmission was through sexual contact, representing 95% of cases in 2013 (Table 6.6). Heterosexual transmission accounted for 39.9% of all cases in 2013 while homosexual and bisexual transmission accounted for 54.6%. There were four cases infected via intravenous drug use, accounting for 0.9% of the new cases. Two of these were detected as a result of prison screening and the other two were due to HIV-related symptoms.

Table 6.6
Distribution of Singapore residents with HIV/AIDS by mode of transmission, 2013

Mode of Transmission	No.	(%)
Sexual Transmission		
Heterosexual	181	39.9%
Homosexual	210	46.3%
Bisexual	38	8.4%
Intravenous drug use	4	0.9%
Blood Transfusion	0	0.0%
Renal Transplant overseas	0	0.0%
Perinatal (mother to child)	0	0.0%
Uncertain/Others	21	4.6%
Total	**454**	**100.00%**

HIV surveillance programmes

Table 6.7 shows the overall results for the three HIV surveillance programmes in Singapore. The proportion of cases tested positive for HIV within each programme has remained stable over the last four years. In 2013, the prevalence of HIV infection among cases tested in anonymous test sites was highest, at 1.6%, followed by inpatient opt-out testing and antenatal screening, at 0.12% and 0.09% respectively.

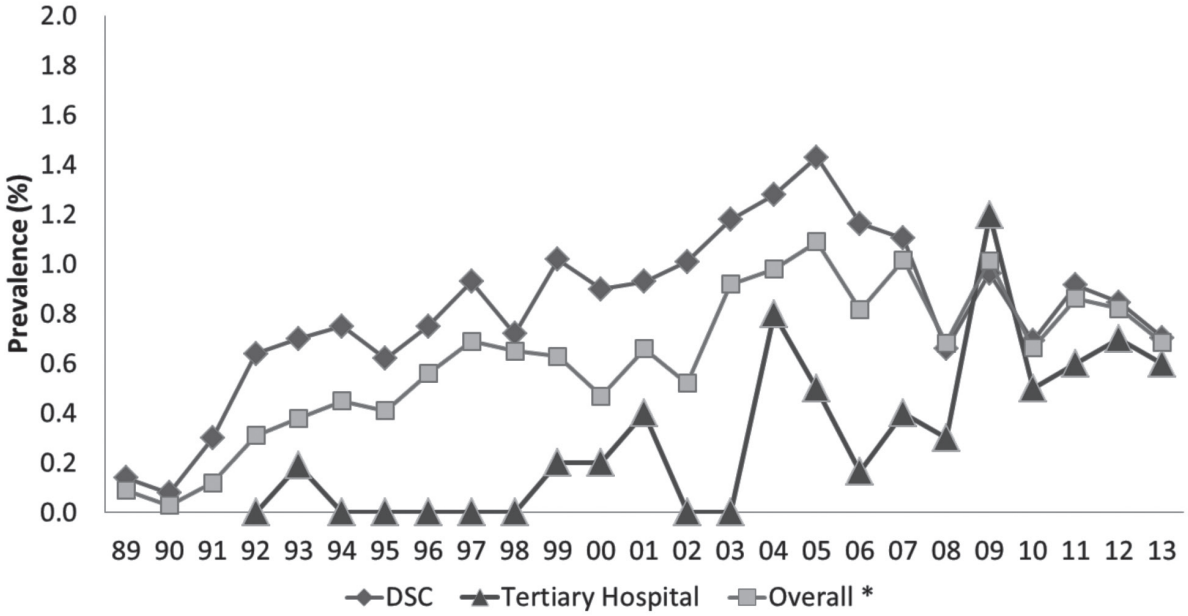
Table 6.7: Results for HIV Surveillance Programmes, 2010 – 2013

Programme		Year			
		2010	2011	2012	2013
Anonymous test sites	Total number of tests done	9,592	9,370	11,243	13,893
test sites	Number tested positive	134	184	173	227
	Percentage tested positive	1.4	2.0	1.5	1.6
Inpatient opt-out testing	Total number of tests done	31,601	35,015	34,515	33,297
	Number tested positive	41	34	39	41
	Prevalence (%)	0.13	0.10	0.11	0.12
Antenatal screening	Total number of tests done	13,915	14,439	14,950	14,877
	Number tested positive	8	11	8	13
	Prevalence (%)	0.06	0.08	0.05	0.09

HIV unlinked anonymous sero-surveillance programme

Two sentinel populations are currently monitored through unlinked anonymous testing (UAT) to monitor HIV seroprevalence. They are patients with sexually transmitted infections (STIs) attending the Department of STI Control (DSC) clinic; and inpatients at one tertiary Restructured Hospital. The HIV seroprevalence among STI attendees peaked in 2005 at 1.4% and decreased to 0.7% in 2013. Among inpatients, there has been an increasing trend in the HIV seroprevalence. In 2013, the seroprevalence was 0.6%. The overall HIV seroprevalence in 2013 was 0.7% (Figure 6.2).

Figure 6.2
Unlinked HIV Seroprevalence, 1989-2013



*Overall includes data from the other surveillance populations

HIV molecular surveillance program

In 2013, the proportion of recently-infected individuals in newly-diagnosed HIV patients was estimated at 17.1% in treatment-naïve patients (n=123). Among these recently-infected patients, the predominant circulating HIV subtype was CRF01_AE (47.6%), followed by subtype B (42.9%). The overall prevalence of transmitted drug resistance (TDR) to any antiretroviral (ARV) class was 3.3% in 2013. Transmitted resistance to nucleoside reverse transcriptase inhibitors (NRTI) and non-nucleoside reverse transcriptase inhibitors (NNRTI) were 2.4% and 0.8% respectively.

SEXUALLY TRANSMITTED INFECTIONS

Sexually transmitted infections (STIs) are infections caused by different pathogens (e.g. bacteria, viruses, parasites, fungi) which are spread from person to person primarily through sexual contact. The common and important STIs are caused by *Treponema pallidum* (Syphilis), *Neisseria gonorrhoeae*, *Chlamydia trachomatis* (infection of the urethra, cervix, pharynx and rectum), herpes simplex virus – types 1 and 2 (anogenital herpes), human papilloma virus (anogenital warts), *Trichomonas vaginalis* (infection of the urethra and vagina) and human immunodeficiency virus (HIV) infection.

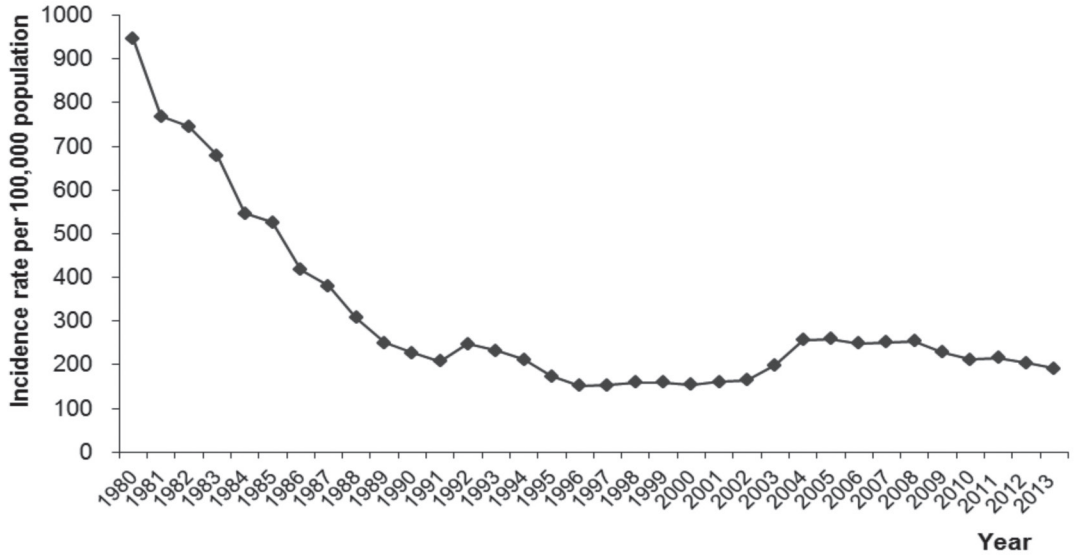
The diagnosis of an STI is a “sentinel” event which indicates unprotected sexual activity and therefore, patients presenting with one STI are at increased risk of acquisition of others. The presence of STIs can increase the risk of acquisition of HIV infection and also promote its transmission. Sexually transmissible pathogens are also implicated in other reproductive system problems such as pelvic inflammatory disease (PID), infertility and ectopic pregnancy.

The Department of STI Control (DSC) Clinic of the National Skin Centre (NSC) is a public clinic for the diagnosis, treatment and control of sexually transmitted infections (STI) in Singapore. The DSC runs the National STI Control Programme in Singapore, and its activities include health and public education on STI/HIV, clinic services, disease detection, patient management and research.

Disease trend

The overall incidence for STIs was 192 per 100,000 population in 2013. The STI incidence rate increased by 6% from 155 per 100,000 population in 2000 to 165 per 100,000 population in 2002, and then increased sharply by 29% from 199 per 100,000 population in 2003 to 257 in 2004 per 100,000 population. The rate dropped to 250 per 100,000 population in 2006, and thereafter remained similar until 2008. The rate then dropped further to 192 per 100,000 population in 2013 (Figure 6.3). The three main bacterial STIs notified in 2013 were chlamydia, gonorrhoea and syphilis.

Figure 6.3
Incidence rate of STIs, 1980 – 2013

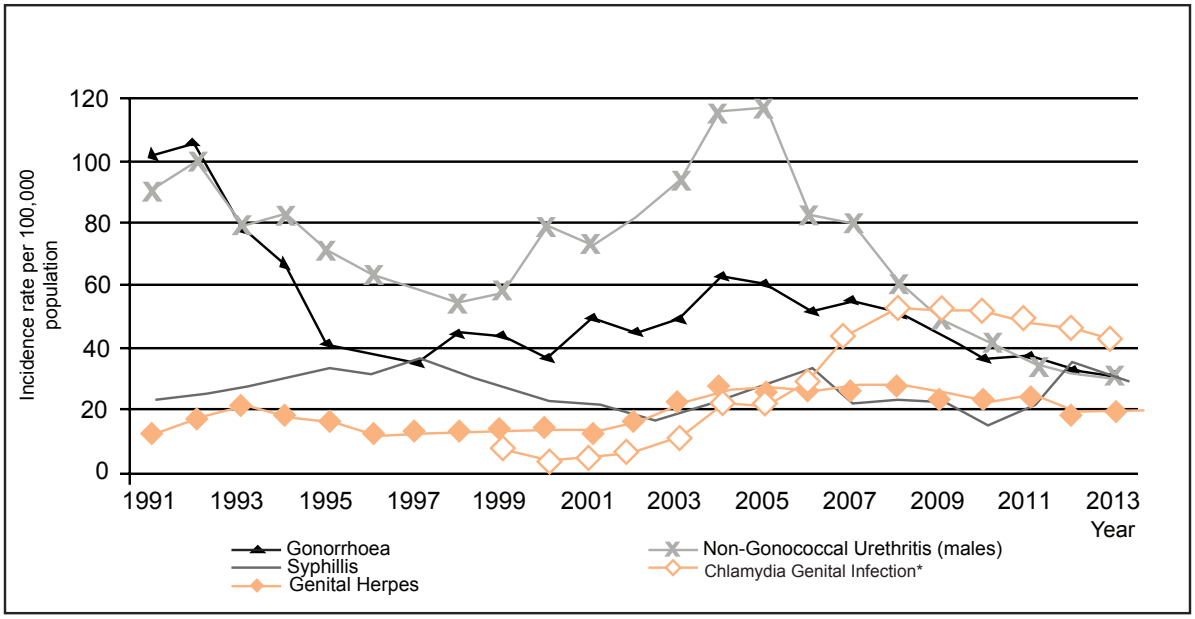


Legally Notifiable STIs

STIs which are legally notifiable under the Infectious Diseases Act (IDA) comprise gonorrhoea, non-gonococcal urethritis, syphilis, chlamydia and genital herpes. Since 19 December 2008, the IDA requires medical practitioners to notify all cases of chlamydia genital infection to NSC within 72 hours of diagnosis.

In the past two decades, the incidence of legally notifiable STIs was highest at 201 per 100,000 population in 1992, followed by 197 per 100,000 in 2005 and thereafter it decreased to 129 per 100,000 in 2013. The incidence rates of individual legally notifiable STIs are shown in Figure 6.4.

Figure 6.4
Incidence rate of legally notifiable STIs, 1992 – 2013



* Monitoring for chlamydia genital infection started in 1999, and it was made legally notifiable since 19 Dec 2008.

Distribution by STIs and gender

Among the five legally notifiable STIs, the overall incidence of chlamydia was the highest, followed by gonorrhoea and syphilis. The incidence of legally notifiable STIs was higher among males than females (Table 6.8).

Table 6.8
Distribution of incidence rates by STIs and gender, 2013

STIs	Incidence rate per 100,000 population*		
	Male	Female	Total
Legally Notifiable STIs			
Chlamydia	51.9	32.1	42.5
Gonorrhoea	49.7	10.4	31.0
Non-Gonococcal Urethritis (NGU) [per 100,000 male population]	28.9	-1	-1
Syphilis	35.4	24.9	30.4
Genital Herpes	23.9	14.7	19.5
Other STIs			
Vaginal discharge (per 100,000 female population)	-2	14.6	-2
Candidiasis	4.0	20.7	12.0
Genital Warts	33.5	6.6	20.7
Mucopurulent cervicitis (MPC) [per 100,000 female population]	-3	17.2	8.2
Chancroid	0.0	0.0	0.0
Others	6.4	4.2	5.4
All types	**233.7**	**145.5**	**191.6**

* Rates are based on 2013 estimated mid-year population.
(Source: Singapore Department of Statistics)

[1] Not applicable, as NGU occurs only in males.
[2] Not applicable, as vaginal discharge occurs only in females.
[3] Not applicable, as MPC occurs only in females.

Distribution by age and gender

In 2013, the male to female ratio for STIs was 1.8:1. As in previous years, the age-specific incidence rate for STIs among females was highest in the age group 20 – 24 years. Among the males, the highest age-specific incidence rate was in the age group 25 - 29 years. The overall rate was highest in the 20 – 24 year age group (Table 6.9).

Table 6.9
Age-gender distribution of STIs incidence rates, 2013

				Incidence rate per 100,000 population*		
Age (Yrs)	**Male**	**Female**	**Total (%)**	**Male**	**Female**	**Total**
0 – 9	0	2	2 (0.0)	0.0	0.9	0.4
10 – 14	1	9	10 (0.1)	0.8	7.5	4.0
15 – 19	126	256	382 (3.7)	80.5	175.7	126.4
20 – 24	977	1,033	2,010 (19.4)	363.8	491.1	419.7
25 – 29	1,385	956	2,341 (22.6)	397.1	337.7	370.5
30 – 34	1,222	575	1,797 (17.4)	384.0	212.3	305.0
35 – 39	836	344	1,180 (11.4)	311.0	147.2	234.8
40 – 44	667	247	914 (8.8)	270.4	119.7	201.8
45 – 49	462	131	593 (5.7)	222.4	72.3	152.4
50 – 54	340	73	413 (4.0)	191.0	43.1	118.8
55 – 59	256	41	297 (2.9)	167.7	26.4	96.4
60+	329	79	408 (3.9)	103.7	21.0	58.8
Total	**6,601**	**3,746**	**10,347 (100)**	**233.7**	**145.5**	**191.6**

* Rates are based on 2013 estimated mid-year population.
(Source: Singapore Department of Statistics)

Ethnic Distribution

Among the three major ethnic groups, the Malays had the highest incidence rate at 213.9 per 100,000 population, followed by the Chinese and the Indians (Table 6.10).

Table 6.10
Ethnic-gender distribution and ethnic-specific notification rates of STIs among Singapore residents, 2013

					Incidence rate per 100,000 population*		
Ethnic group	**Male**	**Female**	**Total**	**(%)**	**Male**	**Female**	**Total**
Chinese	3,448	1,504	4,952	(72.1)	247.1	103.3	173.5
Malay	611	486	1,097	(16.0)	239.4	188.6	213.9
Indian	358	115	473	(6.9)	197.9	67.3	134.5
Others	213	131	344	(5.0)	353.5	197.8	271.9
Total	**4,630**	**2,236**	**6,866**	**(100.0)**	**244.8**	**114.5**	**178.6**

*Rates are based on 2013 mid-year population.
(Source: Singapore Department of Statistics)

Chlamydia

Chlamydia is the most common cause of NGU. Since 2006, there have been more cases of NGU tested for *Chlamydia trachomatis*. NGU cases which test positive for *Chlamydia trachomatis* are classified as chlamydia infection instead of NGU, resulting in a decreasing trend in the incidence of NGU and a converse trend in the incidence of chlamydia. The overall incidence of chlamydia peaked in 2009 at 55 per 100,000 population and decreased to 43 per 100,000 population in 2013 (Figure 6.3). The incidence of chlamydia among males increased sharply from 11 per 100,000 population in 2006 to 59 per 100,000 in 2010 overtaking the incidence among females in 2009. It decreased to 52 per 100,000 population in 2013. The incidence of chlamydia among females increased from 49 per 100,000 population in 2006 to 62 per 100,000 in 2008 before decreasing to 32 per 100,000 population in 2013 (Table 6.8).

Syphilis

The incidence rate of syphilis was 30 per 100,000 population in 2013 which was a 11.8% decrease from 34 per 100,000 population in 2012. From a historical perspective, the incidence rate of syphilis decreased from 45 per 100,000 population in 1980 to 23 per 100,000 population in 1991. From 1992, there was an increase in the incidence rate from 26 per 100,000 population to 36 per 100,000 population in 1997. Subsequently it declined to 18 per 100,000 population in 2002 before rising to 36 per 100,000 population in 2006 and dropping to its lowest point at 16 per 100,000 population in 2010 (Figure 6.3).

The rate of infectious syphilis declined progressively from 18 per 100,000 population in 1986 to 3 per 100,000 population in 1999. It then increased to 5 per 100,000 population in 2004 and remained stable at 4 per 100,000 population to 2009. In 2013, the rate of infectious syphilis was 3 per 100,000 population. There were no cases of congenital syphilis reported in 2013.

Gonorrhoea

The incidence rate of gonorrhoea was 31 per 100,000 population in 2013. Gonorrhoea has been on a decreasing trend since 2004 when the incidence rate was 63 per 100,000 population (Figure 6.3). There were no cases of gonococcal ophthalmia neonatorum reported in 2013.

The percentage of penicillinase-producing Neisseria gonorrhoeae (PPNG) detected among Gonorrhoea positive cultures screened was 45.0% in 2013, which was an increase from 36.8% in 2012 (Table 6.11). The percentage of Neisseria gonorrhoeae cultures resistant to Ciprofloxacin increased from 74.1% in 2012 to 83.1% in 2013 (Table 6.12).

Table 6.11
Gonorrhoea cultures screened for PPNG, 1980 – 2013

Year	No. of Gonorrhoea positive cultures	PPNG cases	
		No.	(%)
1980	8,318	2,462	29.6
1985	3,789	1,316	34.7
1990	2,323	766	33.0
1991	1,894	686	36.2
1992	1,755	622	35.4
1993	1,300	489	37.6
1994	1,046	530	50.7
1995	642	315	49.1
1996	721	383	53.1
1997	722	438	60.7
1998	804	451	56.1
1999	797	413	51.8
2000	651	359	55.1
2001	936	482	51.5
2002	929	462	49.7
2003	200	89	44.5
2004	1,549	699	45.1
2005	1,499	735	49.0
2006	1,347	653	48.5
2007	1,424	742	52.1
2008	1,423	851	59.8
2009*	646	377	58.4
2010	162	62	38.3
2011	169	89	52.7
2012	76	28	36.8
2013	100	45	45.0

* There was a change in testing method in 2009, with fewer and selected cases being tested by culture.

Table 6.12
Gonorrhoea cultures screened for resistance to ciprofloxacin, 1998 – 2013

Year	No. of cultures	Ciprofloxacin resistant cases	
		No.	(%)
1998	768	55	7.2
1999	768	131	17.1
2000	635	121	19.1
2001	741	207	27.9
2002	200	93	46.5
2003	200	103	51.5
2004	160	80	50.0
2005	160	95	59.4
2006	160	99	61.9
2007	160	122	76.3
2008	160	119	74.4
2009	160	127	79.4
2010	160	117	73.1
2011	160	131	81.9
2012	158	117	74.1
2013	160	133	83.1

TUBERCULOSIS

Tuberculosis (TB) is a mycobacterial disease that is a major cause of death and disability in many parts of the world especially in developing countries. Initial tuberculous infection usually goes unnoticed and is a condition known as latent TB infection (LTBI). About 10% of immunocompetent adults with LTBI will eventually progress to active disease, and half of them will do so in the first two years following infection. The risk of progression to active disease is increased in immunocompromised persons and children under 5 years of age.

The National TB Control Programme was established in the late 1950s with the setting up of the Tuberculosis Control Unit and a National TB registry. The programme was enhanced with the launch of the Singapore Tuberculosis Elimination Programme (STEP) in 1997. The main aim of STEP is to eliminate TB in Singapore by detecting, diagnosing and treating all infectious TB cases, identifying and treating infected tuberculosis contacts; and preventing the emergence of multidrug-resistant tuberculosis.

Incidence and site of disease among Singapore's total population (i.e. citizens, permanent residents, and long-staying foreigners)

A total of 2,962 cases of TB were notified in 2013. This comprised 1,420 new and 119 relapsed cases among Singapore residents (citizens and PRs) and 1,381 new and 42 relapsed cases among non-residents (long-and short-term pass holders)

A total of 2,028 new cases of TB were notified among Singapore residents (citizens and PRs) and long-staying foreigners in 2013. The incidence rate of TB was 37.6 per 100,000 population in 2013. (Figure 6.5)

The majority (86.3%) of cases had pulmonary TB with or without extra-pulmonary involvement, while the remainder (13.7%) had exclusively extrapulmonary TB (Table 6.13).

Figure 6.5
Incidence rate of tuberculosis among Singapore residents and long-staying foreigners, 2002-2013

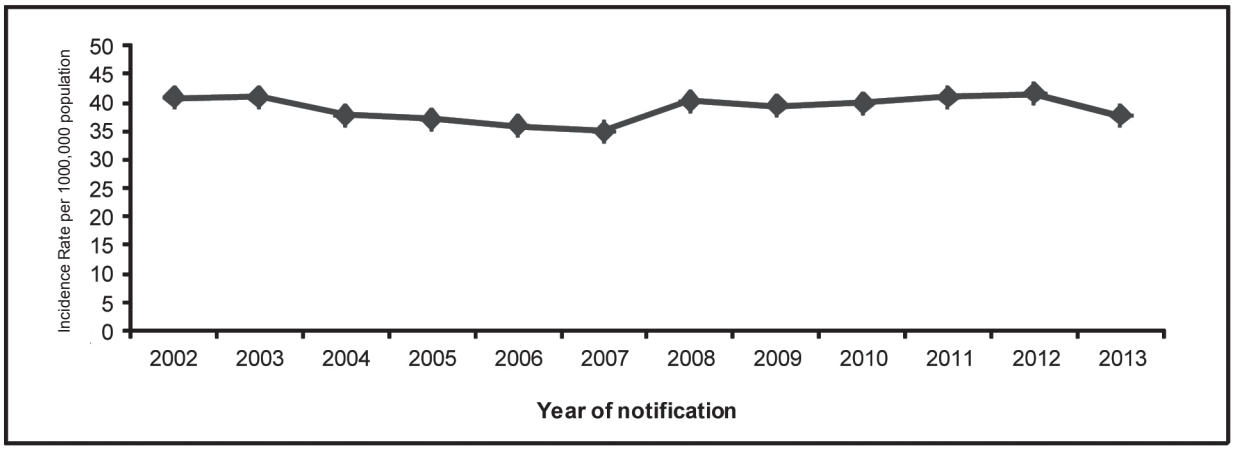


Table 6.13
Distribution of new TB cases by site of disease among Singapore residents and long-staying foreigners, 2002 – 2013

Year	New Cases			Incidence rate per 100,000 population			Index (base 2002)
	Pulmonary[1]	Extra pulmonary	Total	Pulmonary[1]	Extra pulmonary	Total	
2002	1,494	208	1,702	35.8	5.0	40.8	100.0
2003	1,461	223	1,684	35.5	5.4	40.9	100.4
2004	1,346	232	1,578	32.3	5.6	37.9	92.9
2005	1,352	234	1,586	31.7	5.5	37.2	91.2
2006	1,320	261	1,581	30.0	5.9	35.9	88.1
2007	1,349	259	1,608	29.4	5.6	35.0	86.0
2008	1,611	340	1,951	33.3	7.0	40.3	98.9
2009	1,624	342	1,966	32.6	6.9	39.4	96.7
2010	1,727	301	2,028	34.0	5.9	39.9	98.0
2011	1,811	315	2,126	34.9	6.1	41.0	100.6
2012	1,897	306	2,203	35.7	5.8	41.5	101.7
2013	1,750	278	2,028	32.4	5.1	37.6	92.2

[1] Pulmonary TB refers to TB of the lung parenchyma and includes cases that have both pulmonary and extrapulmonary tuberculosis.

Distribution by age and gender

Of the 2,028 new cases notified in 2013, 885 (43.6%) were 50 years old and above, and 1,276 (62.9%) were males. TB continues to be a disease among older males, as shown in the age and gender-specific incidence rates. (Table 6.14)

Table 6.14
Age-gender distribution and incidence rates of reported tuberculosis among Singapore residents and long-staying foreigners, 2013

				Incidence rate per 100,000 population*		
Age (Yrs)	Male	Female	Total (%)	Male	Female	Total
0 – 4	3	2	5 (0.25)	2.6	1.8	2.2
5 – 9	2	1	3 (0.15)	1.7	0.9	1.3
10 – 14	3	1	4 (0.2)	2.4	0.8	1.6
15 – 19	24	21	45 (2.2)	15.3	14.4	14.9
20 – 29	181	234	415 (20.5)	29.3	47.4	37.4
30 – 39	173	181	354 (17.5)	29.5	35.9	32.4
40 – 49	220	97	317 (15.6)	48.4	25.0	37.7
50 – 59	263	62	325 (16.0)	79.5	19.1	49.6
60 – 69	180	60	240 (11.8)	91.4	28.1	58.5
70 – 79	150	47	197 (9.7)	170.1	43.4	100.3
80 +	77	46	123 (6.1)	239.6	84.3	141.9
Total	**1,276**	**752**	**2,028 (100.0)**	**45.2**	**29.2**	**37.6**

* Rates are based on 2013 mid-year population.
(Source: Singapore Department of Statistics)

In 2013, among the 1,750 new pulmonary TB cases in Singapore residents and long-staying foreigners, 1,669 (95.4%) had bacteriological tests done. The proportion found to have demonstrable bacillary disease was 64.9% (Table 6.15)

Table 6.15
Bacillary status of new pulmonary tuberculosis cases among Singapore residents and long-staying foreigners, 2002 – 2013

Year	No. tested for bacillary disease	% of notified pulmonary cases tested	No. of pulmonary cases with bacillary disease	% of pulmonary cases tested positive	Incidence rate per 100,000 population
2002	1,421	95.1	1,001	70.4	24.0
2003	1,395	95.5	1,040	74.6	25.3
2004	1,262	93.8	1,009	80.0	24.2
2005	1,283	94.9	1,084	84.5	25.4
2006	1,268	96.1	1,060	83.6	24.1
2007	1,291	95.7	1,007	78.0	21.9
2008	1,544	95.8	1,177	76.2	24.3
2009	1,548	95.3	1,147	74.1	23.0
2010	1,652	95.7	1,169	70.8	23.0
2011	1,770	97.7	1,259	71.1	24.3
2012	1,816	95.7	1,213	66.8	22.8
2013	1,669	95.4	1,084	64.9	20.1

The table includes only bacteriological investigations (smear and/or cultures) done from three months before to two weeks after the date of notification or date of starting treatment, whichever earlier.

Incidence and site of disease in Singapore Residents (citizens and permanent residents)

The incidence rate of TB was 36.9 per 100,000 population in 2013. From a historical perspective, the incidence rate of TB declined from 307 per 100,000 population in 1960 to 56.3 per 100,000 population in 1987. From 1987 to 1997, the incidence rate of new TB cases among Singapore citizens and permanent residents stagnated around 50-55 per 100,000 population. Following enhanced TB control measures implemented by STEP, the incidence rate declined from 56.9 per 100,000 population in 1998 to a historical low of 35.1 per 100,000 population in 2007. However, in 2008, the incidence rate increased for the first time in ten years to 39.8 per 100,000 population. Between 2009-2012, the incidence rate stagnated at 38.6 to 40.9 per 100,000 population, before decreasing to 36.9 per 100,000 in 2013 (Figure 6.6).

Of the 1,420 new TB cases among Singapore residents notified in 2013, the majority (88.0%) of cases had pulmonary TB with or without extra-pulmonary involvement, while 12.0% had exclusively extrapulmonary TB (Table 6.16). The most common site of extrapulmonary TB was the lymphatic system (123 new cases in 2013) followed by the pleura (110 new cases in 2013). There was no case of tuberculosis meningitis reported among Singapore residents below 15 years of age.

Figure 6.6
Incidence rate of tuberculosis among Singapore residents, 1960 – 1980 and 1987-2013

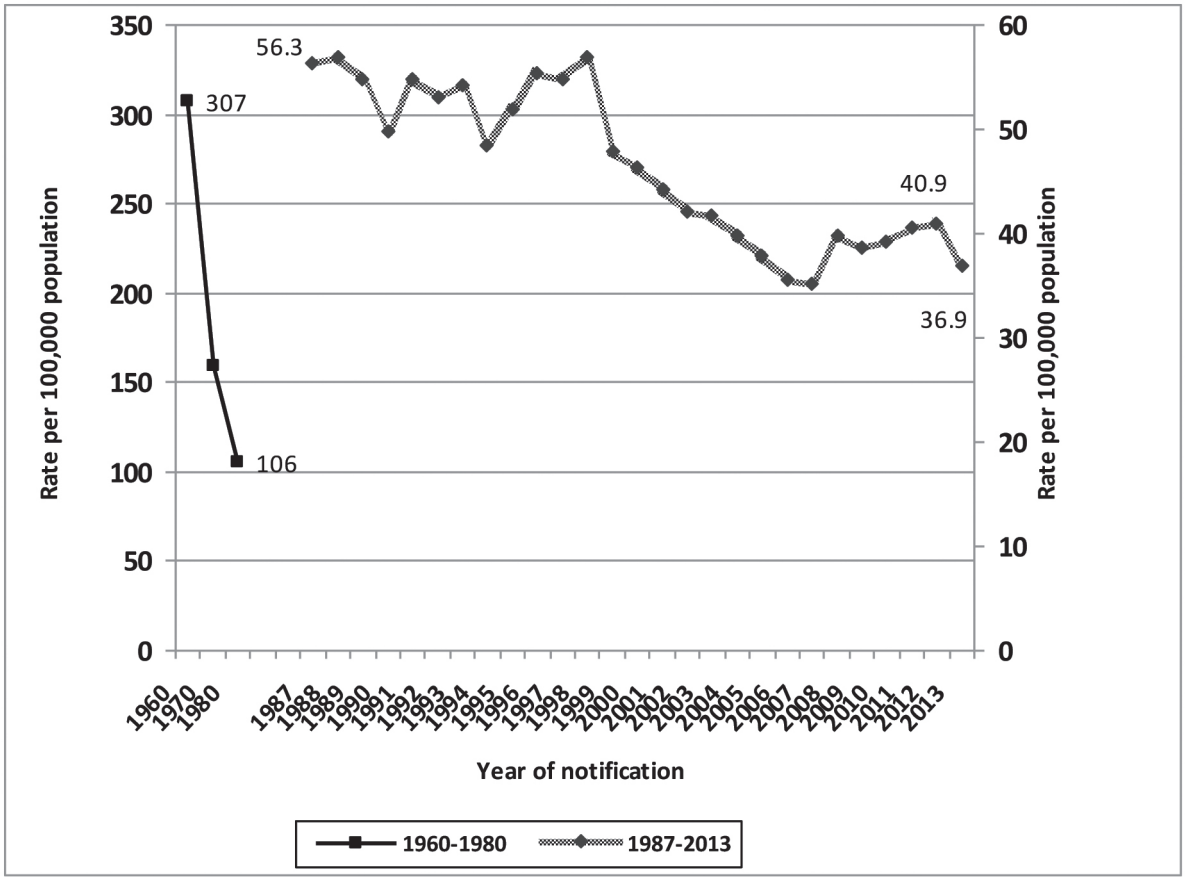


Table 6.16
Distribution of new TB cases by site of disease among Singapore Residents, 1960 – 2013

Year	New Cases			Incidence rate per 100,000 population			Index (base 2002)
	Pulmonary[1]	Extra pulmonary	Total	Pulmonary[1]	Extra pulmonary	Total	
1960	4,985	72	5,057	303	4.0	307.0	100.0
1970	3,135	157	3,292	151	8.0	159.0	51.8
1980	2,253	164	2,417	99	7.0	106.0	34.5
1987	1,346	92	1,438	52.7	3.6	56.3	18.3
1988	1,374	104	1,478	52.9	4.0	56.9	18.5
1989	1,350	102	1,452	51.0	3.9	54.8	17.9
1990	1,243	123	1,366	45.4	4.5	49.9	16.3
1991	1,410	121	1,531	50.5	4.3	54.8	17.9
1992	1,380	130	1,510	48.4	4.6	53.0	17.3
1993	1,471	105	1,576	50.6	3.6	54.3	17.7
1994	1,322	112	1,434	44.7	3.8	48.5	15.8
1995	1,448	116	1,564	48.1	3.8	51.9	16.9
1996	1,591	105	1,696	51.9	3.4	55.3	18.0
1997	1,577	135	1,712	50.5	4.3	54.8	17.9
1998	1,655	155	1,810	52.0	4.9	56.9	18.5
1999	1,405	138	1,543	43.5	4.3	47.8	15.6
2000	1,359	159	1,518	41.5	4.9	46.4	15.1
2001	1,278	196	1,474	38.4	5.9	44.3	14.4
2002	1,271	154	1,425	37.6	4.6	42.1	13.7
2003	1,230	173	1,403	36.5	5.1	41.7	13.6
2004	1,176	184	1,360	34.5	5.4	39.8	13.0
2005	1,142	174	1,316	32.9	5.0	37.9	12.4
2006	1,071	185	1,256	30.4	5.2	35.6	11.6
2007	1,074	182	1,256	30.0	5.1	35.1	11.4
2008	1,208	243	1,451	33.2	6.7	39.8	13.0
2009	1,205	237	1,442	32.3	6.3	38.6	12.6
2010	1,265	213	1,478	33.5	5.6	39.2	12.8
2011	1,309	224	1533	34.5	5.9	40.5	13.2
2012	1,359	201	1,560	35.6	5.3	40.9	13.3
2013	1,249	171	1,420	32.5	4.4	36.9	12.0

[1] Pulmonary TB refers to TB of the lung parenchyma and includes cases that have both pulmonary and extrapulmonary tuberculosis.

Distribution by age and gender

As in previous years, TB in Singapore residents (citizens and PRs) continues to be a disease of older males (Table 6.17). Of the 1420 new cases notified in 2013, 854 (60.1%) were 50 years old and above, and 986 (69.4%) were males. The TB incidence rate among males decreased from 58.7 per 100,000 population in 2012 to 52.1 per 100,000 population in 2013, while that among females remained stable at 22.2 per 100,000 population compared to 23.6 per 100,000 population in 2012.

Table 6.17
Age-gender distribution and incidence rates of reported tuberculosis among Singapore residents, 2013

Age (Yrs)	Male	Female	Total (%)	Incidence rate per 100,000 population*		
				Male	Female	Total
0 – 4	1	0	1 (0.1)	1.1	0.0	0.5
5 – 9	1	1	2 (0.2)	1.0	1.0	1.0
10 – 14	3	1	4 (0.3)	2.6	0.9	1.8
15 – 19	17	19	36 (2.5)	13.1	15.2	14.1
20 – 29	57	64	121(8.5)	22.1	24.2	23.2
30 – 39	87	78	165 (11.6)	30.1	24.9	27.4
40 – 49	169	68	237 (16.7)	54.3	21.4	37.7
50 – 59	247	56	303 (21.3)	82.7	19.0	51.0
60 – 69	178	58	236 (16.6)	98.5	31.0	64.1
70 – 79	149	44	193 (13.6)	186.7	45.6	109.4
80 +	77	45	122 (8.6)	252.5	86.9	148.3
Total	**986**	**434**	**1,420 (100.0)**	**52.1**	**22.2**	**36.9**

* Rates are based on 2013 mid-year population.
(Source: Singapore Department of Statistics)

Ethnic distribution

As in previous years, Malays had the highest TB incidence among the three main ethnic groups. The incidence rate in Malays decreased from 66.1 per 100,000 in 2012 to 57.3 per 100,000 population in 2013. Over the same period, the incidence rate in the Chinese population decreased from 37.6 per 100,000 population to 34.3 per 100,000 population, while that of the Indians was stable at 26.4 per 100,000 population (Table 6.18)

Table 6.18
Ethnic-gender distribution and ethnic-specific incidence rates of reported tuberculosis among Singapore residents, 2013

Ethnic group	Male	Female	Total	Incidence rate per 100,000 population*
Chinese	688	292	980 (69.0)	34.3
Malay	210	84	294 (20.7)	57.3
Indian	66	27	93 (6.6)	26.4
Others	22	31	53 (3.7)	41.9
Total	**986**	**434**	**1,420 (100.0)**	**36.9**

*Rates are based on 2013 mid-year population.
(Source: Singapore Department of Statistics)

Clinical presentation and bacteriological status

In 2013, 1,207 (96.6%) of the 1,249 new pulmonary TB cases in Singapore residents had bacteriological tests done. The proportion found to have demonstrable bacillary disease was 72.8% (Table 6.19).

Table 6.19
Bacillary status of new pulmonary tuberculosis cases among Singapore Residents, 1987 – 2013

Year	No. tested for bacillary disease	% of notified pulmonary cases tested	No. of pulmonary cases with bacillary disease	% of pulmonary cases tested positive	Incidence rate per 100,000 population
1987	1,299	96.5	665	51.2	26.0
1988	1,341	97.6	710	52.9	27.3
1989	1,307	96.8	764	58.5	28.9
1990	1,183	95.2	741	62.6	27.1
1991	1,362	96.6	870	63.9	31.1
1992	1,330	96.4	843	63.4	29.6
1993	1,394	94.8	887	63.6	30.5
1994	1,255	94.9	861	68.6	29.1
1995	1,361	94.0	919	67.5	30.5
1996	1,550	97.4	1,034	66.7	33.7
1997	1,534	97.3	1,001	65.3	32.0
1998	1,617	97.7	1,114	68.9	35.0
1999	1,382	98.4	994	71.9	30.8
2000	1,326	97.6	888	67.0	27.1
2001*	1,218	95.3	878	72.0	26.4
2002	1,250	98.4	903	72.2	26.7
2003	1,204	97.9	911	75.7	27.1
2004	1,107	94.1	892	80.6	26.1
2005	1,092	95.6	933	85.4	26.9
2006	1,034	96.5	885	85.6	25.1
2007	1,036	96.5	844	81.5	23.6
2008	1,177	97.4	952	80.9	26.1
2009	1,164	96.6	937	80.5	25.1
2010	1,236	97.7	951	76.9	25.2
2011	1,276	97.5	977	76.6	25.8
2012	1,321	97.2	981	74.3	25.7
2013	1,207	96.6	879	72.8	22.9

* Starting with 2001, the table includes only bacteriological investigations (smear and/or cultures) done from three months before to two weeks after the date of notification or date of starting treatment, whichever earlier.

Relapsed TB cases

In 2013, there were 119 relapsed TB cases notified among Singapore residents. This accounted for 7.7%of all cases (new & relapse) among Singapore residents (Table 6.20).

Table 6.20
Singapore residents with relapsed tuberculosis by gender, 2009 – 2013

Age (Years)	No. of relapses									
	2009		2010		2011		2012		2013	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
0 – 9	0	1	0	0	0	0	0	0	0	0
10 – 19	0	1	0	0	0	0	2	0	0	3
20 – 29	1	1	2	3	1	4	1	3	0	2
30 – 39	4	2	4	2	1	4	4	5	5	3
40 – 49	14	6	12	5	9	6	11	2	12	3
50 – 59	16	3	16	4	33	11	22	4	20	2
60 – 69	31	3	15	9	22	4	34	3	20	5
70 +	34	8	40	14	52	11	42	3	37	7
Total	**100**	**25**	**89**	**37**	**118**	**40**	**116**	**20**	**94**	**25**
Male & Female	**125**		**126**		**158**		**136**		**119**	

Distribution of TB cases among Singapore residents by country of birth (local vs. foreign-born)

Of the 1,420 new cases notified among residents in 2013, 1,171 (82.5%) were Singapore-born and 248 (17.5%) were foreign-born. Of the 119 relapsed TB cases notified among residents, 108 (90.8%) were Singapore-born and 11 (9.2%) were foreign-born (Table 6.21).

Table 6.21
Distribution of TB cases by age group and country of birth among Singapore Residents, 2012 – 2013

Age (Years)	New cases						Relapsed cases					
	2012			2013			2012			2013		
	S'pore-born	For-eign born	Unk#	S'pore-born	For-eign born	Unk#	S'pore-born	For-eign born	Unk#	S'pore-born	For-eign born	Unk#
0 – 9	2	1	0	2	1	0	0	0	0	0	0	0
10 – 19	47	4	0	40	0	0	1	1	0	3	0	0
20 – 29	112	20	0	103	18	0	3	1	0	1	1	0
30 – 39	128	57	0	102	63	0	4	5	0	6	2	0
40 – 49	216	32	0	196	41	0	13	0	0	15	0	0
50 – 59	312	29	0	277	26	0	25	1	0	21	1	0
60 – 69	249	36	0	200	36	0	35	2	0	25	0	0
70 +	271	44	0	251	63	1	36	8	1	37	7	0
Total	**1,337**	**223**	**0**	**1,171**	**248**	**1**	**117**	**18**	**1**	**108**	**11**	**0**

Unknown country of birth

Tuberculosis – HIV infection in residents

Persons with HIV are known to be particularly susceptible to TB, both from the reactivation of latent infection and from new infection with rapid progression to active disease.

In 2013, 3.1% of the 1420 new cases notified among Singapore residents had prior diagnosis of HIV, similar to 2.7% in 2012. Of the 119 relapsed TB cases notified among Singapore residents in 2013, 6.7% had been previously diagnosed with HIV, compared with 3.7% in 2012. Most of these TB-HIV infections were observed in older age groups and in the male population (Table 6.22). The majority of the TB-HIV infections occurred in Chinese (Table 6.23).

Table 6.22
Age-gender distribution of reported tuberculosis-HIV infection among Singapore residents, 2012 – 2013

Age (Years)	New cases				Relapsed cases			
	2012		2013		2012		2013	
	Male	Female	Male	Female	Male	Female	Male	Female
0 – 9	0	0	0	0	0	0	0	0
10 – 19	0	0	0	0	0	0	0	0
20 – 29	0	0	0	1	0	0	0	0
30 – 39	8	0	4	1	0	0	1	0
40 – 49	11	1	14	1	3	0	3	0
50 – 59	14	1	12	1	0	0	4	0
60 – 69	6	0	8	0	2	0	0	0
70 +	1	0	2	0	0	0	0	0
Total	**40**	**2**	**40**	**4**	**5**	**0**	**8**	**0**
Male & Female	**42**		**44**		**5**		**8**	

Table 6.23
Ethnic-gender distribution of reported tuberculosis-HIV infection among Singapore residents, 2012 – 2013

Ethnic group	New cases				Relapsed cases			
	2012		2013		2012		2013	
	Male	Female	Male	Female	Male	Female	Male	Female
Chinese	34	2	31	2	4	0	6	0
Malay	5	0	5	2	0	0	2	0
Indian	1	0	1	0	0	0	0	0
Others	0	0	3	0	1	0	0	0
Total	**40**	**2**	**40**	**4**	**5**	**0**	**8**	**0**

Tuberculosis in Non-residents

In 2013, there were 1,381 new TB cases notified among non-residents in Singapore. As in previous years, the number of new TB cases notified among short-term pass holders outnumbered long-term pass holders. However in 2013, work permit holders formed the largest group (434 cases), in contrast to the preceding two years when work permit applicants formed the largest group (Table 6.24). As a proportion, long-term pass holders and short-term pass holders contributed 21.7% (Table 6.25) and 27.6% (Table 6.26) of notified new cases in 2013, respectively.

Table 6.24
Distribution of non-residents with new tuberculosis by pass category/status, 2009 – 2013

Pass category / status	No. of new TB cases notified				
	2009	2010	2011	2012	2013
Long-Term Immigration Pass Holders Residing in Singapore					
Work Permit Holders	403	403	442	458	434
Employment Pass Holder	32	41	47	53	52
Other Pass Holders *	89	106	104	132	122
Sub-total	**524**	**550**	**593**	**643**	**608**
Short Stay Foreigners					
Work Permit Applicants	218	329	462	528	389
Visitors **	220	253	237	238	216
Others ***	113	181	207	151	168
Sub-total	**551**	**763**	**906**	**917**	**773**
Total	**1,075**	**1,313**	**1,499**	**1,560**	**1,381**

* Professional pass holder, dependent pass holder, long-term social visit pass holder and student pass holder and S pass holder

** Short term social visitor

*** Professional visit pass applicant, dependent pass applicant, long-term social visit pass applicant, student pass applicant, employment pass applicant, S pass applicant and illegal immigrant

Table 6.25
Distribution of new TB cases by site of disease
Long-term pass holders, 2001 – 2013

Year	No. of new TB cases notified					
	Pulmonary		Extrapulmonary		Total	
	No.	% of total new cases notified	No.	% of total new cases notified	No.	% of total new cases notified
2001	247	11.7	64	3.0	311	14.7
2002	223	11.2	54	2.7	277	13.9
2003	231	11.6	50	2.5	281	14.1
2004	170	8.9	48	2.5	218	11.4
2005	210	10.8	60	3.1	270	13.9
2006	249	12.6	76	3.9	325	16.5
2007	275	13.6	77	3.8	352	17.5
2008	403	16.5	97	4.0	500	20.5
2009	419	16.6	105	4.2	524	20.8
2010	462	16.6	88	3.2	550	19.7
2011	502	16.5	91	3.0	593	19.6
2012	538	17.2	105	3.4	643	20.6
2013	501	17.9	107	3.8	608	21.7

Table 6.26
Distribution of new TB cases by site of disease
Short-term pass holders, 2001 – 2013

Year	No. of new TB cases notified					
	Pulmonary		Extrapulmonary		Total	
	No.	% of total new cases notified	No.	% of total new cases notified	No.	% of total new cases notified
2001	283	13.4	45	2.1	328	15.5
2002	244	12.3	41	2.1	285	14.3
2003	283	14.2	29	1.5	312	15.6
2004	279	14.6	59	3.1	338	17.6
2005	295	15.2	55	2.8	350	18.1
2006	316	16.0	75	3.8	391	19.8
2007	340	16.9	66	3.3	406	20.2
2008	412	16.8	81	3.3	493	20.2
2009	482	19.1	69	2.7	551	21.9
2010	672	24.1	91	3.3	763	27.3
2011	833	27.4	73	2.4	906	29.9
2012	832	26.7	85	2.7	917	29.4
2013	678	24.2	95	3.4	773	27.6

TB drug resistance

In the following, analyses related to TB drug resistance for Singapore residents would be presented separately amongst those who are Singapore-born and foreign-born. Cases with unknown place of births were excluded from the analysis. The data presented is based on the drug susceptibility testing result of mycobacterial cultures taken at baseline (from three months before to two weeks after the date of notification or date of starting treatment, whichever earlier).

Singapore –born residents

The overall incidence of drug resistance among 713 new pulmonary TB cases in whom drug-susceptibility testing was performed was 6.6%: with 5.3% (38 cases) resistant to one drug and 1.3% (9 cases) resistant to more than one drug (Table 6.27). Multi-drug-resistant TB (MDR-TB), i.e. resistance to both rifampicin and isoniazid, was detected in 2 cases (0.3%), while resistance to isoniazid but not rifampicin was detected in 21 cases (2.9 %).

The overall incidence of drug resistance among 61 relapsed pulmonary TB cases with drug susceptibility testing performed was 6.6%: 5.0% (3 cases) were resistant to one drug and 1.6% (1 case) was resistant to more than one drug. There was one MDR-TB case (1.6%) and one case (1.6%) resistant to isoniazid but not rifampicin. No Singapore-born resident with initially pan-sensitive or isoniazid mono-resistant TB developed MDR-TB during treatment in 2013. There was no case of extensively-drug-resistant TB (XDR-TB), i.e. MDRTB with resistance to any fluoroquinolone and second-line injectable agent, among Singapore-born TB cases in 2013

Table 6.27
Mycobacterium tuberculosis drug susceptibility in Singapore-born residents with pulmonary tuberculosis, 2010 – 2013

Sensitivity result of sputum examination *	2010		2011		2012		2013	
	No.	%	No.	%	No.	%	No.	%
New cases								
**Sensitive to: Streptomycin, Isoniazid, Rifampicin	738	95.0	762	94.7	784	92.7	666	93.4
Resistant to:								
Single drug	33	4.2	32	4.0	52	6.1	38	5.3
More than 1 drug	6	0.8	11	1.3	10	1.2	9	1.3
Total examined	**777**	**100.0**	**805**	**100.0**	**846**	**100.0**	**713**	**100.0**
***Resistant to Isoniazid	**12**	**1.5**	**16**	**2.0**	**28**	**3.3**	**21**	**2.9**
Resistant to Rifampicin & Isoniazid	**1**	**0.1**	**3**	**0.4**	**6**	**0.7**	**2**	**0.3**
Relapsed cases								
Sensitive to: Streptomycin, Isoniazid, Rifampicin	58	85.3	78	88.6	70	92.1	57	93.4
Resistant to:								
Single drug	8	11.8	9	10.2	5	6.6	3	5.0
More than 1 drug	2	2.9	1	1.1	1	1.3	1	1.6
Total examined	**68**	**100.0**	**88**	**100.0**	**76**	**100.0**	**61**	**100.0**
Resistant to Isoniazid	**3**	**4.4**	**6**	**6.8**	**3**	**3.9**	**1**	**1.6**
Resistant to Rifampicin & Isoniazid	**1**	**1.5**	**0**	**0.0**	**0**	**0.0**	**¥ 1**	**1.6**

* In the case of dual lesions, the sensitivity result recorded is that of organisms cultured from sputum.
** Sensitive to Isoniazid, Rifampicin,Streptomycin and Ethambutol
*** Any of isoniazid resistance, exclusive of MDR
¥ MDR case was notified as both pulmonary and extra-pulmonary TB, but MDR result was from an extra-pulmonary specimen only

Foreign –born residents

In 2013, the overall incidence of drug resistance among 143 new pulmonary TB cases in whom drug-susceptibility testing was performed was 11.9%, with 8.4% (12 cases) resistant to one drug and 3.5% (5 cases) resistant to more than one drug (Table 6.28). There were no MDR-TB cases. Resistance to isoniazid was 6.9% (10 cases). No drug resistance was detected among the 6 relapsed pulmonary TB cases in foreign-born residents with drug susceptibility testing performed.

Table 6.28
Mycobacterium tuberculosis drug susceptibility in foreign-born residents with pulmonary tuberculosis, 2010 – 2013

Sensitivity result of sputum examination *	2010		2011		2012		2013	
	No.	%	No.	%	No.	%	No.	%
New cases								
**Sensitive to: Streptomycin, Isoniazid, Rifampicin	133	92.4	135	91.8	101	89.4	126	88.1
Resistant to:								
Single drug	7	4.9	5	3.4	7	6.2	12	8.4
More than 1 drug	4	2.8	7	4.8	5	4.4	5	3.5
Total examined	**144**	**100.0**	**147**	**100.0**	**113**	**100.0**	**143**	**100.0**
***Resistant to Isoniazid	**7**	**4.9**	**5**	**3.4**	**7**	**6.2**	**10**	**7.0**
Resistant to Rifampicin & Isoniazid	**1**	**0.7**	**3**	**2.0**	**2**	**1.8**	**0**	**0.0**
Relapsed cases								
Sensitive to: Streptomycin, Isoniazid, Rifampicin	7	77.8	13	86.7	9	90.0	6	100.0
Resistant to:								
Single drug	2	22.2	1	6.6	0	0.0	0	0.0
More than 1 drug	0	0.0	1	6.6	1	10.0	0	0.0
Total examined	**9**	**100.0**	**15**	**100.0**	**10**	**100.0**	**6**	**100.0**
Resistant to Isoniazid	**1**	**11.1**	**1**	**6.6**	**0**	**0.0**	**0**	**0.0**
Resistant to Rifampicin & Isoniazid	**0**	**0.0**	**0**	**0.0**	**1**	**10.0**	**0**	**0.0**

* In the case of dual lesions, the sensitivity result recorded is that of organisms cultured from sputum.
** Sensitive to Isoniazid, Rifampicin,Streptomycin and Ethambutol
*** Any of isoniazid resistance, exclusive of MDR

Non-residents

In 2013, the overall incidence of drug resistance in new pulmonary TB cases among 392 non-residents with drug-susceptibility testing performed was 13.0%, with 8.2% (32 cases) being resistant to one drug and 4.8% (19 cases) resistant to more than one drug (Table 6.29). MDR-TB was detected in 12 cases (3.1%), and resistance to isoniazid but not rifampicin was detected in 27 cases (6.9%).

Among the 20 relapsed pulmonary TB cases with drug susceptibility testing performed, 5.0% (1 case) was resistant to one drug and 20.0% (4 cases) to more than one drug. Four cases (20.0%) were MDR-TB, and 1 case (5.0%) was resistant to isoniazid but not rifampicin.

Table 6.29
Mycobacterium tuberculosis drug susceptibility in non-residents with pulmonary tuberculosis, 2010 – 2013

Sensitivity result of sputum examination *	2010		2011		2012		2013	
	No.	%	No.	%	No.	%	No.	%
New cases								
**Sensitive to: Streptomycin, Isoniazid, Rifampicin	363	84.6	435	84.5	346	83.2	341	87.0
Resistant to:								
Single drug	28	6.5	44	8.5	35	8.4	32	8.2
More than 1 drug	38	8.9	36	6.9	35	8.4	19	4.8
Total examined	**429**	**100.0**	**515**	**100.0**	**416**	**100.0**	**392**	**100.0**
***Resistant to Isoniazid	**42**	**9.8**	**40**	**7.8**	**35**	**8.4**	**27**	**6.9**
Resistant to Rifampicin & Isoniazid	**13**	**3.0**	**13**	**2.5**	**20**	**4.8**	**¥ 12**	**3.1**
Relapsed cases								
Sensitive to: Streptomycin, Isoniazid, Rifampicin	8	53.3	19	65.5	15	78.9	15	75.0
Resistant to:								
Single drug	0	0.0	3	10.3	1	5.3	1	5.0
More than 1 drug	7	46.7	7	24.1	3	15.8	4	20.0
Total examined	**15**	**100.0**	**29**	**100.0**	**19**	**100.0**	**20**	**100.0**
Resistant to Isoniazid	**1**	**6.7**	**3**	**10.3**	**1**	**5.3**	**1**	**5.0**
Resistant to Rifampicin & Isoniazid	**6**	**40.0**	**6**	**20.7**	**3**	**15.8**	**4**	**20.0**

* In the case of dual lesions, the sensitivity result recorded is that of organisms cultured from sputum.
** Sensitive to Isoniazid, Rifampicin,Streptomycin and Ethambutol
*** Any of isoniazid resistance, exclusive of MDR
¥ One MDR case was notified as both pulmonary and extra-pulmonary TB, but MDR result was from an extra-pulmonary specimen only

Tuberculosis mortality

In 2013, there were 46 deaths from tuberculosis among Singapore residents giving a mortality rate of 1.2 cases per 100,000 population (Table 6.30). The majority were males (76.1%) and aged 60 years and above (84.8%).

Table 6.30
Age-gender distribution and age-specific mortality rates of tuberculosis, 2013

Age (Years)	Male	Female	Total (%)	Incidence rate per 100,000 population*
10 – 19	0	0	0 (0.0)	0.0
20 - 29	0	0	0 (0.0)	0.0
30 – 39	0	1	1 (2.2)	0.2
40 – 49	3	0	3 (6.5)	0.5
50 – 59	3	0	3 (6.5)	0.5
60 – 69	5	2	7 (15.2)	1.9
70 +	24	8	32 (69.6)	12.4
Total	**35**	**11**	**46 (100.0)**	**1.2**

LEPROSY

Leprosy is a chronic bacterial disease of the skin, peripheral nerves and (in lepromatous patients) the upper airway by *Mycobacterium leprae*. The manifestations of the disease vary in a continuous spectrum between the two polar forms, lepromatous and tuberculoid leprosy.

In the past, leprosy was regarded as a highly contagious, mutilating and incurable disease and this led to a lot of social stigma associated with the disease and the people afflicted with it. Before effective treatment for leprosy was available, patients were segregated in leprosariums to prevent the spread of leprosy to the community. Modern treatment for leprosy was introduced in 1941 when dapsone and its derivatives were used. With effective chemotherapy, leprosy is curable today and patients are now treated in the general health services alongside other diseases. Currently, the Cutaneous Infections Unit of the National Skin Centre undertakes the treatment of leprosy and is responsible for its control in Singapore. The incidence rate of leprosy among Singapore residents has declined over the past five decades, from 21.3 per 100,000 population in 1960 to 0.1 per 100,000 population in 2013 (Figure 6.7). In 2013, a total of four Singapore residents with leprosy were notified (Table 6.31).

Figure 6.7
Incidence rate of leprosy among Singapore residents, 1960 – 2013

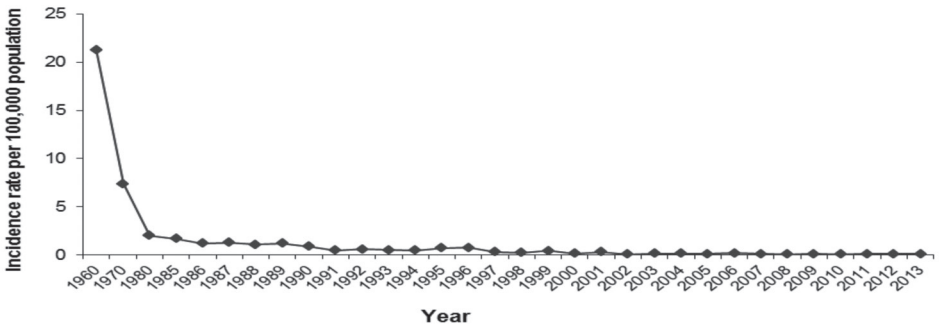


Table 6.31
Age-gender distribution and age-specific incidence rates of reported leprosy among Singapore residents, 2013

Age (Years)	Male	Female	Total (%)	Incidence rate per 100,000 population*
0 – 9	0	0	(0.0)	0
10 – 19	0	0	(0.0)	0
20 – 29	0	0	(0.0)	0
30 – 39	0	0	(0.0)	0
40 – 49	1	1	(50.0)	0.3
50 – 59	0	0	(0.0)	0
60 – 69	1	0	(0.25)	0.3
70 +	0	1	(0.25)	0.4
Total	**2**	**2**	**4 (100.0)**	**0.1**

* Rates are based on 2013 estimated mid-year population.
(Source: Singapore Department of Statistics)

Clinical presentation

Leprosy patients were classified into lepromatous, borderline lepromatous, borderline tuberculoid, tuberculoid and neuroleprosy types. Among the four residents, two had lepromatous and two had borderline lepromatous leprosy (Table 6.32).

Table 6.32
Clinical presentation in Singapore residents with leprosy, 2013

Type of leprosy	No. of cases
Lepromatous	2
Borderline Lepromatous	2
Borderline Tuberculoid	0
Tuberculoid	0
Neuroleprosy	0
All types	**4**

Leprosy in non-residents

The contribution of non-residents to the total number of cases has fluctuated over the years. In 2013, there were three non-residents notified with leprosy, accounting for 43% of the total cases (Table 6.33).

Table 6.33
Distribution of non-residents with leprosy by gender, 1980 – 2013

Year	No. of cases			% of total cases notified
	Male	Female	Total	
1980	14	7	21	32
1985	10	6	16	28
1986	7	2	9	23
1987	5	6	11	25
1988	4	6	10	26
1989	8	10	18	37
1990	7	5	12	33
1991	6	3	9	41
1992	15	9	24	59
1993	5	4	9	38
1994	8	5	13	48
1995	7	4	11	33
1996	8	2	10	43
1997	9	4	13	57
1998	10	2	12	63
1999	5	3	8	36
2000	9	4	13	72
2001	1	2	3	21
2002	7	1	8	73
2003	5	1	6	54
2004	4	4	8	57
2005	6	3	9	69
2006	3	2	5	42
2007	6	2	8	67
2008	4	3	7	70
2009	3	1	4	50
2010	6	2	8	73
2011	3	4	7	64
2012	7	3	10	71
2013	2	1	3	43

Air-/Droplet-Borne Diseases

Vector-Borne/ Zoonotic Diseases

Food-/Water-Borne Diseases

Blood-Borne Diseases

Environmental-Related Diseases

HIV/AIDS, STIs, Tuberculosis & Leprosy

Childhood Immunisation

VII
CHILDHOOD IMMUNISATION

NATIONAL CHILDHOOD IMMUNISATION PROGRAMME IN 2013

The National Childhood Immunisation Programme (NCIP) in Singapore covers vaccination against tuberculosis; hepatitis B; diphtheria, pertussis and tetanus (DPT); poliomyelitis; measles, mumps and rubella (MMR); pneumococcal disease; and human papillomavirus. Only diphtheria and measles immunisations are compulsory by law. Since 1st January 1990, the monovalent measles vaccine given to one-year-old children was replaced by the trivalent MMR vaccine. As of 1st January 1998, the monovalent rubella vaccine given to primary school leavers was also replaced by the second dose of MMR vaccine (Table 7.1).

BCG vaccination began in mid 1950s in Singapore as part of the NCIP. All new-borns were vaccinated at birth. Although parental consent is required, acceptances have been high and close to 100% of children have been vaccinated in the last decade (Table 7.2). The BCG immunisation programme has contributed significantly to the near eradication of tuberculous meningitis in young children. BCG was discontinued for Mantoux non-reactors and BCG booster was also discontinued on 1 July 2001. The BCG vaccination coverage of infants and new-borns has been over 97% annually since 1987.

Hepatitis B vaccination for infants born to carrier mothers was incorporated into the NCIP in October 1985. This was extended to all newborns since 1st September 1987. To protect those born before 1987, a 4-year hepatitis B immunisation programme was implemented for students in secondary 3, junior college year 2, centralised institute year 3, institutes of technical education (ITE), polytechnics and universities in January 2001. In addition, full-time national servicemen who were non-immune were offered hepatitis B immunisation.

The NCIP was reviewed by the Expert Committee on Immunisation and a revised schedule was implemented in 2011. With the change in the immunisation schedule, both doses of measles, mumps and rubella would be brought forward to 12 months and 15-18 months respectively. School Health Services will continue to provide the second dose to primary one (6-7 years old) children.

Pneumococcal conjugate vaccine (PCV) was included as the 10th vaccine in the NCIP in 2009 to reduce morbidity and mortality of invasive pneumococcal diseases in Singapore. The ECI recommended a schedule of two doses for the primary series and one booster dose (2+1 schedule). The two doses in the primary series are to be given at age 3 and 5 months respectively and the booster dose at age 12-24 months. After the introduction of PCV to NCIP, immunisation coverage for pneumococcal vaccination increased from 20% in 2009 to 60% for children aged one year who received two doses of PCV in 2012

IMPLEMENTATION OF THE IMMUNISATION PROGRAMME

The vaccination programme is carried out by:

(a) National Healthcare Group (NHG) polyclinics and SingHealth (SH) polyclinics
(b) Youth Health Division (YHD) of the Health Promotion Board (HPB)
(c) Private medical practitioners

Immunisation of pre-school children is carried out at the polyclinics and by private medical practitioners. The target population is based on notification of births obtained from the Registry of Births and Deaths.

Immunisation of school children is carried out by YHD. The target population is based on student population data from the Ministry of Education.

Table 7.1
Singapore National Childhood Immunisation Schedule, 2013

Vaccination against	Birth	1 Month	3 Month	4 Month	5 Month	6 Month	12 Month	15 Month	18 Month	10-11 years^
Tuberculosis	**BCG**									
Hepatitis B	**HepB** (D1)	**HepB** (D2)			**HepB** (D3)#					
Diphtheria, Tetanus, Pertussis			**DTaP** (D1)	**DTaP** (D2)	**DTaP** (D3)				**DTaP** (B1)	**DTaP** (B2)
Poliovirus			**IPV** (D1)	**IPV** (D2)	**IPV** (D3)				**IPV** (B1)	**IPV** (B2)
Haemophilus influenzae type b			**Hib** (D1)	**Hib** (D2)	**Hib** (D3)				**Hib** (B1)	
Measles, Mumps, Rubella							**MMR** (D1)	**MMR** (D2)##		
Pneumococcal Disease			**PCV** (D1)		**PCV** (D2)		**PCV** (B1)			
Human Papillomavirus	***Recommended for females 9 to 26 years; three doses are required at intervals of 0, 2, 6 months***									

Notes:

BCG	Bacillus Calmette-Guérin vaccine
HepB	Hepatitis B vaccine
Hib	Haemophilus influenzae type b vaccine
DTaP	Paediatric diphtheria and tetanus toxoid and acellular pertussis vaccine
Tdap	Tetanus toxoid, reduced diphtheria toxoid and acellular pertus¬sis vaccine
MMR	Measles, mumps, and rubella vaccine
IPV	Inactivated polio vaccine
OPV	Oral polio vaccine
PCV	Pneumococcal conjugate vaccine
D1/D2/D3	1st dose, 2nd dose, 3rd dose
B1/B2	1st booster, 2nd booster
^	Primary 5
#	3rd dose of HepB can be given at the same time as the 3rd dose of DTaP, IPV, and Hib for the convenience of parents.
##	2nd dose of MMR can be given between 15-18 months

Table 7.2
BCG vaccination of infants in Singapore in public and private sectors, 1981 – 2013

Year	Government & Restructured Hospital (%)	Government Clinic (%)	Private Sector (%)	Total (%)	Coverage[1] for children at 2 years of age
1981	33,917 (96.4)	1,260 (3.6)	-	35,177 (100)	83.3
1982	28,270 (76.4)	5,863 (15.8)	2,923 (7.8)	37,056 (100)	86.9
1983	27,019 (80.6)	4,377 (13.1)	2,106 (6.3)	33,502 (100)	82.5
1984	26,528 (68.4)	4,102 (10.6)	8,165 (21.0)	38,795 (100)	93.4
1985	26,740 (67.5)	4,018 (10.1)	8,882 (22.4)	39,640 (100)	93.3
1986	20,991 (58.1)	2,781 (7.7)	12,328 (34.2)	36,100 (100)	94.1
1987	20,242 (47.5)	2,991 (7.0)	19,359 (45.5)	42,592 (100)	97.7
1988	26,771 (51.6)	3,049 (5.9)	22,001 (42.5)	51,821 (100)	97.9
1989	22,545 (47.7)	2,921 (6.2)	21,772 (46.1)	47,238 (100)	99.1
1990	21,419 (42.3)	2,789 (5.5)	26,381 (52.2)	50,589 (100)	98.9
1991	20,704 (42.5)	2,029 (4.2)	25,948 (53.3)	48,681 (100)	99.1
1992	21,948 (44.7)	1,479 (3.0)	25,651 (52.3)	49,078 (100)	99.3
1993	22,093 (45.0)	1,611 (3.3)	25,436 (51.7)	49,140 (100)	97.8
1994	20,918 (43.5)	1,251 (2.6)	25,933 (53.9)	48,102 (100)	97.1
1995	18,614 (39.3)	1,312 (2.8)	27,392 (57.9)	47,318 (100)	97.3
1996	19,240 (37.2)	1,208 (2.3)	31,231 (60.4)	51,679 (100)	98.1
1997	20,001 (39.5)	1,257 (2.5)	29,290 (57.9)	50,548 (100)	98.0
1998	18,984 (38.9)	1,307 (2.8)	26,276 (56.4)	46,567 (100)	98.4
1999	19,007 (40.2)	1,261 (2.8)	24,669 (54.9)	44,937 (100)	99.1
2000	18,415 (35.9)	1,191(2.5)	28,825 (59.5)	48,431 (100)	98.9
2001	19,124 (43.6)	495 (1.2)	22,907 (53.9)	42,526 (100)	98.4
2002	19,295 (46.4)	285 (0.7)	22,034 (52.9)	41,614 (100)	97.7
2003	16,839 (44.1)	291 (0.8)	21,063 (55.1)	38,193 (100)	99.3
2004	16,966 (44.1)	307 (0.8)	21,173 (55.1)	38,446 (100)	99.2
2005	16,352 (42.4)	208 (0.5)	22,010 (57.1)	38,570 (100)	97.8
2006	15,904 (41.3)	177 (0.5)	22,412 (58.2)	38,493 (100)	98.3
2007	16,399 (43.8)	205 (0.5)	20,796 (55.6)	37,400 (100)	99.4
2008	16,120 (42.1)	176 (0.5)	21,963 (57.4)	38,259 (100)	99.5
2009	15,967 (41.7)	123 (0.3)	22,228 (58.0)	38,318 (100)	99.3
2010	13,878 (42.6)	85 (0.3)	18,623 (57.2)	33,454 (100)	98.9
2011	13,123 (41.8)	67 (0.2)	18,172 (57.9)	31,362 (100)	99.6
2012	12,145 (41.2)	110 (0.4)	17,225 (58.4)	29,480 (100)	99.2
2013	15,756 (40.5)	70 (0.2)	23,076 (59.3)	38,902 (100)	99.3

[1] Data refer to immunisation given to all Singaporean and Singapore-PR children

Notification of Immunisation

The data utilised in this report was based on:

(a) notifications of all immunisation carried out in pre-school children by healthcare institutions in both the public and private sectors to the National Immunisation Registry (NIR) at HPB. (Note: notifications of diphtheria and measles immunisation are compulsory.)

(b) immunisation records kept by YHD (immunisations administered in schools and at the Immunisation Clinic, Student Health Centre of the Health Promotion Board).

Immunisation against Diphtheria, Pertussis and Tetanus

Infants and pre-school children

The primary immunisation course was completed in 29,733 children in 2013 giving an estimated coverage of 96.8% (Table 7.3). Booster doses were given to 27,987pre-school children under 2 years of age (91.1%) under the first booster programme.

Table 7.3
Diphtheria, Pertussis and Tetanus immunisations, 2003 – 2013

	Coverage[1] for children at 2 years of age			
	Completed primary course		Boosters given	
Year	No.	Coverage (%)	No.	Coverage (%)
2003	38,064	96.0	33,389	84.0
2004	36,587	94.6	34,740	89.9
2005	34,030	96.1	32,205	91.0
2006	31,948	95.4	30,138	90.0
2007	31,778	96.6	29,050	88.3
2008	30,975	96.9	27,888	87.3
2009	34,481	96.8	32,431	91.0
2010	32,523	96.1	30,377	89.8
2011	30,242	96.0	28,642	90.9
2012	28,776	96.7	27,196	91.4
2013	29,733	96.8	27,987	91.1

[1] Data refers to immunisation given to all Singaporean and Singapore PR children

School children

In 2013, Tdap boosters were given to 39,217 (91.4%) primary 5 students (Table 7.4)

Table 7.4
Diphtheria, tetanus and pertussis boosters given to primary 5 students (10 – 11 years of age), 2008 – 2013

Year	Total No. of primary 5 students	Booster given#	
		No.	Coverage (%)
2008	49,126	47,146	96.0
2009	45,498	43,240	95.0
2010	45,555	43,238	94.9
2011	49,071	45,848	93.4
2012	43,579	40,079	92.0
2013	42,901	39,217	91.4

Coverage by YHD does not include booster immunisations done by private practitioners

Immunisation against *Haemophilus influenzae* type b

In 2013, the primary course of *Haemophilus influenzae* type b (Hib) immunisation was completed in 25,764 infants. The overall coverage for children who have completed the full course of vaccination at two years of age was 83.9% (Table 7.5).

Table 7.5
Haemophilus influenzae type b immunisation, 2009 – 2013

Year	Coverage[1] for children at 2 years of age			
	Completed primary course		Boosters given	
	No.	Coverage (%)	No.	Coverage (%)
2009	27,406	92.0	26,716	89.6
2010	25,524	85.6	24,126	81.0
2011	25,262	84.8	24,223	81.3
2012	24,319	81.6	23,289	78.1
2013	25,764	83.9	24,796	80.7

[1] Data refers to immunisation given to all Singaporean and Singapore PR children

Immunisation against Poliomyelitis

Infants and pre-school children

Primary poliomyelitis immunisation was completed in 29,726 giving coverage of 96.8% (Table 7.6).

A total of 27,945 polio boosters were given to children under the first booster programme (90.9% coverage).

School children

In 2013, 37,275 (92.3%) school entrants were given boosters (Table 7.6). In 2012, 2,900 (7.3%) of the school entrants missed their booster doses. Of these children, 2,275 (78.4%) were immunised in 2013 (Table 7.7).

During the year, 41,661 (97.1%) primary 5 students (Table 7.8) received booster doses.

Table 7.6
Poliomyelitis immunisation of infants, pre-school and school children, 2003 –2013

Year	Coverage[1] for children at 2 years of age				School Children		
	Completed primary polio course		Boosters given		Boosters given #		
	No.	Coverage %	No.	Coverage %	School entrants	No.#	Coverage %
2003	38,010	95.9	33,026	83.0	49,788	46,506	93.0
2004	36,548	94.5	34,211	88.5	47,918	45,085	94.0
2005	33,997	96.0	32,070	90.6	44,110	41,478	94.0
2006	31,935	95.4	30,009	89.7	44,572	41,312	93.0
2007	31,768	96.6	28,909	87.9	48,122	44,380	92.0
2008	30,964	96.9	27,679	86.6	43,548	40,055	92.0
2009	34,466	96.7	32,272	90.6	43,142	39,752	92.1
2010	32,496	96.0	30,299	89.5	39,465	37,037	93.8
2011	30,230	95.9	28,597	90.8	39,886	36,714	92.1
2012	28,767	96.6	27,159	91.2	39,682	36,782	92.7
2013	29,726	96.8	27,945	90.9	40,385	37,275	92.3

Coverage by YHD does not include booster immunisations done by private practitioners

[1] Data refers to immunisation given to all Singaporean and Singapore PR children

Table 7.7
Poliomyelitis boosters given to missed vaccinees in the following year 2003 – 2012

Year	No. of missed vaccinees among school entrants	% of missed vaccinees over total new school entrants	No. given boosters in the following year #	% of missed vaccinees covered
2003	3,282	7.0	912	28.0
2004	2,833	6.0	974	34.0
2005	2,632	6.0	1,282	49.0
2006	3,260	7.0	1,594	49.0
2007	3,742	8.0	2,185	58.0
2008	3,493	8.0	2,127	60.9
2009	3,390	7.9	2,182	64.4
2010	2,428	6.2	2,022	83.3
2011	3,172	7.9	2,097	66.1
2012	2,900	7.3	2,275	78.4

Coverage by YHD does not include booster immunisations done by private practitioners

Table 7.8
Poliomyelitis boosters given to primary 5 students (10 – 11 years of age), 2008 - 2013

Year	Total No. of primary 5 students	Booster given #	
		No	Coverage (%)
2008	49,126	47,314	96.0
2009	45,498	43,895	96.5
2010	45,555	44,286	97.2
2011	49,071	47,531	96.9
2012	43,579	42,091	96.6
2013	42,901	41,661	97.1

[#] Coverage by YHD does not include booster immunisations done by private practitioners

Immunisation against Measles, Mumps and Rubella

Infants and pre-school children

In 2013, a total of 29,195 children were immunised against measles, mumps and rubella by 2 years of age, giving coverage of 95.0% (Table 7.9).

Table 7.9
Measles, mumps and rubella immunisations, 2003 – 2013

Infants and pre-school children [1]		
No. Completed first dose by age 2 years		
Year	No.	Coverage %
2003	36,956	93.2
2004	36,845	95.3
2005	33,843	95.6
2006	31,638	94.5
2007	31,217	95.0
2008	30,352	94.9
2009	34,057	95.2
2010	32,165	95.1
2011	29,992	95.2
2012	28,320	95.1
2013	29,195	95.0

[1] Data refers to immunisation given to all Singaporean and Singapore PR children

School children

The MMR vaccine was given to 34,654 (85.8%) school entrants in 2013 (Table 7.10).

Table 7.10
2nd dose of measles, mumps and rubella immunisations, 2012 - 2013

	Total No.	No. given	Coverage# (%)
School Entrants			
2012	39,682	36,641	91.6
2013	40,385	34,654	85.8

Coverage by YHD does not include booster immunisations done by private practitioners

In 2012, 3,341 (8.4%) school entrants missed their 2nd dose MMR. 1,438 (43.0%) were immunised in 2013 (Table 7.11).

Table 7.11
2nd dose of MMR given to missed vaccinees in the following year, 2011 - 2012

Year	No. of missed vaccinees among school entrants	% of missed vaccinees over total new school entrants	No. given in the following year #	% of missed vaccinees covered
2011	3,338	8.4	1,396	41.8
2012	3,341	8.4	1,438	43.0

Coverage by YHD does not include booster immunisations done by private practitioners

Immunisation against Hepatitis B

A total of 19,177 blood samples were screened at the KK Women's and Children's Hospital for HBsAg and HBeAg in 2013. Of these, 441 (2.3%) were HBsAg positive and 127 (0.7%) were HBeAg positive.

In 2013, the primary course of hepatitis B immunisation was completed in 29,668 infants. The overall coverage rate for babies who have completed the full course of vaccination under two years of age remained high at 96.6% (Table 7.12).

Table 7.12
Hepatitis B immunisation, 2003 – 2013

Full course of Hepatitis B vaccination completed by age 2 years		
Year	No.	Coverage[1] (%)
2003	37,787	95.3
2004	36,156	93.5
2005	33,873	95.3
2006	31,662	94.6
2007	31,449	95.6
2008	30,924	96.8
2009	34,341	96.4
2010	32,376	95.7
2011	30,159	95.7
2012	28,730	96.5
2013	29,668	96.6

[1] Data refers to immunisation given to all Singaporean and Singapore PR children

Immunisation against Pneumococcal Disease

In 2013, a total of 22,829 children received at least two doses of PCV by age one year, giving an estimated coverage of 76.6%. (Table 7.13)

Table 7.13
Pneumococcal Vaccination, 2009 – 2013

Year	No. completed two doses by age 1 year		No. completed booster (3rd) dose by age 2 years	
	No.	Coverage[1] %	No.	Coverage[1] %
2009	7,180	24.1	5,514	18.5
2010	16,930	56.8	6,906	23.2
2011	15,981	53.6	12,327	41.4
2012	18,834	61.3	15,169	50.9
2013	22,829	76.6	18,081	58.9

[1] Data refers to immunisation given to all Singaporean and Singapore PR children

EFFECTIVENESS OF THE IMMUNISATION PROGRAMME

The effectiveness of the childhood immunisation programme against poliomyelitis and diphtheria is shown in Figure 7.1 and 7.2. In 2013, no indigenous case of diphtheria, poliomyelitis and neonatal tetanus was reported.

With the implementation of the 'catch-up' measles vaccination programme using the MMR vaccine in 1997, and the introduction of the second dose of MMR vaccine to all primary six school children in 1998 and primary one school children with effect from 2008, the incidence of measles decreased sharply from 1,413 cases in 1997 to 46 in 2013 (Figure 7.3).

Rubella incidence decreased from 64 cases in 2012 to 48 in 2013. There were no reported cases of indigenous congenital rubella and two termination of pregnancy carried out in 2013 due to rubella infection (Table 7.14).

The resurgence of mumps which began in 1998, continued until the year 2002. The resurgence was due to poor protection conferred by the Rubini strain of the MMR vaccine which was subsequently de-registered in 1999. The incidence of mumps has decreased from 521 cases in 2012 to 495 cases in 2013 (Table 7.15).

The incidence of indigenous acute hepatitis B has declined from 243 cases (9.5 per 100,000 population) in 1985 to 55 cases (1.0 per 100,000 population) in 2013 (Figure 7.4). During the same period, the reported number of cases in children <15 years plummeted from 10 to 0 (Table 7.15).

A national sero-prevalence survey was conducted in 2012 to determine the prevalence of antibody against vaccine preventable diseases and other diseases of public health importance in the adult Singapore resident population aged 18 – 79 years using residual sera from the National Health Survey 2010. The overall sero-prevalence was 85.0% for rubella in those aged 18 – 79 years. 11.1% of women 18 – 44 years of age remained susceptible to rubella infection. About 43.9% of Singapore residents aged 18 – 79 years possessed immunity against hepatitis B virus (anti-HBs ≥10 mIU/mL). The overall prevalence of HBsAg in the population was 3.6%.

PUBLIC EDUCATION AND PROGRAMMES

The Health Promotion Board educates parents on the importance of childhood immunisations through educational materials such as "Childhood Immunisations: Give Your Child The Best Protection" and "Protect your child against Measles, Mumps and Rubella with the MMR vaccination". These are distributed in the polyclinics and other healthcare institutions. Under the Healthier Child, Brighter Future initiative, the "Healthy Start For Your Baby" guide also contains a chapter on childhood immunisations. This educates parents the importance of immunisation and to immunise their children according to the recommended National Childhood Immunisation Schedule. The guide is distributed to mothers who have delivered and before they are discharged from the maternity hospitals.

Figure 7.1
Incidence per 100,000 population from poliomyelitis and immunisation coverage rates in Singapore, 1946 – 2013

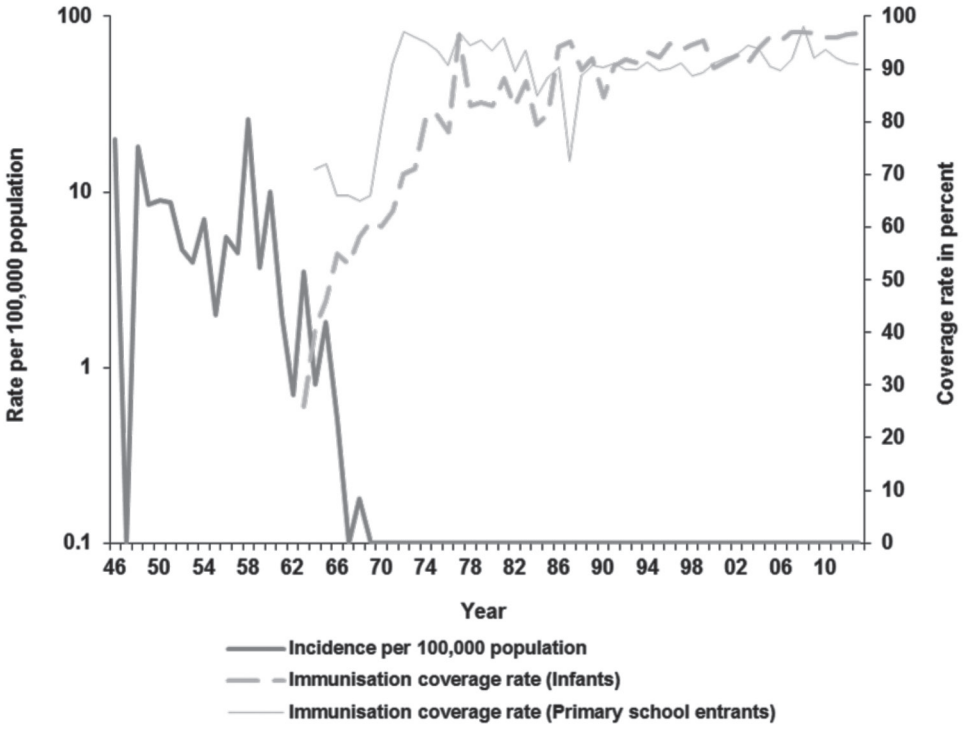


Figure 7.2
Incidence per 100,000 population from diphtheria and immunisation coverage rates in Singapore, 1946 – 2013

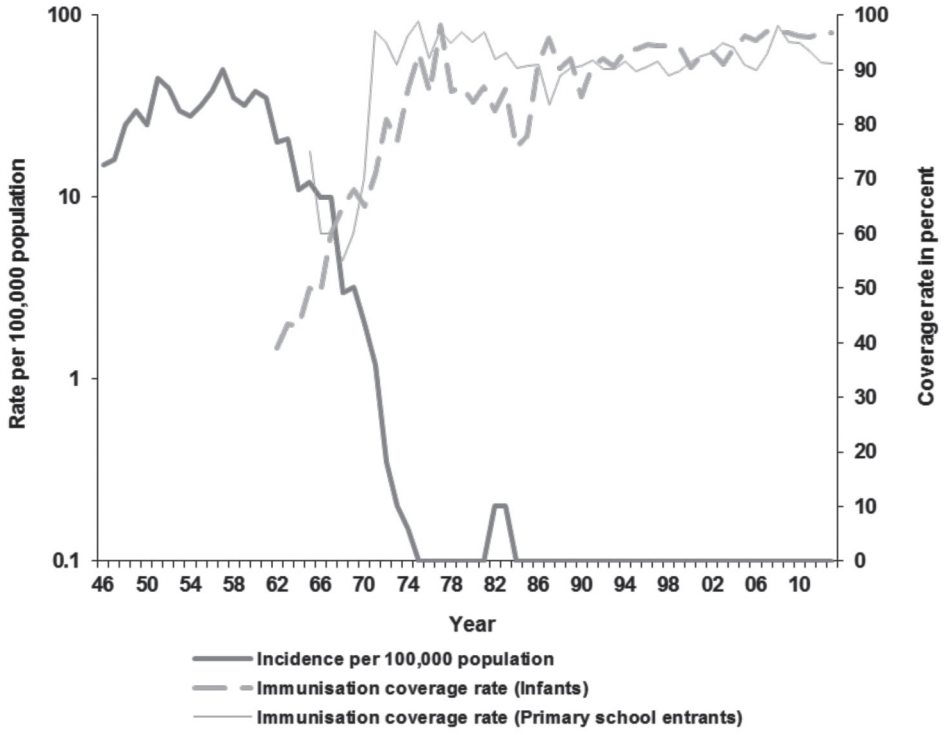
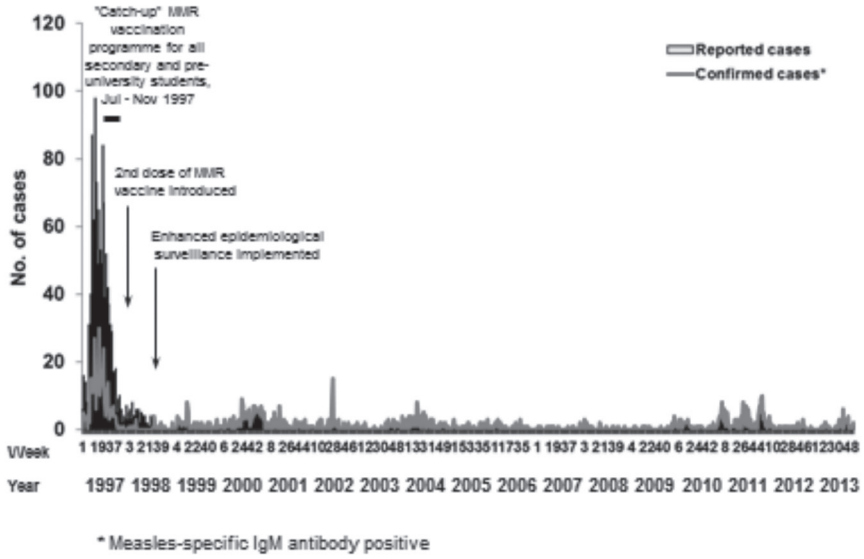
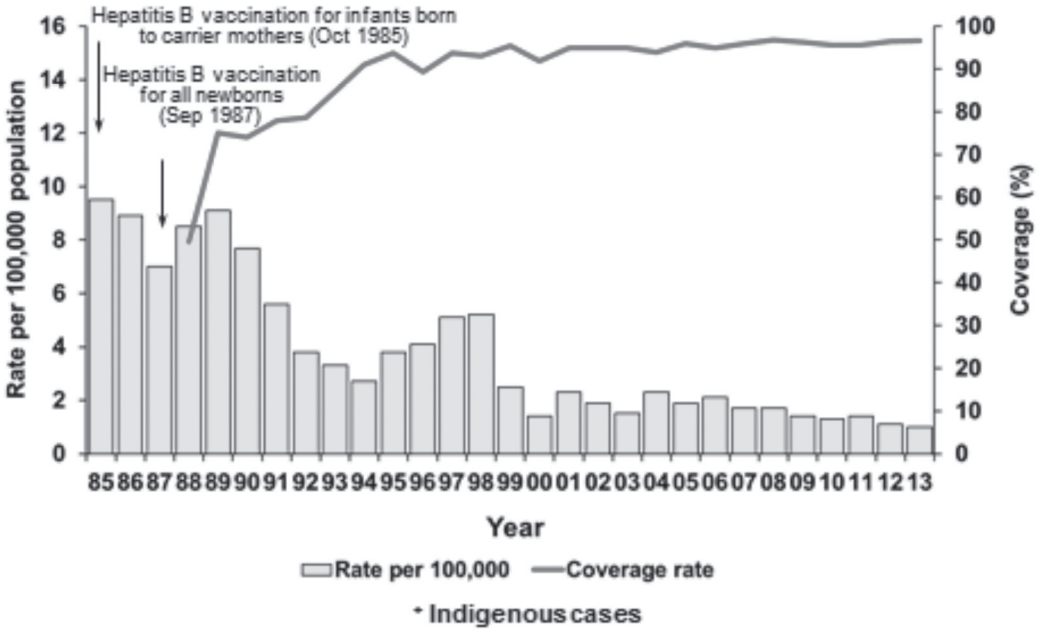


Figure 7.3
Impact of the "catch-up" MMR vaccination programme and introduction of second dose of MMR vaccine in the incidence of report measles cases in Singapore, 1946 – 2013



* Measles-specific IgM antibody positive

Figure 7.4
Incidence per 100,000 population from acute hepatitis B* and immunisation coverage rates, Singapore, 1985 – 2013



* Indigenous cases

Table 7.14
No. of therapeutic abortions performed for rubella infection, 1984 – 2013

Year	Total no. of abortions	No. of therapeutic abortions performed for rubella infections	
		No.	(%)
1984	22,190	77	0.35
1985	23,512	46	0.20
1986	23,035	45	0.20
1987	21,226	55	0.26
1988	20,135	56	0.28
1989	20,619	76	0.37
1990	18,669	36	0.19
1991	17,798	30	0.17
1992	17,073	21	0.12
1993	16,476	8	0.05
1994	15,690	10	0.06
1995	14,504	9	0.06
1996	14,365	15	0.10
1997	13,827	5	0.04
1998	13,838	2	0.01
1999	13,753	6	0.04
2000	13,754	2	0.01
2001	13,140	3	0.02
2002	12,749	0	0.00
2003	12,272	0	0.00
2004	12,070	2	0.02
2005	11,482	0	0.00
2006	12,032	3	0.02
2007	11,933	1	0.01
2008	12,222	0	0.00
2009	12,316	0	0.00
2010	12,082	0	0.00
2011	11,940	0	0.00
2012	10, 624	1	0.01
2013	9,282	2	0.02

Table 7.15
Reported diphtheria, poliomyelitis, measles, acute hepatitis B, neonatal tetanus, pertussis, congenital rubella and childhood tuberculous meningitis in Singapore, 1983 – 2013

Year	Diphtheria	Poliomy-elitis	Measles	Mumpsφ	Rubellaφ	Acute hepatitis B@	Neonatal tetanus*	Pertussis@@	Congenital rubella#	Childhood tuberculous meningitis##
1983	4 (4)	2 (2)	677	-	-	10	3	7	10	1
1984	0	2 (2)	2,417	-	-	10	1	1	7	0
1985	0	0	136	-	-	7	0	0	3	1
1986	1	2 (2)	218	-	-	5	3	9++	3	1
1987	1 (1)	0	123	-	-	6	0	9++	2	1
1988	0	0	192	-	-	2	0	11++	0	0
1989	1 (1)	0	146	-	-	4	0	1++	2	0
1990	1	1 (1)	143	-	-	1	0	8+++	4	0
1991	1 (1)	0	216	636	51	3	0	5++	1	0
1992	1	0	606	1,981	370	3	0	14++	4	0
1993	0	0	665	1,962	423	2	0	1++	4	0
1994	0	0	159	1,636	299	2	1	2++	2	0
1995	0	0	185	786	326	0	0	1++	2*	2*

Year	Diphtheria	Poliomy-elitis	Measles	Mumpsφ	Rubellaφ	Acute hepatitis B@	Neonatal tetanus*	Pertussis@@	Congenital rubella#	Childhood tuberculous meningitis##
1996	1 (1)	0	308	765	487	3	0	4 (1)+++	2*	2*
1997	0	0	1,413	674	360	0	0	2++	0*	2*
1998	0	0	114	1,183	179	0	0	1+	0*	0
1999	0	0	65++	6,384 (28)	432	0	0	1++	2*	1*
2000	0	0	141++	5,981+	312+	0	0	2 (1)+++	0	1*
2001	0	0	61++	1,399+	242+	0	0	1+	2*	0
2002	0	0	57++	1,090+	152+	0	0	0	1	1
2003	0	0	33++	878+	88+	0	0	1+++	0	0
2004	0	0	96++	1,003+	141+	0	0	1+++	0	0
2005	0	0	33++	1,004+	139+	0	0	2++	1	0
2006	0	1(1) &	28++	844+	90+	0	0	3+++	0	0
2007	0	0	15++	780+	83+	0	0	38++	0	0
2008	0	0	18++	801+	180+	0	0	33++	2	0
2009	0	0	.....13++	...631+	178+	0	0	13	0	0
2010	0	0	49++	452+++	158+++	0	0	8++	2&	2
2011	0	0	148++	501+++	110+++	0	0	29++	2	0
2012	0	0	38++	521+++	64+++	0	0	24++	2&	0
2013	0	0	46++	495+++	48+++	0	0	17++	1&	0

* Source: Central Claims Processing System, Ministry of Health.

( ) Imported cases.
φ Notifiable with effect from April 1990.
@ Indigenous cases below 15 years of age.
@@ All pertussis cases reported prior to 1986 were based on clinically diagnosed cases seen at the Communicable Disease Centre.
\+ Based on clinically diagnosed cases
++ Based on laboratory confirmed cases.
+++ Based on laboratory confirmed and clinically diagnosed cases.
# Cases diagnosed in KK Women's and Children's Hospital, Singapore General Hospital and National University Hospital.
Below 10 years of age
& Foreigner who came for treatment

INFECTIOUS DISEASE NOTIFICATIONS IN SINGAPORE, 1990 - 2013

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
	Number of Notifications																							
Air-/Droplet-Borne Diseases																								
Chickenpox	18934	17930	29976	43876	39558	23224	49763	27723	27183	31592	24074	18220	27124	15265	20083	24248	24026	30548	ND	ND	ND	ND	ND	ND
Diphtheria	1	1	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hand, Foot and Mouth Disease	-	58	28	310	154	184	84	358	1344	1408	6402	5187	16228	5603	6411	15257	15282	20003	29686	17278	30878	20687	37125	31741
Measles	143	216	606	665	159	185	308	1413	114	65	141	61	57	33	96	33	28	15	18	13	49	148	38	46
Meningococcal infection	-	-	-	-	-	-	-	-	-	-	-	4	13	11	7	5	10	5	6	5	7	6	0	3
Mumps	67	636	1981	1962	1636	786	765	674	1183	6384	5981	1399	1090	878	1003	1004	844	780	801	631	452	501	521	495
Rubella	-	51	370	423	299	326	487	360	179	432	312	242	152	88	141	139	90	83	180	178	158	110	64	48
Vector-Borne/Zoonotic Diseases																								
Chikungunya Fever	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	718	341	26	12	22	1059
Dengue fever/Dengue haemorrhagic fever	1733	2179	2878	946	1239	2008	3128	4300	5258	1355	673	2372	3945	4788	9459	14209	3127	8826	7031	4497	5363	5330	4632	22170
Malaria	216	267	221	354	277	316	364	421	405	316	266	229	175	118	152	166	181	155	152	172	190	149	143	111
Plague	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Yellow fever	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Food -/ Water-Borne Diseases																								
Campylobacteriosis	-	36	69	106	84	102	107	121	269	343	231	105	50	144	131	241	236	170	177	261	320	372	443	397
Cholera	26	34	17	24	42	14	19	11	31	11	10	8	2	2	11	1	0	7	1	4	4	2	2	2
Hepatitis A	162	281	397	173	138	131	152	149	138	88	77	60	236	55	67	98	146	88	107	89	68	66	108	88
Hepatitis E	-	-	-	11	10	1	20	17	24	20	17	3	24	17	24	36	31	35	54	90	112	97	104	55
Enteric fever																								
Typhoid	187	109	127	117	98	110	109	93	57	48	80	82	49	32	52	69	60	67	84	69	82	71	84	84
Paratyphoid	44	23	35	27	51	61	207	19	23	15	21	34	25	9	32	26	23	33	29	28	38	33	57	23
Listerosis	-	-	-	-	-	-	-	-	-	-	-	1	1	2	4	5	9	6	5	ND	ND	ND	ND	ND
Salmonellosis	-	-	-	-	-	-	-	-	-	-	99	198	129	192	345	296	380	309	719	1144	1480	1374	1499	1735
Shigellosis	108	69	35	25	24	38	33	15	25	11	7	14	4	4	17	9	19	13	29	ND	ND	ND	ND	ND
Blood-Borne Diseases																								
Hepatitis B	244	200	165	133	109	135	146	179	205	140	117	80	63	64	98	83	96	79	87	69	65	73	58	57
Environment-Related Diseases																								
Legionellosis	32	14	58	17	33	22	32	43	37	79	65	52	40	46	17	21	19	16	25	22	25	21	31	24
Leptospirosis	-	-	-	-	-	-	-	-	-	-	-	-	34	29	9	32	29	26	57	ND	ND	ND	ND	ND
Melioidosis	22	43	46	56	40	90	70	58	114	81	77	59	34	44	98	78	62	61	62	40	60	34	31	36
Murine Typhus	-	-	-	-	-	-	-	-	-	19	122	128	31	16	27	27	11	21	13	ND	ND	ND	ND	ND
HIV/AIDS, STIs, Tuberculosis & Leprosy																								
HIV/AIDS*	17	42	55	64	86	111	139	173	199	206	226	237	234	242	311	317	359	423	456	463	441	461	469	454
Sexually Transmitted Infections	6938	6545	8005	7692	7242	6140	5570	5801	6258	6318	6251	6686	6891	8173	10697	11048	10989	11523	12280	11381	10742	11159	10869	10347
Tuberculosis **	1366	1531	1510	1576	1434	1564	1696	1712	1810	1543	1518	1474	1702	1684	1578	1586	1581	1608	1951	1966	2028	2126	2203	2028
Leprosy	36	22	41	24	27	33	23	23	19	22	18	14	11	11	14	13	12	12	10	8	11	11	14	7

* Refers to Singaporeans/PR cases

** Refers to Singaporeans/PR cases & long staying foreigners from year 2002

INFECTIOUS DISEASE NOTIFICATIONS IN SINGAPORE, 1990 - 2013(cont'd)

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
	Incidence Rate (per 100,000 population)																							
Air-/Droplet-Borne Diseases																								
Chickenpox	621.4	571.9	927.8	1324.2	1157.0	658.9	1355.7	730.3	692.2	798.0	597.7	440.3	649.5	371.0	482.0	568.4	545.9	511.6	NA	NA	NA	NA	NA	NA
Diphtheria	0.0	0.0	0.0	-	-	-	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hand, Foot and Mouth Disease	-	1.9	0.9	9.4	4.5	5.2	2.3	9.4	34.2	35.6	158.9	125.4	388.6	136.2	153.9	357.7	347.2	435.9	613.4	346.4	608.2	399.1	698.8	587.9
Measles	4.7	6.9	18.8	20.1	4.7	5.2	8.4	37.2	2.9	1.6	3.5	1.5	1.4	0.8	2.3	0.8	0.6	0.3	0.4	0.3	1.0	2.9	0.7	0.9
Meningococcal infection	-	-	-	-	-	-	-	-	-	-	-	0.10	0.31	0.3	0.2	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.0	0.1
Mumps	2.2	20.3	61.3	59.2	47.9	22.3	20.8	17.8	30.1	161.3	148.5	33.8	26.1	21.3	24.1	23.5	19.2	17.0	16.6	12.7	8.9	9.7	9.8	9.2
Rubella	-	1.6	11.5	12.8	8.7	9.2	13.3	9.5	4.6	10.9	7.7	5.8	3.6	2.1	3.4	3.3	2.0	1.8	3.7	3.6	3.1	2.1	1.2	0.9
Vector-Borne/Zoonotic Diseases																								
Chikungunya Fever	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14.8	6.8	0.5	0.2	0.4	19.6
Dengue fever/Dengue haemorrhagic fever	56.9	69.5	89.1	28.5	36.2	57.0	85.2	113.3	133.9	34.2	16.7	57.3	94.5	116.4	227.0	333.1	71.0	192.3	145.3	90.2	105.6	102.8	87.2	410.6
Malaria	7.1	8.5	6.8	10.7	8.1	9.0	9.9	11.1	10.3	8.0	6.6	5.5	4.2	2.9	3.6	3.9	4.1	3.4	3.1	3.4	3.7	2.9	2.7	2.1
Plague	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Yellow fever	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Food & Water-Borne Diseases																								
Campylobacteriosis	-	1.1	2.1	3.2	2.5	2.9	2.9	3.2	6.8	8.7	5.7	2.5	1.2	3.5	3.1	5.6	5.4	3.7	3.7	5.2	6.3	7.2	8.3	7.4
Cholera	0.9	1.1	0.5	0.7	1.2	0.4	0.5	0.3	0.8	0.3	0.2	0.2	0.0	0.0	0.3	0.0	0.0	0.2	0.0	0.1	0.1	0.04	0.0	0.0
Hepatitis A	5.3	9.0	12.3	5.2	4.0	3.7	4.1	3.9	3.5	2.2	1.9	1.4	5.7	1.3	1.6	2.3	3.3	1.9	2.2	1.8	1.3	1.3	2.0	1.6
Hepatitis E	-	-	-	0.3	0.3	0.0	0.5	0.4	0.6	0.5	0.4	0.1	0.6	0.4	0.6	0.8	0.7	0.8	1.1	1.8	2.2	1.9	2.0	1.0
Enteric fever																								
Typhoid	6.1	3.5	3.9	3.5	2.9	3.1	3.0	2.4	1.5	1.2	2.0	2.0	1.2	0.8	1.2	1.6	1.4	1.5	1.7	1.4	1.6	1.4	1.6	1.6
Paratyphoid	1.4	0.7	1.1	0.8	1.5	1.7	5.6	0.5	0.6	0.4	0.5	0.8	0.6	0.2	0.8	0.6	0.5	0.7	0.6	0.6	0.7	0.6	1.1	0.4
Listerosis	-	-	-	-	-	-	-	-	-	-	-	0.0	0.0	0.0	0.1	0.1	0.2	0.1	0.1	-	-	-	-	
Salmonellosis	-	-	-	-	-	-	-	-	-	-	2.5	4.8	3.1	4.7	8.3	6.9	8.6	6.7	14.9	22.9	29.2	26.5	28.2	32.1
Shigellosis	3.5	2.2	1.1	0.8	0.7	1.1	0.9	0.4	0.6	0.3	0.2	0.3	0.1	0.1	0.4	0.2	0.4	0.3	0.6	-	-	-	-	
Blood-Borne Diseases																								
Hepatitis B	8.0	6.4	5.1	4.0	3.2	3.8	4.0	4.7	5.2	3.5	2.9	1.9	1.5	1.6	2.4	1.9	2.2	1.7	1.8	1.4	1.3	1.4	1.1	1.1
Environment-Related]Diseases																								
Legionellosis	1.1	0.4	1.8	0.5	1.0	0.6	0.9	1.1	0.9	2.0	1.6	1.3	1.0	1.1	0.4	0.5	0.4	0.3	0.5	0.4	0.5	0.4	0.6	0.4
Leptospirosis	-	-	-	-	-	-	-	-	-	-	-	-	0.8	0.7	0.2	0.8	0.7	0.6	1.2	-	-	-	-	-
Melioidosis	0.7	1.4	1.4	1.7	1.2	2.6	1.9	1.5	2.9	2.0	1.9	1.4	0.8	1.1	2.4	1.8	1.4	1.3	1.3	0.8	1.2	0.7	0.6	0.7
Murine Typhus	-	-	-	-	-	-	-	-	-	0.5	3.0	3.1	0.7	0.4	0.6	0.6	0.2	0.5	0.3	-	-	-	-	-
HIV/AIDS, STIs, Tuberculosis & Leprosy																								
HIV/AIDS	0.6	1.5	1.9	2.2	2.9	3.7	4.5	5.5	6.3	6.4	6.9	7.1	6.9	7.2	9.1	9.1	10.1	11.8	12.5	12.4	11.7	12.2	12.3	11.8
Sexually Transmitted Infections	227.7	208.8	247.8	232.1	211.8	174.2	151.7	152.8	159.4	159.6	155.2	161.6	165.0	198.6	256.7	259.0	249.7	251.1	253.8	228.2	211.6	215.3	204.6	191.6
Tuberculosis	49.9	54.8	53.0	54.3	48.5	51.9	55.3	54.8	56.9	47.8	46.4	44.3	40.8	40.9	37.9	37.2	35.9	35.0	40.3	39.4	39.9	41.0	41.5	37.6
Leprosy	1.2	0.7	1.3	0.7	0.8	0.9	0.6	0.6	0.5	0.6	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.3	0.1

Remarks
Chikungunya Fever was made notifiable since 2008
ND : Not notifiable since Jan 2009