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FOREWORD

I am pleased to present the Ministry of Health's "Communicable Diseases Surveillance in Singapore 2015" Annual Report.

In 2015, we continued to face communicable diseases threats from around the world. The Middle East Respiratory Syndrome (MERS) outbreak in the Middle East continued, with a cumulative total of 1627 laboratory-confirmed cases, including 586 deaths, from 2012 to 2015. The risk of spread from a single imported case was highlighted when the Republic of Korea had a large outbreak, resulting in 186 cases, including 36 deaths, between May to July 2015. The outbreak of Ebola in Guinea, Liberia and Sierra Leone which started in 2014 resulted in 28,601 cases with 11,300 deaths (from 2014 to 3 January 2016). While the outbreak started to abate in early 2015, the three West African countries remain at high risk of additional small outbreaks. These incidents illustrated the importance of maintaining vigilance and being well prepared against different communicable diseases in an increasingly globalised and interconnected world.

On the home front, we experienced two unusual outbreaks of communicable diseases that tested our surveillance and response systems, namely invasive Group B Streptococcus (GBS) and acute Hepatitis C Virus (HCV) infections. In mid-2015, an uptrend of invasive GBS infections was reported. Investigations subsequently established a hitherto unknown association between the consumption of Chinese-style ready-to-eat raw fish dishes and Type III GBS disease, Sequence Type 283. This resulted in a ban on the sale of freshwater fish for raw consumption, which led to a decline in the number of cases. The other unusual outbreak in 2015 was the cluster of 22 acute HCV cases among patients in the renal ward of Singapore General Hospital between April and June 2015. The investigations into this outbreak revealed gaps in infection control practices. The outbreak prompted a review of the national surveillance systems, as well as our capability to respond to infectious disease outbreaks in both hospitals and the community.

The incidence of TB among residents and long staying non-residents continued to decline from 36.9 cases per 100,000 population in 2014 to 36.1 per 100,000 in 2015 under the Singapore TB Elimination Programme. To further strengthen case detection and treatment, Clinical Practice Guidelines for TB management were issued, with the aim of reinforcing the best practices for management of TB in Singapore. The number of newly reported HIV cases in 2015 (455) was similar to the number reported in 2014 (456). About 40% already had late-stage HIV infection at diagnosis. This is lower than the 49% recorded in 2014. Moving forward, MOH will be reviewing strategies to encourage early voluntary testing, to further drive down the proportion persons with late-stage infection at diagnosis.

This annual report provides comprehensive epidemiological information on communicable diseases that has been made possible 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
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POPULATION PROFILE

In 2015, Singapore had an estimated population of 5.54 million, with a resident population of 3.90 million. The female-to-male ratio in the resident population was 1.04. The ethnic distribution in the resident population showed a Chinese majority of 74.3%, followed by Malays and Indians at 13.3% and 9.1% respectively.

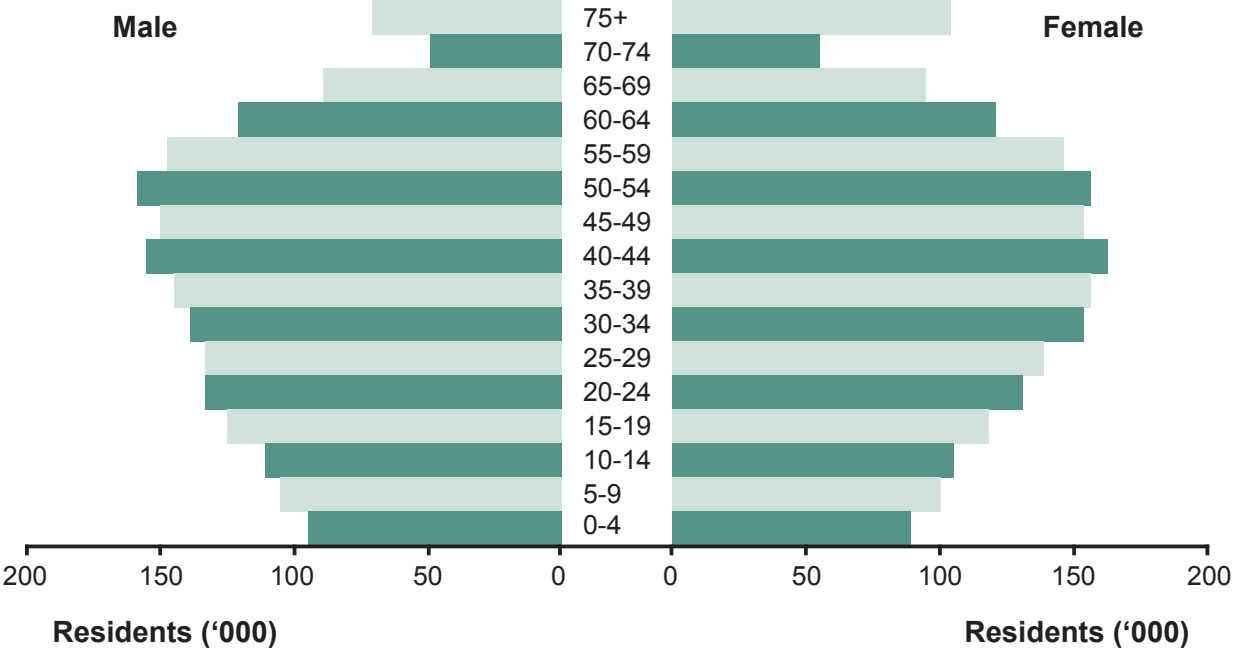
The aging pattern of Singapore's population is shown in the age pyramid below. The proportion of residents aged 15 to 64 years increased from 71.0% in 1990 to 72.8% in 2015 while the proportion of children under 15 years has steadily declined from 23.0% in 1990 to 15.4% in 2015. Currently 11.8% of Singapore residents are aged 65 years and above, compared to 6.0% in 1990.

Demographic profile (mid-year estimates), 2015

	2015
Total population	5,535,002
Resident population	3,902,690
Gender ratio (female to male)	1.04
Ethnic distribution (%)	
Chinese	74.3
Malay	13.3
Indian	9.1
Others	3.3

(Source: Singapore Department of Statistics)

Age Distribution of resident population, 2015



(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 2015 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 2015, hand, foot and mouth disease (HFMD) continued to contribute significantly to the burden of air-/droplet-borne diseases. There were 28,216 notified cases (509.8 per 100,000 population) of HFMD, an increase of 27.3% from 22,171 cases in 2014.

A total of 42 measles cases were notified in 2015 compared to 142 cases in 2014.

A total of 15 rubella cases were notified compared with 17 cases in 2014.

There were 473 notified cases of mumps (8.5 per 100,000 population) in 2015 compared to 478 cases (8.7 per 100,000 population) in 2014.

VECTOR-BORNE/ZOONOTIC DISEASES

In 2015, a total of 11,294 dengue fever (DF)/dengue haemorrhagic fever (DHF) cases were notified compared with 18,326 cases in Year 2014. The majority of the cases were infected locally. DEN-2 was the predominant circulating strain in 2015.

A total of 42 chikungunya fever cases were notified in 2015 compared with 182 cases in Year 2014.

In addition, there were 47 notified cases of malaria in 2015, all 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 50 cases of Hepatitis A notified in 2015, a decrease of 31.5% compared to 73 cases in 2014. The incidence of enteric fevers (typhoid and paratyphoid fevers) showed a 1.3% decrease from 77 cases in 2014 to 76 cases in 2015. Campylobacteriosis and non-typhoidal salmonellosis contributed significantly to foodborne disease morbidity. There were 420 cases of campylobacteriosis and 1,988 cases of salmonellosis reported in 2015. 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 2015, 17 cases of legionellosis and 42 cases of melioidosis were notified. Three patients died of melioidosis-related conditions giving an overall case fatality rate of 7.3%, compared with 6.3% reported in 2014 .

HIV/AIDS, STIs, TUBERCULOSIS & LEPROSY

The number of HIV/AIDS infection notifications in Year 2015 was 455 compared with 456 in 2014.

The three main sexually transmitted infections (STIs) notified in Singapore in 2015 were chlamydia, gonorrhoea and syphilis. The overall incidence rate for STIs was 186 cases per 100,000 population. Chlamydia was the most common STI with an incidence rate of 50.5 cases per 100,000 population.

In 2015, a total of 2,000 new cases of TB were reported (1,498 residents and 502 long staying foreigners), a decrease of 0.9% from 2014.

In 2015, a total of 3 cases of leprosy were notified (1 resident and 2 non-residents). The resident incidence rate was 0.03 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 2015

Diseases	No. of notified cases	No. of Deaths+	Morbidity rate*	Mortality rate*
Air-/Droplet-Borne Diseases				
Hand, Foot and Mouth Disease	28,216	0	509.8	0.0
Measles	42	0	0.8	0.0
Meningococcal Infection	6	0	0.1	0.0
Mumps	473	0	8.5	0.0
Rubella	15	0	0.3	0.0
Vector-Borne/Zoonotic Diseases				
Chikungunya Fever	42	0	0.8	0.0
Dengue Fever/Dengue Haemorrhagic Fever	11,294	6	204.0	0.1
Malaria	47	1	0.8	0.0
Food-/Water-Borne Diseases				
Campylobacteriosis	420	0	7.6	0.0
Cholera	3	0	0.0	0.0
Hepatitis A	50	0	0.9	0.0
Hepatitis E	59	0	1.1	0.0
Paratyphoid	27	0	0.5	0.0
Salmonellosis	1,988	0	35.9	0.0
Typhoid	49	0	0.9	0.0
Blood-Borne Diseases				
Hepatitis B	52	0	0.9	0.0
Hepatitis C	46	0	0.8	0.0
Environmental-Related Diseases				
Legionellosis	17	0	0.3	0.0
Melioidosis	42	0	0.8	0.0
HIV/AIDS, STIs, TB & Leprosy				
HIV/AIDS**	455	79	11.7	2.0
STIs	10,318	0	186.4	0.0
Tuberculosis***	2,000	39	36.1	1.0
Leprosy	3	0	0.0	0.0

+Source: Registry of Births & Deaths
*Rates per 100,000 population, based on estimated mid-year total population, 2015 (Source: Singapore Department of Statistics)
** Refers to Singaporeans/PR cases
*** Refers to Singaporeans/PR cases & long staying foreigners

Chapter I

AIR-/DROPLET-BORNE DISEASES

- Haemophilus Influenzae 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 INFLUENZAE TYPE B DISEASE

Haemophilus Influenzae 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 Influenzae 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 2015, there were three cases of Hib disease reported compared to six cases in 2014 (Figure 1.1). All the cases were laboratory confirmed with positive blood culture. All the cases were aged 65 years and above. Among the three major ethnic groups, Malays had the highest incidence rate (Table 1.1 and 1.2). The three cases were classified as local (Table 1.3).

Figure 1.1
E-weekly distribution of reported Hib cases, 2014 – 2015

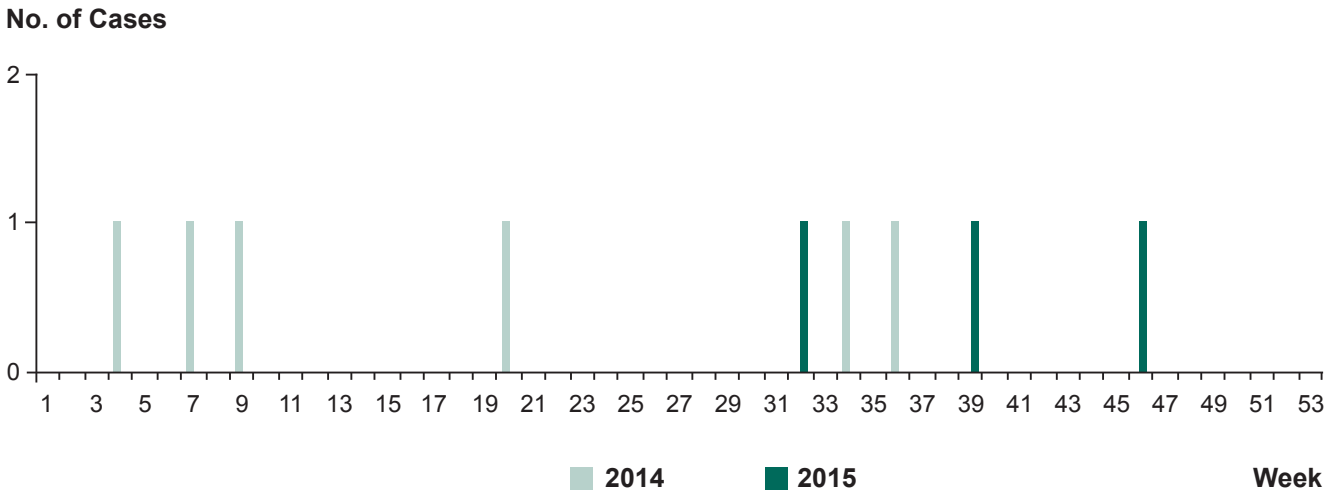


Table 1.1
Age-gender distribution and age-specific incidence rates of reported Hib cases, 2015

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	0	0 (0.0)	0.0
55 - 64	0	0	0 (0.0)	0.0
65+	2	1	3 (100.0)	0.6
Total	**2**	**1**	**3 (100.0)**	**0.1**

*Rates are based on 2015 estimated mid-year population.
(Source: Singapore Department of Statistics)

Table 1.2
Ethnic-gender distribution and ethnic-specific incidence rate of reported Hib cases, 2015

	Male	Female	Total (%)	Incidence rate per 100,000 population*
Singapore Resident				
Chinese	1	0	1 (33.3)	0.0
Malay	0	1	1 (33.3)	0.2
Indian	0	0	0 (0.0)	0.0
Others	1	0	1 (33.4)	0.8
Foreigner	0	0	0 (0.0)	0.0
Total	**2**	**1**	**3 (100.0)**	**0.1**

*Rates are based on 2015 estimated mid-year population.
(Source: Singapore Department of Statistics)

Table 1.3
Total number of notifications received for Hib, 2011 – 2015

Age Group	2011		2012		2013		2014		2015	
	Local	Imported	Local	Imported	Local	Imported	Local	Imported	Local	Imported
0 – 4	0	0	0	0	0	0	1	0	0	0
5 – 14	0	0	0	0	0	0	0	1	0	0
15 – 24	0	0	0	0	0	0	0	0	0	0
25 – 34	0	0	0	0	0	0	1	0	0	0
35 – 44	0	0	0	0	0	0	0	0	0	0
45 – 54	0	0	0	0	2	0	1	0	0	0
55 - 64	0	0	0	0	3	1	0	0	0	0
65+	2	0	1	0	4	0	2	0	3	0
Total	**2**	**0**	**1**	**0**	**9**	**1**	**5**	**1**	**3**	**0**

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 (EV-A71). HFMD can be transmitted from person to person through the faecal-oral or respiratory route.

A total of 28,216 cases of HFMD were reported in 2015, an increase of 27.3% compared to 22,171 cases reported in 2014 (Figure 1.2). There were no local cases with severe complications due to HFMD reported in 2015.

The incidence rate was highest in the 0 - 4 years age group, with an overall male to female ratio of 1.2:1 (Table 1.4). Among the three major ethnic groups, Chinese had the highest incidence rate, followed by Malays and Indians (Table 1.5). No HFMD deaths were reported in 2015.

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) (14.8%), followed by EV 71 (7.2%). Among the coxsackieviruses, CA6 (52.9%) was the predominant serotype, followed by CA 4 (18.6%).

Figure 1.2
E-weekly distribution of reported hand, foot and mouth cases, 2014 – 2015

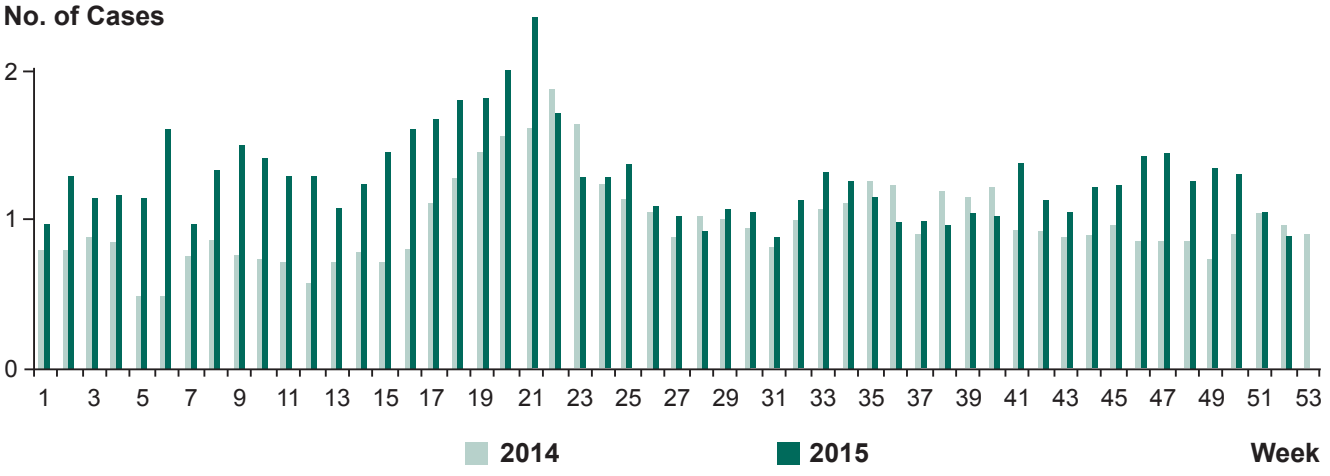


Table 1.4
Age-gender distribution and age-specific incidence rate of reported hand, foot and mouth cases^, 2015

Age (Yrs)	Male	Female	Total (%)	Incidence rate per 100,000 population*
0 – 4	9,774	7,917	17,691 (62.7)	7,766.6
5 – 14	3,698	3,035	6,733 (23.9)	1,424.9
15 – 24	493	517	1,010 (3.6)	134.4
25 – 34	674	746	1,420 (5.0)	113.1
35 – 44	625	440	1,065 (3.8)	107.9
45 – 54	131	68	199 (0.7)	26.6
55+	44	46	90 (0.3)	8.2
Total	**15,439**	**12,769**	**28,208 (100.0)**	**509.6**

^Excluding 8 tourists.
*Rates are based on 2015 estimated mid-year population.
(Source: Singapore Department of Statistics)

Table 1.5
Ethnic-gender distribution and ethnic-specific incidence rate of reported hand, foot and mouth cases^, 2015

	Male	Female	Total (%)	Incidence rate per 100,000 population*
Singapore Resident				
Chinese	10,571	8,774	19,345 (68.6)	667.1
Malay	1,748	1,581	3,329 (11.8)	639.1
Indian	513	412	925 (3.3)	260.6
Others	881	628	1,509 (5.3)	1190.0
Foreigner	1,726	1,374	3,100 (11.0)	189.9
Total	**15,439**	**12,769**	**28,208 (100.0)**	**509.6**

^Excluding 8 tourists.
*Rates are based on 2015 estimated mid-year population.
(Source: Singapore Department of Statistics)

Institutional Outbreaks of HMFD

There were 1,994 reported outbreaks of HFMD in year 2015, each involving two or more cases. Table 1.6 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. 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 2015 with public education enhanced.

Table 1.6
Outbreaks of hand, foot and mouth disease in childcare centres/kindergartens/schools, 2015

Attack rate (%)	Childcare Centres	Kindergartens	Primary Schools	Enrichment Centres	Other Institutions*
< 10	1,036	279	269	21	111
10 - 20	210	5	1	16	1
21 - 30	26	-	-	6	-
31 - 40	8	-	-	1	-
41 - 50	1	-	-	-	-
>50	3	-	-	-	-
Total	**1,284**	**284**	**270**	**44**	**112**

*64 from secondary schools, 25 from international schools, 11 from polytechnic, six from Junior Colleges, five from special schools and one from ITE.

Cluster 1: Childcare centre at Punggol

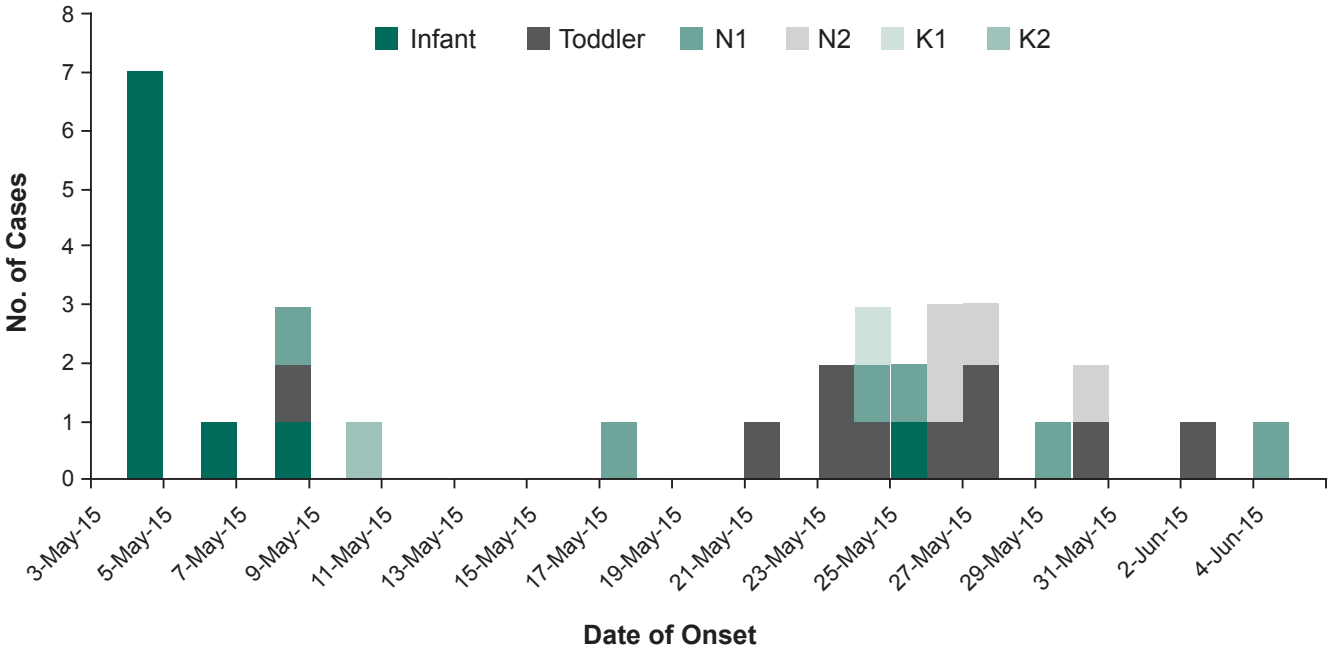
An outbreak of HFMD involving 32 children aged between 0 and 5 years occurred between 4 May and 4 Jun 2015 in a childcare centre at Ang Mo Kio. At the time of the outbreak, the centre had 36 full-time staff and 159 children in six classes: Infant, Toddler (PG), Nursery 1 (N1), Nursery 2 (N2), Kindergarten 1 (K1) and Kindergarten 2 (K2).

The class-specific attack rates ranged from 3.6% to 55.6%, with an overall attack rate of 20.1% (Table 1.7). The index case, an infant, presented with symptoms on 4 May 2015. The infection subsequently spread amongst other children. The last reported case was on 4 Jun 2015 (Figure 1.3). The centre was mandatorily closed for ten days from 12 to 21 Jun 2015 due to the high number of cases and the prolonged disease transmission period.

Table 1.7
Attack rates of hand, foot and mouth disease (HFMD) in a childcare centre at Ang Mo Kio, 4 May 2015 - 4 Jun 2015

	No. Enrolled			No. Affected and Attack Rates					
Class Category	Male	Female	Total	Male	%	Female	%	Total	%
Infant	6	12	18	6	100.0	4	33.3	10	55.6
Toddler	9	11	20	4	44.4	6	54.5	10	50.0
N1	18	17	35	3	16.7	3	17.6	6	17.1
N2	21	15	36	2	9.5	2	13.3	4	11.1
K1	9	13	22	1	11.1	0	0.0	1	4.5
K2	10	18	28	1	10.0	0	0.0	1	3.6
Total	**73**	**86**	**159**	**17**	**23.6**	**15**	**17.4**	**32**	**20.1**

Fig 1.3
Time distribution of 32 cases of hand, foot and mouth disease in a childcare centre at Ang Mo Kio, 4 May 2015 - 4 Jun 2015



Cluster 2: Childcare centre at Hougang

An outbreak of HFMD involving 15 children aged between 1 and 5 years occurred between 25 Sep 2015 and 20 Oct 2015 in a child care centre at Hougang. At the time of the outbreak, the centre had 13 full-time staff and 81 children in seven classes: Infant, Toddler, Playgroup, Nursery 1 (N1), Nursery 2 (N2), Kindergarten 1 (K1) and Kindergarten 2 (K2).

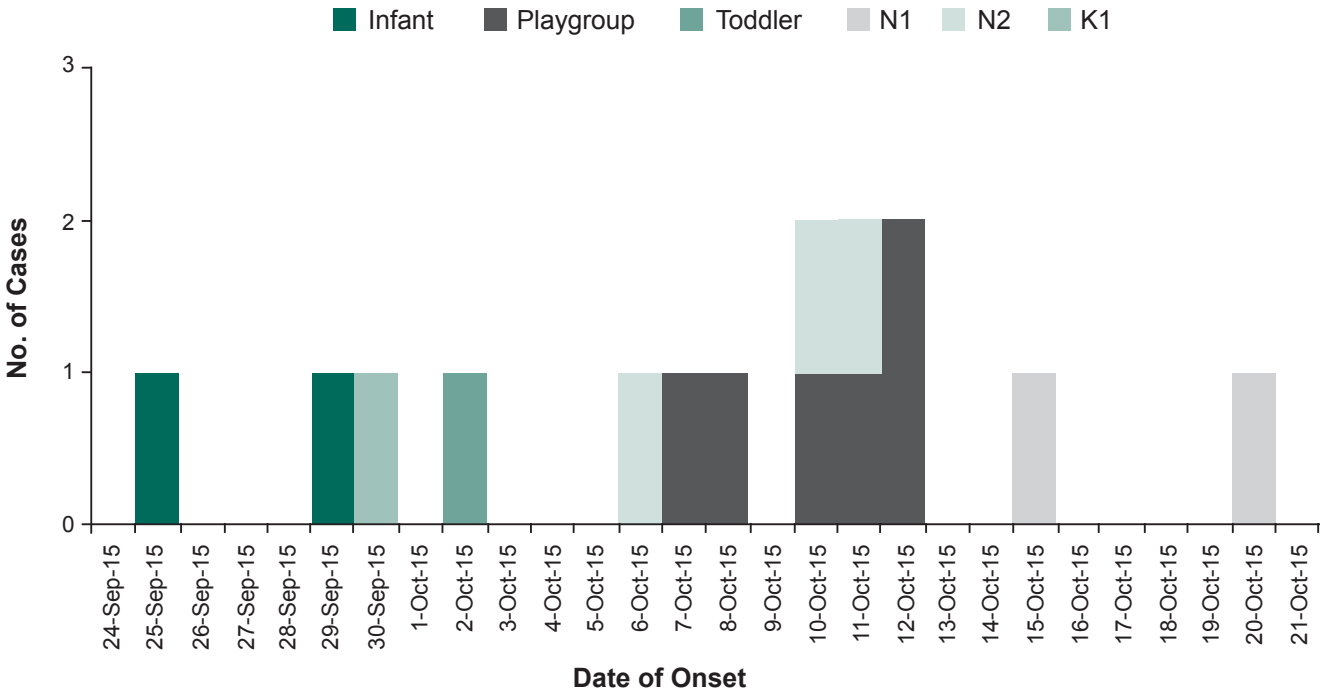
The class-specific attack rates ranged from 8.3% to 54.5%, with an overall attack rate of 18.5% (Table 1.8). The outbreak started with an infant who developed symptoms on 25 September 2015. The infection subsequently spread amongst other children. The last reported case was on 20 October 2015 (Figure 1.4).

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

Table 1.8
Attack rates of hand, foot and mouth disease in a child care centre at Hougang, 25 Sep 2015 - 20 Oct 2015

	No. Enrolled			No. Affected and Attack Rates					
Class Category	Male	Female	Total	Male	%	Female	%	Total	%
Infant	5	2	7	2	40.0	0	0.0	2	28.6
Toddler	4	6	10	0	0.0	1	16.7	1	10.0
Playgroup	4	7	11	2	50.0	4	57.1	6	54.5
N1	7	8	15	2	28.6	0	0.0	2	13.3
N2	7	10	17	2	28.6	1	10.0	3	17.6
K1	6	6	12	0	0.0	1	16.7	1	8.3
K2	6	3	9	0	0.0	0	0.0	0	0.0
Total	**39**	**42**	**81**	**8**	**20.5**	**7**	**16.7**	**15**	**18.5**

Figure 1.4
Time distribution of 15 cases of hand, foot and mouth disease in a childcare centre at Hougang, 25 Sep 2015 - 20 Oct 2015



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.

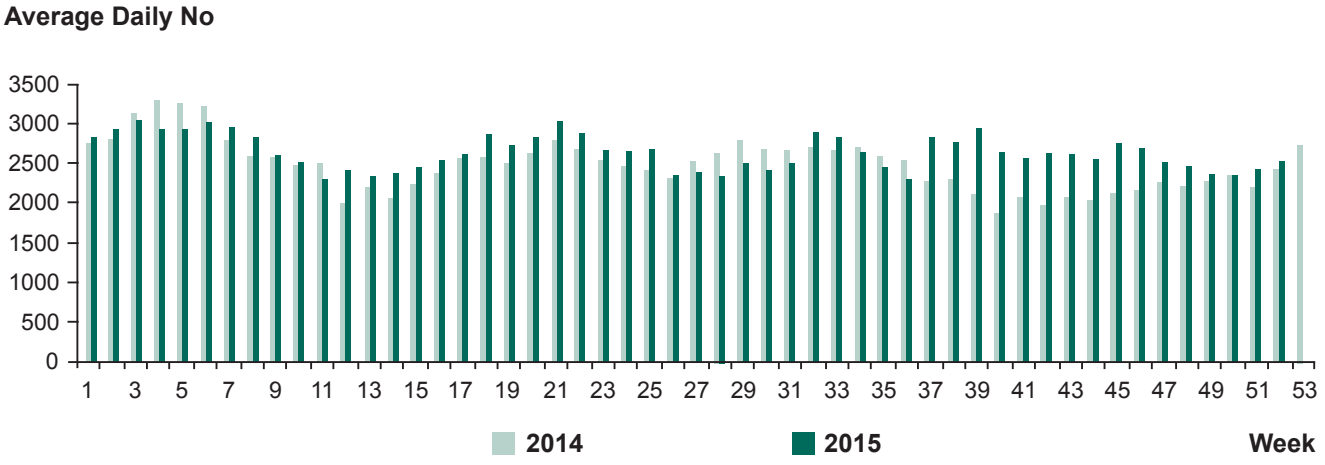
In temperate and cold climates, influenza reaches peak incidence in winter. As the Northern and Southern Hemispheres have winter at different times of the year, there are two flu seasons each year: December-March in the Northern Hemisphere; and June-September in the Southern Hemisphere.

In tropical and subtropical areas, influenza epidemics may occur 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.

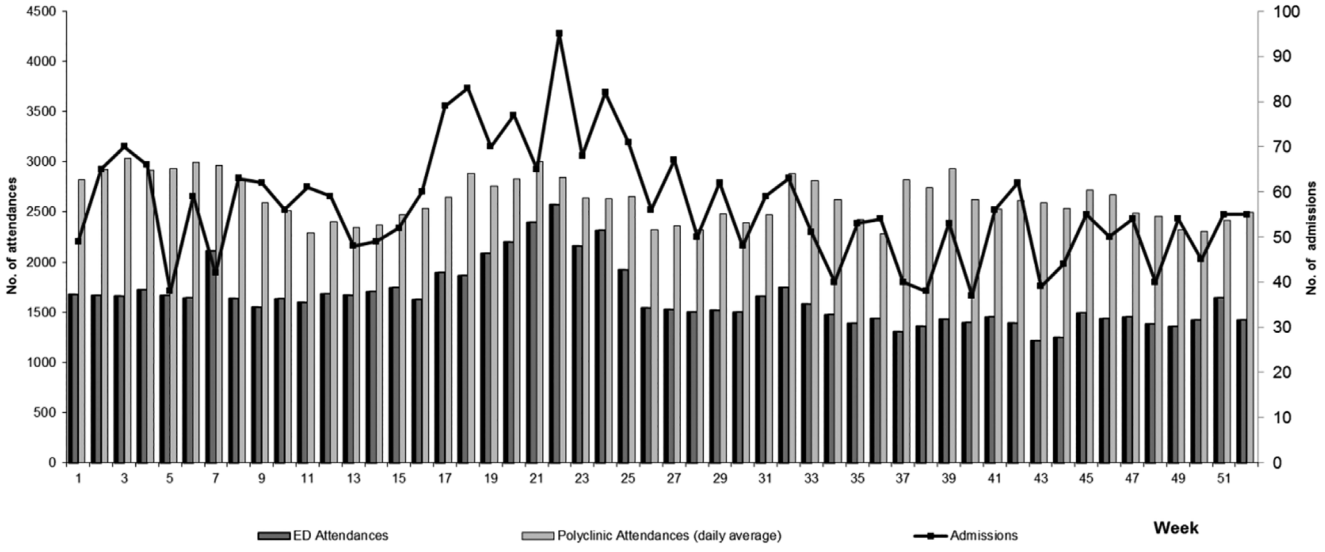
There were a total of 712,082 attendances at polyclinics for ARI in 2015, an increase of 3.8% compared to 686,247 seen in 2014. No clear seasonal pattern for ARI was observed. The average daily number of polyclinics attendances for ARI peaked at 3,035 in E-week 3 (Figure 1.5).

Figure 1.5
E-weekly distribution of acute respiratory infection attendance at polyclinics 2014 – 2015



An annual total of 85,916 ARI cases were seen at the emergency departments (ED) of public hospitals in 2015, a decrease of 10.2% compared to 95,661 cases reported in 2014. The highest average weekly ARI attendance at ED was observed in E-week 22 at 2,577. In addition, ARI admissions peaked at 95 cases in E-week 22 (Figure 1.6).

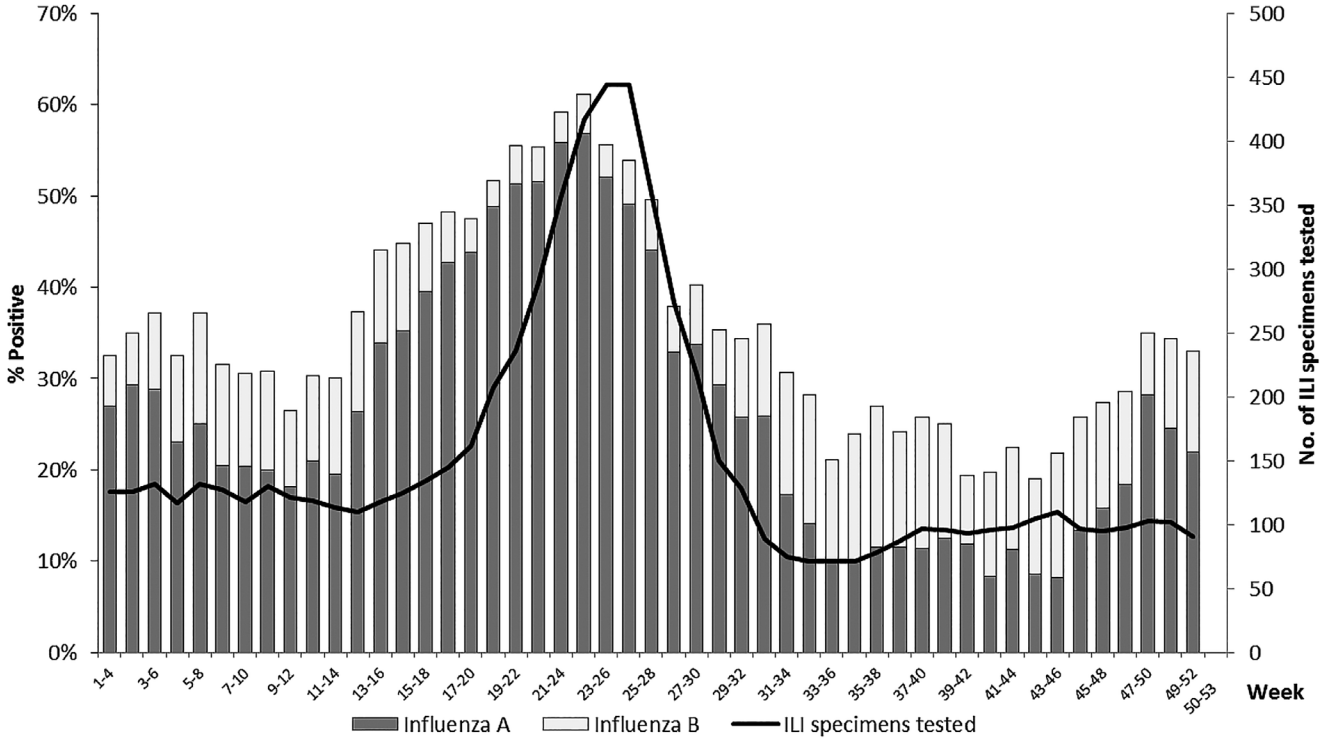
Figure 1.6
Weekly polyclinic attendance, emergency department (ED) attendances and admissions for ARI, 2015



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.

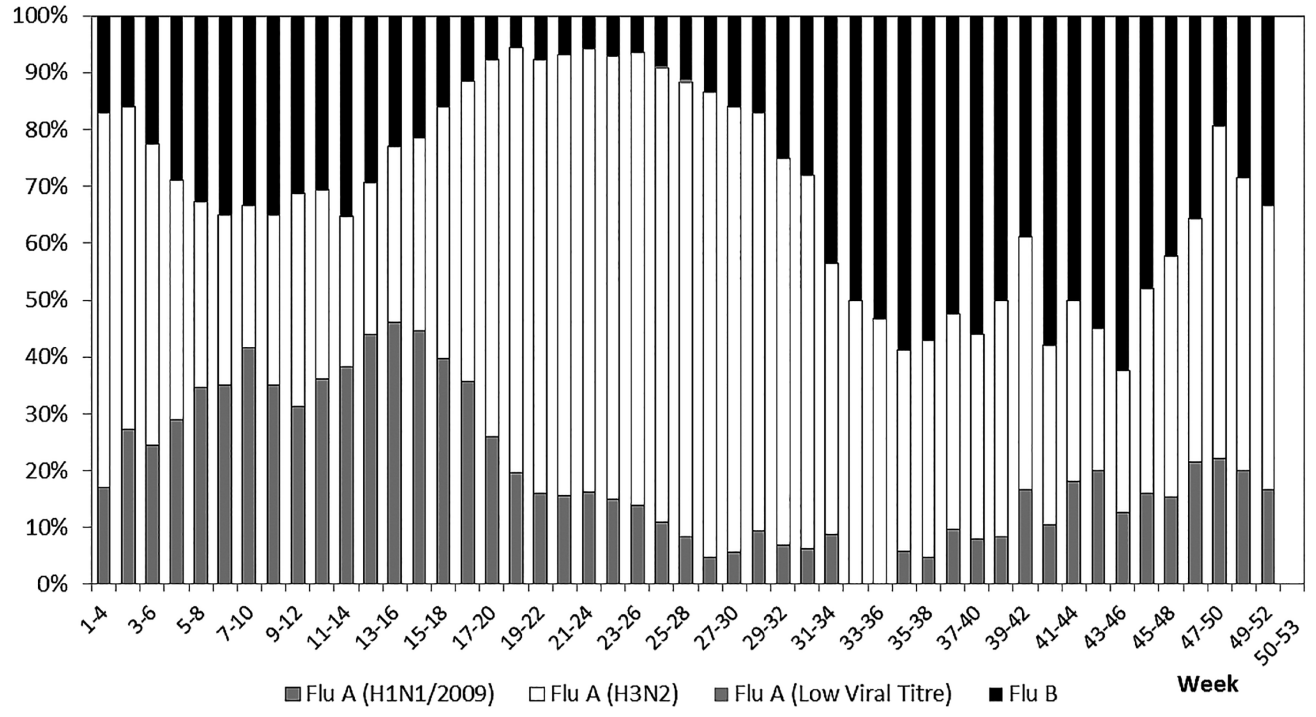
The 4-weekly moving average of the proportion of samples from patients in polyclinics and sentinel private clinics with influenza-like illness (ILI) which were positive for influenza viruses is shown in Figure 1.7. Higher levels of influenza activity were observed for the 4-weekly moving average between E-weeks 13-16 and 25-28, with a range of 44.1% to 61.2%. Influenza activity peaked in E-weeks 22-25 with 61.2% of ILI samples testing positive for influenza viruses. 57% of the positive samples in E-weeks 22-25 were influenza A viruses and of these, 78% were of the H3N2 subtype.

Figure 1.7
4-Week Moving Virological Surveillance of Influenza A & B, 2015



In 2015, 41.3% of all ILI samples tested positive for influenza viruses. Of the positive samples, 82% tested positive for influenza A viruses, of which 63.5% were of the influenza A(H3N2) subtype. Between E-week 33-36 and 44-47, influenza B predominated among the influenza viruses, co-circulating with lower levels of influenza A(H1N1)pdm09 and influenza A(H3N2). Influenza A(H3N2) virus exhibited strong predominance in Singapore for the rest of 2015 (Figure 1.8).

Figure 1.8
4-Week moving influenza typing results, 2015



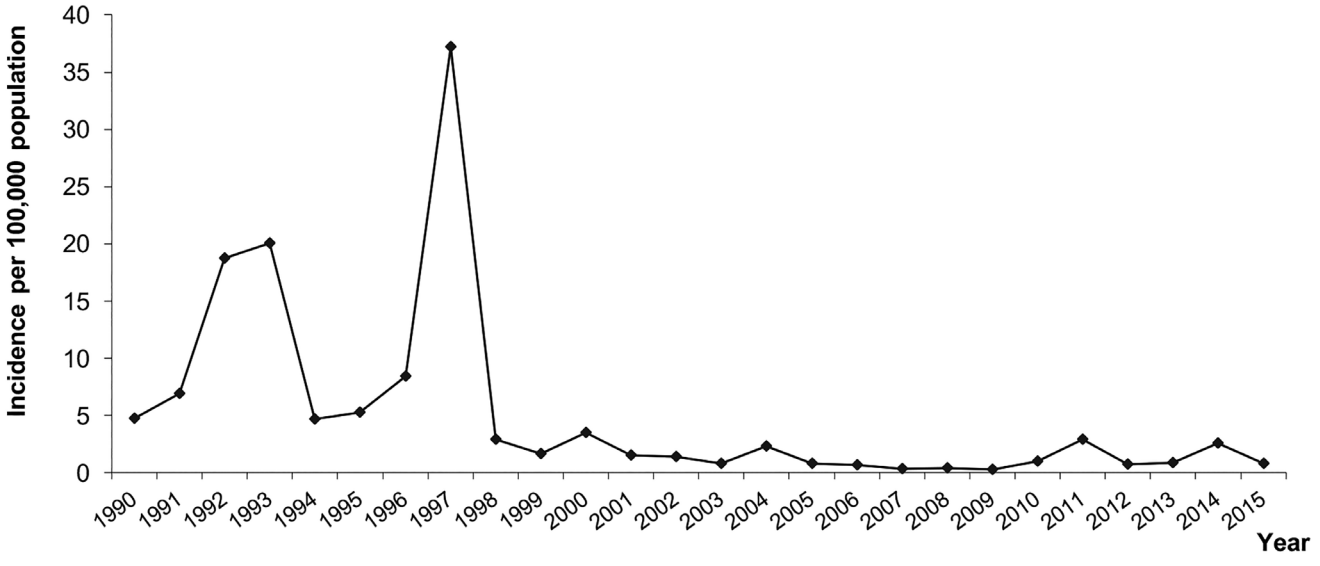
Majority of influenza A(H1N1)pdm09 viruses of 2015 were antigenically homogenous and closely related to the current vaccine strain, A/California/07/2009. Influenza A(H3N2) viruses were grouped in phylogenetic clades 3C.2 and 3C.3, and most viruses remain antigenically related to A/Switzerland/9715293/2013, which was the A(H3N2) component of the 2015 southern hemisphere influenza vaccine as recommended by WHO. Influenza B viruses of the B/Victoria/2/87 and the B/Yamagata/16/88 lineages co-circulated, with the latter predominating among influenza B viruses in many countries. These recently circulating B/Yamagata/16/88 viruses were found to be antigenically similar to influenza B/Phuket/3073/2013, the virus recommended for use in the 2015 southern hemisphere vaccine. Over 180 isolates, including influenza A(H1N1)pdm09, A(H3N2) and B viruses, were analysed for the resistance to neuraminidase inhibitors oseltamivir, peramivir, laninamivir and zanamivir. Resistance to oseltamivir was detected in one influenza A(H1N1)pdm09 isolate.

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 – 2015



A total of 42 laboratory confirmed cases of measles were reported in 2015 compared to 142 cases reported in 2014 (Figure 1.10). The highest incidence rate was observed in children under the age of 1 year (Table 1.10). Among the three major ethnic groups, Malays had the highest incidence rate, followed by Chinese and Indian (Table 1.11). Four cases had at least one dose of MMR vaccination prior to onset of illness (Source: National Immunisation Registry).

WHO classification of measles cases

A total of 40 laboratory confirmed measles cases were reported to WHO Western Pacific Regional Office (WPRO) from January to December 2015. During this period, 95% of cases were sporadic and the rest were involved in a small cluster. The source of infection and the method of confirmation based on WHO classification are shown in Table 1.12.

Of the 40 measles cases, 28 were classified as locally acquired and 12 were imported. The majority of imported cases originated from Malaysia, followed by Indonesia (Table 1.13).

Figure 1.10
E-weekly distribution of reported measles cases, 2014 – 2015

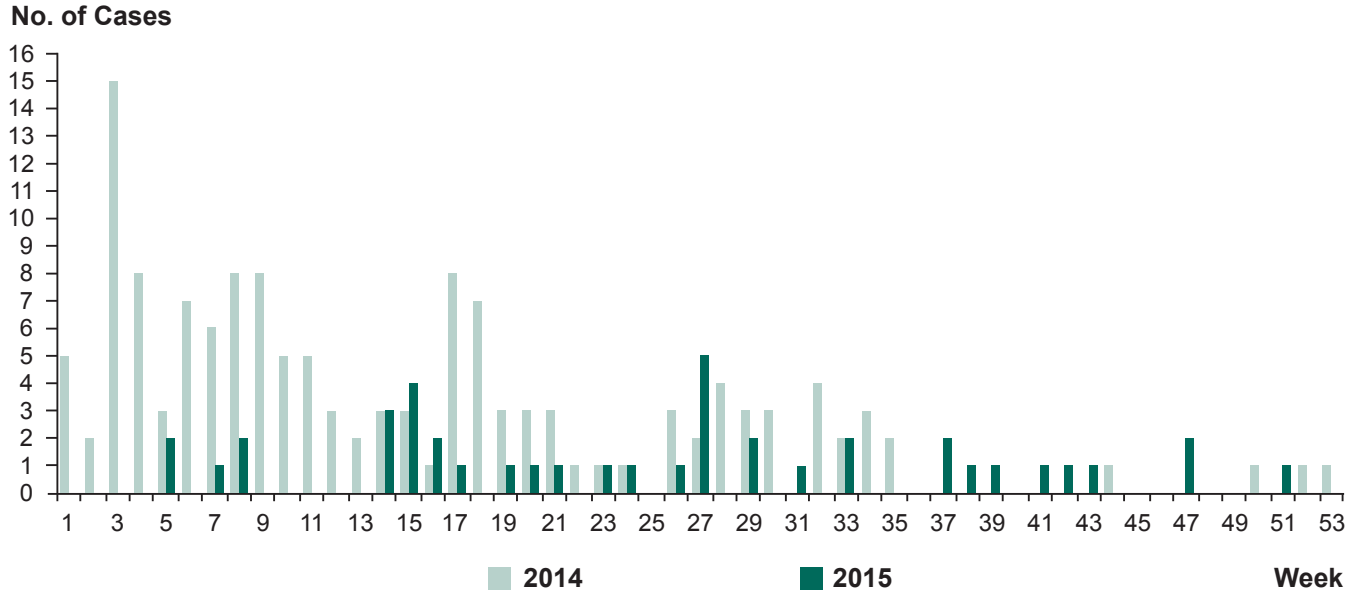


Table 1.9
Total number of notifications received for Measles, 2011 – 2015*

Age	2011		2012		2013		2014		2015	
	Local	Imported	Local	Imported	Local	Imported	Local	Imported	Local	Imported
< 6 mths	6	0	1	0	2	1	4	0	1	0
6 mths – < 1yr	20	3	2	0	12	3	21	7	9	0
1 – 4 yrs	51	8	9	0	9	5	31	9	6	2
5 – 9 yrs	6	1	3	0	0	4	2	0	1	0
10 – 14 yrs	1	0	1	0	1	0	0	0	1	0
15 – 24 yrs	6	0	3	0	1	0	4	2	2	1
25 – 34 yrs	14	6	7	4	2	0	20	8	4	6
35 – 44 yrs	9	2	4	2	4	0	14	1	5	2
45 – 54 yrs	0	0	0	0	0	0	3	2	0	0
55+	0	0	1	0	0	0	0	0	0	0
Total	**113**	**20**	**31**	**6**	**31**	**13**	**99**	**29**	**29**	**11**

Excluding one tourist and one foreigner seeking medical treatment in Singapore

Table 1.10
Age-gender distribution and age-specific incidence rate of reported measles cases^, 2015

Age	Male	Female	Total (%)	Incidence rate per 100,000 population*
< 6 mths	1	0	1 (2.5)	24.3
6 mths – < 1yr	5	4	9 (22.5)	
1 – 4 yrs	1	7	8 (20.0)	4.3
5 – 9 yrs	1	1	2 (5.0)	0.4
10 – 14 yrs	1	2	3 (7.5)	0.4
15 – 24 yrs	6	4	10 (25.0)	0.8
25 – 34 yrs	4	3	7 (17.5)	0.7
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	**19**	**21**	**40 (100.0)**	**0.7**

^Excluding one tourist and one foreigner seeking medical treatment in Singapore
*Rates are based on 2015 estimated mid-year population.
(Source: Singapore Department of Statistics)

Table 1.11
Ethnic-gender distribution and ethnic-specific incidence rate of reported measles cases^, 2015

	Male	Female	Total (%)	Incidence rate per 100,000 population*
Singapore Resident				
Chinese	10	7	17 (42.5)	0.6
Malay	2	7	9 (22.5)	1.7
Indian	0	1	1 (2.5)	0.3
Others	1	0	1 (2.5)	0.8
Foreigner	6	6	12 (30.0)	0.7
Total	**19**	**21**	**40 (100.0)**	**0.7**

^Excluding one tourist and one foreigner seeking medical treatment in Singapore
*Rates are based on 2015 estimated mid-year population.
(Source: Singapore Department of Statistics)

Table 1.12
WHO classification of measles cases, January – December 2015^

Source#	Confirmed measles cases			
	Laboratory confirmed		Epidemiological Linkage	Total
	Respiratory specimen	Blood specimen		
Endemic	0	0	0	0
Unknown	8	20	0	28
Imported	8 (1*)	4	0	11
Imported-Related	0	1	0	1
Total	**16 (1*)**	**25**	**0**	**40**

#Source – whether the source of virus was imported, import-related, endemic or unknown, as extracted from description provided by WHO in the WHO monthly summary excel spreadsheet.

- **Imported:** A case exposed outside the region or country during the 7-21 days prior onset to rash and supported by epidemiological or virological evidence, or both.
- **Import-Related:** A locally acquired infection occurring as part of a chain of transmission originating from an imported case as supported by epidemiological or virological evidence, or both.
- **Endemic:** Laboratory or epidemiologically-linked confirmed cases of measles resulting from endemic transmission of measles virus.
- **Unknown:** A confirmed case for which an epidemiologically or virological link to importation or to endemic transmission cannot be established after a thorough investigation.

* Persons who had both respiratory and blood samples collected
^ Reporting is based on the date of onset of rashes from 1 Jan - 31 Dec 2015.

Table 1.13
Distribution of measles cases by genotype, January - December 2015

Genotypes	Classification			
	Local	Imported	Total	Country of importation (No. of persons)
B3	1	0	1	
D8	9	3	12	Indonesia (1) India (1) Malaysia (1)
D9	6	1	7	Malaysia (1)
H1	0	1	1	China(1)
Genotyping not performed	12	7	19	Indonesia (2) India(1) Malaysia (3) Europe* (1)
Total	**28**	**12**	**40**	

*Person travelled to Paris and Zurich.

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 2015, there were six cases of meningococcal infection reported compared to nine cases in 2014 (Tables 1.14 and 1.15). All the cases were laboratory confirmed with positive blood/ cerebral spinal fluids culture or virginal swab PCR (Table 1.16).

Table 1.14
Total number of notifications received for meningococcal infection, 2011 – 2015

Age Group	2011		2012		2013		2014		2015	
	Local	Imported	Local	Imported	Local	Imported	Local	Imported	Local	Imported
0 – 4	0	0	0	0	1	0	3	0	2	0
5 – 14	1	0	0	0	0	0	0	0	0	0
15 – 24	0	0	0	0	0	0	0	0	2	0
25 – 34	0	0	0	0	0	0	1	0	2	0
35 – 44	1	0	0	0	0	1	1	0	0	0
45 – 54	0	0	0	0	0	0	2	0	0	0
55 - 64	1	0	0	0	1	0	2	0	0	0
65+	3	0	0	0	0	0	0	0	0	0
Total	**6**	**0**	**0**	**0**	**2**	**1**	**9**	**0**	**6**	**0**

Table 1.15
Age-gender distribution and age-specific incidence rates of reported meningococcal infection cases, 2015

Age	Male	Female	Total (%)	Incidence rate per 100,000 population*
0 - 4	1	1	2	0.9
5 – 14	0	0	0	0
15 – 24	2	0	2	0.3
25 – 34	1	1	2	0.2
35 – 44	0	0	0	0
45 – 54	0	0	0	0
55 - 64	0	0	0	0
65+	0	0	0	0
Total	**4**	**2**	**6 (100.0)**	**0.1**

*Rates are based on 2015 estimated mid-year population.
(Source: Singapore Department of Statistics)

Table 1.16
Epidemiological data of six reported meningococcal infection cases, 2015

Case particulars				
Gender	**Age**	**Ethnic group**	**Causative agent**	**Status**
M	1 year	Chinese	*Neisseria meningitides* Grp B	Recovered
M	20 years	Chinese	*Neisseria meningitides* Grp B	Recovered
M	20 years	Indian	*Neisseria meningitides* Grp B	Recovered
M	25 years	Foreigner	*Neisseria meningitides* Grp B	Recovered
F	1 year	Chinese	*Neisseria meningitides* Grp B	Recovered
F	25 years	Chinese	*Neisseria meningitides* (non-groupable)	Recovered

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 – 2015

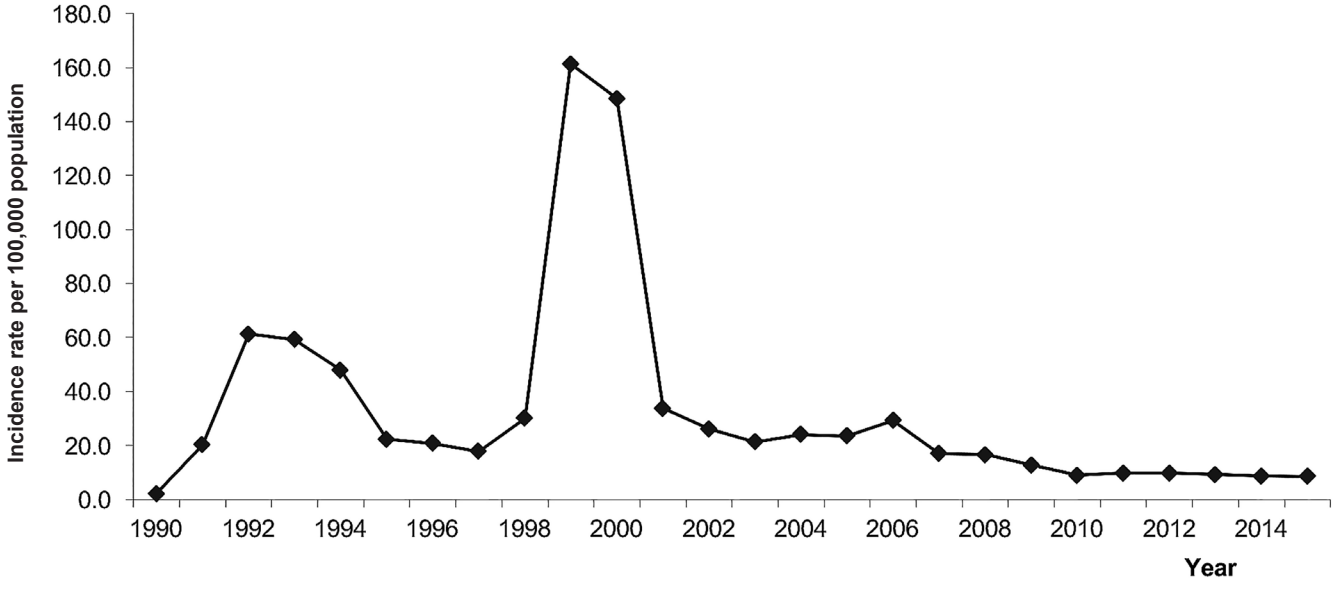
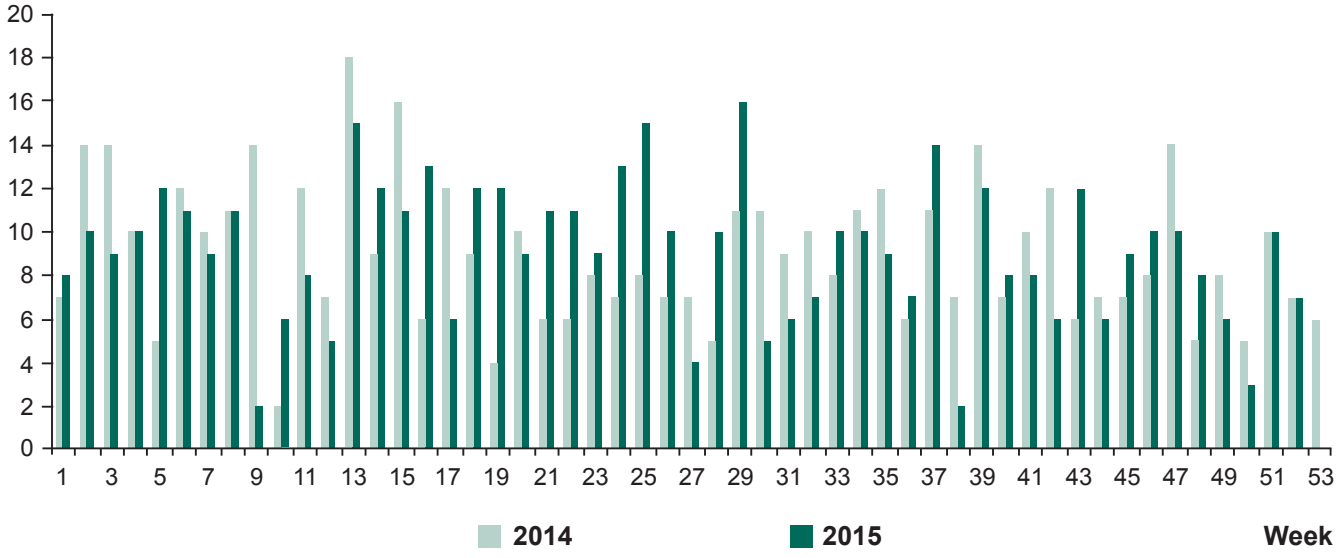


Figure 1.12
E-weekly distribution of reported mumps cases, 2014 – 2015



A total of 473 cases (8.5 per 100,000 population) were reported in 2015 as compared to 478 cases in 2014 (Figure 1.12). The incidence rate was highest in the 5 – 14 years age group (Table 1.17). Among the three major ethnic groups, Malays had the highest incidence rate, followed by Chinese. Foreigners comprised 27.3% of cases (Table 1.18).

Table 1.17
Age-gender distribution and age-specific incidence rate of reported mumps cases, 2015

Age	Male	Female	Total (%)	Incidence rate per 100,000 population*
0 – 4	35	23	58 (12.3)	25.5
5 – 14	77	49	126 (26.6)	26.7
15 – 24	16	20	36 (7.6)	4.8
25 – 34	48	35	83 (17.5)	6.6
35 – 44	41	33	74 (15.6)	7.5
45 – 54	33	16	49 (10.5)	6.6
55+	21	26	47 (9.9)	4.3
Total	**271**	**202**	**473 (100.0)**	**8.5**

*Rates are based on 2015 estimated mid-year population.
(Source: Singapore Department of Statistics)

Table 1.18
Ethnic-gender distribution and ethnic-specific incidence rate of reported mumps cases, 2015

	Male	Female	Total (%)	Incidence rate per 100,000 population*
Singapore Resident				
Chinese	140	107	247 (52.2)	8.5
Malay	26	28	54 (11.4)	10.4
Indian	13	5	18 (3.8)	5.1
Others	16	9	25 (5.3)	19.7
Foreigner	76	53	129 (27.3)	7.9
Total	**271**	**202**	**473 (100.0)**	**8.5**

*Rates are based on 2015 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 57 laboratory confirmed cases of pertussis were reported in 2015 compared to 21 in 2014 (Figure 1.13). Of the 57 reported cases, one was imported and the remaining 56 were indigenous cases (Table 1.19). Of the cases, 46 were aged below 1 year, two were aged between 1 and 9 years, seven were young adults aged 15-24 years and two were adults aged above 50 years. Among the three major ethnic groups, Malays had the highest incidence rate, followed by Chinese (Table 1.20 and 1.21). 47 cases had not received DPT vaccination prior to onset of illness (Source: National Immunisation Registry).

Figure 1.13
E-weekly distribution of reported pertussis cases, 2014 – 2015

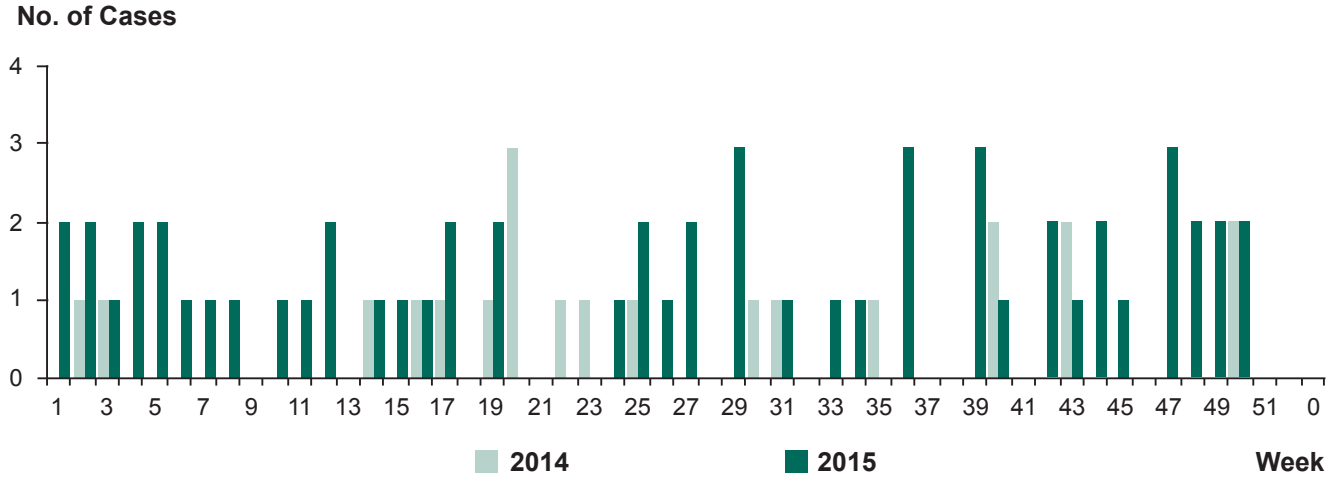


Table 1.19
Total number of notifications received for pertussis, 2011 – 2015

Age Group	2011		2012		2013		2014		2015	
	Local	Imported	Local	Imported	Local	Imported	Local	Imported	Local	Imported
0 – 4	19	1	9	4	14	1	9	2	47	1
5 – 14	1	0	0	0	0	0	1	0	0	0
15 – 24	8	0	11	0	0	1	9	0	7	0
25 – 34	0	0	0	0	1	0	0	0	0	0
35 – 44	0	0	0	0	0	0	0	0	0	0
45 – 54	0	0	0	0	0	0	0	0	1	0
55 - 64	0	0	0	0	0	0	0	0	1	0
65+	0	0	0	0	0	0	0	0	0	0
Total	**28**	**1**	**20**	**4**	**15**	**2**	**19**	**2**	**56**	**1**

Table 1.20
Age-gender distribution and age-specific incidence rate of reported pertussis cases, 2015

Age	Male	Female	Total (%)	Incidence rate per 100,000 population*
0 – <1yr	30	16	46 (80.7)	111.7
1 – 4 yrs	2	0	2 (3.5)	1.1
5 – 9 yrs	0	0	0 (0.0)	0.0
10 – 14 yrs	0	0	0 (0.0)	0.0
15 – 24 yrs	7	0	7 (12.2)	0.9
25 – 34 yrs	0	0	0 (0.0)	0.0
35 – 44 yrs	0	0	0 (0.0)	0.0
45 – 54 yrs	1	0	1 (1.8)	0.1
55 – 64 yrs	1	0	1 (1.8)	0.2
65 yrs+	0	0	0 (0.0)	0.0
Total	**41**	**16**	**57 (100.0)**	**1.0**

*Rates are based on 2015 estimated mid-year population.
(Source: Singapore Department of Statistics)

Table 1.21
Ethnic-gender distribution and ethnic-specific incidence rate of reported pertussis cases, 2015

	Male	Female	Total (%)	Incidence rate per 100,000 population*
Singapore Resident				
Chinese	20	7	27 (47.4)	0.9
Malay	16	8	24 (42.1)	4.6
Indian	2	0	2 (3.5)	0.6
Others	2	1	3 (5.3)	2.4
Foreigner	1	0	1 (1.7)	0.1
Total	**41**	**16**	**57 (100.0)**	**1.0**

*Rates are based on 2015 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 146 laboratory confirmed cases of invasive pneumococcal infection were reported in 2015, a decrease of 0.7% compared to 147 cases reported in 2014 (Figure 1.14). Of the 146 reported cases, three were imported cases and 143 indigenous cases (Table 1.22). The incidence rate was highest in those aged 65 years and above. Among the three major ethnic groups, Malays had the highest incidence rate, followed by Chinese and Indians (Tables 1.23 and 1.24). Of these 146 laboratory confirmed IPD cases, the number of serotyped cases was 119, which correspond to 81.5% of laboratory confirmed IPD cases. The predominant pneumococcal type for children cases was 19A and for adult cases was 3. (Tables 1.25 and 1.26). 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, 2014 – 2015

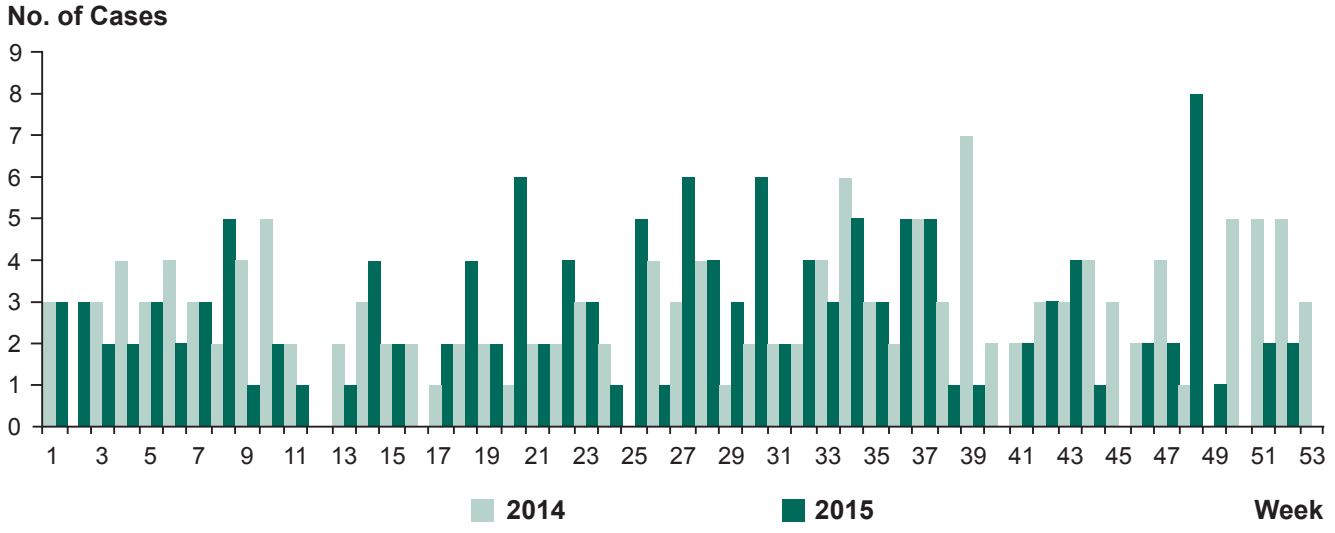


Table 1.22
Total number of notifications received for invasive pneumococcal disease, 2011 – 2015

Age Group	2011		2012		2013		2014		2015	
	Local	Imported	Local	Imported	Local	Imported	Local	Imported	Local	Imported
0 – 4	15	0	16	1	9	1	14	0	10	1
5 – 14	11	0	9	0	8	1	7	1	9	0
15 – 24	8	0	10	0	1	1	2	1	4	0
25 – 34	7	0	19	0	13	3	11	0	9	1
35 – 44	14	0	8	0	11	0	9	1	11	0
45 – 54	19	0	16	0	17	1	11	1	15	0
55 - 64	21	0	31	0	36	0	24	3	25	0
65+	53	0	52	1	64	1	62	0	60	1
Total	**148**	**0**	**161**	**2**	**159**	**8**	**140**	**7**	**143**	**3**

Table 1.23
Age-gender distribution and age-specific incidence rate of reported invasive pneumococcal cases, 2015

Age	Male	Female	Total (%)	Incidence rate per 100,000 population*
0 – 4	8	3	11 (7.54)	4.8
5 – 14	4	5	9 (6.16)	1.9
15 – 24	3	1	4 (2.74)	0.5
25 – 34	5	5	10 (6.85)	0.8
35 – 44	9	2	11 (7.53)	1.1
45 – 54	13	2	15 (10.27)	2.0
55 - 64	14	11	25 (17.12)	4.3
65+	44	17	61 (41.79)	12.0
Total	**100**	**46**	**146 (100.0)**	**2.6**

*Rates are based on 2015 estimated mid-year population.
(Source: Singapore Department of Statistics)

Table 1.24
Ethnic-gender distribution and ethnic-specific incidence rate of reported invasive pneumococcal cases, 2015

	Male	Female	Total (%)	Incidence rate per 100,000 population*
Singapore Resident				
Chinese	54	27	81 (55.48)	2.8
Malay	19	12	31 (21.23)	6.0
Indian	8	2	10 (6.85)	2.8
Others	2	1	3 (2.05)	2.4
Foreigner	17	4	21 (14.39)	1.3
Total	**100**	**46**	**146 (100.0)**	**2.6**

*Rates are based on 2015 estimated mid-year population.
(Source: Singapore Department of Statistics)

Table 1.25
Distribution of pneumococcal serotypes among children cases, 2015

Pneumococcal Type/ Group	Number of isolates (n = 18) (%)
Type 3 *§	4 (22.21)
Group 11	1 (5.56)
Group 15	2 (11.11)
Type 15C	1 (5.56)
Type 18C *§	1 (5.56)
Type 19A §	5 (27.78)
Type 6B *§	1 (5.56)
Type 23A	3 (16.66)

* Serotype included in PCV7, § serotype included in PCV13

Table 1.26
Distribution of pneumococcal serotypes among adult cases, 2015

Pneumococcal Type/ Group	Number of isolates (n = 101) (%)
Type 1 *§	3 (2.97)
Type 3 *§	15 (14.85)
Type 4 *§	3 (2.97)
Type 8	5 (4.95)
Group 10	1 (0.99)
Group 11	2 (1.98)
Group 12	2 (1.98)
Type 14 *§	7 (6.93)
Group 18	1 (0.99)
Type 20	3 (2.97)
Type 15A	1 (0.99)
Type 15B	2 (1.98)
Type 15C	1 (0.99)
Type 15F	1 (0.99)
Type 18C *§	2 (1.98)
Type 19A §	5 (4.95)
Type 19F *§	2 (1.98)
Type 22A	1 (0.99)
Type 22F	2 (1.98)
Type 23A	4 (3.96)
Type 23B	2 (1.98)
Type 23F *§	6 (5.94)
Type 6A §	3 (2.97)
Type 6B *§	7 (6.93)
Type 6C	2 (1.98)
Type 7C §	1 (0.99)
Type 7F §	8 (7.92)
Type 9V *§	1 (0.99)
Non-groupable	8 (7.92)

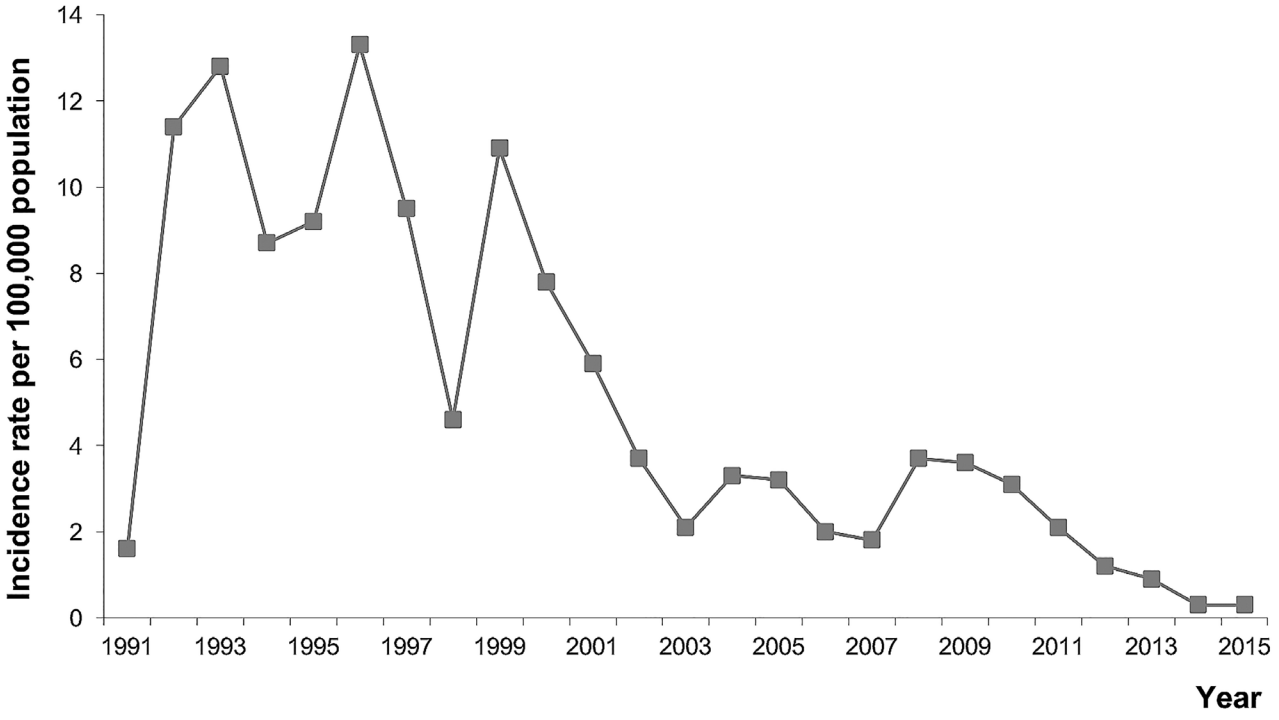
* Serotype included in PCV7, § serotype included in PCV13

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 2015 (0.3 per 100,000 population) (Figure 1.15).

Figure 1.15
Incidence of reported rubella cases, 1991 – 2015



A total of 15 cases of rubella were reported in 2015, a decrease of 11.8% compared to 17 cases reported in 2014 (Figure 1.16). The incidence rate was highest in the 0 - 4 year age group (Table 1.27). 2 out of 3 female cases (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, Malay and Indian had no cases reported. Foreigners comprised 53.8% of cases (Table 1.28).

There were no cases of congenital rubella.

Figure 1.16
E-weekly distribution of reported rubella cases, 2014 – 2015

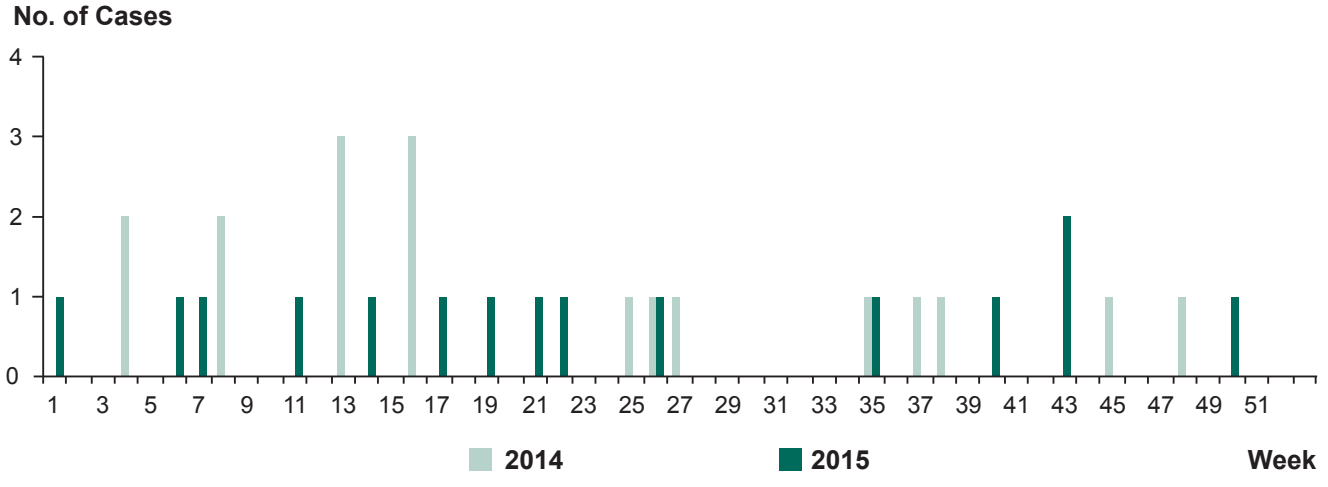


Table 1.27
Age-gender distribution and age-specific incidence rate of reported rubella cases^, 2015

Age (Yrs)	Male	Female	Total (%)	Incidence rate per 100,000 population*
0 – 4	3	1	4 (30.8)	1.8
5 – 14	1	0	1 (7.7)	0.2
15 – 24	0	1	1 (7.7)	0.1
25 – 34	4	0	4 (30.8)	0.3
35 – 44	2	1	3 (23.0)	0.3
45 – 54	0	0	0	0.0
55+	0	0	0	0.0
Total	**10**	**3**	**13 (100.0)**	**0.2**

^Excluding two foreigners seeking medical treatment in Singapore
*Rates are based on 2015 estimated mid-year population.
(Source: Singapore Department of Statistics)

Table 1.28
Ethnic-gender distribution and ethnic-specific incidence rate of reported rubella cases^, 2015

	Male	Female	Total (%)	Incidence rate per 100,000 population*
Singapore Resident				
Chinese	5	1	6 (46.2)	0.2
Malay	0	0	0 (0.0)	0.0
Indian	0	0	0 (0.0)	0.0
Others	0	0	0 (0.0)	0.0
Foreigner	5	2	7 (53.8)	0.4
Total	**10**	**3**	**13 (100.0)**	**0.2**

^Excluding two foreigners seeking medical treatment in Singapore
*Rates are based on 2015 estimated mid-year population.
(Source: Singapore Department of Statistics)

Table 1.29
Total number of notifications received for Rubella, 2011 – 2015 ^

Age	2011		2012		2013		2014		2015	
	Local	Imported	Local	Imported	Local	Imported	Local	Imported	Local	Imported
< 6 mths	9	0	3	0	2	0	0	0	1	0
6 mths – < 1yr										
1 – 4 yrs	10	0	9	0	3	0	5	0	3	0
5 – 9 yrs	5	0	3	0	0	0	1	0	1	0
10 – 14 yrs	2	0	1	0	0	0	1	0	0	0
15 – 24 yrs	18	0	10	0	2	0	0	0	1	0
25 – 34 yrs	28	1	21	1	10	1	3	1	4	0
35 – 44 yrs	15	1	4	0	12	2	2	2	3	0
45 – 54 yrs	8	0	5	0	7	0	0	0	0	0
55+	7	0	1	0	5	0	0	0	0	0
Total	**102**	**2**	**57**	**1**	**41**	**3**	**12**	**3**	**13**	**0**

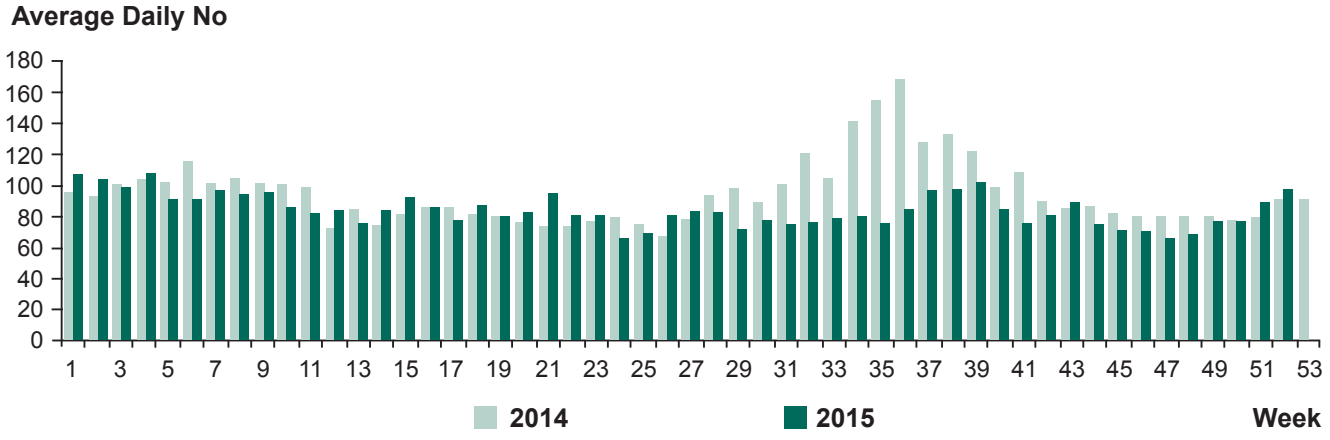
^excludes tourists and foreigners seeking medical treatment in Singapore

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 2015, the polyclinics reported 22,693 attendances for conjunctivitis, a decrease of 13.5% compared to 26,227 attendances reported in 2014 (Figure 1.17).

Figure 1.17
E-weekly distribution of reported conjunctivitis cases, 2014 – 2015



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 2015, a total of 12,406 hospital patients were screened by SIDPIC project coordinators in participating hospitals (Table 1.30). Of these, 217 SIDPIC cases that fulfilled the inclusion criteria were identified. The majority of SIDPIC cases (35.48%) had illnesses with respiratory syndromes (Table 1.31). Of the 217 cases identified in 2015, 108 were found to have alternate aetiologies. 47 of these 108 cases had causative pathogens found. The top two causative pathogens were respiratory viruses (17%), and Streptococcus (17%). 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 109 (50.23%) cases remained unknown. Table 1.32 lists the pathogens which may be tested for under the SIDPIC programme.

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[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 1.30
SIDPIC Performance Indicators 2015

Surveillance Indicators	NUH	TTSH	SGH	KKH	TOTAL
No. of cases screened*	**3832**	**6745**	**867**	**962**	**12406**
Death	1806	3106	151	112	5175
Non-death	2026	3639	716	850	7231
No. of SIDPIC cases	**108**	**65**	**8**	**36**	**217**
Aetiology Found	48	41	2	17	108
Unknown Aetiology	60	24	6	19	109
Co-morbidity found	0	7	0	0	7
No. of missed cases#	1	4	4	1	10

*The total number of cases screened refers to the sum of ICU admissions and death certificates screened.
#Based on surrogate indicator of viral encephalitis notified to MOH that is not identified as SIDPIC cases. All 10 cases did not fulfil SIDPIC recruitment criteria.

Table 1.31
Distribution of cases based on syndrome classification, 2015

Syndrome	Aetiology Found	Unknown Aetiology	Total (%)
Neurological	16	17	33 (15.21)
Cardiac	24	8	32 (14.75)
Respiratory	17	60	77 (35.48)
Gastrointestinal	5	4	9 (4.15)
Multisystem	46	20	66 (30.41)
Total	**108**	**109**	**217 (100.0)**

[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 1.32
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
	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 3,837 attendances in polyclinics for chickenpox in 2015 compared with 3,987 attendances in 2014. 87.9% of the attendances were by Singaporeans and Permanent Residents. Persons below the age of 20 years represented 67.4% of attendances for chickenpox (Table 1.33).

Table 1.33
Profile of chickenpox (varicella) polyclinic attendances by age group and nationality, 2015

Age	Singaporeans/PRs			Foreigners			Total
	Total	Male	Female	Total	Male	Female	Total (%)
0 - 9	1706	893	813	19	8	11	1725 (45.0)
10 -19	849	480	369	11	10	1	860 (22.4)
20 - 29	278	158	120	273	234	39	551 (14.4)
30 - 39	140	68	72	128	108	20	268 (7.0)
40 - 49	181	107	74	32	25	7	213 (5.5)
50 - 59	140	88	52	0	0	0	140 (3.6)
60+	79	43	36	1	0	1	80 (2.1)
Total	**3,373**	**1,837**	**1,536**	**464**	**385**	**79**	**3,837 (100.0)**

Chapter II

VECTOR-BORNE DISEASES

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

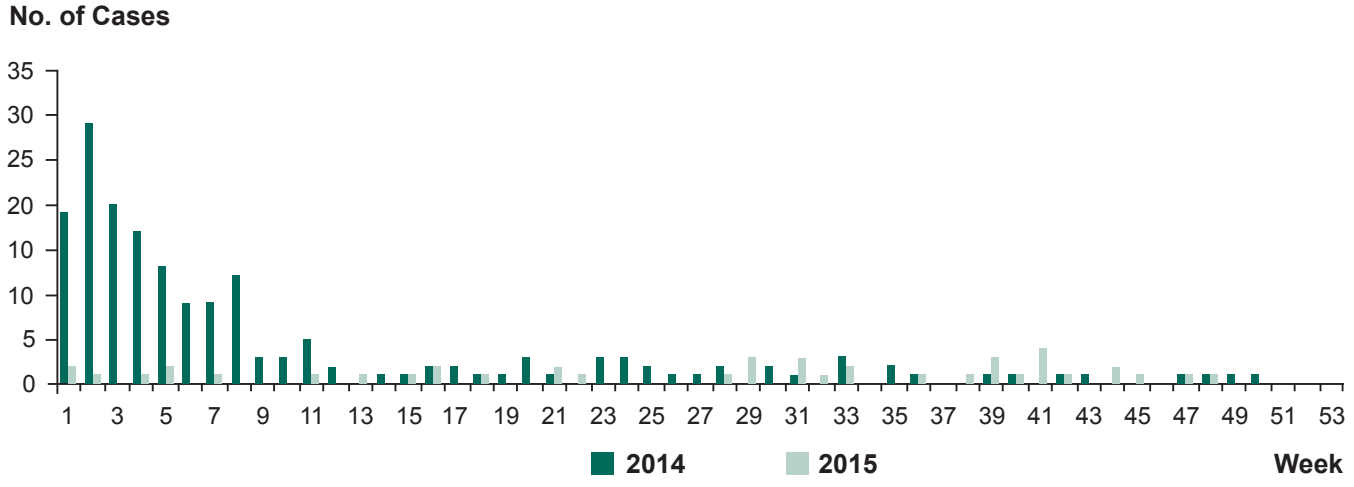
II
VECTOR-BORNE DISEASES

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 42 laboratory-confirmed cases of chikungunya fever were reported in 2015, compared to 182 laboratory-confirmed cases in 2014 (Figure 2.1). Out of the 42 cases, 30 were imported cases, involving 4 Singapore residents, 10 foreigners including work permit holders and 16 tourists or foreigners seeking medical treatment. The remaining 12 cases were indigenous cases. No deaths due to chikungunya were reported in 2015.

Figure 2.1
E-weekly distribution of Chikungunya fever cases, 2014 – 2015



The incidence rate among indigenous cases was highest in the 25 – 34 and 65+ years age groups, (Table 2.1). Among the three major ethnic groups, Indians had the highest incidence. Foreigners comprised 50% of the indigenous cases (Table 2.2).

Table 2.1
Age-gender distribution and age-specific incidence rate of indigenous chikungunya fever cases^, 2015

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	5	0	5 (41.7)	0.4
35 – 44	3	0	3 (25.0)	0.3
45 – 54	0	1	1 (8.3)	0.1
55 – 64	1	0	1 (8.3)	0.2
65+	1	1	2 (16.7)	0.4
Total	**10**	**2**	**12 (100)**	**0.2**

^Cases acquired locally among Singaporeans, permanent and temporary residents.
*Rates are based on 2015 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^, 2015

	Male	Female	Total (%)	Incidence rate per 100,000 population*
Singapore Resident				
Chinese	2	1	3 (25.0)	0.1
Malay	0	0	0 (0.0)	0.0
Indian	1	1	2 (16.7)	0.6
Others	1	0	1 (8.3)	0.8
Foreigner	6	0	6 (50.0)	0.4
Total	**10**	**2**	**12 (100.0)**	**0.2**

^Cases acquired locally among Singaporeans, permanent and temporary residents.
*Rates are based on 2015 estimated mid-year population.
(Source: Singapore Department of Statistics)

There were 30 (71.4%) 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. 15 (50%) and 9 (30%) had travelled to India and Indonesia respectively (Table 2.3).

Table 2.3
Imported chikungunya fever cases, 2011 – 2015

	Year				
	2011	**2012**	**2013**	**2014**	**2015**
Southeast Asia					
Thailand	0	0	2	1	0
Myanmar	0	0	0	0	0
Malaysia	4	0	5	1	0
Indonesia	1	5	15	33	9
Philippines	0	2	7	4	0
East Timor	0	0	0	0	3
South Asia					
Bangladesh	0	0	1	0	0
India	3	12	18	1	15
Maldives	0	0	0	0	0
Sri Lanka	0	0	0	0	1
Other Regions	1	0	0	0	0
Americas	0	0	0	2	2
Europe	0	0	0	1	0
Total	**9**	**19**	**48**	**43**	**30**

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, 2015

(Source: National Environment Agency)

Table 2.4
Total number of notifications received for chikungunya disease, 2011-2015*

Age Group	2011		2012		2013		2014		2015	
	Local	Imported	Local	Imported	Local	Imported	Local	Imported	Local	Imported
0 – 4	0	0	0	0	4	0	1	0	0	0
5 – 14	1	0	0	0	30	2	5	0	0	2
15 – 24	0	0	2	0	82	2	17	0	0	0
25 – 34	1	4	0	4	294	8	39	3	5	4
35 – 44	0	4	1	8	294	17	33	4	3	5
45 – 54	0	0	0	2	141	4	18	5	1	1
55 - 64	0	0	0	0	101	4	17	1	1	2
65+	0	0	0	0	65	2	9	2	2	0
Total	**2**	**8**	**3**	**14**	**1011**	**39**	**139**	**15**	**12**	**14**

*excludes tourists and foreigners seeking medical treatment in Singapore

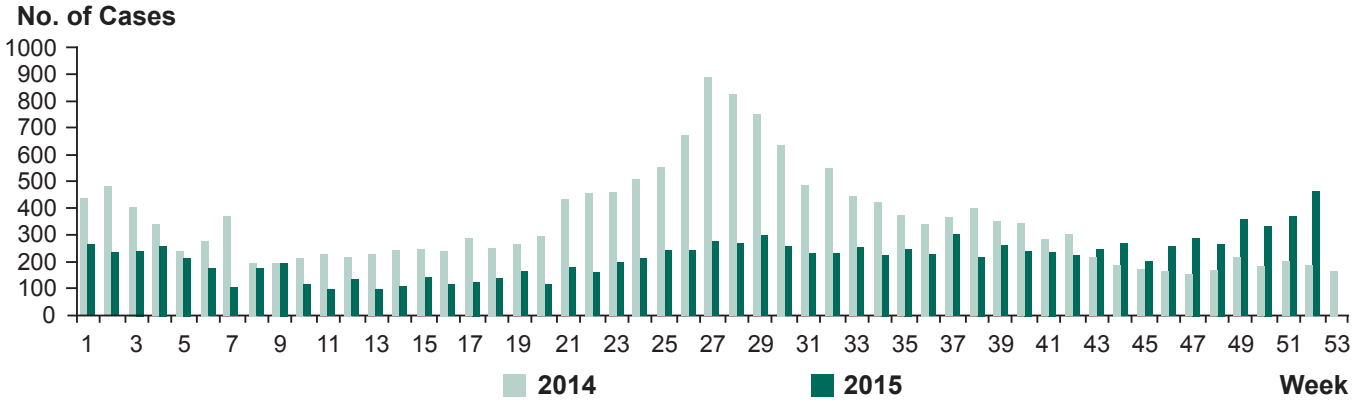
DENGUE FEVER/DENGUE HAEMORRHAGIC FEVER (DF/DHF)

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 11,294 laboratory confirmed cases of DF/DHF [comprising 11,282 cases of dengue fever (DF) and 12 cases of dengue haemorrhagic fever (DHF)] were reported in 2015, a decrease of about 38 percent from the 18,326 dengue fever cases reported in 2014. Out of the 11,294 cases, 438 cases were imported cases involving 182 Singapore residents and 256 foreigners including work permit holders. The remaining 10,856 cases were classified as indigenous cases.

The incidence in the beginning of 2015 was slightly high in E-weeks 1-5, but remained relatively low until E-week 25, where cases rose gradually above the mean +2SD level. Despite some occasional lows, the number of dengue cases did not decrease below the mean +1SD level (except for E-week 45) for the rest of the year. Additionally, starting in E-week 47, there was an observable upward trend till the end of 2015, with the number of dengue cases exceeding the mean +2SD level by a fair margin (Figure 2.3).

Figure 2.3
E-weekly distribution of DF/DHF cases, 2014 – 2015



The incidence rate among indigenous cases was highest in the age group of 15-24 with a male to female ratio of 2:1 (Table 2.5). Among the three major ethnic groups, Chinese had the highest incidence rate, followed by Malays and Indians. Foreigners comprised 33.4% of the indigenous cases (Table 2.6).

Table 2.5
Age-gender distribution and age-specific incidence rates of indigenous^ DF/DHF cases, 2015

Age (Yrs)	Male	Female	Total (%)	Incidence rate per 100,000 population*
0 – 4	60	36	96 (0.9)	42.1
5 – 14	375	250	625 (5.7)	132.3
15 – 24	1,175	617	1,792 (16.5)	238.4
25 – 34	1,958	958	2,916 (26.9)	232.3
35 – 44	1,404	780	2,184 (20.1)	221.2
45 – 54	909	599	1,508 (13.9)	201.7
55 - 64	551	461	1,012 (9.3)	172.5
65+	384	339	723 (6.7)	142.8
Total	**6,816**	**4,040**	**10,856 (100.0)**	**196.1**

^Cases acquired locally among Singaporeans, permanent and temporary residents.
*Rates are based on 2015 estimated mid-year population.
(Source: Singapore Department of Statistics)

Table 2.6
Ethnic-gender distribution and ethnic-specific incidence rates of indigenous^ DF/DHF cases, 2015

	Male	Female	Total (%)	Incidence rate per 100,000 population*
Singapore Resident				
Chinese	3,137	2,383	5,520 (50.8)	190.3
Malay	471	293	764 (7.0)	146.7
Indian	242	137	379 (3.5)	106.8
Others	356	214	570 (5.3)	449.5
Foreigner	2,610	1,013	3,623 (33.4)	222.0
Total	**6,816**	**4,040**	**10,856 (100.0)**	**196.1**

^Cases acquired locally among Singaporeans, permanent and temporary residents.
*Rates are based on 2015 estimated mid-year population.
(Source: Singapore Department of Statistics)

Table 2.7
Total number of notifications received for DF/DHF Cases^, 2011 – 2015

Age Group	2011		2012		2013		2014		2015	
	Local	Imported	Local	Imported	Local	Imported	Local	Imported	Local	Imported
0 – 4	70	-	72	2	157	2	181	4	96	4
5 – 14	325	5	315	5	1,257	9	1,165	18	625	15
15 – 24	839	16	864	27	4,118	18	3,169	46	1792	39
25 – 34	1,153	27	1,252	47	5,907	32	4,971	106	2916	93
35 – 44	1,019	22	1,049	26	4,552	41	3,789	83	2184	72
45 – 54	739	13	643	19	2,889	18	2,384	46	1508	37
55 - 64	479	7	463	3	1,660	16	1,256	23	1012	20
65+	475	1	434	4	1,323	7	897	13	723	11
Total	**5,099**	**91**	**5,092**	**133**	**21,863**	**143**	**17,812**	**339**	**10,856**	**291**

^excludes tourists and foreigners seeking treatment in Singapore

There were 438 (3.9%) imported cases, defined as Singaporeans, permanent and temporary residents, tourists and other foreigners with a history of travel to dengue endemic countries within seven days prior to the onset of illness. The majority of these cases (84.7%) were from Southeast Asian countries: 191 from Malaysia, 116 from Indonesia, 26 from the Philippines, 21 from Thailand, 9 from Myanmar, 7 from Vietnam and the rest are from other regions (Table 2.8).

Table 2.8
Imported DF/DHF cases, 2011 – 2015

	Year				
	2011	**2012**	**2013**	**2014**	**2015**
Southeast Asia					
Brunei	1	0	1	1	0
Cambodia	8	11	2	1	1
East Timor	2	4	1	5	0
Indonesia	110	111	116	143	116
Laos	0	0	0	1	0
Malaysia	21	39	90	214	191
Myanmar	3	1	9	8	9
Philippines	12	13	10	17	26
Thailand	15	22	21	27	21
Vietnam	9	4	6	8	7
South Asia					
Bangladesh	13	5	4	6	6
China	1	3	12	9	2
India	16	32	17	39	35
Maldives	1	2	1	6	3
Nepal	0	0	0	1	0
Pakistan	2	0	1	0	1
Sri Lanka	5	4	1	6	2
Other Regions	12	12	15	22	18
Total	**231**	**263**	**307**	**514**	**438**

Residents in Housing & Development Board (HDB) flats, Landed Properties (including shophouses) and Condominiums constituted 66.1%, 15.5% and 17.5% of the cases respectively. The incidence rate of residents of landed properties houses (447.3 per 100,000) was about three times of residents in HDB flats (151.1 per 100,000). (Table 2.9).

Table 2.9
Incidence rates of reported indigenous DF/DHF cases by housing type for Singapore residents, 2015

Housing Type	No.	%	Incidence rate per 100,000 population*
HDB Flats	4,779	66.1	151.1
Landed Properties (including shophouses)	1,123	15.5	447.3
Condominiums and Other Apartments	1,264	17.5	279.0
Others	67	0.9	184.8
Total	**7,233**	**100.0**	**185.3**

*Rates are based on 2015 estimated mid-year population.
(Source: Singapore Department of Statistics)

A total of 1,114 clusters involving 6,441 epidemiologically linked cases were identified in 2015, of which 108 clusters (9.7%) had 10 or more cases. Areas with more than 50 cases are listed in Table 2.11. The median number of cases in these 108 clusters was 17 (range 10 to 280) and the median duration of transmission was 37 days (range 8 to 134) (Table 2.10).

Table 2.10
Dengue clusters identified, 1990 – 2015

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	4,369	328	1,403 (30.9)	21 (6.4)	3	6
2013	21,863	1,475	10,256(46.3)	188 (12.7)	3	9
2014	17,812	1,418	9,474 (51.7)	137 (9.7)	3	9
2015	10,856	1,114	5,744 (50.9)	108 (9.7)	3	10

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

Table 2.11
Dengue clusters identified, 2015 (50 or more cases)

S/No.	Locality	No. of cases	Month
1	Tampines Ave 1 (Blk 890B) / Tampines Ave 3 / CS @ Tampines Ave 4 / Tampines Ave 4 (Blk 801, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 815, 816 / Tampines Ave 5 (Blk 943) / Tampines Ave 8 (Blk 892, 892A, 893) / Tampines St 81 (Blk 813, 814, 817, 818, 819, 820, 887, 889A, 894, 894A, 895, 895A, 896, 897, 898, 898A, 899, 899A) / Tampines St 91 (Blk 912, 916, 927, 929, 932, 933, 934, 935)	280	Nov-15 - Feb-16

S/No.	Locality	No. of cases	Month
2	Bishan St 22 (Blk 238, 239, 240, 241, 242, 243, 244, 245, 246, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 283, 285) / Bishan St 24 (Blk 264, 265, 266, 268, 270, 271, 272, 278, 287)	176	May-15 - Aug-15
3	Bishan St 22 (Blk 232, 233, 234, 235, 236, 237, 282, 293) / Bishan St 23 (Blk 212, 214, 215, 220, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231) / Bishan St 24 (Blk 273B, 281, 288, 289, 290, 291) / Bishan St 25 (Clover By The Park)	141	May-15 - Aug-15
4	Yishun Ring Rd (Blk 622, 846, 853) / Yishun St 81 (Blk 816, 817, 820, 821, 822, 823, 824, 825, 827, 828, 829, 830, 832, 833, 834, 835, 836, 838, 839, 841, 844, 852, 865, 866, 868, 871, 874, 876, 877, 879, 880) / Yishun St 81 (Orchid Pk Condo)	112	Dec-15 - Feb-16
5	Joo Ave / Kent Rd (Blk 52, 53) / Mergui Rd / Owen Rd / Oxford Rd (Kentish Ct, Kentish Lodge, Oxford Suites) / Perumal Rd / Race Course Rd (Blk 68, 682, 684, 685) / Rangoon Rd (Blk 677) / Rangoon Rd / RangoonLn, Rd / S'goon Rd / Sing Ave /Sing Ave (Sing Joo Wlk / Starlight Rd / Sturdee Rd / CS Site @ Tessensohn Rd / Tessensohn Rd (Blk 683)	108	Oct-15 - Feb-16
6	Pasir Ris Dr 6 (Blk 442) / Pasir Ris St 11 (Blk 109, 110, 111, 112, 113, 116, 117, 119, 120, 121, 122, 124, 125, 126, 127, 128, 129, 132, 133, 134) / Pasir Ris St 12 (Blk 101,102,108,191,199) / Pasir Ris St 21 (Blk213,216) / Pasir Ris St 51(Blk551,558)	107	Oct-15 - Feb-16
7	Ang Mo Kio Ave 1 (Kingsgrove) / Burghley Dr / Cardiff Gr / Cardiff Gr (Cardiff Residence) / Carisbrooke Gr / Chiselhurst Gr / Colchester Gr / Golden Dr, Rise, Walk / Coniston Gr / Conway Gr / Jln Pacheli / Li Hwan Cl, Dr, Pl, Ter, View / Lor Chuan / Summer Pl / Tai Hwan Cres, Dr, Gr, Hts, Ln	102	Dec-15 - Mar-16
8	Chiap Guan Ave / Dix Rd / Ee Teow Leng Rd / Flower Rd / Glasgow Rd / Hendry Cl / Highland Cl, Rd, Walk / Hillside Dr / Jln Sahabat / Kovan Rd / Lange Rd / Palm Gr, Ave / Palm Gr Ave / Phillips Ave / Teow Hock Ave / Upp S'goon Rd / Yio Chu Kang Rd	92	Nov-15 - Mar-16
9	Bowmont Gdns / Burnfoot Ter / Carlton Ave / Cheviot Hill / Dryburgh Ave / Dunbar Walk / Ettrick Ter / Frankel Ave / Greenfield Dr / Jedburgh Gdns / La Salle St / Roseburn Ave / Siglap Bank, Dr, Plain, Rise, Walk / Wilton Gdns / Yarrow Gdns	87	Dec-15 – May-16

S/No.	Locality	No. of cases	Month
10	Geylang Rd / Geylang Rd (Le Regal) / Guillemard Rd / Lor 4 Geylang (Wang Lodge) / Lor 6 Geylang (Sun flower Court) / Lor 7 Geylang (Centra Residence) / Lor 8 Geylang (Aston Lodge, Familie Mansion, Swann Court) / Lor 9 Geylang (Kim Court) /Lor 4, 6, 7, 8, 9, 11, 12, 13, 15, 17, 23 Geylang / Sims Ave	80	Dec-15 - Feb-16
11	CS @ Pasir Ris Gr / Elias Green (Elias Green) / Pasir Ris Gr (Livia, NV Residences)	73	Sep-15 - Nov-15
12	Lucky Cres, Gdns, Hts, View / Riviera Dr (Riviera Residences) / Sennett Cl / Upp East Coast Rd (The Summit, The Baycourt, Venezio)	71	Dec-15 - Feb-16
13	CS @ Flora Dr / Flora Dr (Hedges Pk Condo) / Flora Rd (Edelweiss Pk Condo, Estella Gdns) / Mariam Way (Ballota Pk Condo)	65	Apr-15 - Jun-15
14	Eastwood Dr, Green, Pl, Rd, Ter, Walk, Way / Eastwood Rd (Fairmount Condo, Laguna 88) / Jln Greja	51	Oct-15 - Jan-16

Dengue Deaths

A total of six fatal cases were reported in 2015. Of these, four fatal cases were classified as indigenous infections among local residents. The first imported case involved a British national who demised while on-board an inbound flight to Singapore. The second imported case involved an American national who was visiting Singapore from his retirement home in Malaysia, and developed symptoms the day after his arrival.

Laboratory Surveillance

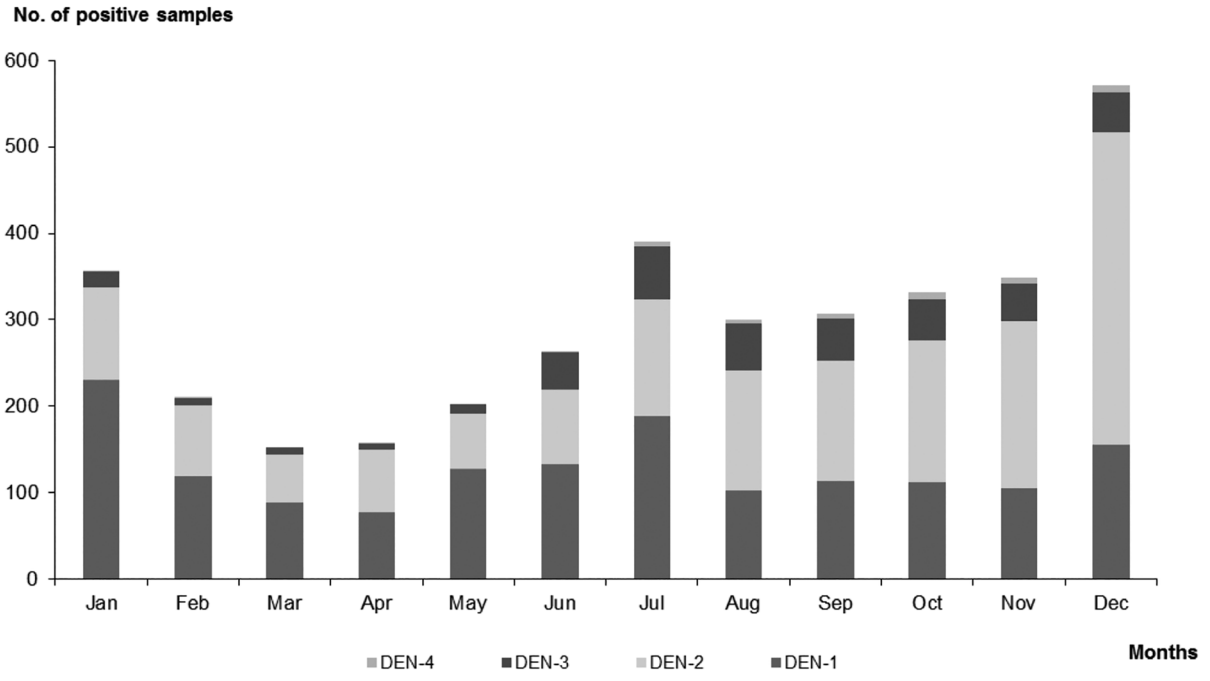
All reported cases of DF/DHF were confirmed by one or more laboratory tests; viz. anti-dengue IgM antibody, enzyme linked immunosorbent assay (ELISA), and polymerase chain reaction (PCR).

A total of 3,590 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 in 2015, comprising DENV-1 (43.2%), DENV-2 (44.5%), DENV-3 (11.2%) and DENV-4 (1.1%) (Figures 2.4 & 2.5).

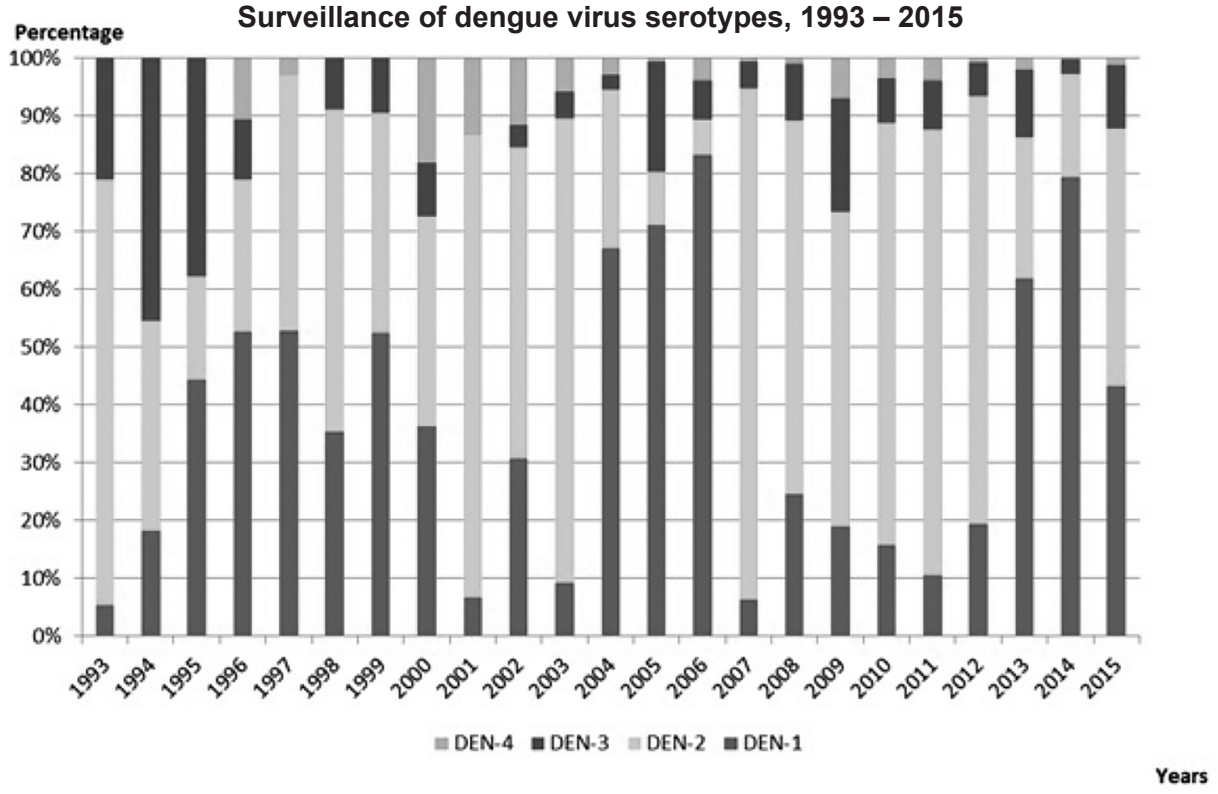
DENV-1 was the predominant circulating serotype from 2012 to 2014. DENV-2 was found to be the predominant circulating serotype in 2015 (Figure 2.5).

Figure 2.4
Surveillance of dengue virus serotypes, 2015



(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 – 2015



(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 comprising of surveillance, control, community outreach & social mobilisation, enforcement and research.

Surveillance is built on the current regime of inspecting premises and ground surveys for mosquito breeding. 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. This is complemented by adult mosquito sentinel surveillance using Gravitraps, which capture gravid mosquitoes. The Gravitrap-based sentinel surveillance system monitors the Aedes mosquito population in HDB housing estates at 34 locations around Singapore. Data collected from the sentinel surveillance system helps to provide insights on mosquito population and distribution, and informs operational deployment.

Source reduction 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 search and destroy of mosquito breeding sources complemented by space spraying of insecticides to kill adult mosquitoes. Apart from surveillance, Gravitraps are also used to monitor the extent of control efforts.

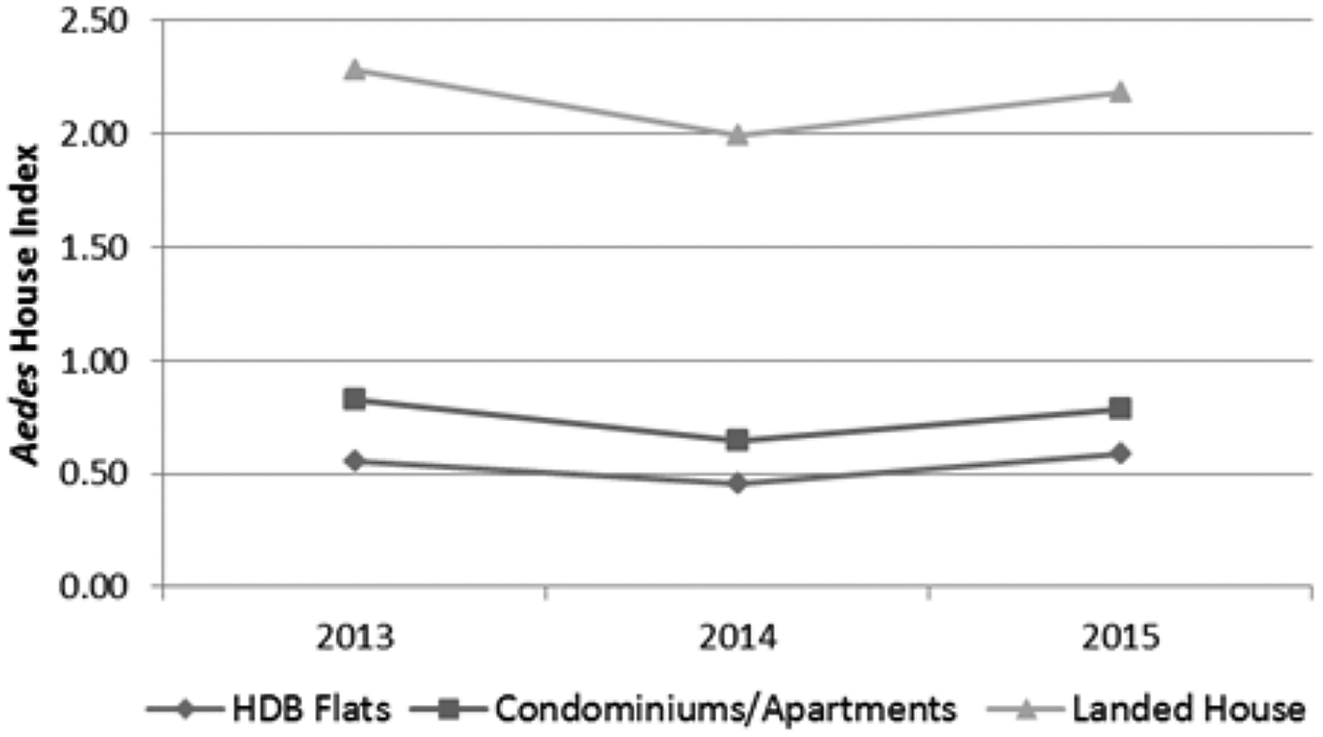
Situation in 2015

A total of 11,294 cases were reported in 2015. This was 38% lower than 2014. DENV-2 was the predominant virus serotypes in 2015. Overall, 44.5% of the serotyped dengue cases were DENV-2, followed by DENV-1 (43.2%), DENV-3 (11.2%) and DENV-4 (1.1%).

In 2015, NEA inspected some 1.4 million premises and surveyed over 110,000 outdoor areas. These include residential premises, construction sites, schools and factories. The geographical distribution of dengue cases, Aedes aegypti and Aedes albopictus mosquito breeding habitats are shown in Figures 2.6, 2.7,& 2.8. The overall Aedes House Index (HI) was 1.24%, with landed houses showing the highest HI among the residential premises (Figure 2.6).

The top five breeding habitats for Aedes aegypti were domestic containers (39.7%), ornamental containers (16.3%), flower pot plate/tray (14.4%), closed perimeter drain (4.3%), and discarded receptacles (3.0%) (Figure 2.7). As for Aedes albopictus, the most common breeding habitats were domestic containers (15.1%), flower pot plate/tray (14.7%), discarded receptacles (11.6%), closed perimeter drain (8.9%) and ornamental containers (7.5%) (Figure 2.8).

Figure 2.6
Aedes House Index (2013 – 2015)



* Based on accessible inspections only

Figure 2.7
Distribution of Aedes aegypti top 5 breeding habitats, 2015

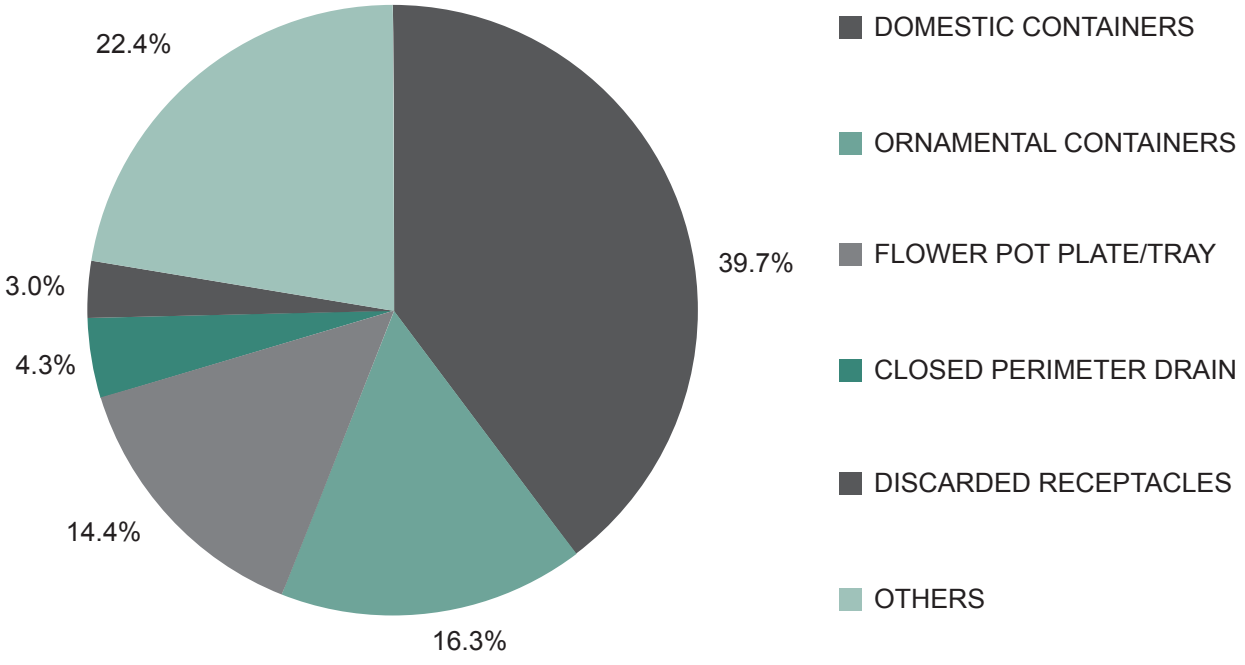
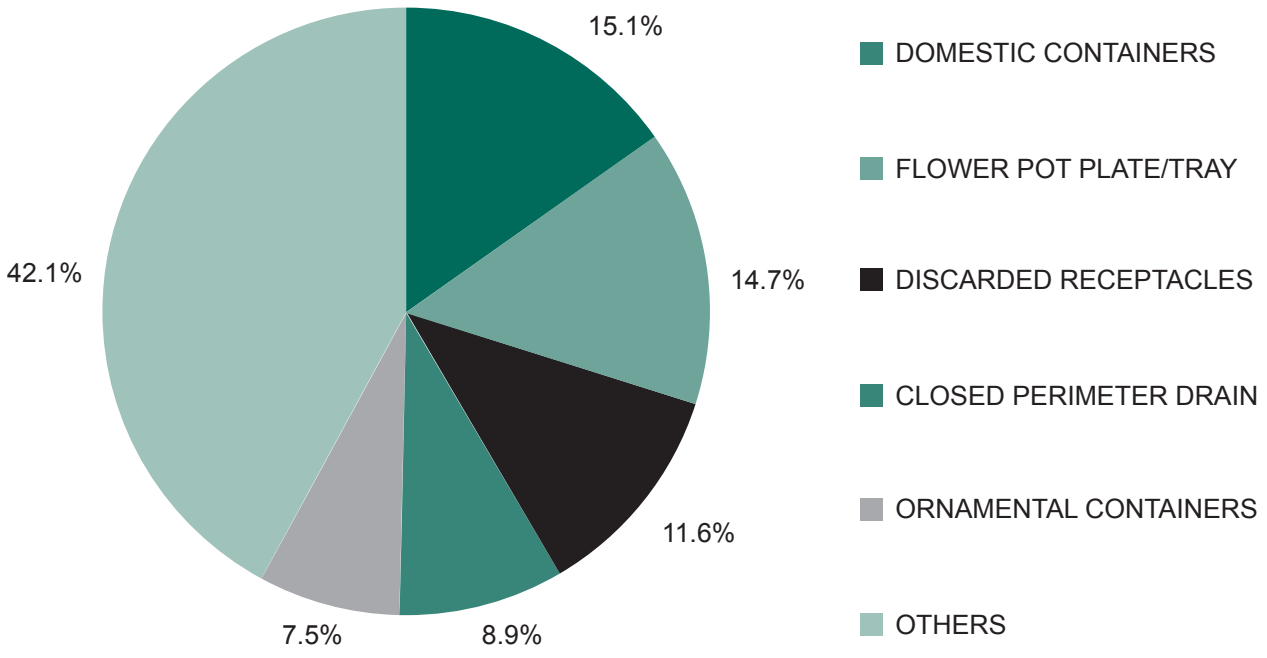


Figure 2.8
Distribution of Aedes albopictus top 5 breeding habitats, 2015



There were a total of 1,114 clusters notified in 2015. The two largest clusters in 2015 were in Bishan and Tampines area.

Outbreak of dengue fever at Construction Site @ Tampines Ave 1 (Blk 890B) / Tampines Ave 3 / Construction Site @ Tampines Ave 4 / Tampines Ave 4 (Blk 801, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 815, 816) / Tampines Ave 5 (Blk 943) / Tampines Ave 8 (Blk 892, 892A, 893) / Tampines St 81 (Blk 813, 814, 817, 818, 819, 820, 887, 889A, 894, 894A, 895, 895A, 896, 897, 898, 898A, 899, 899A) / Tampines St 91 (Blk 912, 916, 927, 929, 932, 933, 934, 935)

On 27 October 2015, the Ministry of Health was notified of a dengue case working at Tampines West Downtown Line construction site. Within two days, another case was reported. Epidemiological investigations and vector control operations were carried out. A total of 280 cases were reported in the outbreak. All the cases had onset dates between 20 October 2015 and 3 February 2016. Of the 280 cases, 85 cases had DENV-2, 13 had DENV-1 and 1 had DENV-3. The epidemic curve of the cluster is shown in Figure 2.9.

Of the 280 cases, 180 (64.3%) were Singapore residents. Majority of the cases (93.9%) were in the 15-65 years age group. The female to male ratio was 1:1.7. Based on the reported occupations, the cases comprised 82 construction workers, 14 students, 13 housewives, 5 retiree, 3 unemployed persons and 34 working adults. Information was not available for 129 cases.

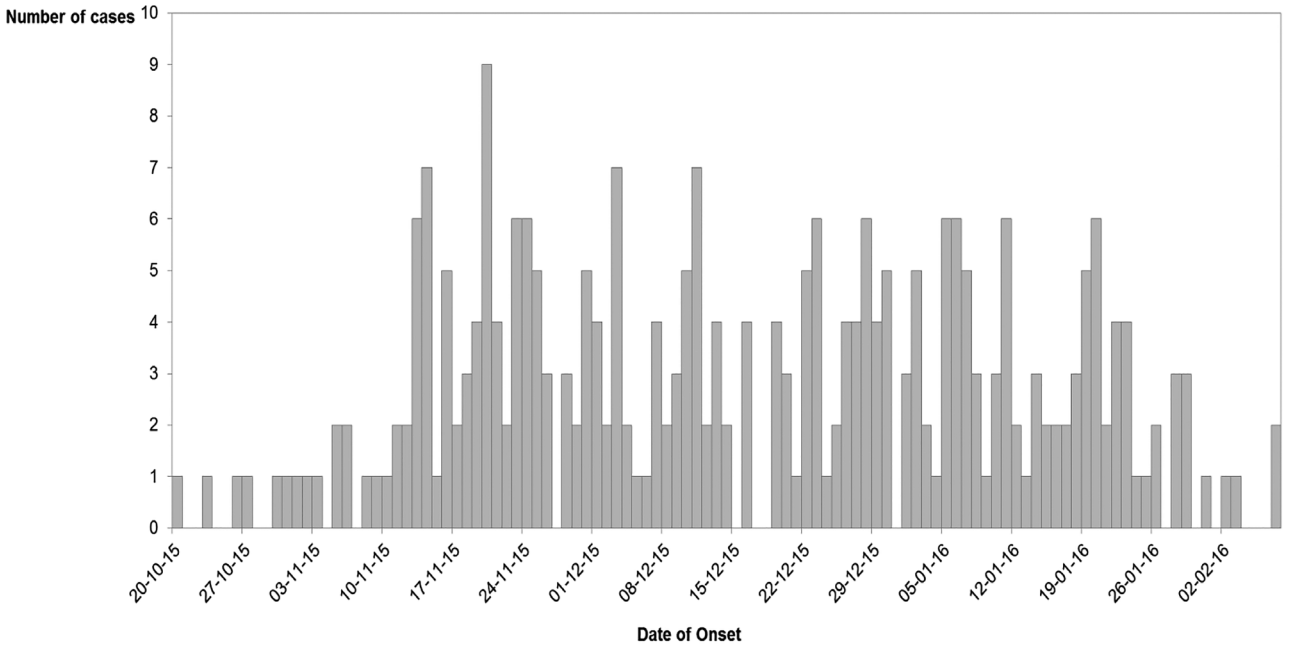


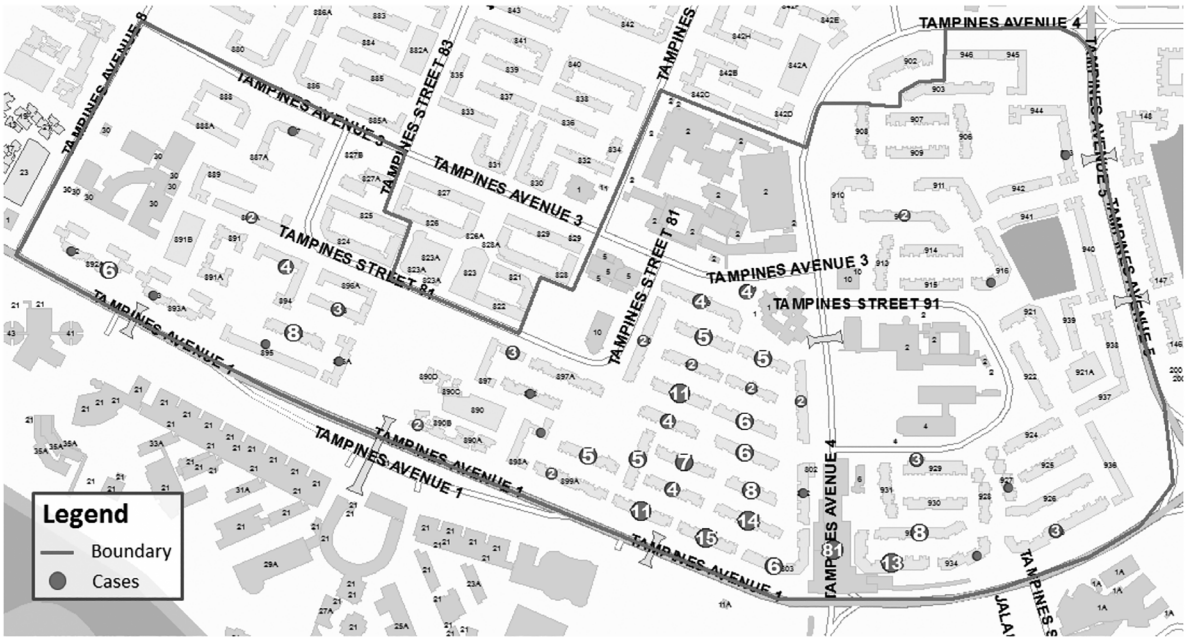
Figure 2.9

Time distribution of 280 DF/DHF cases in cluster at Tampines Ave 1 (Blk 890B) / Tampines Ave 3 / Construction Site @ Tampines Ave 4 / Tampines Ave 4 (Blk 801, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 815, 816) / Tampines Ave 5 (Blk 943) / Tampines Ave 8 (Blk 892, 892A, 893) / Tampines St 81 (Blk 813, 814, 817, 818, 819, 820, 887, 889A, 894, 894A, 895, 895A, 896, 897, 898, 898A, 899, 899A) / Tampines St 91 (Blk 912, 916, 927, 929, 932, 933, 934, 935)

Figure 2.10 shows the geographical distribution of cases in the cluster.

Figure 2.10

Geographical distribution of 280 DF/DHF cases in Tampines Ave 1 (Blk 890B) / Tampines Ave 3 / Construction Site @ Tampines Ave 4 / Tampines Ave 4 (Blk 801, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 815, 816) / Tampines Ave 5 (Blk 943) / Tampines Ave 8 (Blk 892, 892A, 893) / Tampines St 81 (Blk 813, 814, 817, 818, 819, 820, 887, 889A, 894, 894A, 895, 895A, 896, 897, 898, 898A, 899, 899A) / Tampines St 91 (Blk 912, 916, 927, 929, 932, 933, 934, 935)



A total of 121 mosquito breeding habitats were detected and destroyed. 39.7% of the breeding habitats found in the cluster were domestic containers (containers and pails) and 19.8% were ornamental containers (flower vase and pots). 70.2% of the breeding habitats were detected in residential premises, with the remainder on outdoor grounds. Aedes aegypti accounted for 77.7% of the breeding.

There were six profuse breeding detected, including three roof top ground puddle (200 larvae or more per habitat), a tree hole (100 larvae), an inspection chamber (100 larvae) and a zinc cover on the rooftop (100 larvae).

Outbreak of Dengue fever at Bishan St 22 (Blk 238, 239, 240, 241, 242, 243, 244, 245, 246, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 283, 285) / Bishan St 24 (Blk 264, 265, 266, 268, 270, 271, 272, 278, 287).

On 7 May 2015, the Ministry of Health was notified of a dengue case residing at Block 252 Bishan St 22. Within two weeks, two additional cases were reported in the vicinity. Epidemiological investigations and vector control operations were carried out. A total of 176 cases were reported in the outbreak. The cases had onset dates between 3 May 2015 and 31 July 2015. 50 of the 176 (28.4%) cases had DENV-1. The epidemic curve is shown in Figure 2.11.

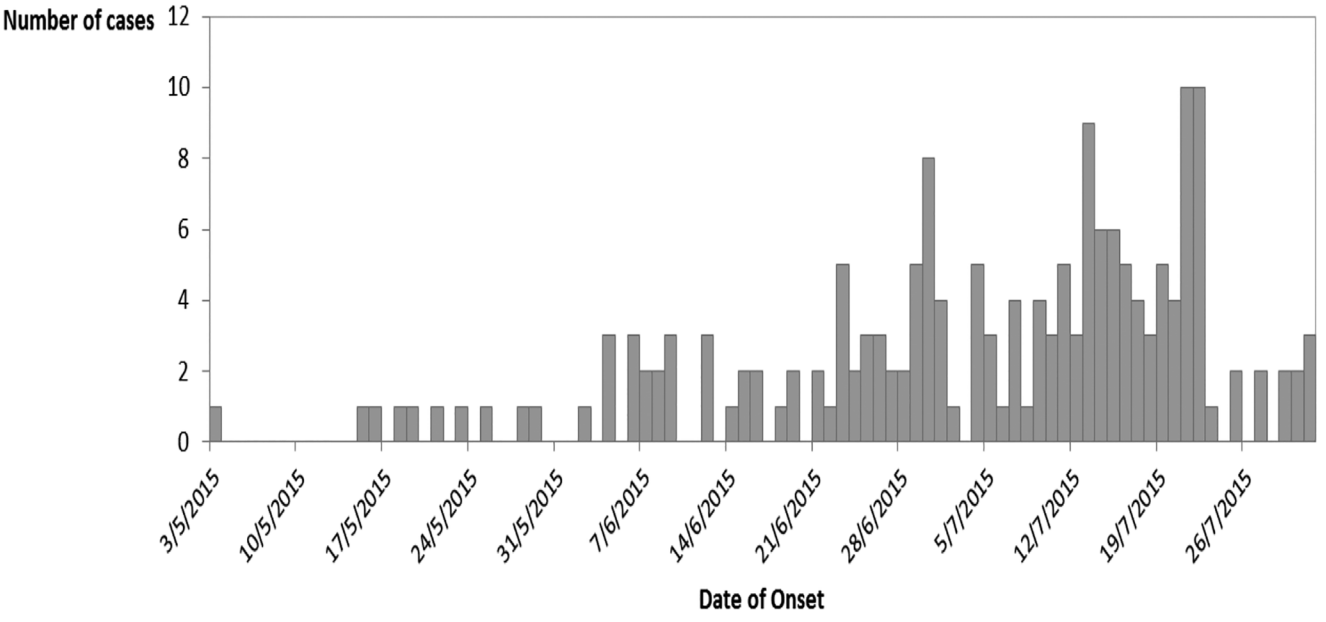


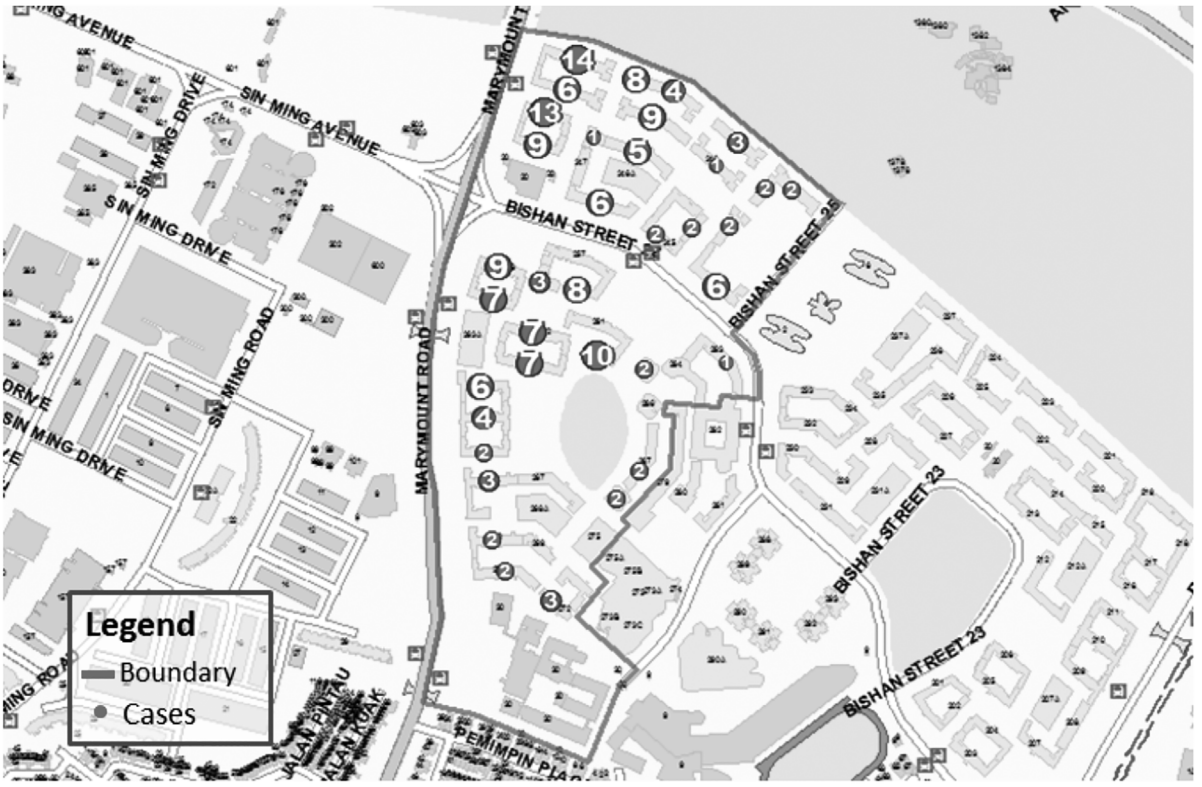
Figure 2.11

Time distribution of 176 DF/DHF cases in Bishan St 22 (Blk 238, 239, 240, 241, 242, 243, 244, 245, 246, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 283, 285) / Bishan St 24 (Blk 264, 265, 266, 268, 270, 271, 272, 278, 287)

Of these 176 cases, 161 (91.5%) were Singapore Residents. Majority of the cases (84.7%) were in the 11-60 years age group. The female to male ratio was 1:1.5. Based on the reported occupations, the cases comprised 35 students, 13 housewives, 6 retirees, 4 unemployed persons and 69 working adults. Information was not available for 49 cases. Figure 2.12 shows the geographical distribution of cases in the cluster.

Figure 2.12

Geographical distribution of 176 DF/DHF cases in Bishan St 22 (Blk 238, 239, 240, 241, 242, 243, 244, 245, 246, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 283, 285) / Bishan St 24 (Blk 264, 265, 266, 268, 270, 271, 272, 278, 287)



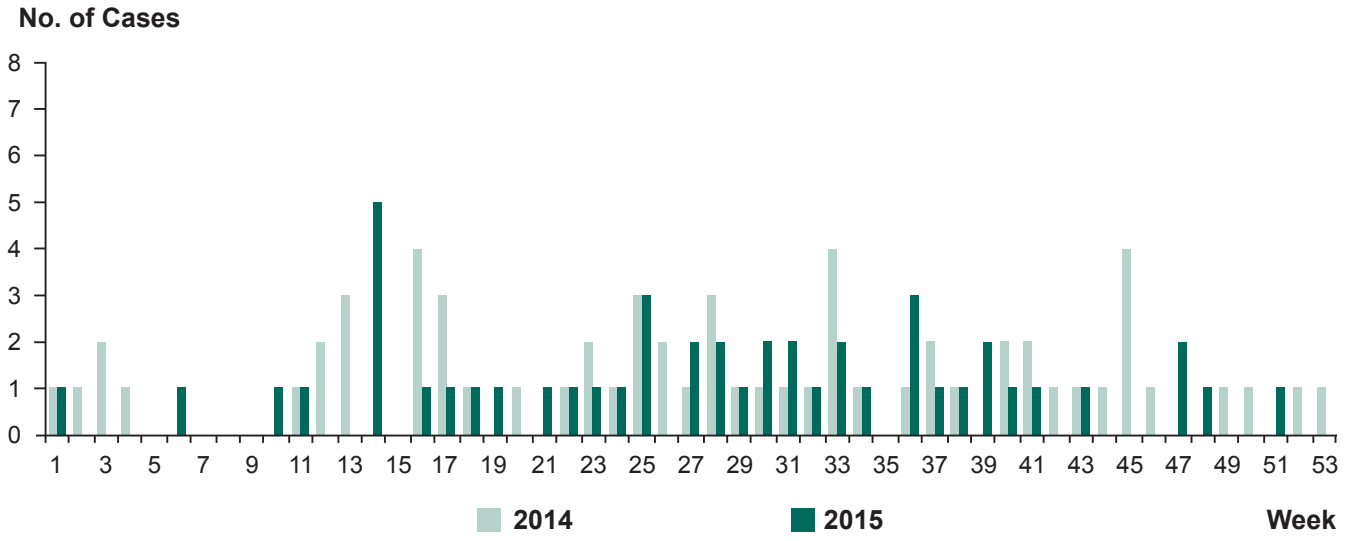
96 mosquito breeding habitats were detected and destroyed. 28.1% of the breeding habitats found in the cluster were domestic containers (pails and dish trays), and 17.7% were flower pot plates and trays. 70.8% of the breeding habitats were detected in residential premises, with the remainder on outdoor ground. Aedes aegypti accounted for 66.7% of the breeding. There were two profuse breeding detected, in a plastic pail (100 larvae), and in a flower pot (100 larvae) in residential premises.

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 2015, a total of 47 laboratory-confirmed cases were reported, a decrease of 24.2% compared to the 62 cases reported in 2014 (Figure 2.13). All 47 cases were imported.

Figure 2.13
E-weekly distribution of reported malaria cases, 2014-2015



The incidence rate was highest in the 15-24 years age group, with a male to female ratio of 1.7:1 (Table 2.12). Among the three major ethnic groups, Indians had the highest incidence rate, followed by Chinese and Malay (Table 2.13).

Table 2.12
Age-gender distribution and age-specific incidence rate of reported malaria cases^, 2015

Age	Male	Female	Total (%)	Incidence rate per 100,000 population*
0 – 4	0	0	0 (0.0)	0.0
5 – 14	0	1	1 (3.3)	0.2
15 – 24	5	3	8 (26.7)	1.1
25 – 34	12	1	13 (43.3)	1.0
35 – 44	3	1	4 (13.3)	0.4
45 – 54	1	0	1 (3.3)	0.1
55 - 64	2	1	3 (10.0)	0.5
65+	0	0	0 (0.0)	0.0
Total	**23**	**7**	**30**	**0.5**

^Excluding 8 foreigners seeking medical treatment in Singapore and 9 tourists.
*Rates are based on 2015 estimated mid-year population.
(Source: Singapore Department of Statistics)

Table 2.13
Ethnic-gender distribution and ethnic-specific incidence rate of reported malaria cases^, 2015

	Male	Female	Total (%)	Incidence rate per 100,000 population*
Singapore Resident				
Chinese	1	2	3 (10.0)	0.1
Malay	0	0	0 (0.0)	0.0
Indian	2	0	2 (6.7)	0.6
Others	1	1	2 (6.7)	1.6
Foreigner	19	4	23 (76.7)	1.4
Total	**23**	**7**	**30 (100.0)**	**0.5**

^Excluding 8 foreigners seeking medical treatment in Singapore and 9 tourists.
*Rates are based on 2015 estimated mid-year population.
(Source: Singapore Department of Statistics)

Malaria parasite species

The distribution of the cases by parasite species was P. vivax (63.8%), P. falciparum (27.7%), P. knowlesi (4.3%), P. ovale (4.3%) and P. malariae (0.0%) (Table 2.14).

Table 2.14
Classification of reported malaria cases by parasite species, 2015

	Parasite species					Total (%)
Classification	**P.v.**	**P.f.**	**P.o.**	**P.m.**	**P.k.**	
Imported**	30	13	2	0	2	47 (100.0)
Introduced	0	0	0	0	0	0 (0.0)
Indigenous	0	0	0	0	0	0 (0.0)
Cryptic	0	0	0	0	0	0 (0.0)
Induced	0	0	0	0	0	0 (0.0)
Total	**30 (63.8)**	**13 (27.7)**	**2 (4.3)**	**0 (0.0)**	**2 (4.3)**	**47 (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 (55.3%), Indonesia (6.4%) and Malaysia (6.4%). P. vivax accounted for 92.3% and 66.7% of the infections acquired in India and Malaysia respectively and P. falciparum accounted for 87.5% and 100.0% of the infections acquired in the African region and Indonesia respectively (Table 2.15).

Table 2.15
Imported malaria cases by country of origin and by parasite species, 2015

	Parasite species					Total (%)
Classification	**P.v.**	**P.f.**	**P.o.**	**P.m.**	**P.k.**	
Southeast Asia						
Brunei Darussalam	0	0	0	0	2	2 (4.3)
Indonesia	0	3	0	0	0	3 (6.4)
Malaysia	2	0	1	0	0	3 (6.4)
Myanmar	1	1	0	0	0	2 (4.3)
South Asia						
India	24	2	0	0	0	26 (55.3)
Africa						
Ivory Coast	0	1	1	0	0	2 (4.3)
Malawi	0	2	0	0	0	2 (4.3)
Mozambique	0	1	0	0	0	1 (2.1)
Nigeria	0	1	0	0	0	1 (2.1)
Sudan	0	1	0	0	0	1 (2.1)
Tanzania	0	1	0	0	0	1 (2.1)
Other countries						
South Korea	1	0	0	0	0	1 (2.1)
Papua New Guinea	2	0	0	0	0	2 (4.3)
Total	**30**	**13**	**2**	**0**	**2**	**47 (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 (70.2%) had onset of fever within three weeks of entry into Singapore (Table 2.16). For P. vivax malaria, 40.0% of cases did not develop symptoms until more than six weeks after entry.

Table 2.16
Imported malaria cases by interval between period of entry and onset of illness and by parasite species, 2015

	Parasite species					Total (%)
Interval in weeks	**P.v.**	**P.f.**	**P.o.**	**P.m.**	**P.k.**	
<2	12	13	2	0	2	29 (61.7)
2 – 3	4	0	0	0	0	4 (8.5)
4 – 5	2	0	0	0	0	2 (4.3)
6 - 7	1	0	0	0	0	1 (2.1)
8 – 9	1	0	0	0	0	1 (2.1)
10 – 11	0	0	0	0	0	0 (0.0)
12 – 13	1	0	0	0	0	1 (2.1)
14 – 15	0	0	0	0	0	0 (0.0)
16 – 17	0	0	0	0	0	0 (0.0)
18 – 19	2	0	0	0	0	2 (4.3)
20 – 23	0	0	0	0	0	0 (0.0)
24 – 27	3	0	0	0	0	3 (6.4)
28 – 31	4	0	0	0	0	4 (8.5)
32 – 35	0	0	0	0	0	0 (0.0)
36 – 39	0	0	0	0	0	0 (0.0)
40+	0	0	0	0	0	0 (0.0)
Total	**30**	**13**	**2**	**0**	**2**	**47 (100.0)**

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

The 47 imported cases comprised 7 Singapore residents (14.9%), 21 work permit/employment pass holders (44.7%), 1 student pass holders (2.1%), 1 foreigners residing in Singapore (2.1%), 8 foreigners seeking medical treatment in Singapore (17.1%) and 9 tourists (19.1%) (Table 2.17).

Table 2.17
Classification of imported malaria cases by population group, 2014-2015

Classification	2014		2015	
	Cases	**%**	**Cases**	**%**
Local Residents				
Singapore residents	10	16.1	7	14.9
Work permit/Employment pass holders	32	51.6	21	44.7
Student pass holders	1	1.6	1	2.1
Other foreigners	8	12.9	1	2.1
Foreigners seeking medical treatment	7	11.3	8	17.1
Tourists	4	6.5	9	19.1
Total	**62**	**100.0**	**47**	**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 2.18 and 2.19).

Table 2.18
Purpose of travel for Singapore residents who contracted malaria overseas, 2011-2015

Purpose of Travel	2011	2012	2013	2014	2015
Social visits/holidays	10	24	10	5	5
Business	4	1	3	4	0
Military service	1	1	0	0	0
Volunteer/Missionary work	0	1	2	1	1
Employment	1	2	1	0	1
Total	**16**	**29**	**16**	**10**	**7**

Table 2.19
History of chemoprophylaxis for Singapore residents who contracted malaria overseas, 2011 - 2015

Chemoprophylaxis	2011	2012	2013	2014	2015
Took complete chemoprophylaxis	0	1	0	0	0
No chemoprophylaxis	15	27	16	10	7
Irregular/incomplete chemoprophylaxis	1	1	0	0	0
Total	**16**	**29**	**16**	**10**	**7**

Table 2.20
Total number of notifications received for malaria cases, 2011-2015*

Age	2011		2012		2013		2014		2015	
	Local	Imported	Local	Imported	Local	Imported	Local	Imported	Local	Imported
0 – 4	0	1	0	0	0	0	0	0	0	0
5 – 14	0	1	0	2	0	1	0	1	0	1
15 – 24	0	35	0	26	1	27	0	8	0	8
25 – 34	0	33	0	45	0	39	0	25	0	13
35 – 44	0	10	0	9	0	12	0	9	0	4
45 – 54	0	5	0	10	0	3	0	5	0	1
55 - 64	0	6	0	2	0	5	0	3	0	3
65+	0	1	0	4	0	0	0	0	0	0
Total	**0**	**92**	**0**	**98**	**1**	**87**	**0**	**51**	**0**	**30**

*excludes tourists and foreigners seeking medical treatment in Singapore

JAPANESE ENCEPHALITIS

Japanese encephalitis is an arthropod-borne disease, characterized by sudden onset of high fever, chills, severe headache, meningismus, photophobia, nausea, abdominal pain, drowsiness and obtundation. The mode of transmission is through the bite of infective mosquitoes from the Culex tritaeniorhynchus species. The infectious agent is the Japanese encephalitis virus (a Flavivirus), which the mosquitoes acquire mainly from domestic pigs and wild birds.

There was an imported case of Japanese encephalitis reported in 2015. The case involved a 11-year-old student from the Netherlands who arrived from Indonesia for medical treatment on 30 July 2015. She was on holiday with her family in Bali. She developed fever, severe headache, vomiting, abdominal pain, confusion, behavior change and hallucinations since 26 July 2015 and was evacuated from Indonesia to Singapore. She was subsequently warded in KKH. Blood serology was positive for Japanese Encephalitis IgM and IgG antibodies.

Chapter III

FOOD-/WATER-BORNE DISEASES

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

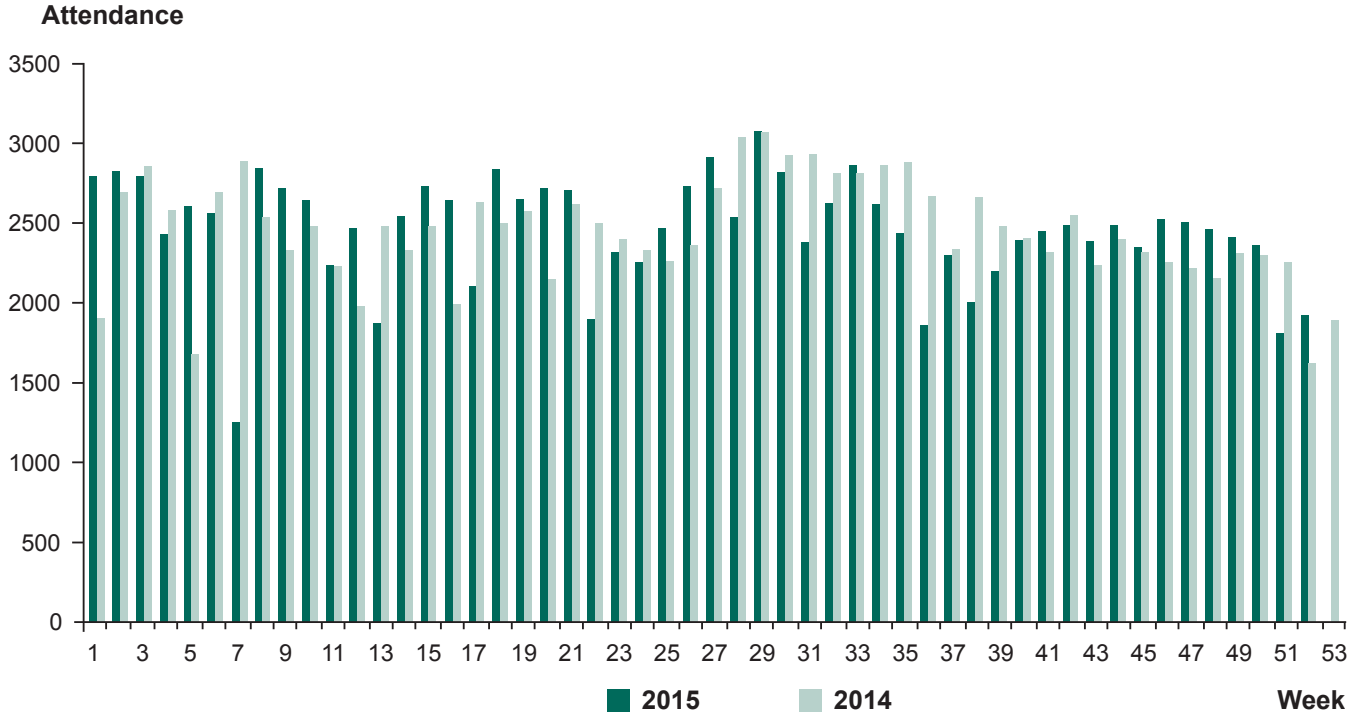
III
FOOD-/WATER-BORNE DISEASES

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 127,150 attendances at polyclinics for acute diarrhoeal illnesses in 2015 – a decrease of 2.2% compared to the 130,004 seen in 2014. 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, 2014 – 2015



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 420 cases of Campylobacter enteritis was reported in 2015, a decrease of 3.5% compared to 435 cases reported in 2014. Campylobacter jejuni was isolated in the majority of the cases (Table 3.1). Of the 420 reported cases, 26 were imported cases and 388 indigenous cases (Table 3.2). The other 6 cases comprised 5 foreigners who travelled to Singapore to seek medical treatment and 1 tourist.
The incidence among indigenous cases was highest in the 0-4 years age group, with an overall male to female ratio of 1:1.4 (Table 3.3). Among the three major ethnic groups, Malay had the highest incidence followed by the Chinese (Table 3.4).

Table 3.1
Incidence of reported Campylobacter enteritis, 2002 – 2015

Year	No. of cases caused by					Incidence, 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
2014	370	18	0	45	435	8.0
2015	334	31	0	55	420	7.6

^ 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 annual estimated mid-year population.
(Source: Singapore Department of Statistics)

Table 3.2
Total number of notifications received for Campylobacter enteritis, 2011 – 2015*

Age Group	2011		2012		2013		2014		2015	
	Local	Imported	Local	Imported	Local	Imported	Local	Imported	Local	Imported
0 – 4	160	11	180	8	166	13	154	9	168	6
5 – 14	88	4	105	14	75	8	90	11	88	6
15 – 24	20	2	14	2	14	1	18	7	21	6
25 – 34	9	0	13	3	15	6	10	2	23	3
35 – 44	12	2	9	6	9	0	16	6	10	1
45 – 54	11	1	13	4	10	1	12	4	15	0
55+	39	2	53	4	68	6	70	1	63	4
Total	**339**	**22**	**387**	**41**	**357**	**35**	**370**	**40**	**388**	**26**

*excludes tourists and foreigners seeking medical treatment in Singapore

Table 3.3
Age-gender distribution and age-specific incidence of reported Campylobacter enteritis cases^, 2015

Age (Yrs)	Male	Female	Total (%)	Incidence rate per 100,000 population*
0 – 4	98	76	174 (42.0)	76.4
5 – 14	57	37	94 (22.7)	19.9
15 – 24	18	9	27 (6.5)	3.6
25 – 34	10	16	26 (6.3)	2.1
35 – 44	6	5	11 (2.7)	1.1
45 – 54	14	1	15 (3.6)	2.0
55+	39	28	67 (16.2)	11.4
Total	**242**	**172**	**414 (100)**	**7.5**

^Excluding 5 foreigners who travelled to Singapore to seek medical treatment and 1 tourist.
*Rates are based on 2015 estimated mid-year population.
(Source: Singapore Department of Statistics)

Table 3.4
Ethnic-gender distribution and ethnic-specific incidence of reported Campylobacter enteritis cases^, 2015

	Male	Female	Total (%)	Incidence rate per 100,000 population*
Singapore Resident				
Chinese	132	80	212 (51.2)	7.3
Malay	35	19	54 (13.0)	10.4
Indian	10	14	24 (5.8)	6.8
Others	9	19	28 (6.8)	22.1
Foreigner	56	40	96 (23.2)	5.9
Total	**242**	**172**	**414 (100)**	**7.5**

^Excluding 5 foreigners who travelled to Singapore to seek medical treatment and 1 tourist.
*Rates are based on 2015 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 2015, two imported cases and one indigenous case of cholera were reported (Figure 3.2), all three were Singapore citizens. The indigenous case was positive for V. cholerae O1 El Tor biotype. The overall incidence rate was 0.05 per 100,000 population (Table 3.5 and 3.6).

Figure 3.2
E-weekly distribution of reported cholera cases, 2014 - 2015

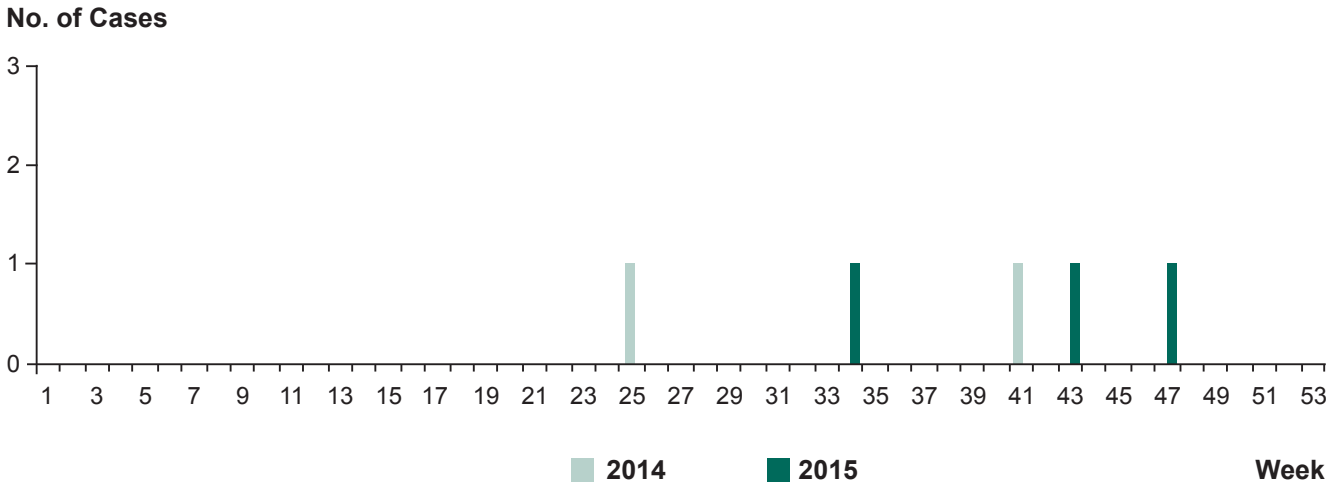


Table 3.5
Age-gender distribution and age-specific incidence rate of reported cholera cases, 2015

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	2	0	2 (66.6)	0.20
45 – 54	0	0	0 (0.0)	0.00
55 – 64	0	1	1 (33.3)	0.17
65 +	0	0	0 (0.0)	0.00
Total	**2**	**1**	**3 (100.0)**	**0.05**

*Rates are based on 2015 estimated mid-year population.
(Source: Singapore Department of Statistics)

Table 3.6
Ethnic-gender distribution and ethnic-specific incidence rate of reported cholera cases, 2015

	Male	Female	Total (%)	Incidence rate per 100,000 population*
Singapore Resident				
Chinese	2	1	3 (100.0)	0.10
Malay	0	0	0 (0.0)	0.00
Indian	0	0	0 (0.0)	0.00
Others	0	0	0 (0.0)	0.00
Foreigner	0	0	0 (0.0)	0.00
Total	**2**	**1**	**3 (100.0)**	**0.05**

*Rates are based on 2015 estimated mid-year population
(Source: Singapore Department of Statistics)

Table 3.7
Total number of notifications received for reported cholera cases, 2011-2015*

Age Group	2011		2012		2013		2014		2015	
	Local	Imported	Local	Imported	Local	Imported	Local	Imported	Local	Imported
0 – 4	0	0	0	0	0	0	0	1	0	0
5 – 14	0	0	0	0	0	0	0	0	0	0
15 – 24	0	1	0	0	0	0	0	0	0	0
25 – 34	0	0	0	0	0	0	0	1	0	0
35 – 44	0	0	0	1	0	2	0	0	0	2
45 – 54	0	1	0	0	0	0	0	0	0	0
55 – 64	0	0	0	0	0	0	0	0	1	0
65 +	0	0	0	0	0	0	0	0	0	0
Total	**0**	**2**	**0**	**1**	**0**	**2**	**0**	**2**	**1**	**2**

*excludes tourists and foreigners seeking medical treatment in Singapore

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 2011 to 2015, a total of 505 cases of enteric fever were reported, of which 346 (68.5%) cases were typhoid and 159 (31.5%) cases were paratyphoid. The majority (91.5%) were imported cases (Table 3.8).

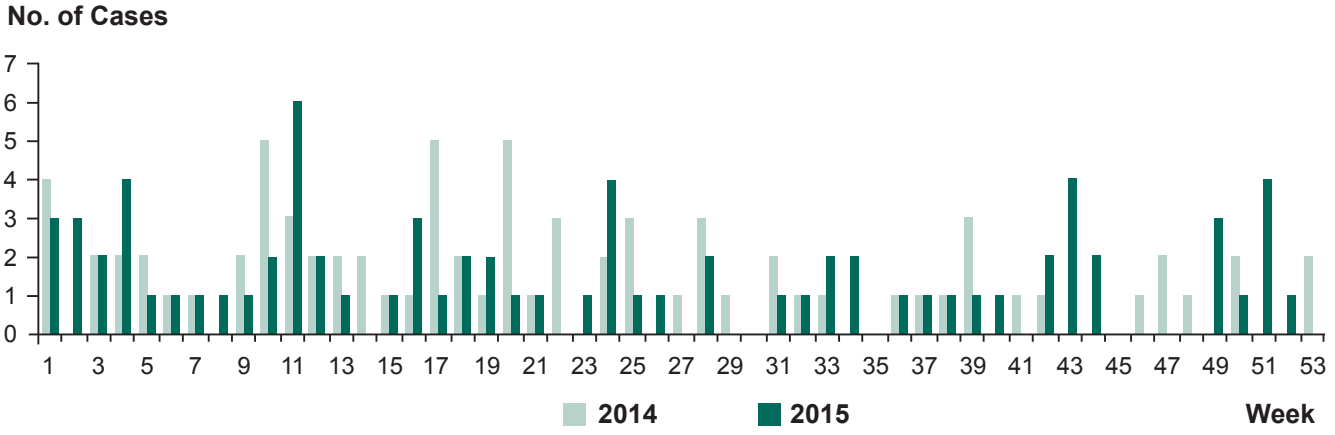
Table 3.8
Classification of reported enteric fever cases, 2011 – 2015

		Paratyphoid		
Year	**Typhoid**	**A**	**B**	**Total**
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)
2014	58 (52)	18 (17)	1 (0)	77 (69)
2015	49 (44)	25 (24)	2 (0)	76 (67)
Total	**346 (322)**	**155 (141)**	**4 (0)**	**505 (462)**

( ) imported cases

In 2015, a total of 76 cases of enteric fevers, comprising 49 cases of typhoid, and 25 cases of paratyphoid A and two case of paratyphoid B were reported, a decrease of 1.3% compared to 77 cases reported in 2014 (Figure 3.3).

Figure 3.3
E-weekly distribution of reported enteric fever cases, 2014 – 2015



Typhoid Fever

Of the 49 reported cases of typhoid, 15 were Singapore residents, four were foreigners seeking medical treatment in Singapore and two were tourists. Of the remaining 28 foreigners, 26 were foreigners working in Singapore, and two were student pass holders (Table 3.9). During the period 2011 to 2015, majority of the cases of typhoid were imported and in the 25 – 34 age group (Table 3.10). The overall incidence rate of typhoid fever among local residents was 0.8 per 100,000 population and was highest in the 25 – 34 age group in 2015 (Table 3.11).

Table 3.9
Classification of reported typhoid and paratyphoid cases, 2015

Population Group	Typhoid No. (%)	Paratyphoid No. (%)
Singapore residents	15 (30.6)	14 (51.9)
Foreigners seeking medical treatment in Singapore	4 (8.2)	1 (3.7)
Tourists	2 (4.1)	2 (7.4)
Other categories of foreigners	28 (57.1)	10 (37.0)
Total	**49 (100.0)**	**27 (100.0)**

Table 3.10
Total number of reported typhoid cases*, 2011-2015

Age Group	2011		2012		2013		2014		2015	
	Local	Imported	Local	Imported	Local	Imported	Local	Imported	Local	Imported
0 – 4	0	5	0	7	0	5	0	7	1	1
5 – 14	0	10	0	11	0	10	0	11	0	3
15 – 24	0	10	0	9	0	10	0	9	1	9
25 – 34	1	22	1	27	1	22	1	27	1	17
35 – 44	0	10	1	15	0	10	1	15	1	8
45 – 54	0	1	0	2	0	1	0	2	0	0
55 - 64	0	0	0	3	0	0	0	3	0	1
65+	1	1	0	3	1	1	0	3	0	0
Total	**2**	**59**	**2**	**77**	**2**	**59**	**2**	**77**	**4**	**39**

*excludes tourists and foreigners seeking medical treatment in Singapore

Table 3.11
Age-gender distribution and age-specific incidence rate of reported typhoid cases^, 2015

Age	Male	Female	Total (%)	Incidence rate per 100,000 population*
0 – 4	1	1	2 (4.7)	0.9
5 – 14	2	1	3 (7.0)	0.6
15 – 24	8	2	10 (23.3)	1.3
25 – 34	13	5	18 (41.8)	1.4
35 – 44	8	1	9 (20.9)	0.9
45 – 54	0	0	0 (0.0)	0.0
55 – 64	0	1	1 (2.3)	0.2
65+	0	0	0 (0.0)	0.0
Total	**32**	**11**	**43 (100.0)**	**0.8**

^ Excluding four foreigners seeking medical treatment in Singapore and two tourists
*Rates are based on 2015 estimated mid-year population.
(Source: Singapore Department of Statistics)

Among the three major ethnic groups, Indians had the highest incidence rate (Table 3.12). Foreigners comprised 65.1% of the cases.

Table 3.12
Ethnic-gender distribution and ethnic-specific incidence rate of reported typhoid cases^, 2015

	Male	Female	Total (%)	Incidence rate per 100,000 population*
Singapore Resident				
Chinese	4	1	5 (11.6)	0.2
Malay	1	2	3 (7.0)	0.6
Indian	5	1	6 (14.0)	1.7
Others	1	0	1 (2.3)	0.8
Foreigner	21	7	28 (65.1)	1.7
Total	**32**	**11**	**43 (100.0)**	**0.8**

^ Excluding four foreigners seeking medical treatment in Singapore and two tourists
*Rates are based on 2015 estimated mid-year population.
(Source: Singapore Department of Statistics)

The majority of the cases acquired the infection from South Asia (62.5%) and Southeast Asia (32.5%) (Table 3.13). Most Singapore residents acquired the disease while overseas on vacation (92.9%) (Table 3.14).

Table 3.13
Imported typhoid by country of origin, 2014 and 2015

Classification	2014 No. (%)	2015 No. (%)
Country visited		
Southeast Asia		
Cambodia	1 (1.9)	1 (2.5)
Indonesia	10 (19.2)	5 (12.5)
Malaysia	0 (0.0)	2 (5.0)
Myanmar	0 (0.0)	3 (7.5)
Philippines	3 (5.8)	1 (2.5)
Thailand	1 (1.9)	0 (0.0)
Vietnam	0 (0.0)	1 (2.5)
South Asia		
Bangladesh	11 (21.2)	14 (35.0)
India	23 (44.3)	11 (27.5)
Nepal	1 (1.9)	0 (0.0)
Other Countries		
Hong Kong	1 (1.9)	2 (5.0)
Taiwan	1 (1.9)	0 (0.0)
Total	**52 (100.0)**	**40 (100.0)**

Table 3.14
Singapore residents who contracted typhoid overseas by purpose of travel, 2011 – 2015

	2011 No. (%)	2012 No. (%)	2013 No. (%)	2014 No. (%)	2015 No. (%)
Purpose of travel					
Vacation	25 (96.2)	26 (92.9)	23 (95.8)	14 (77.8)	13 (92.9)
Business/employment	1 (3.8)	2 (7.1)	1 (4.2)	2 (11.1)	1 (7.1)
Others	0 (0.0)	0 (0.0)	0 (0.0)	2 (11.1)	0 (0.0)
Total	**26 (100.0)**	**28 (100.0)**	**24 (100.0)**	**18 (100.0)**	**14 (100.0)**

Paratyphoid Fever

Of the 27 reported cases of typhoid, 14 were Singapore residents, one was a foreigner seeking medical treatment in Singapore and two were tourists. Of the remaining 10 foreigners, nine were foreigners working in Singapore, and one was a student pass holder (Table 3.9). During the period 2011 to 2015, majority of the cases of paratyphoid were imported and in the 25 – 34 age group (Table 3.15). The overall incidence rate of paratyphoid fever among local residents was 0.4 per 100,000 population and was highest in the 25 – 34 years age group in 2015 (Table 3.16).

Table 3.15
Total number of reported paratyphoid cases, 2011-2015*

Age Group	2011		2012		2013		2014		2015	
	Local	Imported	Local	Imported	Local	Imported	Local	Imported	Local	Imported
0 – 4	0	1	0	0	0	0	0	0	0	1
5 – 14	0	1	0	4	0	3	0	1	0	2
15 – 24	0	7	2	5	0	2	0	5	0	3
25 – 34	0	6	6	16	0	6	1	7	1	7
35 – 44	1	8	1	9	0	2	0	0	0	4
45 – 54	0	2	0	5	0	3	0	1	0	3
55 – 64	0	2	2	0	0	1	0	1	0	1
65+	1	1	0	1	0	0	1	0	2	0
Total	**2**	**28**	**11**	**40**	**0**	**17**	**2**	**15**	**3**	**21**

*excludes tourists and foreigners seeking medical treatment in Singapore

Table 3.16
Age-gender distribution and age-specific incidence rate of reported paratyphoid cases^, 2015

Age (Yrs)	Male	Female	Total (%)	Incidence rate per 100,000 population*
0 – 4	1	0	1 (4.2)	0.4
5 – 14	1	1	2 (8.3)	0.4
15 – 24	2	1	3 (12.5)	0.4
25 – 34	6	2	8 (33.3)	0.6
35 – 44	4	0	4 (16.7)	0.4
45 – 54	1	2	3 (12.5)	0.4
55 - 64	1	0	1 (4.2)	0.2
65 +	1	1	2 (8.3)	0.4
Total	**17**	**7**	**24 (100.0)**	**0.4**

^ Excluding one foreigner seeking medical treatment in Singapore and two tourists.
*Rates are based on 2015 estimated mid-year population.
(Source: Singapore Department of Statistics)

Among the three major ethnic groups, Indians had the highest incidence rate (Table 3.17). Foreigners comprised 41.7% of the cases.

Table 3.17
Ethnic-gender distribution and ethnic-specific incidence rate of reported paratyphoid cases^, 2015

	Male	Female	Total (%)	Incidence rate per 100,000 population*
Singapore Resident				
Chinese	5	4	9 (45.8)	0.3
Malay	0	0	0 (0.0)	0.0
Indian	1	1	2 (8.3)	0.6
Others	3	0	3 (12.5)	2.4
Foreigner	8	2	10 (41.7)	0.6
Total	**17**	**7**	**24 (100.0)**	**0.4**

^ Excluding one foreigner seeking medical treatment in Singapore and two tourists.
*Rates are based on 2015 estimated mid-year population.
(Source: Singapore Department of Statistics)

All of the cases acquired the infection from Southeast Asia (66.7%) and South Asia (33.3%) (Table 3.18). Most Singapore residents acquired the disease while overseas on vacation (83.3%) (Table 3.19).

Table 3.18
Imported paratyphoid by country of origin, 2014 and 2015

	2014 No. (%)	2015 No. (%)
Country visited		
Southeast Asia		
Cambodia	4 (23.5)	1 (4.8)
Indonesia	7 (41.2)	2 (9.5)
Myanmar	0 (0.0)	10 (47.6)
Philippines	0 (0.0)	1 (4.8)
Vietnam	1 (5.9)	0 (0.0)
South Asia		
Bangladesh	0 (0.0)	3 (14.3)
India	5 (29.4)	4 (19.0)
Total	**17 (100.0)**	**21 (100.0)**

Table 3.19
Singapore residents who contracted paratyphoid overseas by purposes of travel, 2011 – 2015

Classification	2011 No. (%)	2012 No. (%)	2013 No. (%)	2014 No. (%)	2015 No. (%)
Purpose of travel					
Vacation	11 (84.6)	18 (64.3)	6 (54.6)	8 (88.9)	10 (83.3)
Business/employment	2 (15.4)	10 (35.7)	5 (45.4)	1 (11.1)	2 (16.7)
Total	**13 (100.0)**	**28 (100.0)**	**11 (100.0)**	**9 (100.0)**	**12 (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 50 cases of laboratory confirmed acute hepatitis A as compared to 73 cases in 2014 (Figures 3.4). Of the 50 reported cases, 29 were imported cases and 16 indigenous cases (Table 3.23). The remaining five cases involved foreigners seeking medical treatment in Singapore. (Table 3.21).

Among local residents, the age-specific incidence of acute hepatitis A was highest in the 15 - 24 years age group (1.6 per 100,000 population). The overall male to female ratio was 2.3:1 (Table 3.21). Among the three major ethnic groups, Indians had the highest incidence while Malays and Chinese had lower incidence (Table 3.22).

Figure 3.4
E-weekly distribution of reported acute hepatitis A cases, 2014 – 2015

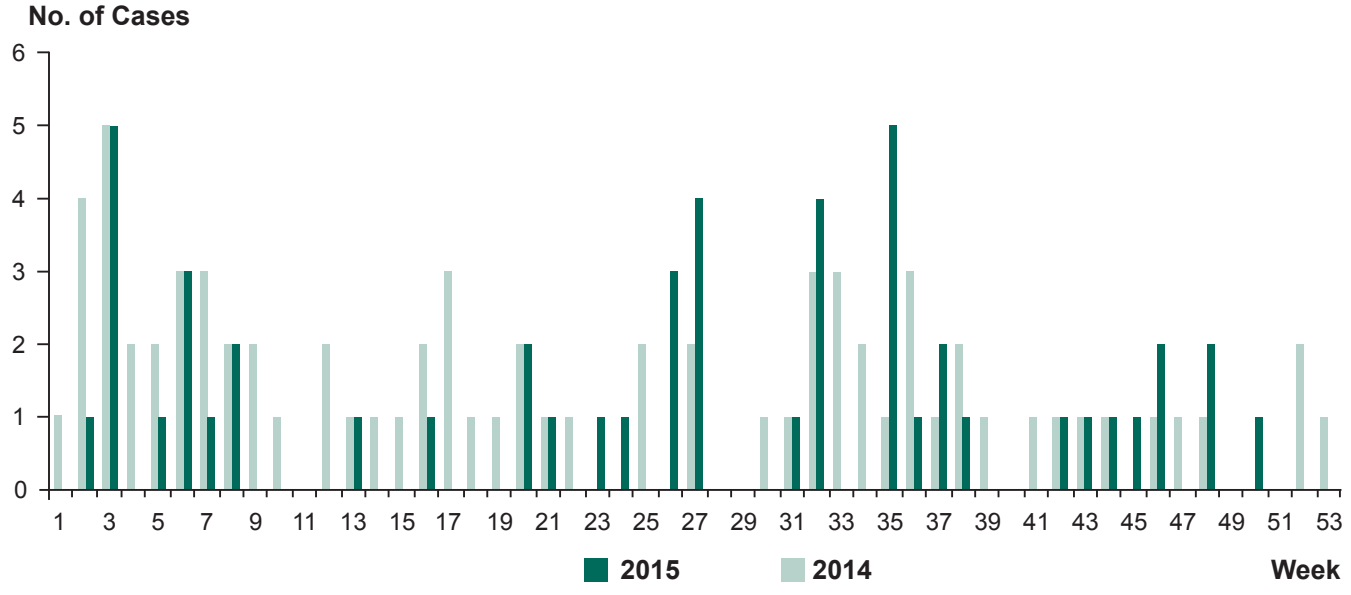


Table 3.20
Classification of reported acute hepatitis A cases, 2015

Population Group	No. of cases (%)
Singapore residents	30 (60.0)
Work permit holders/ other foreigners	15 (30.0)
Foreigners seeking medical treatment in Singapore	5(10.0)
Total	**50 (100.0)**

Table 3.21
Age-gender distribution and age-specific incidence of acute hepatitis A cases^, 2015

Age (Yrs)	Male	Female	Total (%)	Incidence rate per 100,000 population*
0 – 4	0	0	0(0.0)	0.0
5 – 14	3	1	4 (8.9)	0.8
15 – 24	5	7	12 (26.7)	1.6
25 – 34	9	4	13 (28.9)	1.0
35 – 44	9	0	9 (20.0)	0.9
45 – 54	3	0	3 (6.7)	0.4
55 – 64	2	0	2 (4.4)	0.3
65+	0	2	2(4.4)	0.4
Total	**31**	**14**	**45 (100.0)**	**0.8**

^Excluding 5 foreigners seeking medical treatment in Singapore
*Rates are based on 2015 estimated mid-year population.
(Source: Singapore Department of Statistics)

Table 3.22
Ethnic-gender distribution and ethnic-specific incidence of acute hepatitis A cases^, 2015

	Male	Female	Total (%)	Incidence rate per 100,000 population*
Singapore Resident				
Chinese	16	3	19 (42.2)	0.7
Malay	2	2	4 (8.9)	0.8
Indian	2	3	5 (11.2)	1.4
Others	2	0	2 (4.4)	1.6
Foreigner	9	6	15 (33.3)	0.9
Total	**31**	**14**	**45 (100.0)**	**0.8**

^Excluding 5 foreigners seeking medical treatment in Singapore
*Rates are based on 2015 estimated mid-year population.
(Source: Singapore Department of Statistics)

Imported acute hepatitis A

Of the 50 cases of acute hepatitis A, 34 (68.0%) cases were acquired overseas (Table 3.23). The majority of the cases acquired the infection from Southeast Asia (67.7%) and the Indian subcontinent (26.4%) (Table 3.24).

Table 3.23
Imported acute hepatitis A by population group, 2015

Population Group	No. of cases (%)
Local Residents	
Residents who contracted the disease overseas	18 (53.0)
Work permit/employment/ dependent pass holders	11 (32.3)
Foreigners seeking medical treatment	5 (14.7)
Total	**34 (100.0)**

Table 3.24
Imported acute hepatitis A by country of origin, 2015

Country visited	No. of cases (%)
Southeast Asia	
Indonesia	7 (20.6)
Myanmar	5 (14.7)
Vietnam	3 (8.8)
Malaysia	2 (5.9)
Philippines	2 (5.9)
Cambodia	2 (5.9)
Thailand	2 (5.9)
Indian Subcontinent	
India	6 (17.6)
Pakistan	2 (5.9)
Bangladesh	1 (2.9)
Other Countries	
Taiwan	2 (5.9)
Total	**34 (100.0)**

Table 3.25
Total number of notifications received for acute hepatitis A, 2011 – 2015*

Age Group	2011		2012		2013		2014		2015	
	Local	Imported	Local	Imported	Local	Imported	Local	Imported	Local	Imported
0 – 4	0	2	0	1	0	0	0	1	0	0
5 – 14	1	4	1	1	1	6	0	4	0	4
15 – 24	4	4	3	12	2	7	3	8	5	7
25 – 34	4	14	8	15	4	15	7	17	2	11
35 – 44	4	4	12	14	10	5	2	8	4	5
45 – 54	0	6	14	4	7	9	0	7	2	1
55 – 64	6	1	4	2	2	5	1	1	1	1
65+	2	1	4	1	4	0	8	0	2	0
Total	**21**	**36**	**46**	**50**	**30**	**47**	**21**	**46**	**16**	**29**

*excludes foreigners seeking medical treatment in Singapore

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 medium of transmission is 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 59 reported cases of serologically confirmed acute hepatitis E compared to 68 cases in 2014 (Figure 3.5). Of the 59 reported cases, 15 were imported cases and 43 indigenous cases (Table 3.21). The remaining case involved a foreigner seeking medical treatment in Singapore (Table 3.22).

Among local residents, the age-specific incidence of acute hepatitis E was highest in the 55-64 years age group (3.9 per 100,000 population). The overall male to female ratio was 3.8:1 (Table 3.23). Of the three main ethnic groups, Chinese had the highest incidence (Table 3.24).

Figure 3.5
E-weekly distribution of reported acute hepatitis E cases, 2014 – 2015

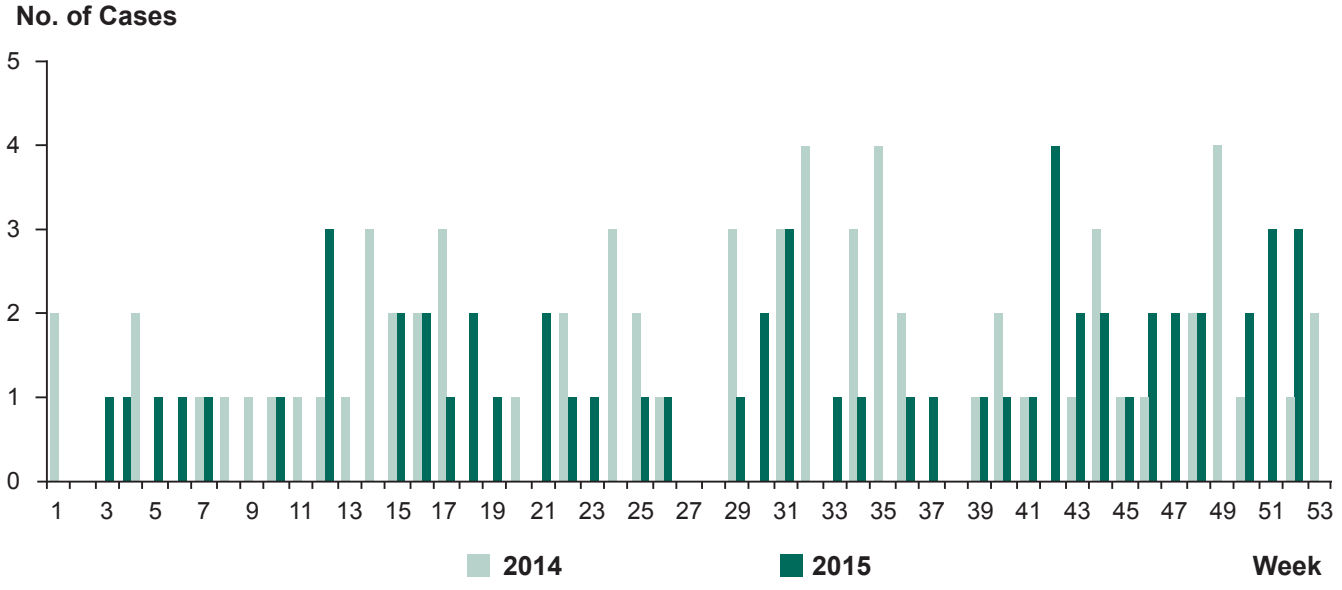


Table 3.26
Classification of reported acute hepatitis E cases, 2015

Population Group	No. of cases (%)
Singapore residents	50 (84.8)
Work permit holders/ other foreigners	8 (13.6)
Foreigners seeking medical treatment in Singapore	1 (1.7)
Total	**59 (100.0)**

Table 3.27
Age-gender distribution and age-specific incidence of acute hepatitis E cases^, 2015

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	3	2	5 (8.6)	0.7
25 – 34	3	1	4 (6.9)	0.3
35 – 44	2	1	3 (5.2)	0.3
45 – 54	5	4	9 (15.5)	1.2
55 – 64	20	3	23 (38.7)	3.9
65+	13	1	14 (24.1)	2.8
Total	**46**	**12**	**58 (100.0)**	**1.0**

^ Excluding one foreigner seeking medical treatment in Singapore
*Rates are based on 2015 estimated mid-year population.
(Source: Singapore Department of Statistics)

Table 3.28
Ethnic-gender distribution and ethnic-specific incidence of acute hepatitis E cases^, 2015

	Male	Female	Total (%)	Incidence rate per 100,000 population*
Singapore Resident				
Chinese	38	7	45 (76.3)	1.6
Malay	1	1	2 (3.4)	0.4
Indian	1	0	1 (1.7)	0.3
Others	0	2	2 (3.4)	1.6
Foreigner	6	2	8 (15.3)	0.5
Total	**46**	**12**	**58 (100.0)**	**1.0**

^ Excluding one foreigner seeking medical treatment in Singapore
*Rates are based on 2015 estimated mid-year population.
(Source: Singapore Department of Statistics)

Imported acute hepatitis E

Of the 59 cases of hepatitis E, 16 (27.1%) cases were acquired overseas (Table 3.29). The majority of the cases acquired the infection from the Indian subcontinent (43.8%) and Southeast Asia (31.2%) (Table 3.30).

Table 3.29
Imported acute hepatitis E by population group, 2015

Population Group	No. of cases (%)
Local Residents	
Residents who contracted the disease overseas	8 (50.0)
Work permit/employment/ dependent pass holders	7 (43.7)
Foreigners seeking medical treatment	1 (6.3)
Total	**16 (100.0)**

Table 3.30
Imported acute hepatitis E by country of origin, 2015

Country visited	No. of cases (%)
Southeast Asia	
Indonesia	1 (6.2)
Philippines	1 (6.2)
Thailand	3 (18.8)
Indian Subcontinent	
Bangladesh	5 (31.3)
India	2 (12.5)
Other Countries	
Australia	1 (6.2)
France	1 (6.2)
Taiwan	2 (12.5)
Total	**16 (100.0)**

Table 3.31
Total number of notifications received for acute hepatitis E cases, 2011 – 2015*

Age Group	2011		2012		2013		2014		2015	
	Local	Imported	Local	Imported	Local	Imported	Local	Imported	Local	Imported
0 – 4	0	0	0	0	0	0	0	0	0	0
5 – 14	0	0	0	0	0	0	0	0	0	0
15 – 24	5	6	5	15	0	8	0	1	0	5
25 – 34	12	27	8	25	2	9	3	5	1	3
35 – 44	2	8	7	6	3	5	1	8	2	1
45 – 54	5	3	7	5	2	2	6	2	9	0
55 – 64	11	6	11	1	4	6	17	3	17	6
65+	10	0	9	0	7	5	15	2	13	1
Total	**45**	**50**	**47**	**52**	**18**	**35**	**42**	**21**	**42**	**16**

*excludes foreigners seeking medical treatment in Singapore

Hepatitis E virus genotypes

Fifty-two serologically confirmed acute hepatitis E samples were forwarded to the National Public Health Laboratory for genotyping. Out of the 29 samples that were PCR-positive (i.e. virus was detected), genotype 3 (n=12/25; 48.3%) was detected among the indigenous cases while genotypes 1 (n=2/4; 50.0%) and 3 (n=1/4; 25.0%) were found among the imported cases; the genotype of the remaining indigenous and imported cases could not be determined.

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 1,988 laboratory-confirmed cases of non-typhoidal salmonellosis were reported in 2015, an increase of 5.6% compared to 1,883 cases reported in 2014 (Figure 3.6). Salmonella Group D is the predominant serogroup identified in 2015 (Table 3.32). Of these Group D cases, 330 cases were caused by S. Enteritidis.

Figure 3.6
E-weekly distribution of reported Salmonellosis cases, 2014 – 2015

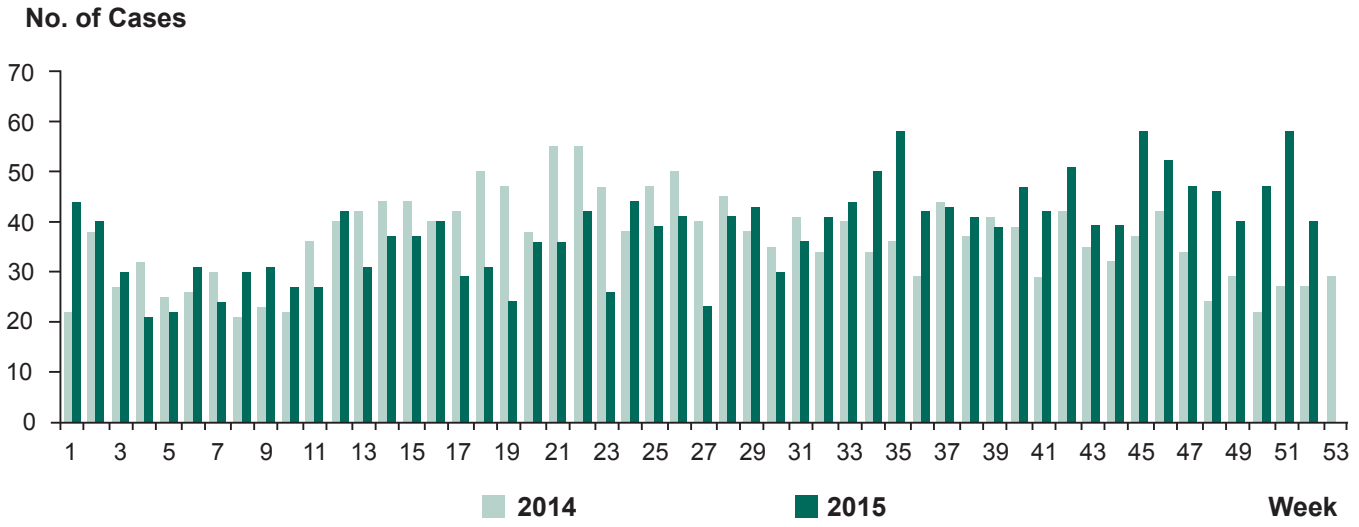


Table 3.32
Reported Salmonellosis Cases by Serogroups, 2015

Country visited	No. of cases (%)	Incidence rate per 100,000 population*
Enterica-D	805	14.5
Enterica-B	508	9.2
Enterica-C	247	4.5
Enterica-E	79	1.4
Enterica-E/G	24	0.4
Enterica-G	3	0.1
Enterica-Unspecified	322	5.8
Grand Total	**1988**	**35.9**

S. Enteritidis

Of the 330 cases reported in 2015, 324 were local residents comprising 320 indigenous and 4 imported and cases. The remaining six cases involved four foreigners seeking medical treatment in Singapore and two tourists.

The notifications of S. Enteritidis among local residents had decreased by 16.2% as compared to 394 cases in 2014. The incidence rate was highest in the 65 + years age group (Table 3.34).

Table 3.33
Total number of notifications received for reported S. Enteritidis cases, 2011-2015*

Age Group	2011		2012		2013		2014		2015	
	Local	Imported	Local	Imported	Local	Imported	Local	Imported	Local	Imported
0 – 4	107	3	81	1	124	3	71	0	34	0
5 – 14	36	2	18	0	36	0	15	1	16	1
15 – 24	22	3	18	0	22	0	20	0	12	1
25 – 34	26	2	35	2	80	1	35	1	34	0
35 – 44	30	2	28	0	29	2	28	0	34	0
45 – 54	30	2	30	1	30	3	36	1	35	0
55 – 64	34	3	36	1	55	4	61	2	54	2
65 +	88	1	101	0	137	4	116	1	101	0
Total	**391**	**18**	**342**	**5**	**513**	**17**	**382**	**6**	**320**	**4**

*Excluding four foreigners who sought medical treatment in Singapore and two tourists.

Table 3.34
Age-gender distribution and age-specific incidence rate of reported S. Enteritidis cases^, 2015

Age (Yrs)	Male	Female	Total (%)	Incidence rate per 100,000 population*
0 – 4	19	15	34 (10.5)	14.9
5 – 14	10	7	17 (5.2)	3.6
15 – 24	3	10	13 (4.0)	1.7
25 – 34	18	16	34 (10.5)	2.7
35 – 44	20	14	34 (10.5)	3.4
45 – 54	20	15	35 (10.8)	4.7
55 - 64	32	24	56 (17.3)	9.5
65 +	54	47	101 (31.1)	20.0
Total	**177**	**148**	**324 (100.0)**	**5.9**

*Excluding four foreigners who sought medical treatment in Singapore and two tourists.
*Rates are based on 2015 estimated mid-year population.
(Source: Singapore Department of Statistics)

Among the three major ethnic groups, Malays had the highest incidence rate, followed by Chinese and Indians (Table 3.35).

Table 3.35
Ethnic-gender distribution and ethnic-specific incidence rate of reported S. Enteritidis^ cases, 2015

	Male	Female	Total (%)	Incidence rate per 100,000 population*
Singapore Resident				
Chinese	91	83	174 (53.7)	6.0
Malay	43	37	81 (25.0)	15.4
Indian	12	7	19 (5.9)	5.4
Others	5	7	12 (3.7)	9.5
Foreigner	25	14	38 (11.7)	2.4
Total	**176**	**148**	**324 (100.0)**	**5.9**

*Excluding four foreigners who sought medical treatment in Singapore and two tourists.
*Rates are based on 2015 estimated mid-year population.
(Source: Singapore Department of Statistics)

FOOD POISONING

There were 228 notifications of food poisoning involving 1,567 cases in 2015, compared with 301 notifications involving 1,612 cases in 2014 (Figure 3.7). Of these, 214 notifications were classified as outbreaks involving two or more cases epidemiologically linked to a common source, as compared to 284 notifications in 2014.

Figure 3.7
Notification of food poisoning in Singapore, 1965-2015

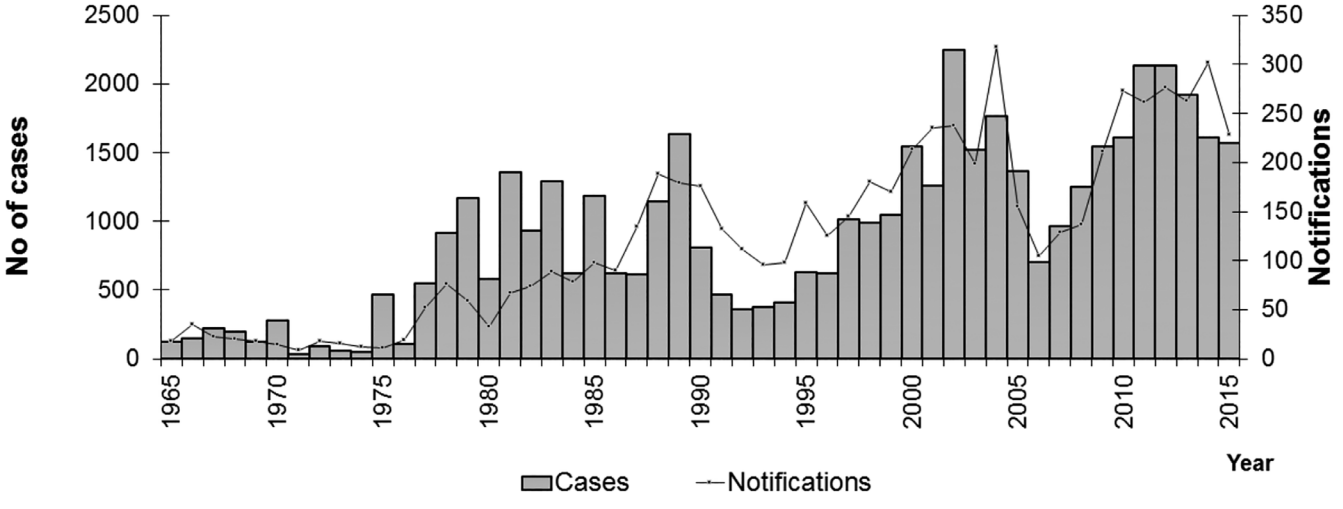


Table 3.36
Food poisoning notifications by type of food establishment, 2015

Type of food establishments	No. of notifications	Notification classified as outbreak*	No. of food establishments involved	No. of cases
General outlets				
Bakery	5	5	5	11
Canteens				
School	5	5	5	39
Tertiary Institution	1	1	1	2
Others	5	5	5	53
Caterer (licensed)	18	18	18	715
Eating house	36	31	34	118
Fair(food fair)	1	1	1	2
Fair (Others)	2	2	2	20
Food court	14	13	14	41
Foodshop (takeaway)	7	7	7	17
Hawker centre	5	5	5	13
Other licensed premises	1	1	1	2
Restaurants				
In Hotel	11	10	10	104
Fast Food	5	5	5	13
Others	93	87	89	320
Supermarket	3	3	3	14
Snackbar	9	8	9	18
Food Factory	1	1	1	26
Sub-total (General outlets)	**222**	**208**	**217**	**1,528**
In house kitchen				
Army	0	0	0	0
Childcare centre	1	1	1	3
Nursing home	0	0	0	0
Workers dormitory	0	0	0	0
Others	4	4	4	26
Unlicensed premises	1	1	1	10
Sub-total (Others)	**6**	**6**	**6**	**39**
Total	**228**	**214**	**217**	**1,567**

*two or more epidemiologically linked cases involved

Microbiological investigations of 73 food samples and 14 environmental swabs were conducted. Of the food samples, one was positive for *Staphylococcus aureus.* Of 226 food handlers sent for screening, 4 were positive for Norovirus, one was positive for *Campylobacter jejuni,* one was positive for rotavirus, one was positive for *Vibrio parahaemolyticus,* one was positive for *Plesiomonas shigelloides* and one was positive for *Vibrio fluvalis.*

Chapter IV

BLOOD-BORNE DISEASES

- Hepatitis B
- Hepatitis C

IV
BLOOD-BORNE DISEASES

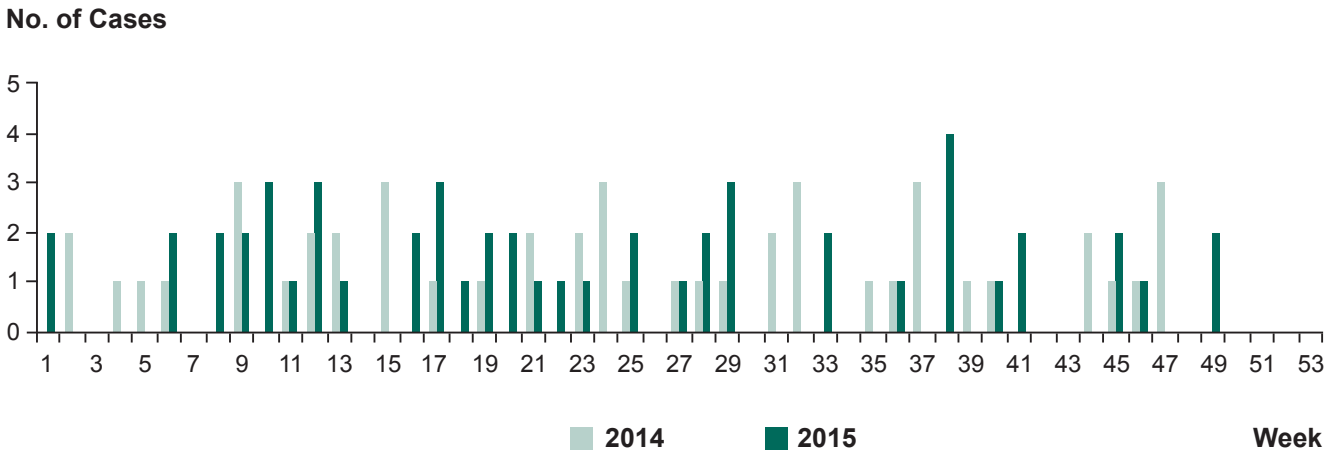
Blood-borne pathogens are microorganisms such as viruses or bacteria that are carried in blood and can cause disease in humans. There are many different blood-borne diseases. We focus on hepatitis B (HBV) and hepatitis C (HCV) in this chapter. The mode of transmission is via infected human blood and 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 acute hepatitis B infection include fever, fatigue, joint pain, abdominal pain, loss of appetite, nausea and vomiting. More severe cases may present with jaundice and ascites.

A total of 52 cases of acute hepatitis B were reported in 2015, compared to 48 cases reported in 2014 (Figure 4.1). All cases were serologically confirmed with the presence of anti-HBc IgM antibody which is associated with acute clinical presentation.

Figure 4.1
E-weekly distribution of reported lab confirmed Hepatitis B cases, 2014 – 2015



The incidence rate was highest in the 25 - 34 years age group, with an overall male to female ratio of 2.8:1 (Table 4.1). Among the three major ethnic groups, Malays had the highest incidence rate (Table 4.2).

Table 4.1
Age-gender distribution and age-specific incidence rate of acute hepatitis B cases, 2015

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	12	8	20 (40.0)	1.6
35 – 44	13	2	15 (30.0)	1.5
45 – 54	5	2	7 (14.0)	0.9
55 - 64	6	0	6 (12.0)	1.0
65+	1	1	2 (4.0)	0.4
Total	**37**	**13**	**50 (100.0)**	**0.9**

Excludes 1 tourist and 1 foreigner seeking medical treatment in Singapore
*Rates are based on 2015 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, 2015

	Male	Female	Total (%)	Incidence rate per 100,000 population*
Singapore Resident				
Chinese	18	5	23 (46.0)	0.8
Malay	5	0	5 (10.0)	1.0
Indian	1	0	1 (2.0)	0.3
Others	1	0	1 (2.0)	0.8
Foreigner	12	8	20 (40.0)	1.2
Total	**37**	**13**	**50 (100.0)**	**0.9**

Excludes 1 tourist and 1 foreigner seeking medical treatment in Singapore
*Rates are based on 2015 estimated mid-year population.
(Source: Singapore Department of Statistics)

The cases comprised people from a wide spectrum of occupational groups. Cleaners, labourers and related workers made up 26.0% of total notifications in 2015 (Table 4.3). The majority of the cases (48 out of 50 cases) were local cases (Table 4.4)

Table 4.3
Distribution of acute hepatitis B cases by occupation, 2015

Occupation	Total	%
Cleaners, Labourers and Related Workers		
Construction labourers and related workers	4	8.0%
Domestic helpers & cleaners	4	8.0%
Labourers & related Workers Not Classified	5	10.0%
Legislator, Senior Officials and Manager		
Manager	2	4.0%
Self-employed/Businessmen	2	4.0%
Professionals		
Accountants/Auditors/Civil servants	4	8.0%
Architects/Engineers	2	4.0%
Army Officers/NS men	1	2.0%
Musician	1	2.0%
Teachers/Lecturers	2	4.0%
Associate Professionals and Technicians		
Supervisors & General foreman	1	2.0%
Technicians/Asst Engineers	2	4.0%
Service Workers and Shop/Market Sales Workers		
Beautician/ Plumber	1	2.0%
Driver	3	6.0%
Hawker/Food handler	3	6.0%
Shop Sales & related Workers	3	6.0%
Production Craftsmen & Workers not classified		
Machine operators/QC checkers	1	2.0%
Ship deck crew, sailors & related workers	2	4.0%
Unclassified		
Housewife	1	2.0%
Retiree	1	2.0%
Unknown	5	10.0%
Total	**50**	**100%**

Excludes 1 tourist and 1 foreigner seeking medical treatment in Singapore

Table 4.4
Total number of notifications received for acute Hepatitis B cases, 2011-2015

Age Group	2011		2012		2013		2014		2015	
	Local	Imported	Local	Imported	Local	Imported	Local	Imported	Local	Imported
0 – 4	0	1	0	0	0	0	0	0	0	0
5 – 14	0	0	0	0	0	0	0	0	0	0
15 – 24	4	3	2	7	2	0	1	1	0	0
25 – 34	15	7	18	4	15	6	12	3	19	1
35 – 44	14	6	12	5	14	2	10	1	14	1
45 – 54	9	0	3	1	9	0	8	2	7	0
55 - 64	7	2	4	0	3	0	4	3	6	0
65+	3	0	1	0	4	0	1	2	2	0
Total	**52**	**18**	**40**	**17**	**47**	**8**	**36**	**12**	**48**	**2**

Excludes tourists and foreigners seeking medical treatment in Singapore

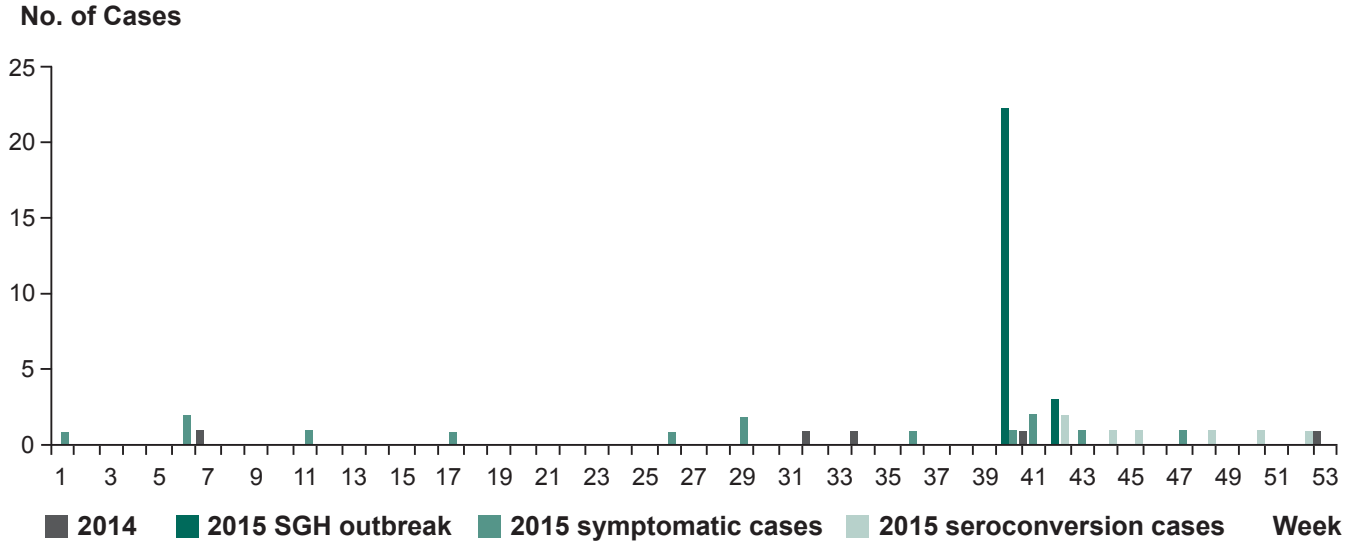
HEPATITIS C

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 46 cases of acute hepatitis C were reported in 2015, compared to five cases reported in 2014 (Figure 4.2). The 46 cases reported in 2015 included 25 cases who were linked to an outbreak of Hepatitis C in Singapore General Hospital, 14 cases who met the previous case definition for acute hepatitis C (the presence of acute clinical symptoms such as fever, jaundice, dark urine and pale stools and positive HCV recombinant immunoblot assay (RIBA) results) and seven seroconversion cases.*

*W.E.F. E-week 41 of 2015 (9 October 2015 onwards), the case definition for acute hepatitis C has been expanded to include acute seroconversion.

Figure 4.2
E-weekly distribution of reported hepatitis C cases, 2014 – 2015



The incidence rate was highest in the 55-64 years age group, with an overall male to female ratio of 1.8:1 (Table 4.5). Among the three major ethnic groups, Malay had the highest incidence rate (Table 4.6). All the 45 reported cases in 2015 were local cases (Table 4.7).

Table 4.5
Age-gender distribution and age-specific incidence rate of acute hepatitis C cases, 2015

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	2	4 (8.9)	0.5
25 – 34	6	1	7 (15.6)	0.6
35 – 44	4	1	5 (11.1)	0.5
45 – 54	8	4	12 (26.7)	1.6
55 - 64	9	6	15 (33.3)	2.6
65+	0	2	2 (4.4)	0.4
Total	**29**	**16**	**45 (100.0)**	**0.8**

Excludes one foreigner seeking medical treatment in Singapore
*Rates are based on 2015 estimated mid-year population.
(Source: Singapore Department of Statistics)

Table 4.6
Ethnic-gender distribution and ethnic-specific incidence rate of acute hepatitis C cases, 2015

	Male	Female	Total (%)	Incidence rate per 100,000 population*
Singapore Resident				
Chinese	12	8	20 (44.4)	0.7
Malay	10	6	16 (35.6)	3.1
Indian	3	1	4 (8.9)	1.1
Others	1	1	2 (4.4)	1.6
Foreigner	3	0	3 (6.7)	0.2
Total	**29**	**16**	**45 (100.0)**	**0.8**

Excludes one foreigner seeking medical treatment in Singapore
*Rates are based on 2015 estimated mid-year population.
(Source: Singapore Department of Statistics)

Table 4.7
Total number of notifications received for acute Hepatitis C cases, 2011 - 2015

Age Group	2011		2012		2013		2014		2015	
	Local	Imported	Local	Imported	Local	Imported	Local	Imported	Local	Imported
0 – 4	0	0	0	0	0	0	0	0	0	0
5 – 14	0	0	0	0	0	0	0	0	0	0
15 – 24	1	0	0	0	0	0	0	0	4	0
25 – 34	0	0	0	0	0	0	0	0	7	0
35 – 44	0	0	1	0	0	0	1	0	5	0
45 – 54	1	0	1	0	1	0	2	1	12	0
55 - 64	0	0	0	0	1	0	1	0	15	0
65+	0	0	0	0	0	0	0	0	2	0
Total	**2**	**0**	**2**	**0**	**2**	**0**	**4**	**1**	**45**	**0**

Excludes tourists and foreigners seeking medical treatment in Singapore

Chapter V

ENVIRONMENT- RELATED DISEASES

- 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 17 cases of laboratory-confirmed legionellosis were reported, compared with 37 cases in 2014 (Figure 5.1). All 17 cases were local residents. Of the 17 local residents, 15 cases had confirmed Legionnaires' disease and two cases had presumptive Legionnaires' disease (Table 5.1). One of the 17 cases had acquired the infections overseas. All the diagnoses were based on positive respiratory antigen detection by immunofluorescence or positive urinary antigen detection.

Figure 5.1
E-weekly distribution of reported legionellosis, 2014 – 2015

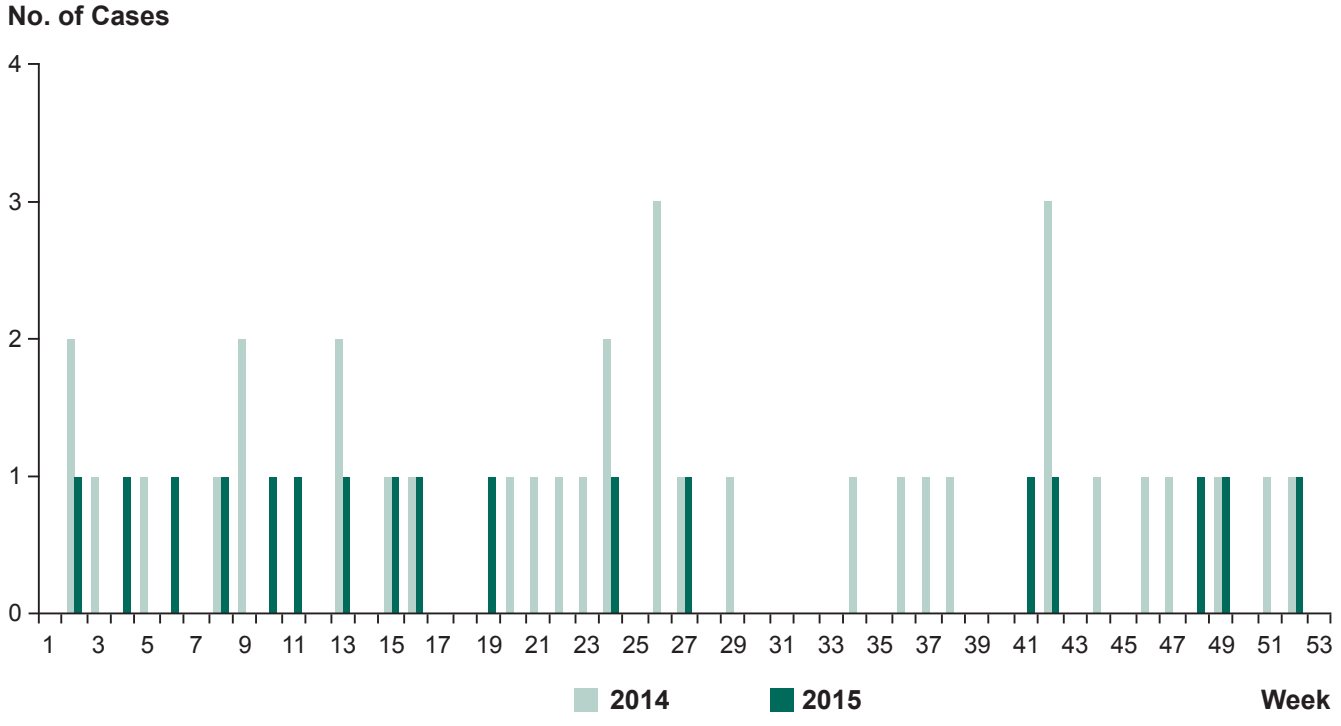


Table 5.1
Classification of reported cases of legionellosis in local residents, 2015

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

The incidence rate among indigenous cases was 0.3 per 100,000 population, with the highest incidence rate in the 65+ years age group (Table 5.2).

Table 5.2
Age-gender distribution and age-specific incidence rate of reported legionellosis cases, 2015

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	2	0	2 (11.8)	0.3
55 – 64	2	1	3(17.6)	0.5
65+	7	5	12 (70.6)	2.4
Total	**11**	**6**	**17 (100.0)**	**0.3**

*Rates are based on 2015 estimated mid-year population.
(Source: Singapore Department of Statistics)

Table 5.3
Total number of notifications received for legionellosis cases, 2011-2015

Age Group	2011		2012		2013		2014		2015	
	Local	Imported	Local	Imported	Local	Imported	Local	Imported	Local	Imported
0– 4 yrs	0	0	0	0	0	0	0	0	0	0
5 – 9 yrs	0	0	0	0	0	0	0	0	0	0
10 – 14 yrs	1	0	0	0	1	0	0	0	0	0
15 – 24 yrs	0	0	0	0	0	0	0	0	0	0
25 – 34 yrs	1	1	1	0	1	1	1	0	0	0
35 – 44 yrs	3	1	2	0	3	1	2	0	0	0
45 – 54 yrs	1	0	4	0	1	0	4	0	2	0
55 – 64 yrs	1	1	2	3	1	1	2	2	3	0
65+	5	1	10	0	5	1	10	2	11	1
Total	**12**	**4**	**19**	**3**	**12**	**4**	**19**	**4**	**16**	**1**

Among the three major ethnic groups, Chinese had the highest incidence rate of 0.5 per 100,000 population (Table 5.4). Various occupational groups were involved (Table 5.5).

Table 5.4
Ethnic-gender distribution and ethnic-specific incidence rate of legionellosis cases, 2015

	Male	Female	Total (%)	Incidence rate per 100,000 population*
Singapore Resident				
Chinese	10	5	15 (88.2)	0.5
Malay	1	1	2 (11.8)	0.4
Indian	0	0	0 (0.0)	0.0
Others	0	0	0 (0.0)	0.0
Foreigner	0	0	0 (0.0)	0.0
Total	**11**	**6**	**17 (100.0)**	**0.3**

*Rates are based on 2015 estimated mid-year population.
(Source: Singapore Department of Statistics)

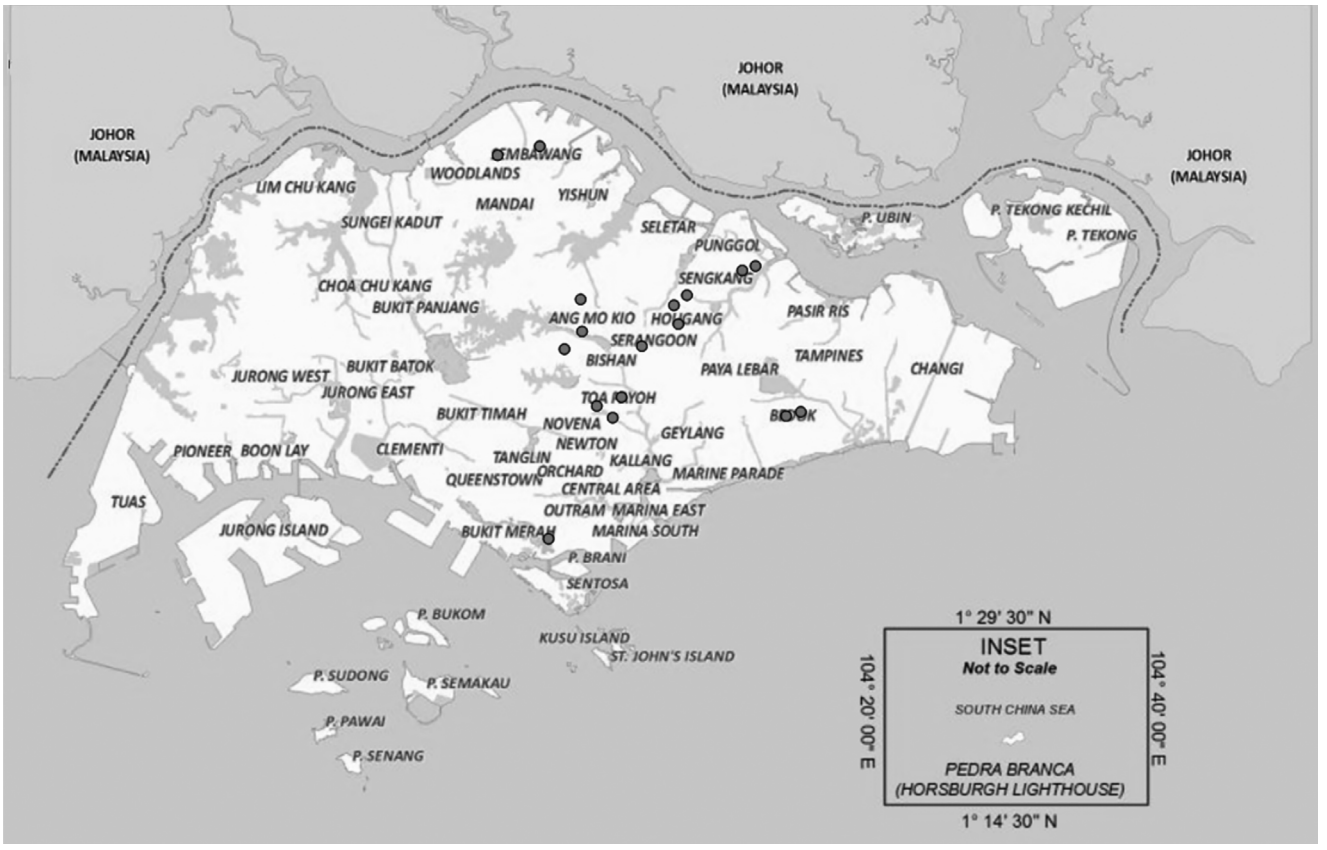
Table 5.5
Occupation of reported legionellosis cases*, 1989 – 2015

Occupation	1989 – 2014 n=799	2015 n=17	Total n=816
Cleaners, labourers & related workers			
Construction labourer	55	2	57
Domestic maid	3	0	3
Other cleaners, labourers & related workers	24	0	24
Armed Forces personnel	28	0	28
Clerical workers	17	0	17
Service & shop/market sales workers	31	1	32
Professionals, Self-employed & Managers	86	0	86
Teachers, Lecturers	3	0	3
Accountants, auditors	1	0	1
Drivers	14	0	14
Production craftsmen & technicians	22	0	22
Others			
Retiree	274	6	280
Housewife	166	3	169
Unemployed	23	0	23
Student	11	0	11
Seaman	6	0	6
Prisoner	2	0	2
Security Guard	1	0	1
No record / Not applicable	32	5	37

*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, 2015



Key presenting symptoms of the 17 legionellosis cases include fever and cough (Table 5.6).

Table 5.6
Clinical presentation* of reported legionellosis cases, 2015

Clinical presentation	No. of cases n=17
Fever (with/without chills and rigors)	9
Respiratory symptoms	
Cough (productive and non-productive)	8
Shortness of breath	3
Runny nose	0
Chest pain and discomfort	0
Sore throat	1
Other signs and symptoms	
Chills	3
Myalgia	2
Loss of Appetite	3
Nausea	2
Giddiness	2
Epigastric pain	2
Generalised weakness	4
Jaundice	1

*Cases may have one or more clinical presentations

16 (94.1%) of the reported cases had co-morbid medical illnesses such as hypertension, hyperlipidemia and diabetes (Table 5.7). Three legionellosis-related deaths were reported (Table 5.7).

Table 5.7
Concurrent medical conditions* of reported legionellosis cases, 1989 – 2015

Concurrent medical condition	1989 – 2014 n=799	2015 n=17	Total n=816
Diseases of the circulatory system			
Cardiomegaly	1	0	1
Hypertensive disease	197	7	204
Ischaemic heart disease	111	2	113
Heart failure	27	1	28
Cerebrovascular disease	36	0	36
Peripheral vascular disease	1	0	1
Moyamoya disease	1	0	1
Atrial fibrillation	4	0	4
Hyperlipidemia	10	6	16
Metabolic diseases			
Diabetes mellitus	148	5	153
Gout	9	0	9
Thyrotoxicosis	2	0	2
Diseases of the respiratory system			
Chronic obstructive pulmonary disease	54	2	56
Asthma	70	0	70
Bronchiectasis	36	0	36

Table 5.7 (cont'd)
Concurrent medical conditions* of reported legionellosis cases, 1989 – 2015

Bronchitis	7	0	7
Dyspnoea	3	0	3
Fibrosing alveolitis	1	0	1
Pneumonia	6	4	10
Interstitial lung disease	1	0	1
Pulmonary fibrosis	1	0	1
Infectious diseases			
Pulmonary tuberculosis	45	2	47
Septicaemia	4	0	4
Melioidosis	2	0	2
Hepatitis	1	2	3
Dengue fever	2	0	2
Leprosy	1	0	1
Neoplasms	25	0	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	7	0	7
Duodenitis	1	0	1
Diseases of blood			
Anaemia	23	1	24
Thalassaemia minor	2	0	2
Mental disorders			
Schizophrenia	6	1	7
Dementia	3	2	5
Diseases of musculoskeletal system and connective tissue			
Arthritis	6	0	6
Systemic lupus erythematosus	3	1	4
Diseases of genitourinary system			
Renal failure	48	0	48
Pyelonephritis	1	0	1
Urinary tract infection	7	0	7
Benign prostatic hypertrophy	1	0	1
Diseases of nervous system			
Parkinson's disease	5	0	5

*Patients may have one or more concurrent medical conditions

Table 5.8
Case-fatality rate of reported legionellosis by history of medical conditions, 2001 – 2015

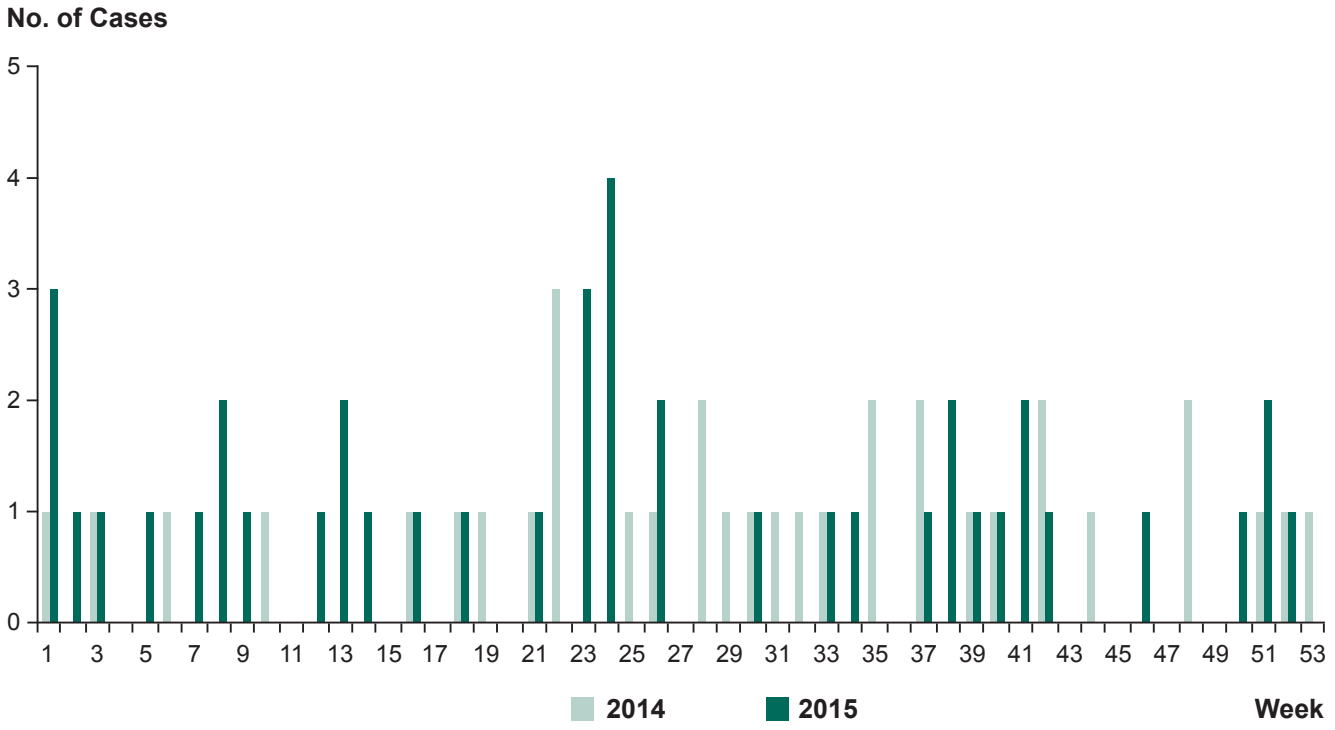
Year	Concurrent medical conditions					
	Present		Absent		Total	
	Cases	Deaths	Cases	Deaths	Cases	Deaths (%)
2001	32	1	20	0	52	1 (1.9)
2002	26	1	14	0	40	1 (2.5)
2003	26	0	20	0	46	0 (0.0)
2004	10	0	7	0	17	0 (0.0)
2005	6	0	12	0	18	0 (0.0)
2006	3	0	10	0	13	0 (0.0)
2007	3	0	9	0	12	0 (0.0)
2008	3	0	12	0	15	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)
2014	28	4	3	0	31	4 (12.9)
2015	13	3	1	0	17	3 (17.6)

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 2015, there were 42 cases of laboratory confirmed melioidosis, compared with 34 cases in 2014 (Figure 5.3). Out of the 42 cases, there were 5 imported cases, involving 3 Singapore residents and 2 foreigners including a foreigner seeking treatment and a work permit holder. The remaining 37 cases were classified as indigenous cases.

Figure 5.3
E-weekly distribution of reported melioidosis cases, 2014 – 2015



The mean age of the reported cases was 53 years (range 14 – 95 years). The overall incidence rate among indigenous cases was 0.7 per 100,000 population, with the highest incidence rate in the 55-64 years age group (Table 5.9).

Table 5.9
Age-gender distribution and age-specific incidence rate of melioidosis cases^, 2015

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 (2.7)	0.2
15 – 24	3	0	3 (8.1)	0.4
25 – 34	1	0	1 (2.7)	0.1
35 – 44	3	0	3 (8.1)	0.3
45 – 54	8	1	9 (24.3)	1.2
55 – 64	11	0	11 (29.7)	1.9
65+	8	1	9 (24.3)	1.8
Total	**34**	**3**	**37 (100.0)**	**0.7**

^Cases acquired locally among Singaporeans, permanent and temporary residents
*Rates are based on 2015 estimated mid-year population.
(Source: Singapore Department of Statistics)

Among the three major ethnic groups, Indians had the highest incidence, followed by Malays and Chinese (Table 5.10).

Table 5.10
Ethnic distribution and ethnic-specific incidence rate of melioidosis cases^, 2015

	Male	Female	Total (%)	Incidence rate per 100,000 population*
Singapore Resident				
Chinese	24	2	26 (70.2)	0.9
Malay	5	0	5 (13.5)	1.0
Indian	3	1	4 (10.8)	1.1
Others	0	0	1 (2.7)	0.0
Foreigner	2	0	2 (5.4)	0.1
Total	**34**	**3**	**37 (100.0)**	**0.7**

Excludes one foreigner seeking medical treatment in Singapore
*Rates are based on 2015 estimated mid-year population.
(Source: Singapore Department of Statistics)

Table 5.11
Total number of notifications received for melioidosis cases, 2011-2015*

Age Group	2011		2012		2013		2014		2015	
	Local	Imported	Local	Imported	Local	Imported	Local	Imported	Local	Imported
0– 4 yrs	0	0	0	0	0	0	0	0	0	0
5 – 9 yrs	1	0	0	0	1	0	0	0	0	0
10 – 14 yrs	1	2	2	0	1	2	2	0	1	0
15 – 24 yrs	1	0	2	0	1	0	2	0	3	0
25 – 34 yrs	1	1	2	0	1	1	2	0	1	0
35 – 44 yrs	4	0	8	1	4	0	8	1	3	1
45 – 54 yrs	7	0	8	0	7	0	8	0	9	2
55 – 64 yrs	8	2	2	0	8	2	2	0	11	1
65+	5	0	8	0	5	0	8	0	9	0
Total	28	5	32	1	28	5	32	1	37	4

*Excluding foreigner seeking medical treatment in Singapore

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, 2015

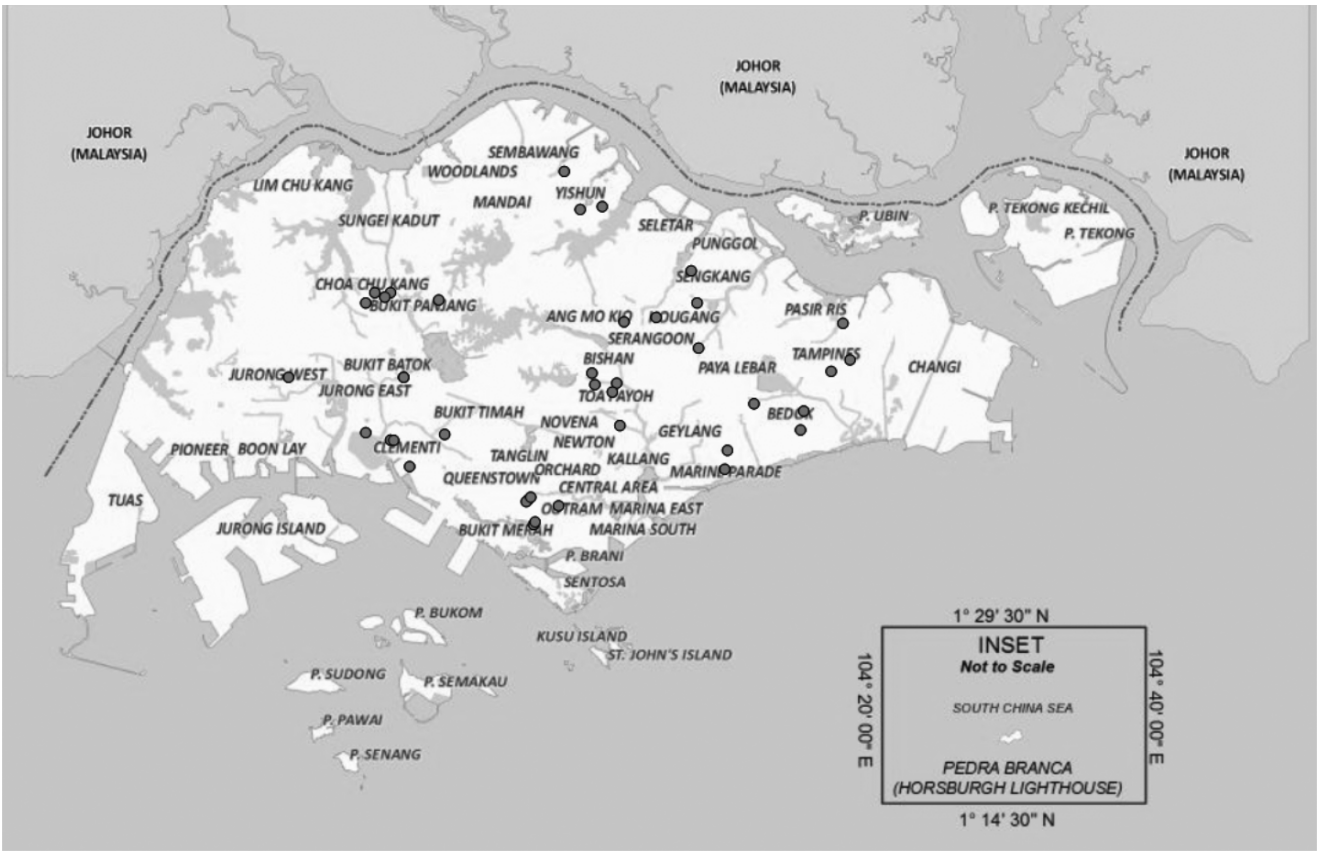
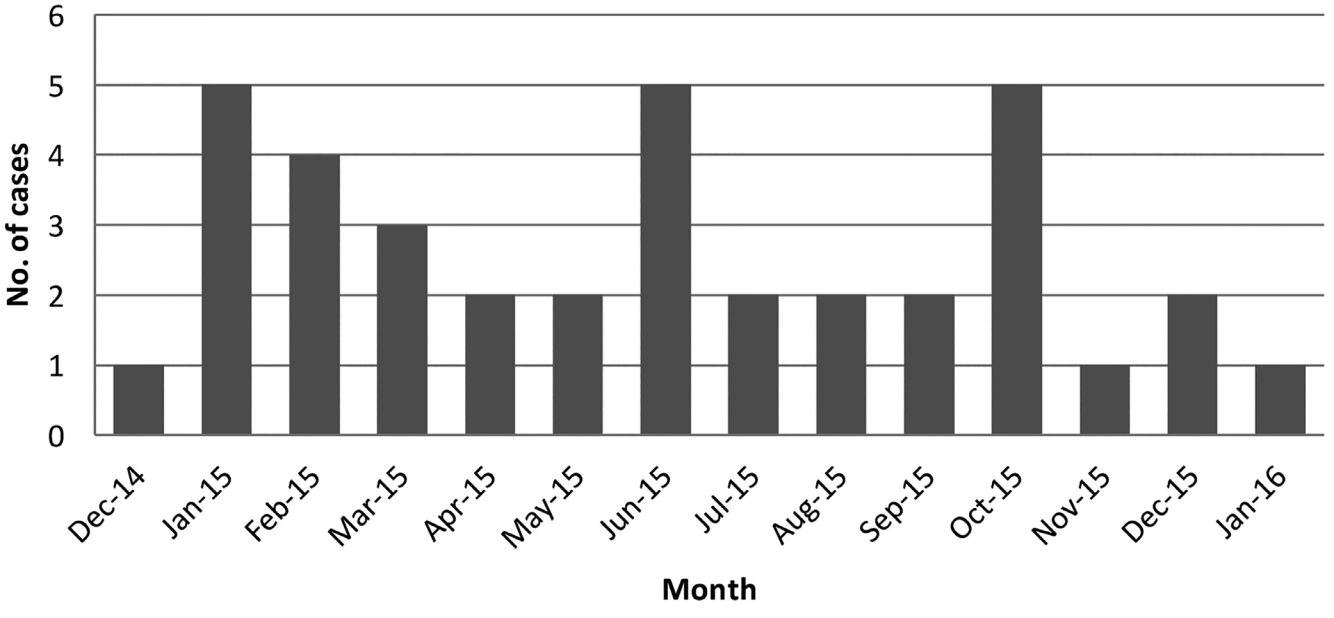


Figure 5.5
Monthly distribution of reported melioidosis cases by onset date, 2015



Among the 41 cases, Burkholderia pseudomallei were isolated from blood culture in 48.8% of the cases. See Table 5.12 for other laboratory diagnostic sources.

Table 5.12
Laboratory diagnosis of melioidosis cases^, 2015

Method of diagnosis	No. of cases (%)
Culture	
Blood	20 (48.8)
Pus	2 (4.9)
Tissue	2 (4.9)
Liver Aspirate	1 (2.4)
Lymph node aspirate	1 (2.4)
Endotracheal tube aspirate	2 (4.9)
Swabs	9 (21.9)
Sputum	2 (4.9)
Urine	2 (4.9)
Total	**41 (100.0)**

^Excluding one foreigner seeking medical treatment in Singapore

The predominant signs and symptoms were fever, cough and ulcers (Table 5.13). 46.3% of the cases presented with localised or multiple abscesses. Those who presented with bacteraemia comprised 53.7% of the cases in 2015 (Table 5.14).

Table 5.13
Main presenting signs and symptoms* of reported melioidosis cases^, 1994 – 2015

Signs and symptoms	1989 – 2014 n=1299		2015 n=41	
	No.	**(%)**	**No.**	**(%)**
Fever (with/without chills and rigors)	932	75.8	28	68.3
Myalgia	11	0.9	2	4.9
Ulcers	3	0.2	14	34.1
Respiratory symptoms				
Cough (productive and non-productive)	527	42.9	14	34.1
Dyspnoea	280	22.8	8	19.5
Chest pain	132	10.7	6	14.6
Runny Nose	7	0.6	1	2.4
Gastrointestinal symptoms				
Abdominal pain/discomfort/epigastric pain	109	8.9	7	2.4
Vomiting	90	7.3	4	9.8
Diarrhoea	80	6.5	1	2.4
Constipation	3	0.2	0	0
Jaundice	8	0.7	1	2.4
Urinary symptoms (dysuria, haematuria)	47	3.8	2	4.9
Abscesses (localised, multiple)	383	31.2	19	46.3

^Excluding one foreigner seeking medical treatment in Singapore
*Cases may have one or more presenting signs and symptoms

Table 5.14
Cases^ of melioidosis presenting with bacteraemia and abscesses, 2001 – 2015

	Bacteraemia			Abscesses			
				All Abscesses		Cutaneous	
Year	Cases	No.	(%)	No.	(%)	No.	(%)
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
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
2014	32	15	46.9	11	18.7	2	6.3
2015	41	22	53.7	19	46.3	9	22.0

^Excluding one foreigner seeking medical treatment in Singapore

Overall, 58.5% of cases had co-morbid medical conditions. The most common was diabetes mellitus (83.3%), followed by pneumonia (58.3 %) (Table 5.15).

Table 5.15
Concurrent medical conditions* of 1,357 melioidosis cases, 1989 – 2015

Concurrent medical condition	1989 – 2014 n=1,357 (294)		2015 n=24 (3)		Total n= 1381 (297)	
Metabolic/nutritional diseases						
Diabetes mellitus	712	(175)	20	(1)	732	(176)
Disorders of the thyroid gland	8	(4)	0		8	(4)
Gout	15	(5)	0		15	(5)
Dyslipidemia	7		1		8	
Hyperlipidemia	63	(16)	7	(1)	70	(17)
Panhypopituitarism	1	(1)	0		1	(1)
Others	7	(3)	0		7	(3)
Diseases of the circulatory system						
Acute Myocardiac Infarction	6	(4)	1	(1)	7	(5)
Cerebrovascular disease	24	(6)	0		24	(6)
Coronary Artery Bypass Graft	3		0		3	
Heart failure	26	(14)	0		26	(14)
Heart disease	35	(8)	5	(1)	40	(9)
Hypertensive disease	352	(87)	9	(2)	361	(89)
Ischaemic heart disease	147	(58)	0		147	(58)
Pulmonary/arterial embolism and thrombosis	8	(3)	0		8	(3)
Rheumatic heart disease	1		0		1	
Others	8	(3)	0		8	(3)

Table 5.15 (cont'd)
Concurrent medical conditions* of 1,357 melioidosis cases, 1989 – 2015

Diseases of the respiratory system						
Asthma	62	(18)	0		62	(18)
Bronchiectasis	13	(5)	0		13	(5)
Chronic obstructive pulmonary disease	29	(13)	0		29	(13)
Pneumonia	199	(59)	14	(1)	213	(60)
Pulmonary edema	1		0		1	
Respiratory failure	5	(4)	0		5	(4)
Others	28	(6)	0		28	(6)
Diseases of the genitourinary system						
Benign prostatic hypertrophy	5	(2)	0		5	(2)
Renal failure/impairment	145	(66)	1	(1)	146	(67)
Nephrosis	14	(2)	0		14	(2)
Urinary Tract Infection	9	(2)	1		10	(2)
Others	10	(1)	0		10	(1)
Diseases of the digestive system						
Cholecystitis	4	(2)	1		5	(2)
Chronic liver disease and cirrhosis	26	(12)	0		26	(12)
Colon cancer	3		0		3	
Colonic polyp	1		0		1	
Hepatocellular disease	6	(2)	1		6	(2)
Hepatomegaly	2	(2)	0		2	(2)
Pancreas cancer	2		1		3	
Pancreatitis	2		0		2	
Ulcer of stomach and duodenum	19	(2)	0		19	(2)
Infectious diseases						
Dengue Fever	10	(3)	0		10	(3)
Hepatitis B	1		3		4	
Hepatitis C	1		0		1	
HIV infection	3	(2)	1		4	(2)
MRSA	2	(1)	0		2	(1)
Salmonellosis	1		0		1	
Tuberculosis	78	(21)	5		83	(21)
Neoplasms	40	(17)	0		40	(17)
Mental disorders						
Alcohol dependence syndrome	4	(2)	2		6	(2)
Drug dependence	4	(4)	0		4	(4)
Psychosis	8	(4)	0		8	(4)
Depression	1		1		2	
Schizophrenia	1		0		1	
Disease of the eye						
Cataract	6		0		6	
Retinopathy	2		0		2	
Diseases of the blood						
Anaemia	25	(6)	3	(1)	28	(7)
α-thalassaemia	1		0		1	
ß-thalassaemia	5		0		5	
Disseminated intravascular coagulation	1	(1)	0		1	(1)

Table 5.15 (cont'd)
Concurrent medical conditions* of 1,357 melioidosis cases, 1989 – 2015

Pancytopenia	1		0	1	
Sepsis	28	(8)	1	29	(8)
Thrombocytopenia	3	(1)	1	4	(1)
Diseases of the nervous system					
Alzheimer's disease	2		0	2	
Dementia	4	(2)	0	4	(2)
Neuropathy	3	(1)	0	3	(1)
Parkinson's disease	3		0	3	
Stroke	6	(1)	0	6	(1)
Immune-mediated Diseases	6	(1)	0	6	(1)
Diseases of Ear, Nose, and Throat					
Otitis media	2		0	2	
Diseases of the musculoskeletal system/ connective tissue					
Cellulitis	4		0	4	
Chondromalacia patellae	1		0	1	
Myopathy	1		0	1	
Mixed connective tissue disease	1		0	1	
Osteoarthritis	6	(3)	0	6	(3)
Osteomyelitis	1		0	1	
Osteoporosis	1	(1)	1	2	(1)
Rheumatoid arthritis	3	(1)	0	3	(1)

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

In 2015, there were three melioidosis-related deaths, giving a case-fatality rate of 7.3% (Table 5.16). Higher case-fatality rates were observed among those with co-morbid medical conditions (8.3%) and without bacteraemia (10.5%). Please refer to Table 5.16 and 5.17.

Table 5.16
Case-fatality rate of reported melioidosis cases by history of concurrent medical condition, 2001 – 2015

	Concurrent medical conditions					
Year	Present		Absent		Total	
	Cases	Deaths (%)	Cases	Deaths (%)	Cases	Deaths (%)
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)
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)
2014	20	1 (5.0)	12	1 (8.3)	32	2 (6.3)
2015	24	2 (8.3)	17	1 (5.9)	41	3 (7.3)

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

Table 5.17
Case-fatality rate of bacteraemic and non-bacteraemic melioidosis in Singapore, 2001 – 2015

	Bacteraemia					
Year	Present		Absent		Total	
	Cases	Deaths (%)	Cases	Deaths (%)	Cases	Deaths (%)
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)
2014	15	1 (6.7)	17	1 (5.9)	32	2 (6.3)
2015	22	1 (4.5)	19	2 (10.5)	41	3 (7.3)

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

Chapter VI

HIV/AIDS, STIs, TUBERCULOSIS & LEPROSY

- 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 71 million people have been infected with the virus and about 34 million have died of HIV worldwide. Globally, 36.9 million [34.3 milion – 41.1million] people were living with HIV at the end of 2014[1].

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, 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 2015, a total of 455 Singapore residents were newly reported to have HIV infection, which is comparable with 456 cases in 2014 (Table 6.1). This brings the cumulative total number of HIV/AIDS infections among residents since the first case was diagnosed in 1985 to 7,140, of whom 3,722 persons were asymptomatic carriers, 1,602 had AIDS-related illnesses at diagnosis, and 1,816 had died. 40% of the newly reported patients presented with late-stage[2] HIV infection.

During 2015, 91 cases of AIDS were reported (Table 6.2), including 88 with AIDS at diagnosis of HIV infection and three previously diagnosed asymptomatic HIV-infected patient who progressed to AIDS.

The notification rate of HIV/AIDS in 2015 was 116.6 per million population, compared to 117.8 per million population in 2014 (Figure 6.1). The rates for newly-reported AIDS cases was 23.3 per million population in 2015, compared to 30.7 per million population in 2014. In 2015, 79 deaths in HIV/AIDS patients were reported, giving a mortality rate of 20.2 per million population.

[1] WHO: Global Health Observatory (GHO) data, 2014.
[2] As defined by CD4+ cell count of less than 200 per cu mm or AIDS-defining opportunistic infections or both.

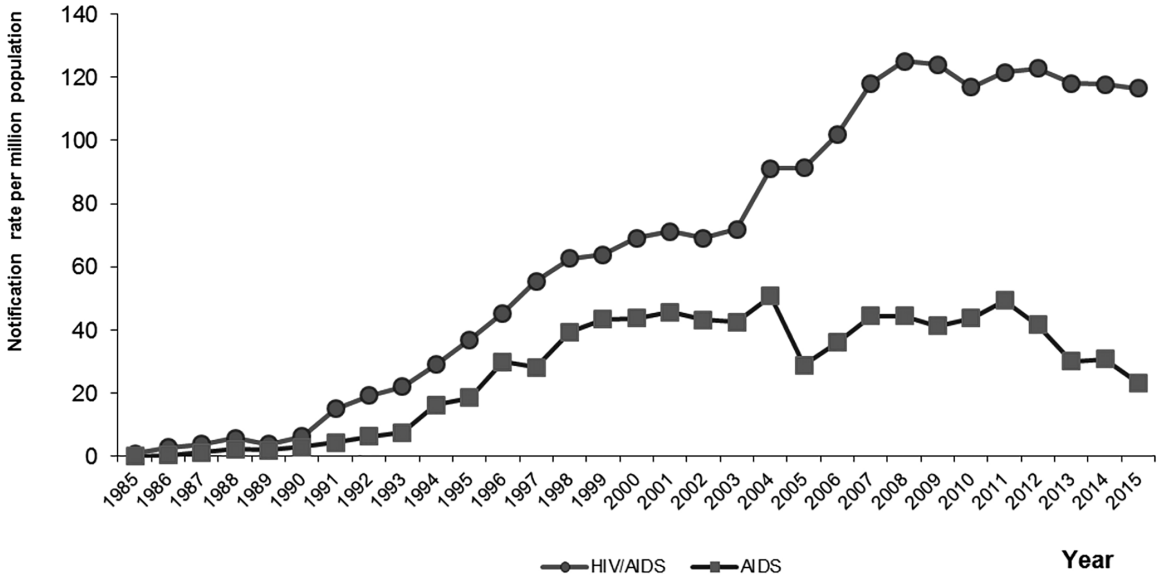
Table 6.1
Distribution of Singapore residents with HIV/AIDS by gender, 1985 – 2015

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
2010	403	38	441	116.9
2011	430	31	461	121.7
2012	437	32	469	122.8
2013	428	26	454	118.1
2014	422	34	456	117.8
2015	423	32	455	116.6
Total	**6499**	**641**	**7140**	

Table 6.2
Distribution of Singapore residents with AIDS by gender, 1985 – 2015

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	14	165	44.0
2011	174	13	187	49.3
2012	148	11	159	41.0
2013	110	6	116	30.2
2014	110	9	119	30.7
2015	80	11	91	23.3
Total	**2695**	**225**	**2920**	

Figure 6.1
Notification rate of HIV/AIDS among Singapore residents, 1985 – 2015



Distribution by age and gender

As in previous years, HIV/AIDS cases were predominantly male with a male to female ratio of 10:1. In 2015, the highest notification rates were observed for males in the 30 - 39 years age group and for females in the 40-49 years age group (Table 6.3).

Table 6.3
Age-gender distribution and age-specific notification rates of HIV/AIDS among Singapore residents, 2015

					Notification rate per million population*		
Age	**Male**	**Female**	**Total**	**(%)**	**Male**	**Female**	**Total**
0 - 14	0	0	0	0.0%	0.0	0.0	0.0
15-19	5	0	5	1.1%	40.2	0.0	20.6
20-29	95	2	97	21.3%	357.1	7.4	181.3
30-39	120	9	129	28.4%	426.1	29.0	218.0
40-49	100	10	110	24.2%	328.9	31.6	177.4
50-59	67	8	75	16.5%	218.7	26.3	122.9
60 & above	36	3	39	8.6%	110.0	8.0	55.7
Total	**423**	**32**	**455**	**100%**	**220.7**	**16.1**	**116.6**

*Rates are based on 2015 mid-year Singapore resident population
(Source: Singapore Department of Statistics)

Ethnic Distribution

Among the three major ethnic groups, the Malays had the highest HIV notification rate at 138.2 per million population, followed by the Chinese (Table 6.4).

Table 6.4
Ethnic-gender distribution and ethnic-specific notification rates of HIV/AIDS among Singapore residents, 2015

					Notification rate per million population*		
Ethnic group	**Male**	**Female**	**Total**	**(%)**	**Male**	**Female**	**Total**
Chinese	327	13	340	74.7%	231.0	8.8	117.2
Malay	63	9	72	15.8%	243.1	34.4	138.2
Indian	17	5	22	4.8%	93.3	29.0	62.0
Others	16	5	21	4.6%	267.1	74.7	165.6
Total	**423**	**32**	**455**	**100%**	**220.7**	**16.1**	**116.6**

*Rates are based on 2015 mid-year Singapore resident population
(Source: Singapore Department of Statistics)

Mode of HIV/AIDS transmission

The main mode of HIV transmission was through sexual intercourse, representing 96.7% of cases in 2015 (Table 6.5). Heterosexual transmission accounted for 38.0% of all cases in 2015, while homosexual and bisexual transmission accounted for 58.7%. There were four cases infected via intravenous drug use while the route of infection could not be determined for 11 cases.

Table 6.5
Distribution of Singapore residents with HIV/AIDS by mode of transmission, 2015

Mode of Transmission	No.	(%)
Sexual Transmission		
Heterosexual	173	38.0%
Homosexual	232	51.0%
Bisexual	35	7.7%
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	11	2.4%
Total	**455**	**100.0%**

Mode of Detection

About 45.7% of the newly reported cases were detected by HIV tests done in the course of medical care provisioning . Another 28.6% were detected during routine programmatic HIV screening while 17.6% were detected as a result of voluntary HIV screening. The rest were detected through other types of screening.

Table 6.6
Distribution of Singapore residents with HIV/AIDS by Mode of Detection, 2015

Mode of Detection	No.	(%)
Medical Care[3]	208	45.7%
Routine programmatic HIV screening[4]	130	28.6%
Voluntary	80	17.6%
Others/Uncertain	37	8.1%
Total	**455**	**100.0%**

Contact Tracing and Notification

In 2015, after excluding those who had died or were in prison, 430 HIV cases were identified to be interviewed for contact tracing. Of these, 420 cases (98%) were interviewed. The remaining cases were hospitalised, overseas or pending interview (as at 31 Dec 2015).

In 2015, after excluding spouses who had died, were divorced or overseas, there were 63 spouses to be contacted under the spousal notification programme. 57 spouses (90%) were notified. The remaining spouses were not notified as it was assessed that there was no ongoing risk of transmission.

A total of 419 sexual contacts were reported during contact tracing interviews conducted among cases diagnosed in 2015. 242 contacts were contactable (58%) and were notified of their exposure to HIV and advised to undergo testing. 158 of them (65%) reported that they tested for HIV, of whom 40 (25%) tested positive.

[3] Includes cases that presented with HIV-specific symptoms and cases with non-HIV related medical conditions
[4] Includes screening programmes for individuals with sexually transmitted infections, hospital inpatients and those identified through contact tracing

HIV surveillance programmes

Table 6.7 shows the overall results for three HIV surveillance programmes in Singapore. The proportion of cases tested positive for HIV within each programme has declined or remained stable over the last five years. In 2015, the prevalence of HIV infection among cases tested in anonymous test sites was highest, at 1.4%, followed by inpatient opt-out testing and antenatal screening, at 0.16% and 0.06% respectively.

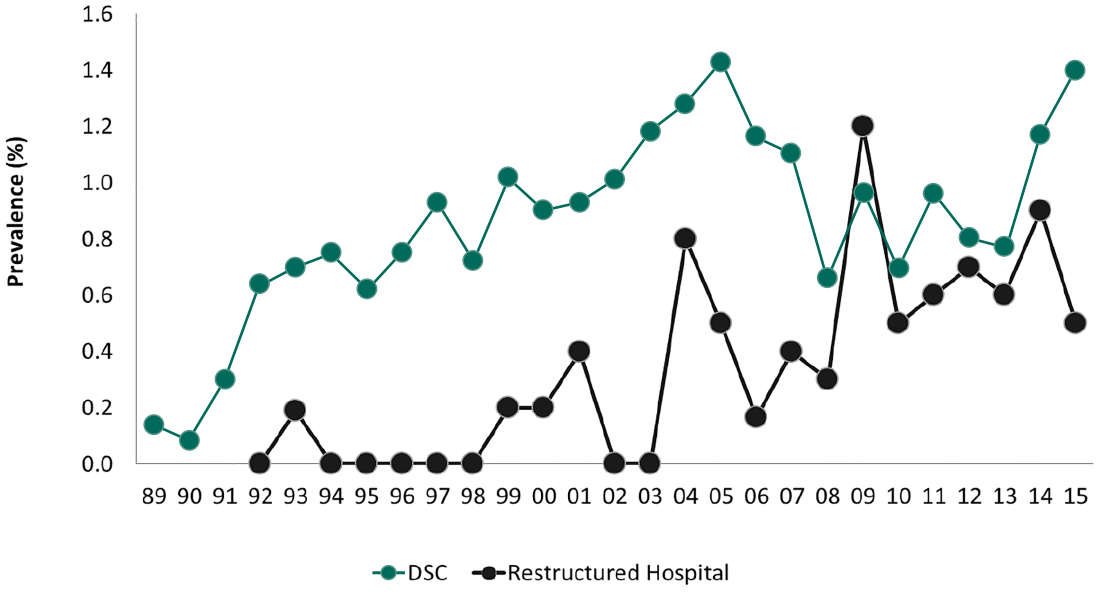
Table 6.7
Results for HIV Surveillance Programmes, 2011 – 2015

Programme		2011	2012	2013	2014	2015
Anonymous test sites	Total number of tests done	9,370	11,243	13,893	15,950	15,641
	Number tested positive	184	173	227	202	223
	Percentage tested positive (%)	2	1.5	1.6	1.3	1.4
Inpatient opt-out testing	Total number of tests done	35,015	34,515	33,297	30,834	30,123
	Number tested positive	34	39	41	58	49
	Prevalence (%)	0.1	0.11	0.12	0.19	0.16
Antenatal screening	Total number of tests done	37,045	33,030	38,088	38,679	33,945
	Number tested positive	11	8	13	20	19
	Prevalence (%)	0.03	0.02	0.03	0.05	0.06

HIV unlinked anonymous sero-surveillance programme

Two sentinel populations are currently monitored through unlinked anonymous testing 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 has risen from 1.2% in 2014 to 1.5% in 2015. Among inpatients, the seroprevalence decreased slightly from 0.9% in 2014 to 0.5% in 2015. (Figure 6.2).

Figure 6.2
Unlinked HIV Seroprevalence, 1989-2015



HIV molecular surveillance program

In 2015, the proportion of recently-infected individuals was estimated at 22.4% in newly-diagnosed, treatment-naïve individuals (n=116). Viral subtype determination among these recently-infected individuals revealed the predominant circulating HIV subtype was CRF01_AE (61.5%), followed by subtype B (34.6%). Resistance testing was also performed to determine the prevalence of transmitted drug resistance-associated mutations in newly diagnosed, treatment-naïve HIV-positive individuals. The overall prevalence of transmitted drug resistance (TDR) to any antiretroviral (ARV) class was 7% in 2015. Transmitted resistance to nucleoside reverse transcriptase inhibitors (NRTIs), non-nucleoside reverse transcriptase inhibitors (NNRTIs) and protease inhibitors (PIs) were 0.9%, 2.6% and 3.5% 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.

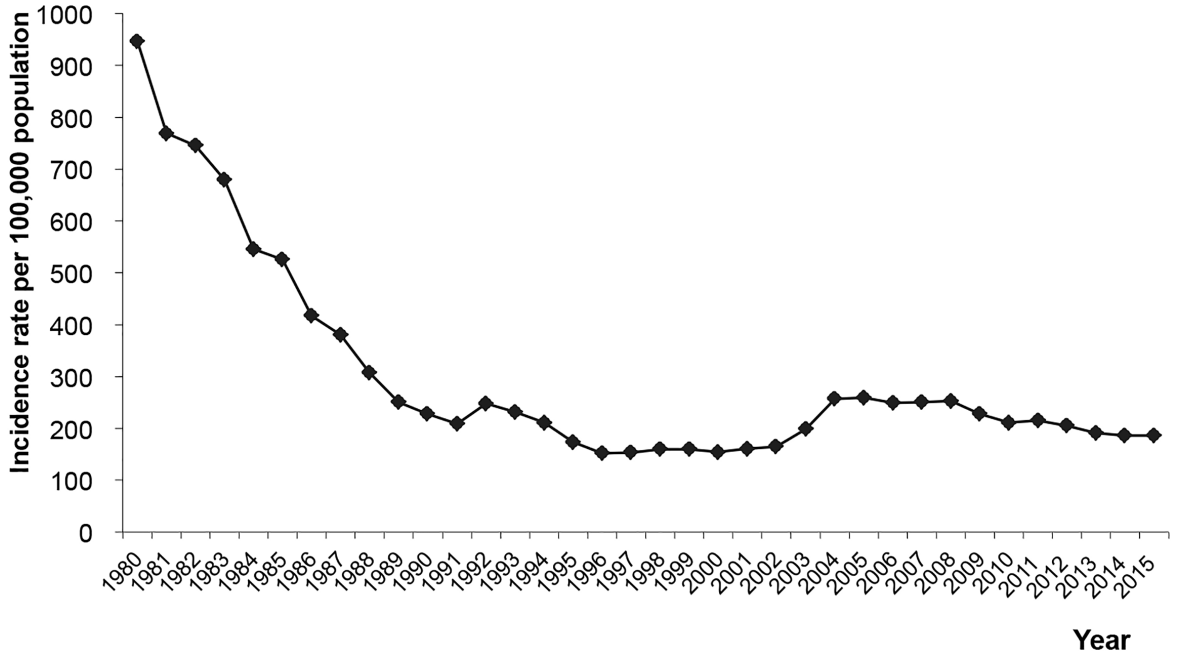
The diagnosis of an STI is a “sentinel” event which indicates unprotected sexual activity and therefore, patients presenting with one STI are at increased risk of acquisition of others. The presence of STIs can increase the risk of acquisition of HIV infection and also promote its transmission. Sexually 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 186 per 100,000 population in 2015. The STI incidence has been gradually declining since 2004 and has stabilised at around 200 per 100,000 population since 2012 (Figure 6.3). The three main bacterial STIs notified in 2015 were chlamydia, gonorrhoea and syphilis.

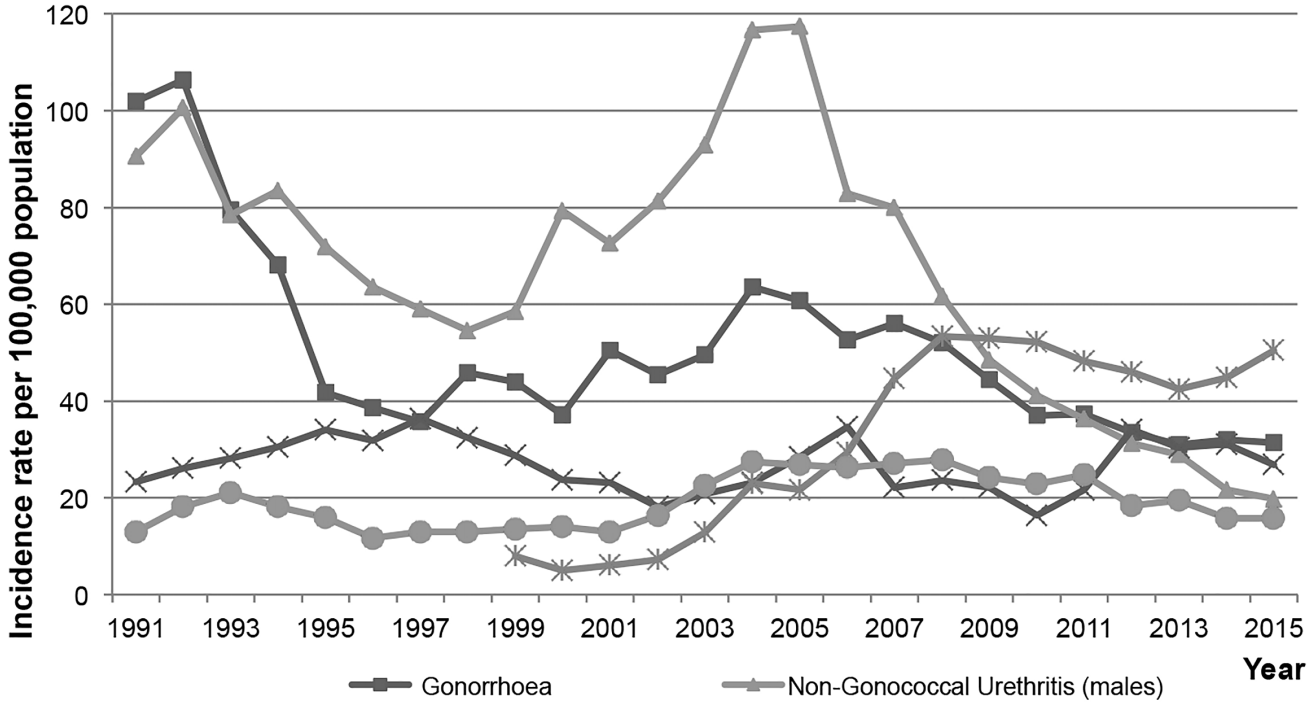
Figure 6.3
Incidence rate of STIs, 1980 – 2015



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 another peak in 2005 at 197 per 100,000, and thereafter it decreased to 135 per 100,000 in 2014 and 2015. The incidence rates of individual legally notifiable STIs are shown in Figure 6.4.

Figure 6.4
Incidence rate of legally notifiable STIs, 1992 – 2015



* 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, 2015

	Incidence rate per 100,000 population*		
	Male	**Female**	**Total**
Legally Notifiable STIs			
Chlamydia	57.4	43.0	50.5
Gonorrhoea	49.2	12.0	31.4
Non-Gonococcal Urethritis (NGU)	19.8	- [1]	- [1]
Syphilis	36.1	16.6	26.8
Genital Herpes	20.7	10.2	15.7
Other STIs			
Vaginal discharge	- [2]	18.1	- [2]
Candidiasis	3.7	16.1	9.6
Genital Warts	30.0	7.8	19.4
Mucopurulent cervicitis (MPC)	- [3]	18.7	- [3]
Chancroid	0.0	0.0	0.0
Others	6.3	3.7	5.1
All types	**223.3**	**146.1**	**186.4**

* Rates are based on 2015 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 2015, the male to female ratio for STIs was 1.5:1. Among females, the highest age-specific incidence of STI was among females in 20-24 year old age group. The age-specific incidence rate for STIs among females in the age group of 20 – 24 years increased from 439 per 100,000 in 2014 to 503.9 per 100,000 in 2015. Among the males, the highest age-specific incidence rate was in the 25 - 29 year age group. The overall rate was highest in the 20 – 24 year age group, which was a shift from previous years where the overall rate was highest in the 25 – 29 year age group (Table 6.9).

Table 6.9
Age-gender distribution of STIs incidence rates, 2015

					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	0	10	10	0.1	0.0	8.7	4.2
15 – 19	193	218	411	4.0	130.3	157.7	143.5
20 – 24	890	1023	1913	18.5	339.3	503.9	411.2
25 – 29	1396	1112	2508	24.3	395.1	389.4	392.6
30 – 34	1069	585	1654	16.0	318.7	208.1	268.3
35 – 39	929	354	1283	12.4	339.5	144.2	247.1
40 – 44	580	222	802	7.8	230.4	102.5	171.3
45 – 49	452	143	595	5.8	215.8	78.3	151.8
50 – 59	625	130	755	7.3	182.1	38.9	111.5
60+	321	64	385	3.7	90.5	15.4	49.9
Total	**6455**	**3863**	**10318**	**100.0**	**223.3**	**146.1**	**186.4**

* Rates are based on 2015 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 188.1 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, 2015

					Notification rate per million population*		
Ethnic group	**Male**	**Female**	**Total**	**(%)**	**Male**	**Female**	**Total**
Chinese	3538	1738	5276	75.8	250.0	117.1	181.9
Malay	545	435	980	14.1	210.3	166.1	188.1
Indian	308	97	405	5.8	168.9	56.2	114.1
Others	207	89	296	4.3	345.5	133.0	233.4
Total	**4598**	**2359**	**6957**	**100.0**	**159.0**	**89.2**	**125.7**

* Rates are based on 2015 estimated 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 incidence of chlamydia has shown a slight increase in both males and females in 2015 (57.4 per 100,000 and 43.0 per 100,000), compared to 2014 (54.3 per 100,000 and 34.4 per 100,000 respectively) (Table 6.8).

Syphilis

The incidence rate of syphilis was 27 per 100,000 population in 2015 which was a decrease from 31 per 100,000 population in 2014 (Figure 6.3).

The rate of infectious syphilis declined progressively from 18 per 100,000 population in 1986 to between 2.4 to 5.2 per population from 1996 onwards. In 2015, the rate of infectious syphilis remained within the expected range, at 4 per 100,000 population. There were no cases of congenital syphilis reported in 2015.

Gonorrhoea

The incidence rate of gonorrhoea was 31 per 100,000 population in 2015. 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 2015.

The percentage of penicillinase-producing Neisseria gonorrhoeae (PPNG) detected among Gonorrhoea positive cultures screened was 47.5% in 2015, which was an increase from 43.1% in 2014 (Table 6.11). The percentage of Neisseria gonorrhoeae cultures resistant to Ciprofloxacin increased from 74.1% in 2012 to 86.3% in 2015 (Table 6.12).

Table 6.11
Gonorrhoea cultures screened for PPNG, 1980 – 2015

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
2014	320	138	43.1
2015	160	76	47.5

* 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 – 2015

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
2014	160	143	89.4
2015	160	138	86.3

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, which is not infectious and usually goes unnoticed, is 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 2,894 cases of TB were notified in 2015. This comprised 1,498 new and 144 relapsed cases among Singapore residents (citizens and PRs) and 1,206 new and 46 relapsed cases among non-residents (long-and short-term pass holders)

A total of 2,000 new cases of TB were notified among Singapore residents (citizens and PRs) and long-staying foreigners in 2015. The incidence rate of TB was 36.1 per 100,000 population in 2015. (Figure 6.5)

The majority (84.5%) of cases had pulmonary TB with or without extra-pulmonary involvement, while the remainder (15.5%) had exclusively extrapulmonary TB (Table 6.13).

Figure 6.5
Incidence rate of tuberculosis among Singapore residents and long-staying foreigners, 2002-2015

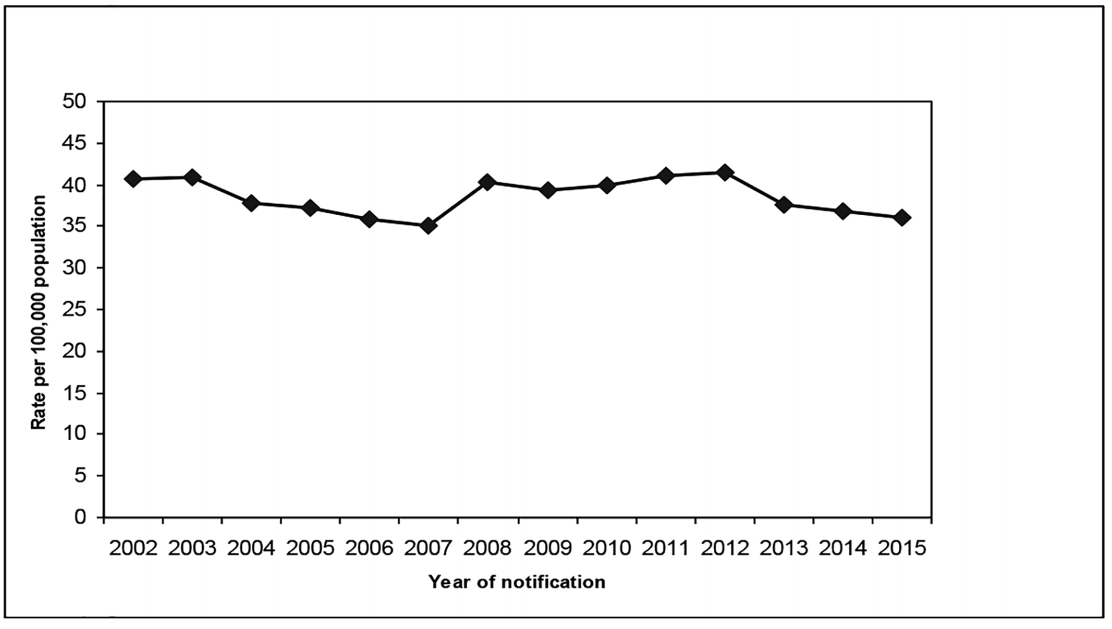


Table 6.13
Distribution of new TB cases by site of disease among Singapore residents and long-staying foreigners, 2002 – 2015

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
2014	1,705	313	2,018	31.2	5.7	36.9	90.4
2015	1,691	309	2,000	30.6	5.6	36.1	88.5

[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 2,000 new cases notified in 2015, 1,043 (52.2%) were 50 years old and above, and 1,222 (61.1%) 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, 2015

Age (Yrs)	Male	Female	Total (%)	Incidence rate per 100,000 population*		
				Male	Female	Total
0 – 4	1	1	2 (0.1)	0.9	0.9	0.9
5 – 9	1	1	2 (0.1)	0.8	0.9	0.8
10 – 14	2	6	8 (0.4)	1.6	5.2	3.4
15 – 19	27	15	42 (2.1)	18.2	10.9	14.7
20 – 29	122	162	284 (14.2)	19.8	33.2	25.7
30 – 39	150	197	347 (17.4)	24.6	37.4	30.6
40 – 49	170	102	272 (13.6)	36.9	25.6	31.6
50 – 59	268	99	367 (18.4)	78.1	29.6	54.2
60 – 69	226	87	313 (15.7)	100.4	35.9	67.0
70 – 79	144	66	210 (10.5)	155.3	58.7	102.4
80 +	111	42	153 (7.7)	300.8	68.1	155.2
Total	**1,222**	**778**	**2,000 (100.0)**	**42.3**	**29.4**	**36.1**

* Rates are based on 2015 mid-year population.
(Source: Singapore Department of Statistics)

In 2015, among the 1,691 new pulmonary TB cases in Singapore residents and long-staying foreigners, 1,646 (97.3%) had bacteriological tests done. The proportion found to have demonstrable bacillary disease was 64.4% (Table 6.15)

Table 6.15
Bacillary status of new pulmonary tuberculosis cases among Singapore residents and long-staying foreigners, 2002 – 2015

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
2014	1,621	95.1	1,033	63.7	18.9
2015	1,646	97.3	1,060	64.4	19.2

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 38.4 per 100,000 population in 2015, remaining within the range where the rate has been fluctuating between 35 to 41 per 100,000 over the past 10 years (Figure 6.6).Of the 1,498 new TB cases among Singapore residents notified in 2015, 84.8% (1,271) of cases had pulmonary TB, of which 14.5% (184) also had extra-pulmonary involvement. 15.2% of the new TB cases (227) had exclusively extrapulmonary TB (Table 6.16). Among cases with extra pulmonary TB disease (411), the most common site of extrapulmonary TB was the pleura (162) followed by the lymphatic system (94) in 2015. 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 1987-2015

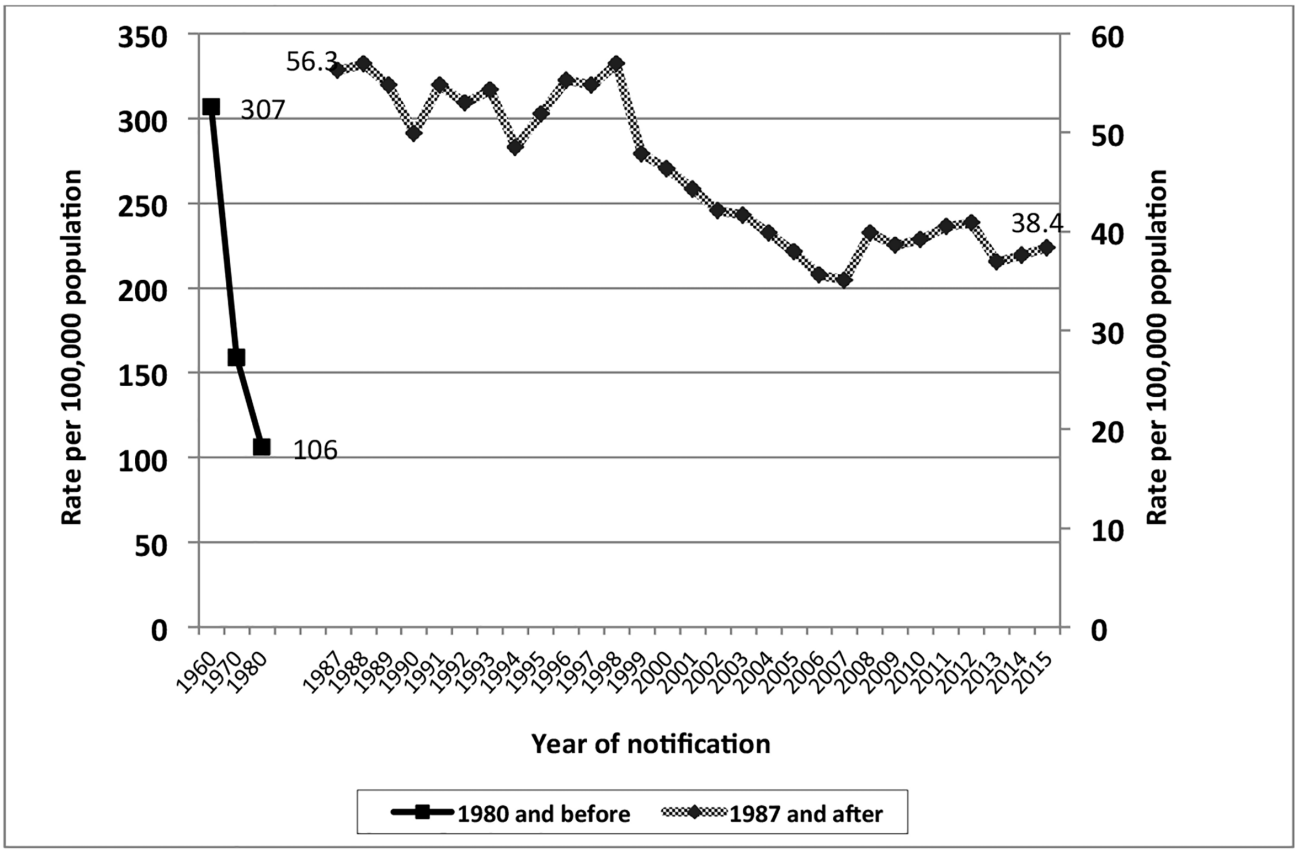


Table 6.16
Distribution of new TB cases by site of disease among Singapore Residents, 1960 – 2015

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

Table 6.16 (cont'd)
Distribution of new TB cases by site of disease among Singapore Residents, 1960 – 2015

Year	New Cases			Incidence rate per 100,000 population			Index (base 2002)
	Pulmonary[1]	Extra pulmonary	Total	Pulmonary[1]	Extra pulmonary	Total	
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
2014	1,220	234	1,454	31.5	6.0	37.6	12.2
2015	1,271	227	1,498	32.6	5.8	38.4	12.5

[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 1,498 new cases notified in 2015, 1,018 (68.0%) were 50 years old and above, and 1,009 (67.4%) were males. The TB incidence rate among males decreased from 53.5 per 100,000 population in 2014 to 52.6 per 100,000 population in 2015, while that among females increased from 22.2 per 100,000 population in 2014 to 24.6 per 100,000 population in 2015.

Table 6.17
Age-gender distribution and incidence rates of reported tuberculosis among Singapore residents, 2015

Age (Yrs)	Male	Female	Total (%)	Incidence rate per 100,000 population*		
				Male	Female	Total
0 – 4	0	1	1 (0.1)	0.0	1.1	0.5
5 – 9	1	1	2 (0.1)	1.0	1.0	1.0
10 – 14	2	4	6 (0.4)	1.8	3.8	2.8
15 – 19	22	13	35 (2.3)	17.7	11.0	14.4
20 – 29	46	43	89 (5.9)	17.3	16.0	16.6
30 – 39	63	72	135 (9.0)	22.4	23.2	22.8
40 – 49	140	72	212 (14.2)	46.0	22.8	34.2
50 – 59	258	94	352 (23.5)	84.2	30.9	57.7
60 – 69	224	82	306 (20.4)	107.5	38.2	72.4
70 – 79	142	65	207 (13.8)	169.2	65.0	112.6
80 +	111	42	153 (10.2)	317.7	71.8	163.7
Total	**1,009**	**489**	**1,498 (100.0)**	**52.6**	**24.6**	**38.4**

* Rates are based on 2015 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 greatly increased from 56.1 per 100,000 in 2014 to 60.1 per 100,000 population in 2015. Over the same period, the incidence rate in the Chinese and Indian population remained stable at 35.7 and 25.9 per 100,000 population respectively, (Table 6.18)

Table 6.18
Ethnic-gender distribution and ethnic-specific incidence rates of reported tuberculosis among Singapore residents, 2015

Ethnic group	Male	Female	Total (%)	Incidence rate per 100,000 population*
Chinese	740	294	1,034 (69.0)	35.7
Malay	190	123	313 (20.9)	60.1
Indian	54	38	92 (6.2)	25.9
Others	25	34	59 (3.9)	46.5
Total	**1,009**	**489**	**1,498 (100.0)**	**38.4**

* Rates are based on 2015 mid-year population.
(Source: Singapore Department of Statistics)

Clinical presentation and bacteriological status

In 2015, 1,249 (98.3%) of the 1,271 new pulmonary TB cases in Singapore residents had bacteriological tests done. The proportion found to have demonstrable bacillary disease was 71.0% (Table 6.19).

Table 6.19
Bacillary status of new pulmonary tuberculosis cases among Singapore Residents, 1987 – 2015

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

Table 6.19 (cont'd)
Bacillary status of new pulmonary tuberculosis cases among Singapore Residents, 1987 – 2015

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
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
2014	1,183	97.0	858	72.5	22.2
2015	1,249	98.3	887	71.0	22.7

* 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 2015, there were 144 relapsed TB cases notified among Singapore residents. This accounted for 8.8% of all cases (new & relapse) among Singapore residents (Table 6.20).

Table 6.20
Singapore residents with relapsed tuberculosis by gender, 2011 – 2015

	No. of relapses									
Age (Years)	**2011**		**2012**		**2013**		**2014**		**2015**	
	Male	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
0 – 9	0	0	0	0	0	0	0	0	0	0
10 – 19	0	0	2	0	0	3	1	0	0	0
20 – 29	1	4	1	3	0	2	3	0	0	3
30 – 39	1	4	4	5	5	3	5	7	3	2
40 – 49	9	6	11	2	12	3	10	3	7	6
50 – 59	33	11	22	4	20	2	22	5	30	9
60 – 69	22	4	34	3	20	5	29	7	18	7
70 +	52	11	42	3	37	7	35	10	53	6
Total	**118**	**40**	**116**	**20**	**94**	**25**	**105**	**32**	**111**	**33**
Male & Female	**158**		**136**		**119**		**137**		**144**	

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

Of the 1,498 new cases notified among residents in 2015, 1,237 (82.6%) were Singapore-born and 260 (17.3%) were foreign-born. Of the 144 relapsed TB cases notified among residents, 130 (90.3%) were Singapore-born and 14 (9.7%) were foreign-born (Table 6.21).

Table 6.21
Distribution of TB cases by age group and country of birth among Singapore Residents, 2014 – 2015

	New cases						Relapsed cases					
	2014			2015			2014			2015		
Age (Years)	S'pore-born	Foreign born	Unk#	S'pore-born	Foreign born	Unk#	S'pore-born	Foreign born	Unk#	S'pore-born	Foreign born	Unk#
0 – 9	8	2	0	3	0	0	0	0	0	0	0	0
10 – 19	31	0	0	37	4	0	1	0	0	0	0	0
20 – 29	80	30	0	74	15	0	3	0	0	2	1	0
30 – 39	78	55	0	80	55	0	5	7	0	5	0	0
40 – 49	165	35	0	164	47	1	11	2	0	9	4	0
50 – 59	295	27	0	317	35	0	26	1	0	36	3	0
60 – 69	265	44	0	277	29	0	32	4	0	24	1	0
70 +	275	63	1	285	75	0	38	7	0	54	5	0
Total	**1,197**	**256**	**1**	**1,237**	**260**	**1**	**116**	**21**	**0**	**130**	**14**	**0**

Unknown country of birth

Tuberculosis – HIV infection in residents

People living with HIV (PLWHIV) 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. PLWHIV are about 26 to 31 times more likely to develop TB disease than those who are HIV-negative worldwide. In 2014, 12% of the 9.6 million people who developed TB worldwide were HIV-positive.[5]

In 2015, 23 (1.5%) of the 1498 new TB cases notified among Singapore residents had prior diagnosis of HIV, which was lower than 2.8% in 2014. Of the 144 relapsed TB cases notified among Singapore residents in 2015, 4 (2.8%) had been previously diagnosed with HIV, compared with 5.1% in 2014. The highest TB-HIV co-infection rates were observed among males above 50 years of age (Table 6.22). Among the three major ethnic groups, the Chinese had the highest TB-HIV co-infection rates (Table 6.23).

Table 6.22
Age-gender distribution and TB-HIV co-infection rates among Singapore residents, 2015

	New cases						Relapsed cases					
				rate per million population*						rate per million population*		
Age	M	F	Total (%)	M	F	Total	M	F	Total (%)	M	F	Total
0 – 9	0	0	0 (0)	0.0	0.0	0.0	0	0	0 (0)	0.0	0.0	0.0
10 – 19	0	0	0 (0)	0.0	0.0	0.0	0	0	0 (0)	0.0	0.0	0.0
20 – 29	3	0	3 (13)	11.3	0.0	5.6	0	0	0 (0)	0.0	0.0	0.0
30 – 39	1	0	1 (4)	3.6	0.0	1.7	1	0	1 (25)	3.6	0.0	1.7
40 – 49	5	1	6 (26)	16.4	3.2	9.7	1	0	1 (25)	3.3	0.0	1.6
50 – 59	8	0	8 (35)	26.1	0.0	13.1	1	0	1 (25)	3.3	0.0	1.6
60 – 69	4	0	4 (17)	19.2	0.0	9.5	1	0	1 (25)	4.8	0.0	2.4
70 +	1	0	1 (5)	8.4	0.0	3.6	0	0	0 (0)	0.0	0.0	0.0
Total	22	1	**23 (100)**	11.5	0.5	5.9	**4**	**0**	**4 (100)**	2.1	0.0	1.0

*Rates are based on 2015 mid-year Singapore resident population
(Source: Singapore Department of Statistics)

[5] WHO: Global tuberculosis report 2015

Table 6.23
Ethnic-gender distribution and ethnic specific TB-HIV co-infection rates among Singapore residents, 2015

	New cases						Relapsed cases					
				rate per million population*						rate per million population*		
Ethnic group	M	F	Total (%)	M	F	Total	M	F	Total (%)	M	F	Total
Chinese	21	0	21(91)	14.8	0.0	7.2	4	0	4 (100)	2.8	0.0	1.4
Malay	1	1	2(9)	3.9	3.8	3.8	0	0	0 (0)	0.0	0.0	0.0
Indian	0	0	0(0)	0.0	0.0	0.0	0	0	0 (0)	0.0	0.0	0.0
Others	0	0	0(0)	0.0	0.0	0.0	0	0	0 (0)	0.0	0.0	0.0
Total	22	1	**23 (100)**	1.1	0.1	0.6	**4**	**0**	**4 (100)**	2.1	0.0	1.0

*Rates are based on 2015 mid-year Singapore resident population
(Source: Singapore Department of Statistics)

Tuberculosis in Non-residents

In 2015, there were 1,206 new TB cases notified among non-residents (long- and short-term pass holders) in Singapore. The number of new TB cases notified among long- and short-term pass holders has decreased from 2012 to 2015. As in previous years, the number of new TB cases notified among short-term pass holders outnumbered long-term pass holders. However, work permit holders formed the largest group (353 cases) in 2015 (Table 6.24). As a proportion, long- and short-term pass holders contributed 18.6% (Table 6.25) and 26.0% of all total notified new cases among residents & non-residents respectively (Table 6.26).

Table 6.24
Distribution of non-residents with new tuberculosis by pass category/status, 2011 – 2015

Pass category / status	No. of new TB cases notified				
	2011	2012	2013	2014	2015
Work Permit Holders	442	458	434	409	353
Employment Pass Holder	47	53	52	27	36
Other Pass Holders *	104	132	122	128	113
Sub-total	**593**	**643**	**608**	**564**	**502**
Short Stay Foreigners					
Work Permit Applicants	462	528	389	391	351
Visitors **	237	238	216	215	204
Others ***	207	151	168	117	149
Sub-total	**906**	**917**	**773**	**723**	**704**
Total	**1,499**	**1,560**	**1,381**	**1,287**	**1,206**

* 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, illegal immigrant and other pass applicants

Table 6.25
Distribution of new TB cases by site of disease
Long-term pass holders, 2001 – 2015

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
2014	485	17.7	79	2.9	564	20.6
2015	420	15.5	82	3.0	502	18.6

Table 6.26
Distribution of new TB cases by site of disease
Short-term pass holders, 2001 – 2015

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
2014	641	23.4	82	3.0	723	26.3
2015	620	22.9	84	3.1	704	26.0

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 730 new pulmonary TB cases in whom drug-susceptibility testing was performed was 6.8%, with 5.9% (43 cases) resistant to one drug and 0.9% (7 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 5 cases (0.7%), while resistance to isoniazid but not rifampicin was detected in 24 cases (3.3%).

The overall incidence of drug resistance among 68 relapsed pulmonary TB cases with drug susceptibility testing performed was 10.3%, with 8.8% (6 cases) were resistant to one drug and 1.5% (1 case) was resistant to more than one drug. There were no MDR-TB cases. Resistant to isoniazid but not rifampicin was 7.4% (5 cases). No Singapore-born resident with initially pan-sensitive or isoniazid mono-resistant TB developed MDR-TB during treatment in 2015. 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 2015.

Table 6.27
Mycobacterium tuberculosis drug susceptibility in Singapore-born residents with pulmonary tuberculosis, 2012 – 2015

Sensitivity result of sputum examination *	2012		2013		2014		2015	
	No.	%	No.	%	No.	%	No.	%
New cases								
**Sensitive to:								
Streptomycin, Isoniazid, Rifampicin	784	92.7	666	93.4	661	92.7	680	93.1
Resistant to:								
Single drug	52	6.1	38	5.3	38	5.3	43	5.9
More than 1 drug	10	1.2	9	1.3	14	2.0	7	1.0
Total examined	**846**	**100.0**	**713**	**100.0**	**713**	**100**	**730**	**100**
***Resistant to Isoniazid	**28**	**3.3**	**21**	**2.9**	**24**	**3.4**	**24**	**3.3**
Resistant to Rifampicin & Isoniazid	**6**	**0.7**	**2**	**0.3**	**# 6**	**0.8**	**5**	**0.7**
Relapsed cases								
Sensitive to:								
Streptomycin, Isoniazid, Rifampicin	70	92.1	57	93.4	54	88.5	61	89.7
Resistant to:								
Single drug	5	6.6	3	5.0	5	8.2	6	8.8
More than 1 drug	1	1.3	1	1.6	2	3.3	1	1.5
Total examined	**76**	**100.0**	**61**	**100.0**	**61**	**100.0**	**68**	**100.0**
Resistant to Isoniazid	**3**	**3.9**	**1**	**1.6**	**6**	**9.8**	**5**	**7.4**
Resistant to Rifampicin & Isoniazid	**0**	**0.0**	**¥ 1**	**1.6**	**0**	**0.0**	**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
¥ MDR case was notified as both pulmonary and extra-pulmonary TB, but MDR result was from an extra-pulmonary specimen only
One 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 2015, the overall incidence of drug resistance among 140 new pulmonary TB cases in whom drug-susceptibility testing was performed was 10.7%, with 8.6% (12 cases) resistant to one drug and 2.1% (3 cases) resistant to more than one drug (Table 6.28). There was no MDR-TB case and resistance to isoniazid but not rifampicin was 6.4% (9 cases). Resistance to one drug was 14.3% (1 case) detected among the 7 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, 2012 – 2015

Sensitivity result of sputum examination *	2012		2013		2014		2015	
	No.	%	No.	%	No.	%	No.	%
New cases								
**Sensitive to:								
Streptomycin, Isoniazid, Rifampicin	101	89.4	126	88.1	116	91.3	125	89.3
Resistant to:								
Single drug	7	6.2	12	8.4	8	6.3	12	8.6
More than 1 drug	5	4.4	5	3.5	3	2.4	3	2.1
Total examined	**113**	**100.0**	**143**	**100.0**	**127**	**100.0**	**140**	**100.0**
***Resistant to Isoniazid	**7**	**6.2**	**10**	**7.0**	**2**	**1.5**	**9**	**6.4**
Resistant to Rifampicin & Isoniazid	**2**	**1.8**	**0**	**0.0**	**1**	**0.8**	**0**	**0.0**
Relapsed cases								
Sensitive to:								
Streptomycin, Isoniazid, Rifampicin	9	90.0	6	100.0	8	88.9	6	85.7
Resistant to:								
Single drug	0	0.0	0	0.0	1	11.1	1	14.3
More than 1 drug	1	10.0	0	0.0	0	0.0	0	0.0
Total examined	**10**	**100.0**	**6**	**100.0**	**9**	**100.0**	**7**	**100.0**
Resistant to Isoniazid	**0**	**0.0**	**0**	**0.0**	**0**	**0.0**	**1**	**14.3**
Resistant to Rifampicin & Isoniazid	**1**	**10.0**	**0**	**0.0**	**0**	**0.0**	**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 2015, the overall incidence of drug resistance in new pulmonary TB cases among 332 non-residents with drug-susceptibility testing performed was 13.5%, with 9.6% (32 cases) being resistant to one drug and 3.9% (13 cases) resistant to more than one drug (Table 6.29). MDR-TB was detected in 6 cases (1.8%), and resistance to isoniazid but not rifampicin was detected in 27 cases (8.1%).

Among the 16 relapsed pulmonary TB cases with drug susceptibility testing performed, 6.2% (1 case) was resistant to one drug and 25.0% (4 cases) to more than one drug. MDR-TB was detected in 2 cases (12.5%), and resistance to isoniazid but not rifampicin was detected in 3 cases (18.8%).

Table 6.29
Mycobacterium tuberculosis drug susceptibility in non-residents with pulmonary tuberculosis, 2012 – 2015

Sensitivity result of sputum examination *	2012		2013		2014		2015	
	No.	%	No.	%	No.	%	No.	%
New cases								
**Sensitive to:								
Streptomycin, Isoniazid, Rifampicin	346	83.2	341	87.0	294	86.7	287	86.5
Resistant to:								
Single drug	35	8.4	32	8.2	23	6.8	32	9.6
More than 1 drug	35	8.4	19	4.8	22	6.5	13	3.9
Total examined	**416**	**100.0**	**392**	**100.0**	**339**	**100.0**	**332**	**100.0**
***Resistant to Isoniazid**	**35**	**8.4**	**27**	**6.9**	**24**	**7.1**	**27**	**8.1**
Resistant to Rifampicin & Isoniazid	**20**	**4.8**	**# 12**	**3.1**	**10**	**2.9**	**6**	**1.8**
Relapsed cases								
Sensitive to:								
Streptomycin, Isoniazid, Rifampicin	15	78.9	15	75.0	11	64.7	11	68.8
Resistant to:								
Single drug	1	5.3	1	5.0	4	23.5	1	6.2
More than 1 drug	3	15.8	4	20.0	2	11.8	4	25.0
Total examined	**19**	**100.0**	**20**	**100.0**	**17**	**100.0**	**16**	**100.0**
Resistant to Isoniazid	**1**	**5.3**	**1**	**5.0**	**3**	**17.6**	**3**	**18.8**
Resistant to Rifampicin & Isoniazid	**3**	**15.8**	**4**	**20.0**	**1¶**	**5.9**	**2**	**12.5**

* 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
¶ MDR-TB resistant to both fluoroquinolone and second-line injectable

Tuberculosis mortality

In 2015, there were 39 deaths from tuberculosis among Singapore residents giving a mortality rate of 1.0 cases per 100,000 population (Table 6.30). The majority were males (69.2%) and aged 70 years and above (59.0%).

Table 6.30
Age-gender distribution and age-specific mortality rates of tuberculosis, 2015

Age (Years)	Male	Female	Total (%)	Incidence rate per 100,000 population*
0 – 9	0	0	0 (0.0)	0.0
10 – 19	1	0	1 (2.6)	0.2
20 - 29	0	0	0 (0.0)	0.0
30 – 39	0	0	0 (0.0)	0.0
40 – 49	3	0	3 (7.7)	0.5
50 – 59	4	4	8 (20.5)	1.3
60 – 69	2	2	4 (10.2)	0.9
70 +	17	6	23 (59.0)	8.3
Total	**27**	**12**	**39 (100.0)**	**1.0**

* Rates are based on 2015 estimated mid-year population.
(Source: Singapore Department of Statistics, Registry of Births & Deaths)

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. It can present as hypopigmented patches with diminished sensation, multiple raised plaques, thickened nerves or neuritis. Diagnosis can be made through clinical features, a slit skin smear or skin biopsy for histological examination.

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 based on the WHO guidelines for therapy.

Table 6.31
Leprosy notifications among Singapore residents and non-residents, 2010 – 2015

Year	No. of cases		
	Resident (% Total Notifications)	Non-Resident (% Total Notifications)	Total
2010	4 (30.8%)	9 (69.2%)	13
2011	5 (31.3%)	11 (68.8%)	16
2012	5 (33.3%)	10 (66.7%)	15
2013	3 (25.0%)	9 (75.0%)	12
2014	1 (16.7%)	5 (83.3%)	6
2015	1 (33.33%)	2 (66.67%)	3

There are very few cases of Leprosy in Singapore. The distribution of leprosy notifications among Singapore residents and non-residents from 2010 to 2015 is shown in Table 6.31.

Leprosy in Singapore Residents

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 0.03 per 100,000 population in 2015 (Figure 6.7). In 2015, there was one female Singapore resident with leprosy notified (Table 6.32). There were no cases reported in those under 15 years of age.

Figure 6.7
Incidence rate of leprosy among Singapore residents, 1960 – 2015

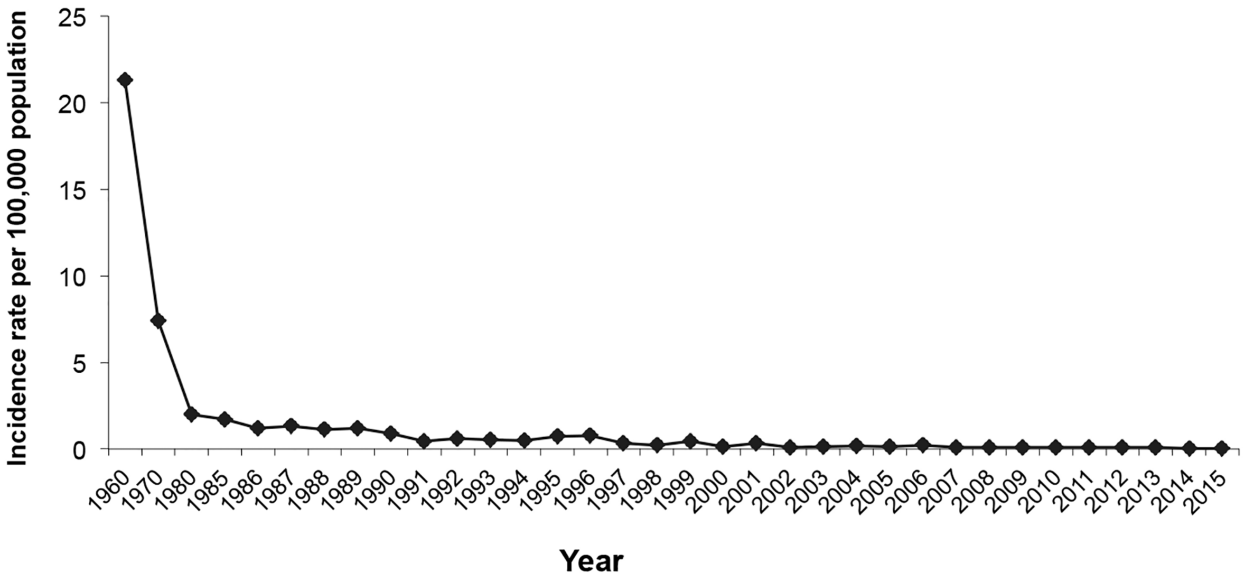


Table 6.32
Distribution of Singapore residents with leprosy by gender, 2010 – 2015

Year	No. of cases		
	Male	Female	Total
2010	3	1	4
2011	2	3	5
2012	4	1	5
2013	1	2	3
2014	1	0	1
2015	0	1	1

Table 6.33
Distribution of Singapore residents with leprosy by type of infection, 2010 – 2015

Year	No. of cases		
	Multibacilliary	Paucibacilliary	Total
2010	2	2	4
2011	3	2	5
2012	5	0	5
2013	2	1	3
2014	1	0	1
2015	1	0	1

Leprosy patients were classified into multibacilliary and paucibacilliary types. One Singapore resident in 2015 had multibacilliary leprosy (Table 6.33).

Leprosy in non-residents

The contribution of non-residents to the total number of cases has fluctuated over the years. In 2015, there were two non-residents (one male and one female) notified with leprosy, accounting for two thirds of the total cases (Table 6.34).

Table 6.34
Distribution of non-residents with leprosy by gender, 1980 – 2015

Year	No. of cases		
	Male	Female	Total
2010	5	4	9
2011	7	4	11
2012	7	3	10
2013	6	3	9
2014	2	3	5
2015	1	1	2

In 2015, there were two cases of paucibacilliary leprosy amongst non-residents (Table 6.35).

Table 6.35
Distribution of non-residents with leprosy by type of infection, 2010 – 2015

Year	No. of cases			
	Multibacilliary	Paucibacilliary	Unknown	Total
2010	4	5	0	9
2011	9	2	0	11
2012	6	4	0	10
2013	6	2	1	9
2014	2	2	1	5
2015	0	2	0	2

Chapter VII

Childhood Immunisation

VII
CHILDHOOD IMMUNISATION

NATIONAL CHILDHOOD IMMUNISATION PROGRAMME IN 2015

The National Childhood Immunisation Programme (NCIP) in Singapore covers vaccination against tuberculosis (BCG); hepatitis B (HepB); diphtheria, pertussis and tetanus (DTaP); poliomyelitis (IPV/OPV); *Haemophilus influenzae* type b (Hib); measles, mumps and rubella (MMR); pneumococcal disease (PCV); and human papillomavirus (HPV) (Table 7.1). Only vaccinations against diphtheria and measles are compulsory by law.

BCG immunisation began in mid-1950s as part of the NCIP. All newborns were vaccinated at birth. Although parental consent is required, acceptance has been high and close to 100% of children has been vaccinated in the last decade (Table 7.2). The BCG immunisation programme has contributed significantly to the eradication of tuberculous meningitis in young children. BCG was discontinued for Mantoux non-reactors and BCG booster dose was also discontinued in July 2001.

Hepatitis B immunisation for infants born to hepatitis B carrier mothers was incorporated into the NCIP in October 1985. This was extended to all newborns in September 1987. To protect those born before 1987, a four-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 starting from January 2001. In addition, full-time national servicemen (NSFs) who have not been vaccinated are offered hepatitis B immunisation. The NSFs are also offered MMR and Tdap if they were not vaccinated previously.

Since January 1990, the monovalent measles vaccine given to one-year-old children was replaced by the trivalent MMR vaccine. As of January 1998, the monovalent rubella vaccine given to primary school leavers was also replaced by the second dose of MMR vaccine. The MMR immunisation was last reviewed by the Expert Committee on Immunisation in 2011 and a revised schedule was implemented in December of the same year. With the change in the immunisation schedule, both doses of MMR vaccine were brought forward to 12 months and 15-18 months respectively. School Health Services continues to provide MMR vaccine to primary one (6-7 years old) students who did not receive the second dose in their pre-school years.

Pneumococcal conjugate vaccine (PCV) was included as the 10th vaccine in the NCIP in November 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 given at ages 3 and 5 months and a single booster dose at 12 – 24 months of age (change to 12 months in December 2011).

The polio immunisation schedule prior to June 2013 comprised of six doses of oral polio vaccine (OPV). Inactivated polio vaccine (IPV) had been available on request and at full cost. In order to reduce the risk of vaccine-associated paralytic poliomyelitis (VAPP) due the use of OPV, the all-OPV schedule was replaced with a sequential IPV-OPV schedule. The ECI recommended a four-dose IPV schedule with three primary doses to be given at 3, 4, and 5 months of age and the first booster dose at 18 months of age. A fifth dose using OPV was recommended at 10-11 years of age (Primary 5). The OPV dose at 6-7 years of age (Primary 1) was discontinued at the end of 2013.

Haemophilus influenzae type b (Hib) immunisation was introduced into the NCIP to reduce the risk of serious complications such as meningitis and pneumonia which may lead to long-term disabilities and deaths. The ECI recommended a four-dose schedule, in line with the schedule for DTaP and IPV at 3, 4, and 5 months of age and a single booster dose at 18 months of age.

The ECI also recommended the use of combination vaccines containing IPV and Hib for the routine schedule. The recommendations for IPV and Hib became effective in June 2013 and the new schedule became a standard of care by January 2014. Between June and December 2013, clinics were allowed to use the existing stocks of DTaP and OPV before the replacement with IPV and Hib-containing combination vaccines.

IMPLEMENTATION OF THE IMMUNISATION PROGRAMME

The NCIP is carried out by:

(a) National Healthcare Group (NHG) polyclinics and SingHealth (SH) polyclinics
(b) Youth Preventive Services Division (YPSD), 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 YPSD. The target population is based on student population data from the Ministry of Education.

Table 7.1
Singapore National Childhood Immunisation Schedule, 2015

Vaccination against	Birth	1 Month	3 months	4 months	5 months	6 months	12 months	15 months	18 months	10-11 years^
Tuberculosis	**BCG**									
Hepatitis B	**HepB (D1)**	**HepB (D2)**		**HepB (D3)#**						
Diphtheria, Tetanus, Pertussis			**DTaP (D1)**	**DTaP (D2)**	**DTaP (D3)**				**DTaP (B1)**	**Tdap (B2)**
Poliovirus			**IPV (D1)**	**IPV (D2)**	**IPV (D3)**				**IPV (B1)**	**OPV (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 <u>females 9 to 26 years</u>; three doses are required at intervals of 0, 1-2, 6 months***									

Notes:

BCG Bacillus Calmette-Guérin vaccine
HepB Hepatitis B vaccine
DTaP Paediatric diphtheria and tetanus toxoid and acellular pertussis vaccine
Tdap Tetanus toxoid, reduced diphtheria toxoid and acellular pertussis vaccine
IPV Inactivated polio vaccine
OPV Oral polio vaccine
MMR Measles, mumps, and rubella vaccine
Hib *Haemophilus influenzae* type b 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 immunisation of infants in Singapore in public and private sectors, 2006 – 2015

Year	Public Hospitals (%)	Polyclinics (%)	Private Clinics & Hospitals (%)	Total (%)	Coverage[1] for children at 2 years of age
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
2014	12,908 (39.6)	44 (0.1)	19,683 (60.3)	32,625 (100)	98.6
2015	12,460 (40.6)	54 (0.2)	18,191 (59.2)	30,705 (100)	99.6

[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 YPSD (immunisations administered in schools and at the Immunisation Clinic, Student Health Centre, the Health Promotion Board).

Immunisation against diphtheria, pertussis and tetanus

Infants and pre-school children

The primary immunisation course was completed in 30,147 children in 2015 giving an estimated coverage of 97.8% (Table 7.3). The first booster dose was given to 27,666 children under two years of age (89.7%).

Table 7.3
Diphtheria, pertussis and tetanus immunisation, 2006 – 2015

	Coverage[1] for children at 2 years of age			
	Completed primary course		1st booster dose given	
Year	No.	Coverage (%)	No.	Coverage (%)
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
2014	31,878	96.3	29,856	90.2
2015	30,147	97.8	27,666	89.7

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

School children

In 2015, the second booster dose (using Tdap) was given to 36,748 (92.2%) primary 5 students (Table 7.4)

Table 7.4
Diphtheria, tetanus and pertussis 2nd booster given to primary 5 students (10 – 11 years of age), 2008 – 2015 (Tdap)

		2nd booster dose given[#]	
Year	Total no. of primary 5 students	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
2014	40,065	36,392	90.8
2015	39,865	36,748	92.2

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

Immunisation against *Haemophilus influenzae* type b

In 2015, the primary course of *Haemophilus influenzae* type b (Hib) immunisation was completed in 29,573 children (95.9%). The overall coverage for children who have completed the full course of Hib immunisation (primary and booster doses) at two years of age was 77.9% (Table 7.5).

Table 7.5
***Haemophilus influenzae* type b immunisation, 2009 – 2015**

	Coverage[1] for children at 2 years of age			
	Completed primary course		Booster dose given	
Year	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
2014	28,221	85.3	27,675	83.6
2015	29,573	95.9	24,028	77.9

[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 29,720 children, giving coverage of 96.4% (Table 7.6). The first booster dose was given to 27,587 children under two years of age (89.5%).

School children

In 2015, 38,663 (97.0%) primary 5 students received the second booster dose (Table 7.7).

Table 7.6
Poliomyelitis immunisation of infants, pre-school and school children, 2006 – 2015

	Coverage[1] for children at 2 years of age				School Children		
	Completed primary course		1st booster dose given		2nd booster dose given #^		
Year	No.	Coverage (%)	No.	Coverage (%)	School entrants	No.#	Coverage (%)
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
2014	31,878	96.3	29,768	90.0	-	-	-
2015	29,720	96.4	27,587	89.5	-	-	-

[1] Data refers to immunisation given to all Singaporean and Singapore PR children
Coverage by YPSD does not include booster immunisations done by private practitioners.
^ The OPV dose for school entrants was discontinued at the end of 2013.

Table 7.7
Poliomyelitis booster dose given to primary 5 students (10 – 11 years of age), 2008 - 2015

		Booster given#	
Year	Total no. of primary 5 students	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
2014	40,065	38,819	96.9
2015	39,865	38,663	97.0

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

Immunisation against measles, mumps and rubella

Infants and pre-school children

In 2015, a total of 29,334 children were immunised against the first dose of measles, mumps and rubella by two years of age, giving coverage of 95.1% (Table 7.8). The second dose was given to 27,243 children by two years of age (89.5%).

Table 7.8
Measles, mumps and rubella immunisation, 2006 – 2015

	Coverage[1] for children at 2 years of age				Primary school children[2]	
	Dose 1		Dose 2[3]		Dose 2[3]	
Year	No.	Coverage (%)	No.	Coverage (%)	No.	Coverage (%)
2006	31,638	94.5	-	-	48,076	95.0
2007	31,217	95.0	-	-	47,351	96.0
2008	30,352	94.9	-	-	40,342	93.0
2009	34,057	95.2	-	-	39,852	92.4
2010	32,165	95.1	-	-	36,979	93.7
2011	29,992	95.2	-	-	36,548	91.6
2012	28,320	95.1	-	-	36,341	91.6
2013	29,195	95.0	26,482	86.2	-	-
2014	31,473	95.1	29,259	88.4	-	-
2015	29,334	95.1	27,243	89.5	-	-

[1] Data refers to immunisation given to all Singaporean and Singapore PR children
[2] Coverage among all students in respective cohort (11-12 years (Primary 6) up to 2007, 6-7 years (Primary 1) from 2008 to 2011) in primary schools under Ministry of Education.
[3] Dose 2 administered at 11-12 years (Primary 6) up to 2007, 6-7 years (Primary 1) from 2008 to 2011, and 15-18 months from December 2011.

Immunisation against hepatitis B

A total of 19,892 blood samples were screened at the KK Women's and Children's Hospital for HBsAg and HBeAg in 2015. Of these, 310 (1.6%) were HBsAg positive and 84 (0.4%) were HBeAg positive.

In 2015, the primary course of hepatitis B immunisation was completed in 29,677 infants. The overall coverage for infants who completed the full course of immunisation under two years of age remained high at 96.3% (Table 7.9).

Table 7.9
Hepatitis B immunisation, 2006 – 2015

	Full course of Hepatitis B vaccination completed by age 2 years	
Year	**No.**	**Coverage (%)**
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
2014	31,824	96.2
2015	29,677	96.3

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

Immunisation against pneumococcal disease

In 2015, a total of 25,349 children received at least two doses of PCV by age one year, giving an estimated coverage of 82.2% (Table 7.10).

Table 7.10
Pneumococcal vaccination, 2009 – 2015

	No. completed two doses by age 1 year		No. completed booster (3rd) dose by age 2 year	
Year	**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
2014	25,955	78.2	22,824	68.8
2015	25,349	82.2	23,202	75.3

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

EFFECTIVENESS OF THE IMMUNISATION PROGRAMME

The effectiveness of childhood immunisation programme against poliomyelitis and diphtheria is shown in Figures 7.1 and 7.2. In 2015, 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 from 1,413 cases in 1997 to 42 in 2015 (Figure 7.3).

Rubella incidence decreased from 48 cases in 2013 to 15 in 2015. There were no reported cases of indigenous congenital rubella and one termination of pregnancy was carried out in 2015 due to rubella infection (Table 7.11).

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 remained largely unchanged in recent years; there were 495 cases in 2013, 478 cases in 2014, and 473 cases in 2015 (Table 7.12).

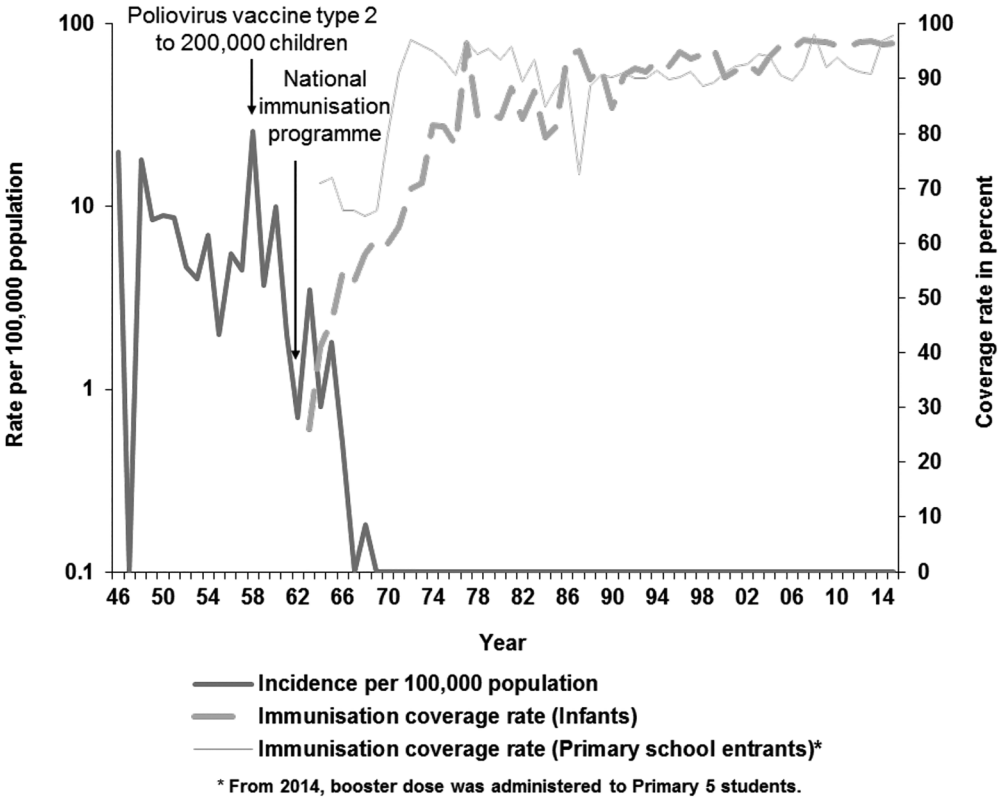
The incidence of indigenous acute hepatitis B for all age groups has declined from 243 cases (9.5 per 100,000 population) in 1985 to 52 cases (0.9 per 100,000 population) in 2015 (Figure 7.4). During the same period, the reported number of cases in children <15 years decreased from 10 to 0 (Table 7.12).

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

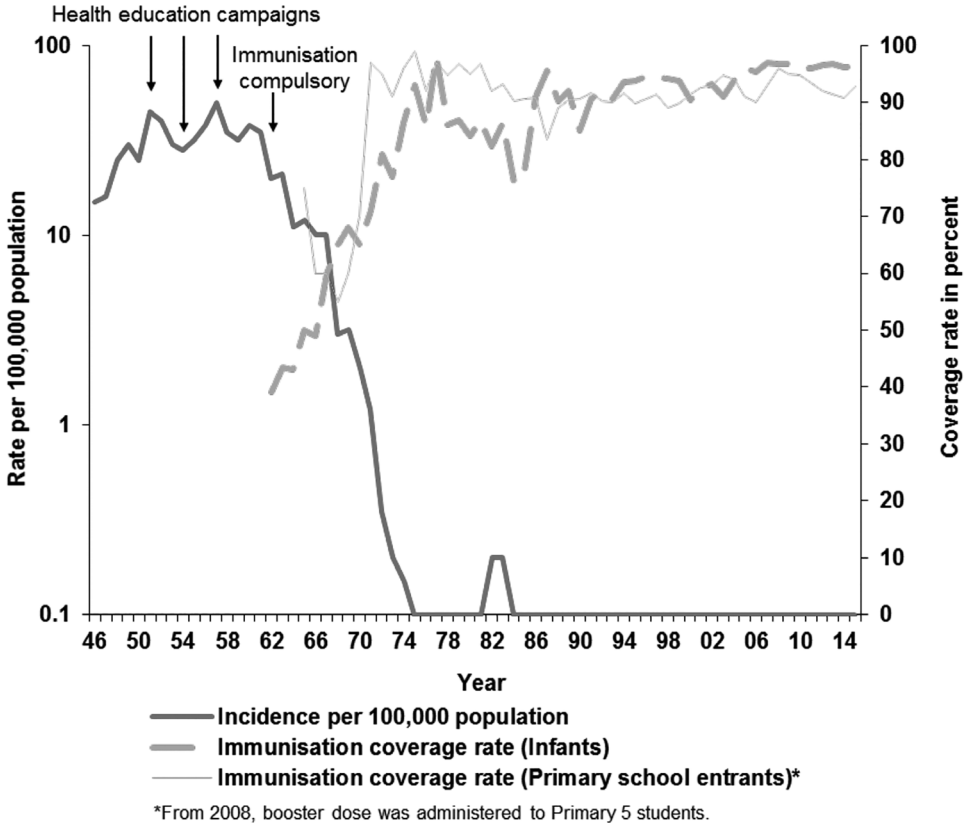
The Health Promotion Board educates parents on the importance of childhood immunisations through educational materials such as "Childhood Immunisations: Give your child the best protection" and "Protect your child against Measles, Mumps and Rubella with the MMR vaccination". These are distributed in 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, 1946-2015



* From 2014, booster dose was administered to Primary 5 students.

Figure 7.2
Incidence per 100,000 population from diphtheria and immunisation coverage rates in Singapore,1946-2015



*From 2008, booster dose was administered to Primary 5 students.

Figure 7.3
Impact of the "catch-up" MMR vaccination programme and introduction of second dose of MMR vaccine on the incidence of reported measles cases in Singapore, 1997-2015

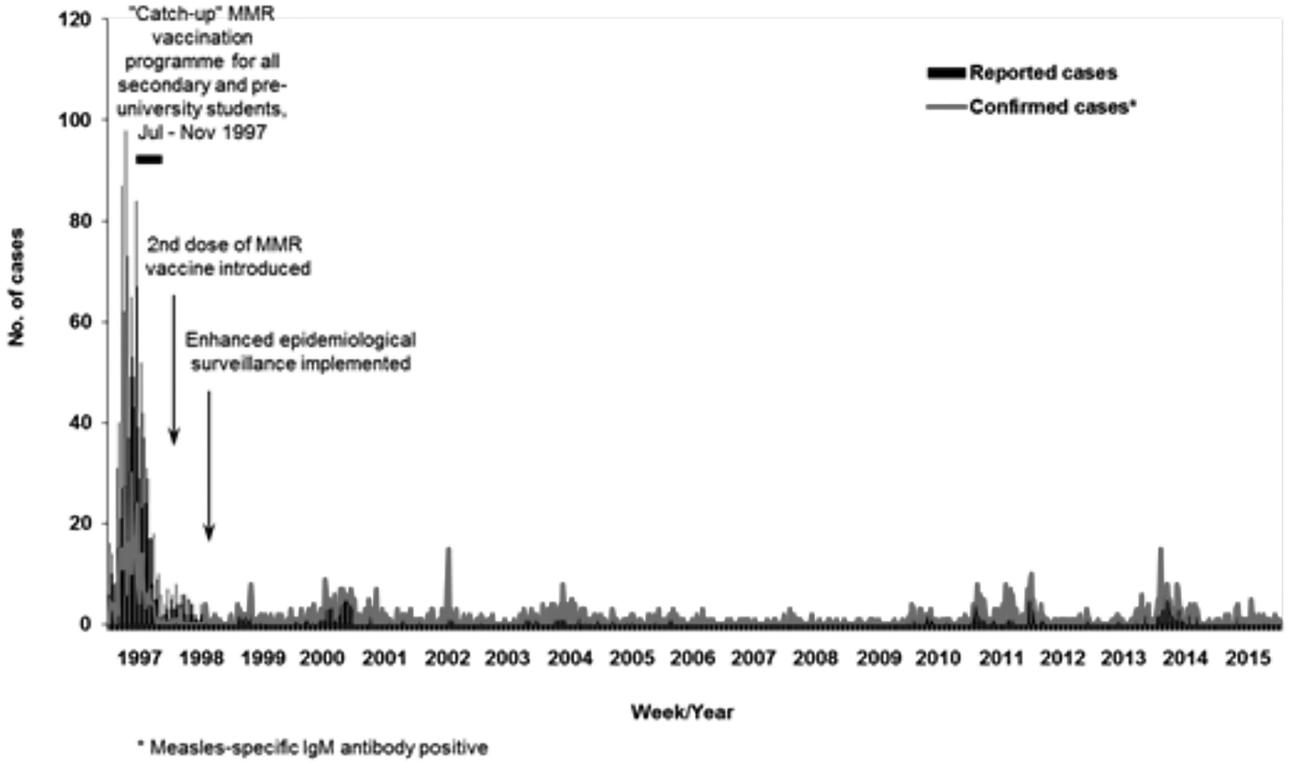
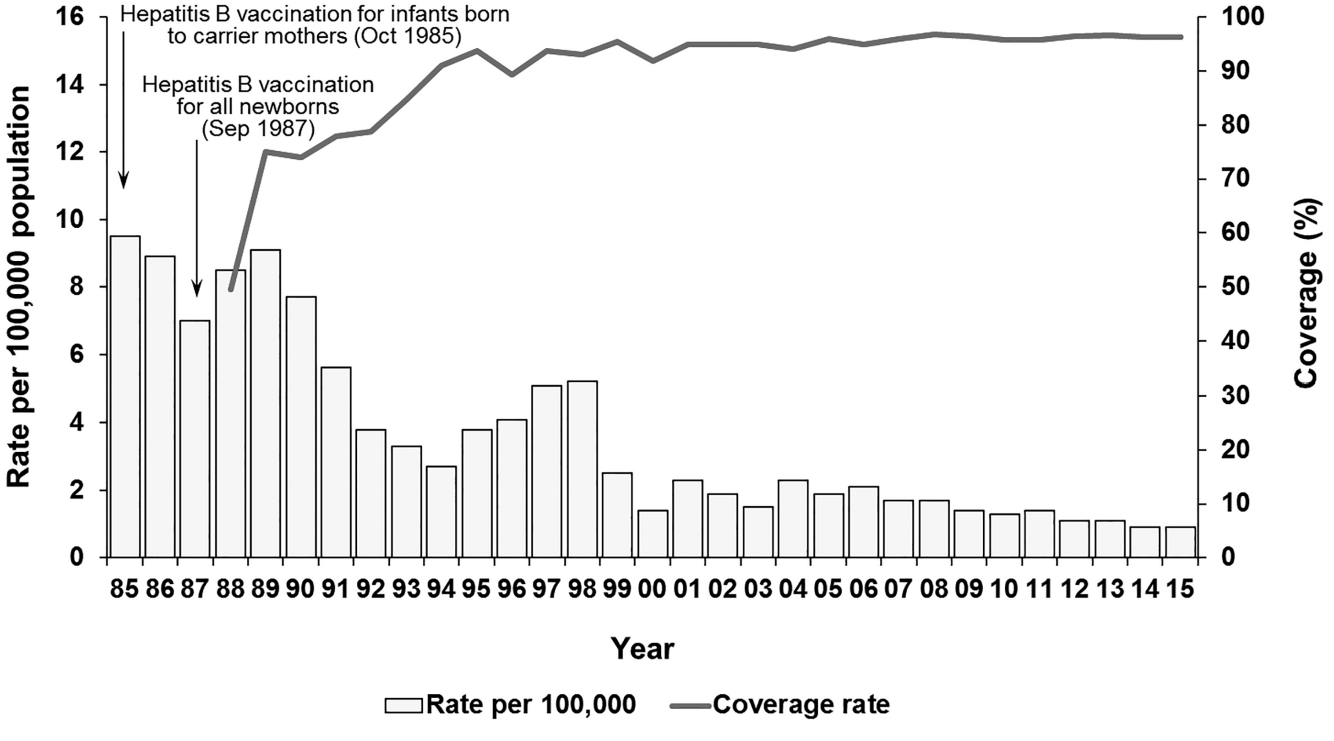


Figure 7.4
Incidence per 100,000 population from acute hepatitis B+ and immunisation coverage rates, Singapore, 1985-2015



+ Indigenous cases

Table 7.11
No. of therapeutic abortions performed for rubella infection, 2006 – 2015

Year	Total no. of abortions	No. of therapeutic abortions performed for rubella infections	
		No.	Coverage (%)
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
2014	8,515	0	0.00
2015	7,942	1	0.00

Table 7.12
Reported incidence of diphtheria, poliomyelitis, measles, acute hepatitis B, neonatal tetanus, pertussis, congenital rubella, and childhood tuberculosis meningitis in Singapore, 1985 – 2015

Year	Diphtheria	Poliomyelitis	Measles	Mumps*	Rubella*	Acute hepatitis B†	Neonatal tetanus‡	Pertussis§	Congenital rubella¶	Childhood tuberculous meningitis#
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*
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
2014	0	0	148††	478‡‡	17‡‡	0	0	21††	0	0
2015	0	0	42††	473‡‡	15‡‡	0	0	57††	0	0

( ) Imported cases.
* Notifiable with effect from April 1990.
† Indigenous cases below 15 years of age.
‡ Source: Central Claims Processing System, Ministry of Health.
§ All pertussis cases reported prior to 1986 were based on clinically diagnosed cases seen at the Communicable Disease Centre.
¶ Cases diagnosed in KK Women's and Children's Hospital, Singapore General Hospital and National University Hospital.
# Below 10 years of age
** Based on clinically diagnosed cases
†† Based on laboratory confirmed cases.
‡‡ Based on laboratory confirmed and clinically diagnosed cases.
§§ Foreigner who came for treatment

Appendix

INFECTIOUS DISEASE NOTIFICATIONS IN SINGAPORE, 1990 - 2015

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	2014	2015
	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	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	22171	28216
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	142	42
Meningococcal infection	-	-	-	-	-	-	-	-	-	-	-	4	13	11	7	5	10	5	6	5	7	6	0	3	9	6
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	478	473
Rubella	-	51	370	423	299	326	487	360	179	432	312	242	152	88	141	139	90	83	180	178	158	110	64	48	17	15
Vector-Borne/Zoonotic Diseases																										
Chikungunya Fever	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	718	341	26	12	22	1059	182	42
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	18326	11294
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	62	47
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	435	420
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	2	3
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	73	50
Hepatitis E	-	-	-	11	10	1	20	17	24	20	17	3	24	17	24	36	31	35	54	90	112	97	104	55	68	59
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	58	49
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	19	27
Listerosis	-	-	-	-	-	-	-	-	-	-	-	1	1	2	4	5	9	6	5	ND	ND	ND	ND	ND	ND	ND
Salmonellosis	-	-	-	-	-	-	-	-	-	-	99	198	129	192	345	296	380	309	719	1144	1480	1374	1499	1735	1883	1988
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	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	48	52
Hepatitis C															3	26	35	17	13	5	6	3	2	2	5	46
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	37	17
Leptospirosis	-	-	-	-	-	-	-	-	-	-	-	-	34	29	9	32	29	26	57	ND	ND	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	34	42
Murine Typhus	-	-	-	-	-	-	-	-	-	19	122	128	31	16	27	27	11	21	13	ND	ND	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	456	455
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	10183	10318
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	2018	2000
Leprosy	36	22	41	24	27	33	23	23	19	22	18	14	11	11	14	13	12	12	10	8	13	16	15	12	6	3

* Refers to Singaporeans/PR cases

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

INFECTIOUS DISEASE NOTIFICATIONS IN SINGAPORE, 1990 - 2015 (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	2014	2015
	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	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	405.3	509.8
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	2.6	0.8
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	0.2	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	8.7	8.5
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	0.3	0.3
Vector-Borne/Zoonotic Diseases																										
Chikungunya Fever	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14.8	6.8	0.5	0.2	0.4	19.6	3.3	0.8
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	335.0	204.0
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	1.1	0.8
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	8.0	7.6
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	0.0	0.0	0.0	0.0	0.1
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	1.3	0.9
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	1.2	1.1
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	1.1	0.9
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	0.3	0.5
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	34.4	35.9
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	0.9	0.9
Hepatitis C															0.1	0.6	0.8	0.4	0.3	0.1	0.1	0.1	0.0	0.0	0.1	0.8
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	0.7	0.3
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	0.6	0.8
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	11.8	11.7
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	186.2	186.4
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	36.9	36.1
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	0.3	0.3	0.3	0.2	0.1	0.0

Remarks

Chikungunya Fever was made notificable since 2008

ND : Not notifiable since Jan 2009

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