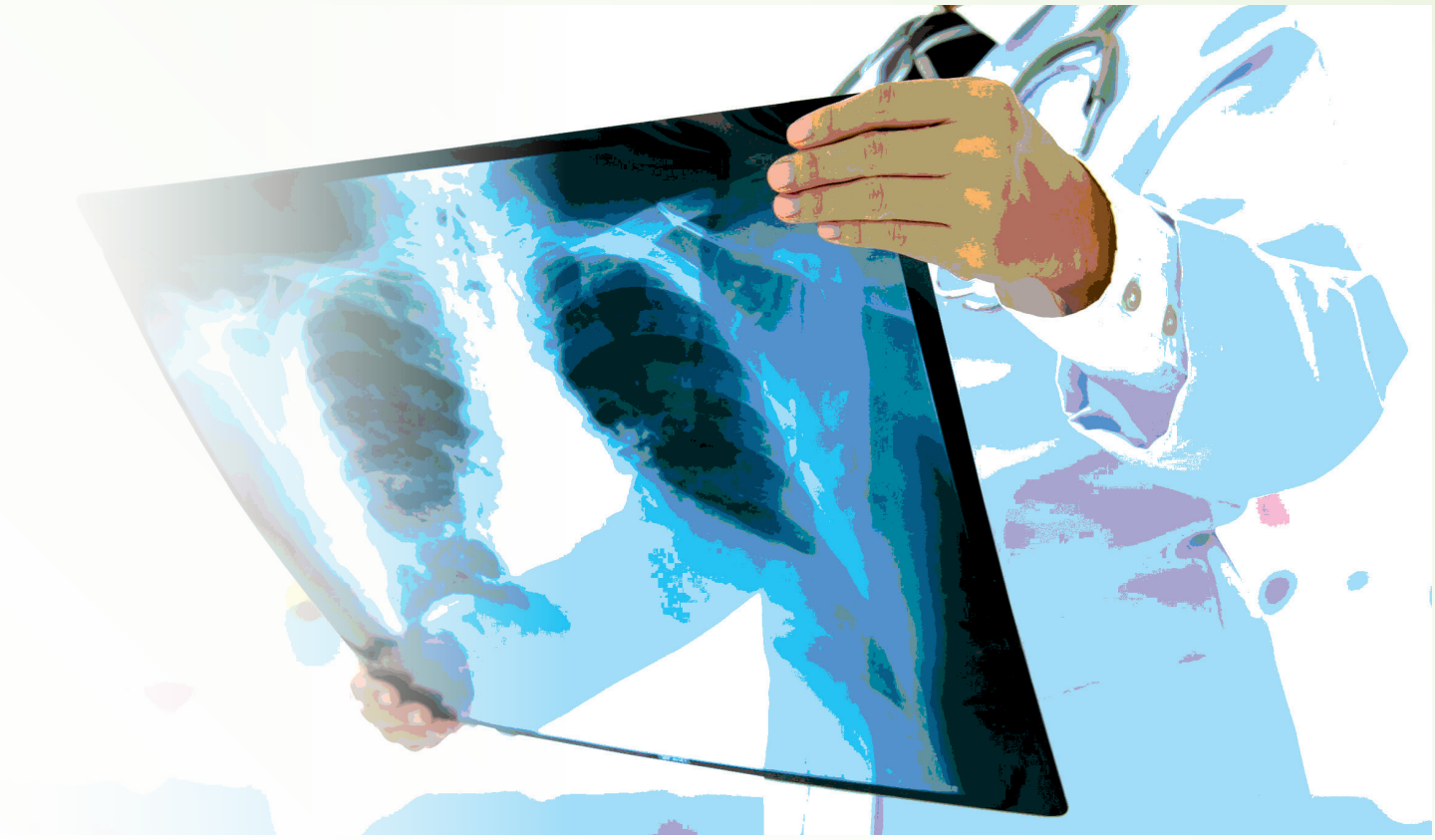
CHAPTER 6

OTHER DISEASES



Tuberculosis is one of the top ten causes of death worldwide, and most often affects the lungs while leprosy is another chronic bacterial disease. Both diseases are treatable. Besides people and animals, sources of infection are present in the environment, and promotion of better environmental management or infection control practices in healthcare settings can prevent the spread of diseases. Singapore also keeps a lookout for novel, emerging diseases through the Severe Illness and Death from Possibly Infectious Causes (SIDPIC) programme.

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, but only Legionniares' disease is associated with pneumonia. The chest X-ray for a patient with Legionnaires' disease may reveal patchy or focal areas of consolidation. The mode of transmission is airborne and includes aspiration of aerosolised water containing the bacteria.

A total of 19 cases of laboratory-confirmed legionellosis were reported in 2017, compared with 12 cases in 2016 (Figure 6.1). 16 of these 19 cases were local residents, while the remaining three included one tourist and two foreigners seeking medical treatment in Singapore. 17 cases had confirmed Legionnaires' disease, one case had confirmed Pontiac fever and one case had presumptive Legionnaires' disease (Table 6.1). Three of the 16 cases had acquired the infections overseas (Table 6.3).

Figure 6.1
Weekly distribution of reported legionellosis cases, 2016-2017

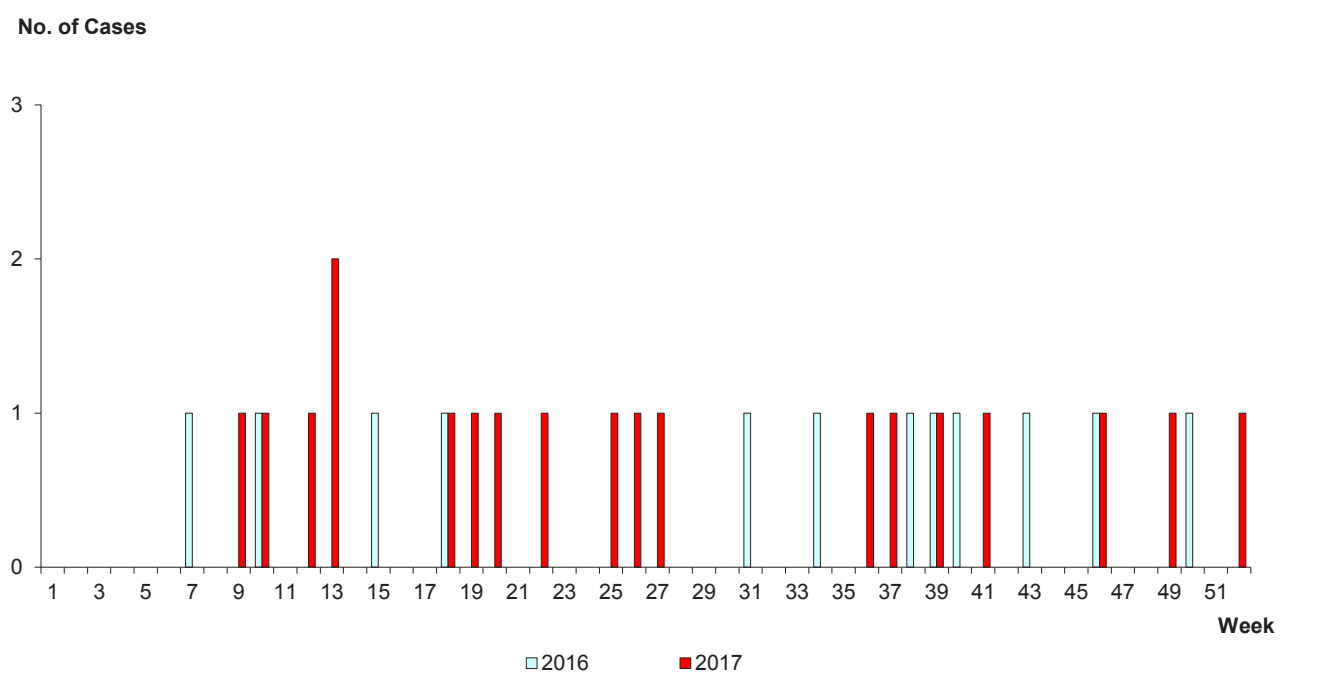


Table 6.1
Classification of reported legionellosis cases, 2017

	Pontiac fever	Legionnaires' disease	Total
Confirmed cases	1	17	18
Presumptive cases	0	1	1
Total	**1**	**18**	**19**

The resident incidence rate was highest among the 65+ years age group (Table 6.2).

Table 6.2
Age-gender distribution and age-specific resident incidence rate of reported legionellosis cases^, 2017

Age group	Male	Female	Total	%	Resident incidence rate per 100,000 population*
0-4	0	0	0	0	0
5-14	0	0	0	0	0
15-24	0	0	0	0	0
25-34	0	0	0	0	0
35-44	2	0	2	12.5	0.2
45-54	2	0	2	12.5	0.3
55-64	2	1	3	18.8	0.5
65+	7	2	9	26.2	1.6
Total	**13**	**3**	**16**	**100**	

^Excluded two foreigners seeking medical treatment in Singapore and one tourist.
*Rates are based on 2017 estimated mid-year population.
(Source: Singapore Department of Statistics)

Table 6.3
Total number of notifications* received for legionellosis cases, 2013-2017

Age group	2013		2014		2015		2016		2017	
	Local	Imported	Local	Imported	Local	Imported	Local	Imported	Local	Imported
0-4	0	0	0	0	0	0	0	0	0	0
5-9	0	0	0	0	0	0	0	0	0	0
10-14	0	0	0	0	0	0	0	0	0	0
15-24	0	0	0	0	0	0	0	0	0	0
25-34	1	0	1	0	0	0	0	0	0	0
35-44	1	0	2	1	0	0	1	0	2	0
45-54	3	0	1	1	2	0	1	0	2	0
55-64	6	2	4	0	3	0	2	1	2	1
65+	4	2	19	2	11	1	4	0	7	2
Total	**15**	**4**	**27**	**4**	**16**	**1**	**8**	**1**	**13**	**3**

*Excluded tourists and foreigners seeking medical treatment in Singapore.

Among the three major ethnic groups, Malays had the highest incidence rate of 0.6 per 100,000 population (Table 6.4). Various occupational groups were also affected (Table 6.5).

Table 6.4
Ethnic-gender distribution and ethnic-specific incidence rate of legionellosis cases^, 2017

	Male	Female	Total	%	Incidence rate per 100,000 population*
Singapore residents					
Chinese	10	2	12	75.0	0.4
Malay	2	1	3	18.7	0.6
Indian	0	0	0	0	0
Others	1	0	1	6.3	0.8
Foreigners	0	0	0	0	0
Total	**13**	**3**	**16**	**100**	**0.3**

^Excluded one tourist and two foreigners seeking medical treatment in Singapore.
*Rates are based on 2017 estimated mid-year population.
(Source: Singapore Department of Statistics)

Table 6.5
Occupations of reported legionellosis cases, 2017*

Occupation	No. of cases (n=16)
Drivers-Taxi/Bus/MRT & Deliveryman	1
Housewife	1
Labourers & Related Workers Not Classified	2
Lawyers & related workers	1
Managers	1
Retiree	3
Self-employed/Businessmen	1
Shop Sales & Related Workers	1
Unemployed	2
Information Technology Professionals	1
Technicians/Asst Engineers	1
Others	1

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

Key presenting symptoms of the 16 legionellosis cases included fever, cough and chills (Table 6.6).

Table 6.6
Clinical presentation of reported legionellosis cases^, 2017*

Clinical presentation	No. of cases (n=16)
Fever (with/without chills and rigors)	16
Respiratory symptoms	
Cough (productive and non-productive)	12
Shortness of breath	3
Other signs and symptoms	
Chills	4
Myalgia	2
Giddiness	2
Abdominal pain	2
Generalised weakness	3
Vomiting	2

* Cases might have one or more clinical presentations.
^ Excluded one tourist and two foreigners seeking medical treatment in Singapore.

Seven (43.8%) of the cases had known risk factors for legionellosis (Table 6.7). There was one legionellosis death reported.

Table 6.7
Number of cases with known risk factors for legionellosis^, 2017*

Risk Factors	No of Cases
Diabetes mellitus	2
Chronic lung disease (e.g. asthma, chronic obstructive pulmonary disease)	2
Immunosupression (e.g. corticosteroid therapy, organ transplantation)	3
Smoking	0

*Cases might have one or more concurrent medical conditions.
^Excluded one tourist and two foreigners seeking medical treatment in Singapore.

LEPROSY

Leprosy is a chronic bacterial disease of the skin, peripheral nerves and the upper airway (in lepromatous patients) caused 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 leading to social stigma towards infected individuals. 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 6.8
Leprosy notifications among Singapore residents and non-residents, 2010-2017

Year	No. of cases		
	Resident (%)	Non-resident (%)	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 (33.3)	2 (66.7)	3
2016	2 (28.6)	5 (71.4)	7
2017	0 (0)	6 (100)	6

Leprosy in Singapore residents

The incidence rate of leprosy among Singapore residents has declined over the past five decades. In 2017, there were no notifications for leprosy among Singapore residents (Table 6.9).

Table 6.9
Distribution of leprosy notifications among Singapore residents by gender, 2010-2017

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
2016	2	0	2
2017	0	0	0

Leprosy patients are classified into multibacillary and paucibacillary types. (Table 6.10).

Table 6.10
Distribution of leprosy notifications among Singapore residents by type of infection, 2010-2017

Year	No. of cases		
	Multibacillary	Paucibacillary	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
2016	1	1	2
2017	0	0	0

Leprosy in non-residents

The contribution of non-residents to the total number of cases has fluctuated over the years. In 2017, there were six non-residents (five males and one female) notified for leprosy (Table 6.11).

Table 6.11
Distribution of leprosy notifications among non-residents by gender, 2010-2017

Year	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
2016	4	1	5
2017	5	1	6

In 2017, there were four cases of multibacillary leprosy and one case of paucibacillary leprosy among non-residents (Table 6.12).

Table 6.12
Distribution of leprosy notifications among non-residents by type of infection, 2010-2017

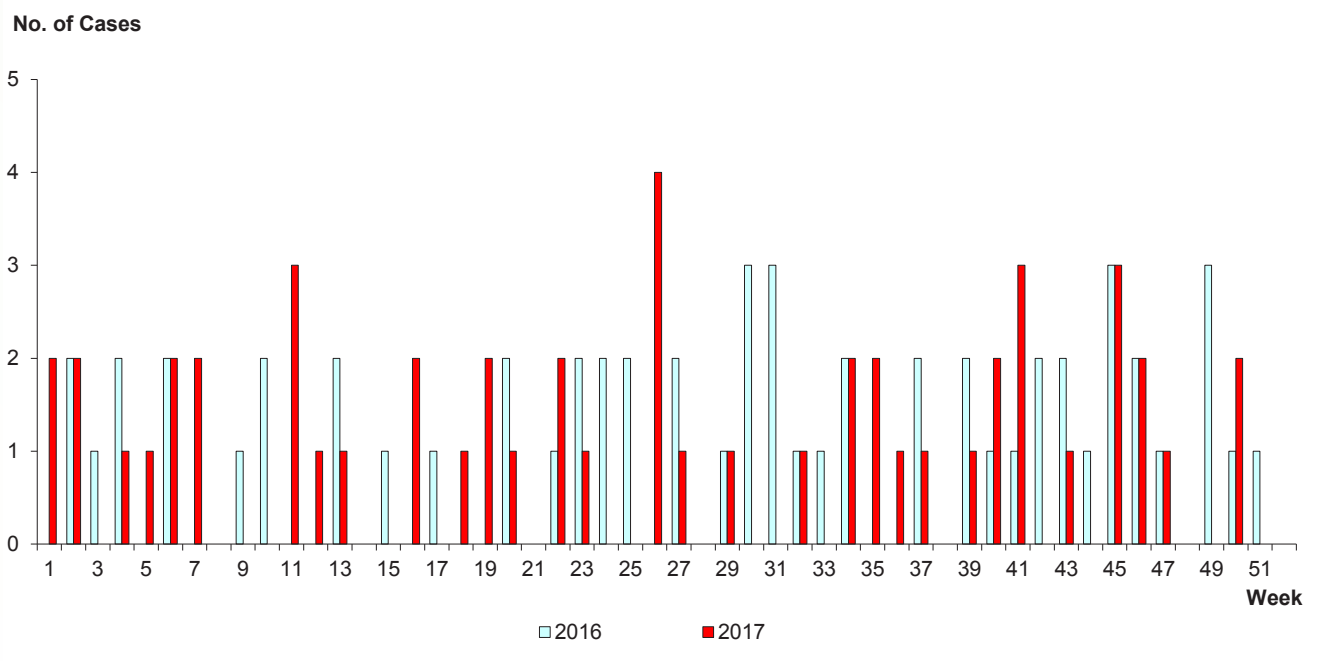
Year	Multibacillary	Paucibacillary	Unknown	Total
2010	4	5	0	9
2011	9	2	0	11
2012	6	4	0	10
2013	6	2	1	9
2014	2	2	1	5
2015	0	2	0	2
2016	2	3	0	5
2017	4	1	1	6

MELIOIDOSIS

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

There were 52 cases of laboratory confirmed melioidosis in 2017, compared with 58 cases in 2016 (Figure 6.2). 47 of these were classified as indigenous cases and five were imported cases. The latter involved one Singapore resident, and four foreigners seeking medical treatment in Singapore (Table 6.15).

Figure 6.2
Weekly distribution of reported melioidosis cases, 2016-2017



The resident incidence rate was highest among the 65+ years age group (Table 6.13).

Table 6.13
Age-gender distribution and age-specific resident incidence rate of melioidosis cases^, 2017

Age group	Male	Female	Total	%	Resident incidence rate per 100,000 population*
0-4	0	0	0	0	0
5-14	1	0	1	2.1	0.2
15-24	2	0	2	4.2	0.2
25-34	2	0	2	4.2	0.2
35-44	3	0	3	6.2	0.2
45-54	12	1	13	27.1	1.6
55-64	8	0	8	16.6	1.6
65+	18	1	19	39.6	3.3
Total	**46**	**2**	**48**	**100**	

^Excluded four foreigners seeking medical treatment in Singapore.
*Rates are based on 2017 estimated mid-year population.
(Source: Singapore Department of Statistics)

Among the three major ethnic groups, Malay had the highest incidence, followed by Indians and Chinese (Table 6.14).

Table 6.14
Ethnic distribution and ethnic-specific incidence rate of melioidosis cases^, 2017

	Male	Female	Total	%	Incidence rate per 100,000 population*
Singapore residents					
Chinese	23	2	25	52.1	0.8
Malay	8	0	8	16.7	1.5
Indian	5	0	5	10.4	1.4
Others	2	0	2	4.1	1.6
Foreigners	8	0	8	16.7	0.5
Total	**46**	**2**	**48**	**100**	**0.9**

^ Excluded four foreigners seeking medical treatment in Singapore.
*Rates are based on 2017 estimated mid-year population.
(Source: Singapore Department of Statistics)

Table 6.15
Total number of notifications* received for melioidosis cases, 2013-2017

Age group	2013		2014		2015		2016		2017	
	Local	Imported	Local	Imported	Local	Imported	Local	Imported	Local	Imported
0-4	0	0	0	0	0	0	0	0	0	0
5-9	1	0	0	0	0	0	0	0	0	0
10-14	1	2	2	0	1	0	1	0	1	0
15-24	1	0	2	0	3	0	2	0	2	0
25-34	1	1	2	0	1	0	1	0	2	0
35-44	4	0	8	1	3	1	7	0	3	0
45-54	7	0	8	0	9	2	9	0	13	0
55-64	8	2	2	0	11	1	18	2	7	1
65+	5	0	8	0	9	0	15	1	19	0
Total	**28**	**5**	**32**	**1**	**37**	**4**	**53**	**3**	**47**	**1**

*Excluded tourists and foreigners seeking medical treatment in Singapore.

Burkholderia pseudomallei were isolated from blood cultures in 24 cases (Table 6.16).

Table 6.16
Types of laboratory sample of melioidosis cases^, 2017

Types of laboratory sample	No. of cases	%
Blood	24	50
Bronchial alveolar lavage	4	8.3
Endotracheal tube aspirate	1	2.1
Pleural Fluid	1	2.1
Pus	4	8.3
Sputum	1	2.1
Swabs	5	10.4
Urine	2	4.2
Others	6	12.5
Total	**48**	**100**

^ Excluded four foreigners seeking medical treatment in Singapore.

The predominant signs and symptoms of melioidosis were fever, and cough (Table 6.17). 29.2% of the cases presented with localised or multiple abscesses. Those who presented with bacteraemia comprised 70.8% of the cases in 2017 (Table 6.18).

Table 6.17
Clinical presentation of reported melioidosis cases^, 2017*

Clinical presentation	No. of cases (n=48)
Fever (with/without chills and rigors)	35
Respiratory symptoms	
Cough (productive and non-productive)	17
Runny nose	0
Chest pain	4
Other signs and symptoms	
Abdominal pain/discomfort/epigastric pain	4
Vomiting	6
Diarrhoea	5
Abscesses (localised, systemic)	14

^ Excluded four foreigners seeking medical treatment in Singapore.
*Cases may have one or more clinical presentations.

Table 6.18
Cases of melioidosis presenting with bacteraemia and abscesses, 2013 – 2017

Year	Cases	Bacteraemia		Abscesses			
		No.	(%)	All Abscesses		Cutaneous	
				No.	(%)	No.	(%)
2013	34	14	41.2	20	58.8	6	17.6
2014	32	15	46.9	11	34.4	2	6.3
2015	41	22	53.7	19	46.3	9	22.0
2016	56	37	66.1	19	33.9	12	21.4
2017^	48	34	70.8	14	29.2	10	20.8

^ Excluded four foreigners seeking medical treatment in Singapore.

27 (56.3%) of the cases had known risk factors for melioidosis (Table 6.19). One melioidosis-related death was reported in 2017.

Table 6.19
Number of cases with known risk factors for melioidosis^, 2017*

Risk factors	No of cases
Diabetes mellitus	27
Chronic lung disease (e.g. asthma, chronic obstructive pulmonary disease)	4
Chronic renal disease (e.g. chronic renal failure, kidney disease)	7

*Cases may have one or more concurrent medical conditions.
^ Excluded four foreigners seeking medical treatment in Singapore.

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 is typically asymptomatic and 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 immunosuppressed persons and in children under five years of age.

The National TB Control Programme was established in the late 1950s with the setting up of the TB Control Unit and a National TB registry. The programme was enhanced with the launch of the Singapore TB 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 TB contacts, and preventing the emergence of multidrug-resistant TB (MDR-TB).

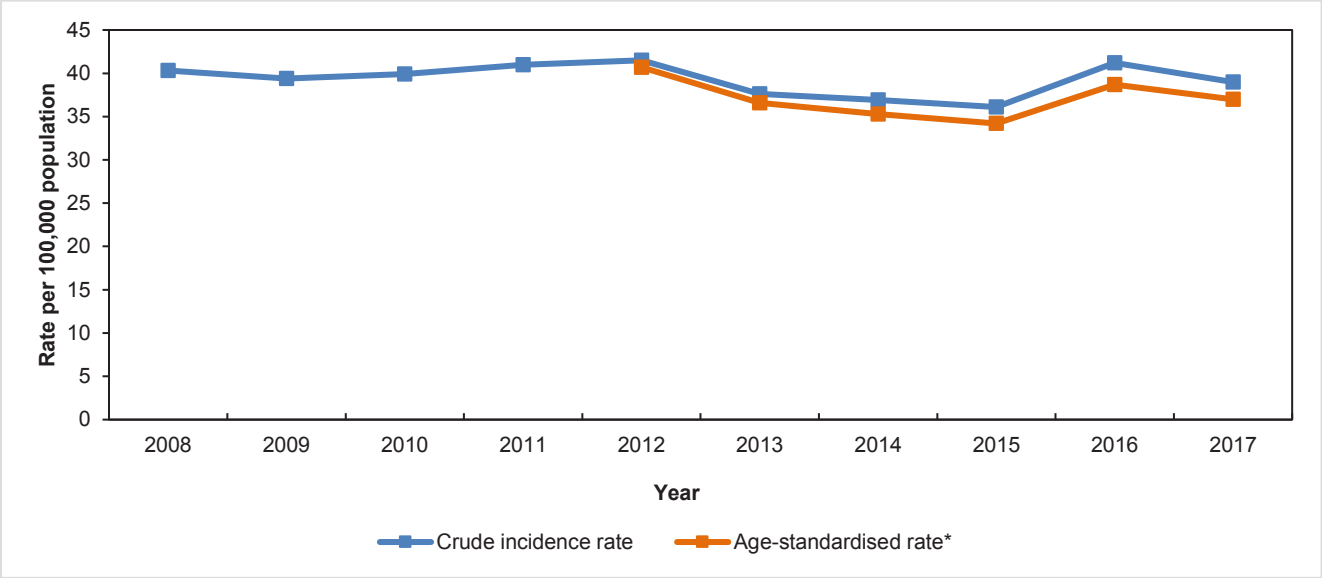
Incidence and site of disease in total population (Singapore residents, long-staying foreigners)

A total of 3,159 cases of TB were notified in 2017. This comprised 1,536 new and 124 relapsed cases among Singapore residents (citizens and PRs) and 1,451 new and 48 relapsed cases among non-residents (long-and short-staying foreigners)

A total of 2,191 new cases of TB were notified among Singapore residents and long-staying foreigners in 2017. The crude incidence rate of TB was 39 per 100,000 population in 2017 (Figure 6.3), while the age-standardised incidence rate of TB was 37.0 per 100,000 population in 2017.

The majority (85.4%) of cases had pulmonary TB with or without extra-pulmonary involvement, while the remainder (14.6%) had exclusively extra-pulmonary TB (Table 6.20).

Figure 6.3
TB incidence rate in Singapore residents and long-staying foreigners, 2008-2017



*Age-standardised rate using 2010 mid-year Singapore resident population.
(Source: Singapore Department of Statistics)

Table 6.20
New TB cases by site of disease in Singapore residents and long-staying foreigners, 2008-2017

Year	New cases			Incidence rate per 100,000 population		
	Pulmonary[1]	Extra-pulmonary	Total	Pulmonary[1]	Extra-pulmonary	Total
2008	1,611	340	1,951	33.3	7.0	40.3
2009	1,624	342	1,966	32.6	6.9	39.4
2010	1,727	301	2,028	34.0	5.9	39.9
2011	1,811	315	2,126	34.9	6.1	41.0
2012	1,897	306	2,203	35.7	5.8	41.5
2013	1,750	278	2,028	32.4	5.1	37.6
2014	1,705	313	2,018	31.2	5.7	36.9
2015	1,691	309	2,000	30.6	5.6	36.1
2016	1,930	380	2,310	34.4	6.8	41.2
2017	1,871	320	2,191	33.3	5.7	39.0

[1] Pulmonary TB referred to TB of the lung parenchyma and included cases that had both pulmonary and extra-pulmonary TB.

In 2017, among the 1,871 new pulmonary TB cases in Singapore residents and long-staying foreigners, 1,823 (97.4%) had bacteriological tests done. The proportion found to have demonstrable bacillary disease was 62.0% (Table 6.21)

Table 6.21
Bacillary status of new pulmonary TB cases in Singapore residents and long-staying foreigners, 2008-2017

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
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
2016	1,831	94.9	1,187	64.8	21.1
2017	1,823	97.4	1,131	62.0	20.2

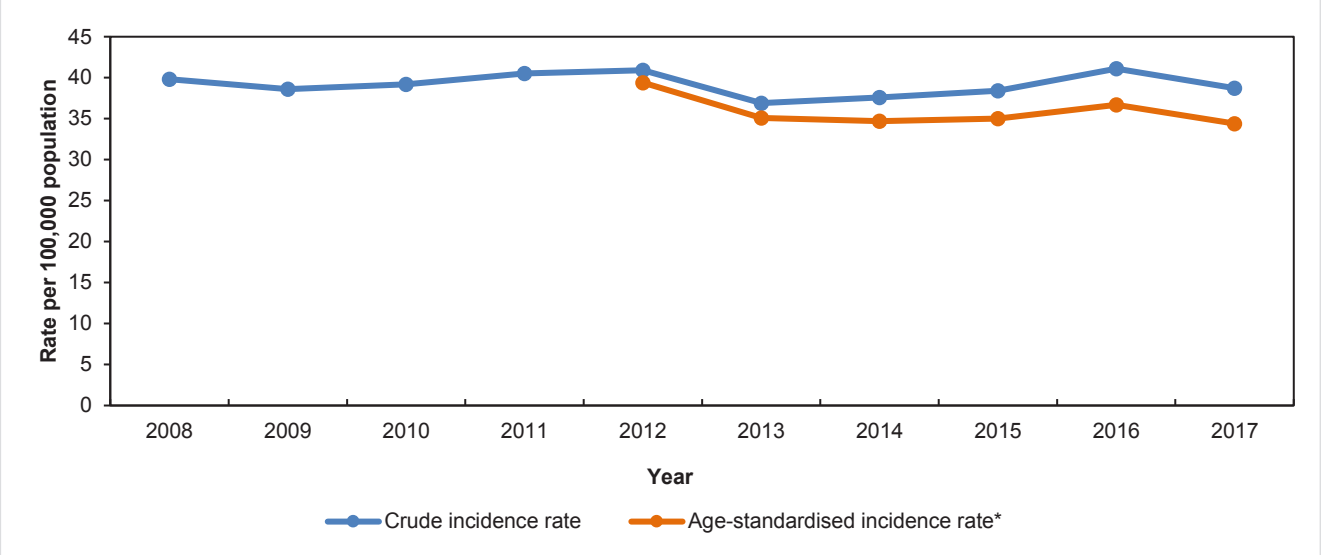
The table included only bacteriological investigations (smear and/or culture) done from three months before to two weeks after the date of notification or date of starting treatment, whichever earlier.

Incidence and site of disease in Singapore residents

From a historical perspective, the crude incidence rate of TB declined from 307 per 100,000 population in 1960 to 56.3 per 100,000 population in 1987. From 1987 to 1997, the crude incidence rate of new TB cases among Singapore residents stagnated around 50-55 per 100,000 population. Following enhanced TB control measures implemented by STEP, the crude incidence rate declined from 56.9 per 100,000 population in 1998 to a historical low of 35.1 per 100,000 population in 2007. However, in 2008, the crude incidence rate increased for the first time in ten years to 39.8 per 100,000 population. Between 2009 and 2015, the crude incidence rate stagnated at 38.6 to 40.9 per 100,000 population, before decreasing to 36.9 per 100,000 in 2013. Since then, the crude incidence rate has remained between 37 to 41 per 100,000 population. In 2017, the crude incidence rate of TB was 38.7 per 100,000 population. In contrast, the age-standardised incidence rate of TB was 34.4 per 100,000 population in 2017 (Figure 6.4).

Of the 1,536 new TB cases among Singapore residents notified in 2017, 1,302 (84.8%) of cases had pulmonary TB while 234 (15.2%) had exclusively extra-pulmonary TB. Of those with pulmonary TB, 181 (13.9%) had extra-pulmonary involvement while 1,121 (86.1%) did not have extra-pulmonary involvement (Table 6.22). Among cases with extra-pulmonary TB disease (415), the most common site of extra-pulmonary TB was the pleura (143), followed by the lymphatic system (114) in 2017.

Figure 6.4
TB incidence rate in Singapore residents, 2008-2017



Age-standardised rate using 2010 mid-year Singapore resident population.
(Source: Singapore Department of Statistics).

Table 6.22
Distribution of new TB cases by site of disease in Singapore residents, 2008-2017

Year	New Cases			Incidence rate per 100,000 population		
	Pulmonary[1]	Extra-pulmonary	Total	Pulmonary[1]	Extra-pulmonary	Total
2008	1,208	243	1,451	33.2	6.7	39.8
2009	1,205	237	1,442	32.3	6.3	38.6
2010	1,265	213	1,478	33.5	5.6	39.2
2011	1,309	224	1533	34.5	5.9	40.5
2012	1,359	201	1,560	35.6	5.3	40.9
2013	1,249	171	1,420	32.5	4.4	36.9
2014	1,220	234	1,454	31.5	6.0	37.6
2015	1,271	227	1,498	32.6	5.8	38.4
2016	1,353	264	1,617	34.4	6.7	41.1
2017	1,302	234	1,536	32.8	5.9	38.7

[1] Pulmonary TB referred to TB of the lung parenchyma and included cases that had both pulmonary and extra-pulmonary TB.

Distribution by age and gender

As in previous years, TB in Singapore residents continues to be a disease of older males (Table 6.23). Of the 1,536 new cases notified in 2017, 1,026 (66.8%) were 50 years old and above, and 1,048 (68.2%) were males. The TB incidence rate among males decreased from 55.2 per 100,000 population in 2016 to 53.9 per 100,000 population in 2017, while that among females decreased from 27.5 per 100,000 population in 2016 to 24.1 per 100,000 population in 2017.

Table 6.23
Age-gender distribution and incidence rate of TB in Singapore residents, 2017

Age group	Male	Female	Total	%	Incidence rate per 100,000 population*		
					Male	Female	Total
0-4	2	1	3	0.2	2.1	1.1	1.6
5-9	0	2	2	0.1	0	2.0	1.0
10-14	1	2	3	0.2	1.0	2.0	1.5
15-19	16	14	30	2.0	13.4	12.3	12.9
20-29	47	69	116	7.6	17.1	25.1	21.1
30-39	66	63	129	8.4	24.0	20.6	22.2
40-49	156	71	227	14.8	52.2	22.5	36.9
50-59	247	83	330	21.5	80.3	27.1	53.7
60-69	267	83	350	22.8	116.1	35.1	75.0
70-79	153	59	212	13.8	157.8	51.5	100.3
80+	93	41	134	8.7	242.6	65.1	132.3
Total	**1,048**	**488**	**1,536**	**100.0**	**53.9**	**24.1**	**38.7**

* Rates are based on 2017 estimated mid-year population.
(Source: Singapore Department of Statistics)

Ethnic distribution

Malays had the highest TB incidence among the three main ethnic groups. The incidence rate in Malays increased from 57.6 per 100,000 population in 2016 to 64.3 per 100,000 population in 2017.The incidence rate among Chinese and Indians decreased from 39.2 and 31.9 per 100,000 population in 2016, to 34.5 and 28.7 per 100,000 population respectively in 2017 (Table 6.24).

Table 6.24
Ethnic-gender distribution and ethnic-specific incidence rate of TB in Singapore residents, 2017

Ethnic group	Male	Female	Total	%	Incidence rate per 100,000 population
Chinese	721	295	1,016	66.1	34.5
Malay	219	122	341	22.2	64.3
Indian	71	32	103	6.7	28.7
Others	37	39	76	5.0	59.4
Total	**1,048**	**488**	**1,536**	**100.0**	**38.7**

* Rates are based on 2017 estimated mid-year population.
(Source: Singapore Department of Statistics).

Clinical presentation and bacteriological status

In 2017, 1,277 (98.1%) of the 1,302 new pulmonary TB cases in Singapore residents had bacteriological tests done. The proportion found to have demonstrable bacillary disease was 68.8% (Table 6.25).

Table 6.25
Bacillary status of new pulmonary TB cases in Singapore residents, 2008-2017

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
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
2016	1,304	96.3	931	71.3	23.7
2017	1,277	98.1	878	68.8	22.1

Relapsed TB cases

In 2017, there were 124 relapsed TB cases notified among Singapore residents. This accounted for 7.5% of all cases (new & relapsed) among Singapore residents (Table 6.26).

Table 6.26
Age-gender distribution of relapsed TB cases in Singapore residents, 2013-2017

Age group	2013		2014		2015		2016		2017	
	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	3	1	0	0	0	0	0	1	1
20-29	0	2	3	0	0	3	0	3	1	3
30-39	5	3	5	7	3	2	3	5	2	2
40-49	12	3	10	3	7	6	8	3	8	6
50-59	20	2	22	5	30	9	16	8	21	2
60- 69	20	5	29	7	18	7	38	8	34	8
70+	37	7	35	10	53	6	42	8	32	3
Sub Total	**94**	**25**	**105**	**32**	**111**	**33**	**107**	**35**	**99**	**25**
Total	**119**		**137**		**144**		**142**		**124**	

TB cases in Singapore residents by country of birth

Of the 1,536 new cases notified among residents in 2017, 1,203 (78.3%) were Singapore-born and 333 (21.7%) were foreign-born. Of the 124 relapsed TB cases notified among residents, 109 (87.9%) were Singapore-born and 15 (12.1%) were foreign-born. (Table 6.27).

Table 6.27
Distribution of TB cases by age group and country of birth in Singapore residents, 2016-2017

Age group	New cases				Relapsed cases			
	2016		2017		2016		2017	
	S'pore born	Foreign born	S'pore born	Foreign born	S'pore born	Foreign born	S'pore born	Foreign born
0-9	10	2	4	1	0	0	0	0
10-19	24	4	26	7	0	0	2	0
20-29	107	20	85	31	1	2	4	0
30-39	88	47	75	54	3	5	3	1
40-49	145	56	167	60	8	3	12	2
50-59	325	41	277	53	23	1	22	1
60- 69	329	45	310	40	43	3	39	3
70+	287	87	259	87	45	5	27	8
Total	**1,315**	**302**	**1,203**	**333**	**123**	**19**	**109**	**15**

TB-HIV co-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. According to the 2017 WHO Global TB Report[1], people living with HIV accounted for 1.0 million (10%) of all new TB cases worldwide in 2016.

In 2017, there was a total of 1,660 notified cases of TB (both new and relapsed cases) among Singapore residents. Of these, 87.9% (1,459 cases) had a documented HIV status[2].

The prevalence of TB-HIV co-infection among TB cases with a documented HIV status was 2.1% (30 cases) of which 18 were diagnosed to be HIV positive within three months of TB diagnosis. The prevalence of TB-HIV co-infection

[1] Global tuberculosis report 2017, WHO. Pg 224
[2] This refers to the proportion of notified TB cases who were previously documented to be HIV-positive before TB diagnosis or had undergone HIV testing in the three months after TB diagnosis to detect TB-HIV co-infection.

among the new and relapsed TB cases were 2.0% (27 out of 1347 cases) and 2.7% (3 out of 112 cases) respectively. The highest TB-HIV co-infection rate among new TB cases were observed among males 50-59 years of age (Table 6.28). By ethnic group, Malays had the highest TB-HIV co-infection rate (Table 6.29).

Table 6.28
Age-gender distribution of new cases with TB-HIV co-infection in Singapore residents, 2017

Age group	New cases				TB-HIV co-infection rate per 100,000 population*		
	Male	Female	Total	(%)	Male	Female	Total
0-14	0	0	0	0	0	0	0
15-19	0	0	0	0	0	0	0
20-29	0	1	1	3.7	0	0.4	0.2
30-39	6	0	3	22.2	2.2	0	1.0
40-49	6	1	7	25.9	2.0	0.3	1.1
50-59	11	0	12	40.7	3.6	0	1.8
60+	2	0	7	7.4	0.5	0	0.3
Total	**25**	**2**	**27**	**100**			
Age-standardised rate (per 100,00 population)					1.3	0.1	0.7
Crude Rate (per 100,00 population)					1.3	0.1	0.7

*Rates are based on 2017 estimated mid-year Singapore resident population and standardized population for Age-standardised rate using 2010 mid-year Singapore resident population.
(Source: Singapore Department of Statistics).

Table 6.29
Ethnic-gender distribution of new cases with TB-HIV co-infection in Singapore residents, 2017

Ethnic group	New cases				TB-HIV co-infection rate per 100,000 population*		
	Male	Female	Total	%	Male	Female	Total
Chinese	14	0	14	51.9	1.0	0	0.5
Malay	8	2	10	37.0	3.0	0.7	1.9
Indian	2	0	2	7.4	1.1	0	0.6
Others	1	0	1	3.7	1.7	0	0.8
Total	**25**	**2**	**27**	**100**	**1.3**	**0.1**	**0.7**

*Rates are based on 2017 estimated mid-year Singapore resident population.
(Source: Singapore Department of Statistics).

TB cases in non-residents

In 2017, there were 1,451 new TB cases notified among non-residents in Singapore (Table 6.30). As in previous years, the number of new TB cases notified among short-staying foreigners outnumbered long-staying foreigners contributing 26.6% (Table 6.31) and 21.9% of total notified new cases respectively (Table 6.32).

Table 6.30
New TB cases by pass category/status in non-residents, 2013-2017

	2013	2014	2015	2016	2017
Long-staying foreigners					
Work Permit Holders	434	409	353	473	446
Employment Pass Holder	52	27	36	44	40
Other Pass Holders*	122	128	113	176	169
Sub-total	**608**	**564**	**502**	**693**	**655**
Short-staying foreigners					
Work Permit Applicants	389	391	351	370	425
Visitors**	216	215	204	233	202
Others***	168	117	149	187	169
Sub-total	**773**	**723**	**704**	**790**	**796**
Total	**1,381**	**1,287**	**1,206**	**1,483**	**1,451**

* Includes dependent pass holder, long-term social visit pass holder, 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 6.31
New TB cases by site of disease in short- staying foreigners, 2008-2017

Year	Pulmonary		Extra-pulmonary		Total	
	No.	% of total new cases notified	No.	% of total new cases notified	No.	% of total new cases notified
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
2016	690	22.3	100	3.2	790	25.5
2017	723	24.2	73	2.4	796	26.6

Table 6.32
New TB cases by site of disease in long-staying foreigners, 2008-2017

Year	Pulmonary		Extra-pulmonary		Total	
	No.	% of total new cases notified	No.	% of total new cases notified	No.	% of total new cases notified
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
2016	577	18.6	116	3.7	693	22.4
2017	569	19.0	86	2.9	655	21.9

TB drug resistance

In this section, 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 countries of birth were excluded from the analysis. With the exception of MDR-TB cases, the data presented was based on the drug susceptibility testing (DST) 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). For the MDR-TB cases, the results of genotypic testing (i.e. GeneXpert MTB/Rif), which complemented the DST, were also presented.

Singapore-born residents

In 2017, drug resistance was detected in 52 (7.6%) of the 686 new pulmonary TB cases among Singapore-born residents in whom DST was performed, whereby 43 (6.3%) were resistant to one drug and 9 (1.3%) were resistant to more than one drug (Table 6.33). Isoniazid resistance was detected in 14 cases (2.0%) while MDR-TB was detected in 2 cases (0.3%).

Drug resistance was detected in 4 (6.8%) of the 59 relapsed pulmonary TB cases with DST performed, of which 2 (3.4% cases) were resistant to one drug and the other 2 cases (3.4%) were resistant to more than one drug. Isoniazid resistance was detected in 2 cases (3.4%) while there were no MDR-TB cases detected. There were no cases of extensively-drug-resistant TB (XDR-TB), i.e. MDR-TB with resistance to any fluoroquinolone and second-line injectable agent, among Singapore-born TB cases in 2017.

Table 6.33
***Mycobacterium tuberculosis* drug susceptibility in Singapore-born residents with pulmonary TB, 2014-2017**

Sensitivity result of sputum examination*	2014		2015		2016		2017	
	No.	%	No.	%	No.	%	No.	%
New cases								
Sensitive to:								
Streptomycin, Isoniazid, Rifampicin & Ethambutol	661	92.7	680	93.1	733	94.7	634	92.4
Resistant to:								
Single drug	38	5.3	43	5.9	34	4.4	43	6.3
More than 1 drug	14	2.0	7	1.0	7	0.9	9	1.3
Total	**713**	**100**	**730**	**100**	**774**	**100**	**686**	**100**
****Resistant to Isoniazid**	24	3.4	24	3.3	19	2.4	14	2.0
*****Phenotypic MDR**	#6	0.8	5	0.7	3	0.4	2	0.3
******Genotypic MDR**	0	0	1	0.1	0	0	0	0
Total MDR	**6**	**0.8**	**6**	**0.8**	**3**	**0.4**	**2**	**0.3**
Relapsed cases								
Sensitive to:								
Streptomycin, Isoniazid, Rifampicin & Ethambutol	54	88.5	61	89.7	64	88.9	55	93.2
Resistant to:								
Single drug	5	8.2	6	8.8	7	9.7	2	3.4
More than 1 drug	2	3.3	1	1.5	1	1.4	2	3.4
Total	**61**	**100**	**68**	**100**	**72**	**100**	**59**	**100**
****Resistant to Isoniazid**	6	9.8	5	7.4	6	8.3	2	3.4
*****Phenotypic MDR**	0	0	0	0	0	0	0	0
******Genotypic MDR**	0	0	0	0	0	0	0	0
Total MDR	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

* In the case of dual lesions, the sensitivity result recorded was that of organisms cultured from sputum.
**Any of isoniazid resistance, exclusive of MDR.
*** Defined as cases which showed resistance to both rifampicin and isoniazid on DST.
****Defined as cases which showed rifampicin resistance on genotypic test and isoniazid resistance on DST.
Includes a MDR-TB case that was notified as both pulmonary and extra-pulmonary TB, but where the MDR result was from the extra-pulmonary specimen only.

Foreign-born residents

In 2017, drug resistance was detected in 14 (8.6%) of the 163 new pulmonary TB cases among foreign-born residents in whom DST was performed, whereby nine (5.5%) were resistant to one drug and five (3.1%) were resistant to more than one drug (Table 6.34). Isoniazid resistance was detected in eight cases (4.9%) while MDR-TB was detected in three cases (1.8%).

Drug resistance was detected in one (11.1%) of the nine relapsed pulmonary TB cases with DST performed, and it was a MDR-TB case.

Table 6.34
***Mycobacterium tuberculosis* drug susceptibility in foreign-born residents with pulmonary TB, 2014-2017**

Sensitivity result of sputum examination *	2014		2015		2016		2017	
	No.	%	No.	%	No.	%	No.	%
New cases								
Sensitive to:								
Streptomycin, Isoniazid, Rifampicin & Ethambutol	116	91.3	125	89.3	138	92.6	149	91.4
Resistant to:								
Single drug	8	6.3	12	8.6	11	7.4	9	5.5
More than 1 drug	3	2.4	3	2.1	0	0	5	3.1
Total	**127**	**100**	**140**	**100**	**149**	**100**	**163**	**100**
****Resistant to Isoniazid**	2	1.5	9	6.4	7	4.7	8	4.9
*****Phenotypic MDR**	1	0.8	0	0	0	0	3	1.8
******Genotypic MDR**	0	0	0	0	0	0	0	0
Total MDR	**1**	**0.8**	**0**	**0**	**0**	**0**	**3**	**1.8**
Relapsed cases								
Sensitive to:								
Streptomycin, Isoniazid, Rifampicin & Ethambutol	8	88.9	6	85.7	8	88.9	8	88.9
Resistant to:								
Single drug	1	11.1	1	14.3	0	0	0	0
More than 1 drug	0	0	0	0	1	11.1	1	11.1
Total	**9**	**100**	**7**	**100**	**9**	**100**	**9**	**100**
****Resistant to Isoniazid**	0	0	1	14.3	1	11.1	0	0
*****Phenotypic MDR**	0	0	0	0	0	0	1	11.1
******Genotypic MDR**	0	0	0	0	0	0	0	0
Total MDR	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**11.1**

* In the case of dual lesions, the sensitivity result recorded was that of organisms cultured from sputum.
**Any of isoniazid resistance, exclusive of MDR
*** Defined as cases which showed resistance to both rifampicin and isoniazid on DST.
****Defined as cases which showed Rifampicin resistance on genotypic test and Isoniazid resistance on DST.

Non-residents

In 2017, drug resistance was detected in 64 (15.3%) of the 419 new pulmonary TB cases among non-residents in whom DST was performed, whereby 42 (10.0%) were resistant to one drug and 22 (5.3%) were resistant to more than one drug (Table 6.36). Isoniazid resistance was detected in 27 cases (6.4%) while MDR-TB was detected in 17 cases (4.1%).

Drug resistance was detected in 2 (15.4%) of the 13 relapsed pulmonary TB cases with DST performed, both of which were MDR-TB cases.

Table 6.35
***Mycobacterium tuberculosis* drug susceptibility in non-residents with pulmonary TB, 2014-2017**

Sensitivity result of sputum examination*	2014		2015		2016		2017	
	No.	%	No.	%	No.	%	No.	%
New cases								
Sensitive to:								
Streptomycin, Isoniazid, Rifampicin & Ethambutol	294	86.7	287	86.5	383	83.8	355	84.7
Resistant to:								
Single drug	23	6.8	32	9.6	49	10.7	42	10.0
More than 1 drug	22	6.5	13	3.9	25	5.5	22	5.3
Total	**339**	**100**	**332**	**100**	**457**	**100**	**419**	**100**
****Resistant to Isoniazid**	24	7.1	27	8.1	33	7.2	27	6.4
*****Phenotypic MDR**	10	2.9	6	1.8	18	3.9	14#	3.3
******Genotypic MDR**	1	0.3	0	0	0	0	3	0.7
Total MDR	**11**	**3.2**	**6**	**1.8**	**18**	**3.9**	**17**	**4.1**
Relapsed cases								
Sensitive to:								
Streptomycin, Isoniazid, Rifampicin & Ethambutol	11	64.7	11	68.8	4	50.0	11	84.6
Resistant to:								
Single drug	4	23.5	1	6.2	1	12.5	0	0
More than 1 drug	2	11.8	4	25.0	3	37.5	2	15.4
Total	**17**	**100**	**16**	**100**	**8**	**100**	**13**	**100**
****Resistant to Isoniazid**	3	17.6	3	18.8	1	12.5	0	0
*****Phenotypic MDR**	1¶	5.9	2	12.5	2	25.0	2	15.4
******Genotypic MDR**	0	0	0	0	0	0	0	0
Total MDR	**1**	**5.9**	**2**	**12.5**	**2**	**25.0**	**2**	**15.4**

* In the case of dual lesions, the sensitivity result recorded was that of organisms cultured from sputum.
**Any of isoniazid resistance, exclusive of MDR.
*** Defined as cases which showed resistance to both rifampicin and isoniazid on DST.
****Defined as cases which showed rifampicin resistance on genotypic test and isoniazid resistance on DST.
¶ MDR-TB resistant to both fluoroquinolone and second-line injectable.
# Includes 2 MDR-TB cases that was notified as both pulmonary and extra-pulmonary TB, but where the MDR result was from the extra-pulmonary specimens only.
Note: Extra-pulmonary MDR-TB was detected in 4 new cases (3 phenotypic & 1 genotypic) among non-residents in 2016. Extra-pulmonary MDR-TB was detected in 1 new case among non-residents in 2017.

TB mortality

In 2017, there were 25 deaths from TB among Singapore residents, giving a mortality rate of 0.6 case per 100,000 population (Table 6.36). The majority were males (88.0%) and those aged 70 years and above (52.0%).

Table 6.36
Age-gender distribution and age-specific mortality rate of TB, 2017

Age group	Male	Female	Total	%	Mortality rate per 100,000 population*
0–9	0	0	0	0	0
10–19	0	0	0	0	0
20-29	0	1	1	4.0	0.2
30–39	0	0	0	0	0
40–49	1	0	1	4.0	0.2
50–59	4	0	4	16.0	0.7
60–69	6	0	6	24.0	1.3
70+	11	2	13	52.0	4.2
Total	**22**	**3**	**25**	**100**	**0.6**

* Rates are based on 2017 estimated mid-year resident population.
(Source: Singapore Department of Statistics, Registry of Births & Deaths)

HEALTHCARE-ASSOCIATED OUTBREAKS

Healthcare-associated outbreaks are defined as clusters of infections in healthcare settings related in time and place, and occurring above a baseline or threshold level for a facility, specific unit, or ward. Healthcare settings include public and private hospitals, nursing homes, welfare homes and day-care centres.

The Healthcare Epidemiology (HCE) team is a team newly formed on 1 April 2016 within the Surveillance, Epidemiology and Response Branch of Communicable Diseases Division in MOH, to assist in the investigation of healthcare institutions associated outbreaks. The team comprised several field epidemiologists, and a public health practitioner. In some outbreaks, member(s) of the National Outbreak Response Team are called upon by DMS to augment the outbreak investigation. The National Outbreak Response Team was set up in March 2016 to draw on national resources and expertise to enhance efforts in dealing with infectious diseases.

Suspected clusters of hospital acquired infections (HAIs) are reported to HCE early so that MOH can detect trends at the national level, monitor the situation and timely dissemination of advice on perspectives that extend beyond individual hospitals. Table 6.37 lists the triggers and guiding criteria for reporting clusters of HAIs to the Ministry.

In 2017, a total of 44 healthcare-associated outbreaks were reported by the hospitals and institution-based care facilities (Table 6.38). Of these, respiratory outbreaks accounted for the largest proportion, with 850 cases (82.6 %) (Table 6.39).

Table 6.37
Guiding criteria for reporting of outbreaks/ clusters of infectious diseases to MOH

Institution Type	Guiding Criteria
Hospital/ Community Hospital	When assessing whether to report an incident, the hospital should report the incident (which may involve Multidrug Resistant Organisms) to MOH as soon as possible, if any of the following guiding criteria are met: 1. Organism e.g. if it involves a pathogen or gene novel to the institution or country. 2. Potential impact beyond the institution e.g. if there is a: a. Risk of community transmission. b. Common product used beyond institution. c. Critical facility that relied upon nationally that is significantly affected especially if closure is being considered e.g. burns units and cardiothoracic intensive care unit (ICU). d. Population of patient with significant healthcare contact outside the facility is affected e.g. renal dialysis. 3. Institutional capability e.g. if the increase in the cluster size does not slow despite control measures, or if assistance/resources are required to control outbreak. 4. Media sensitivity e.g. any incident which potentially may be media sensitive.
	Hospitals should also specifically report the following: 5. Cluster (2 or more cases) of a highly infectious agent (e.g. measles, chickenpox) with suspected transmission to staff or patient in a vulnerable population e.g. neonates, transplant and other immunocompromised patients, or critical facility e.g. ICUs, oncology, and operating rooms.
Institution-based care facilities	1. 10% of the total population (residents and staff) within 14 days are affected with the same illness. 2. 10 cases within 3 consecutive days. 3. Case(s) in the cluster that are severely ill [Dangerously Ill List (DIL) or in ICU] or died. [where this information is available].
Timeline for notification	All clusters/outbreaks of infectious diseases that are identified to have met MOH's reporting criteria, should be notified within 24 hours. After initial notification, the reporting institution will be required to provide daily situational updates to MOH. MOH will adjust the periodicity of the updates, when necessary.

Mode of notification	1. Email: reportidcluster@moh.gov.sg a. For hospitals/community hospitals – to submit Annex C (Reporting form for incident/cluster of healthcare-associated infections). Request for individual case details will be requested separately, if necessary. b. For Institution-based care facilities – refer to email reporting template below: • Name of Institution: e.g. ABC Nursing Home (COO Office) • Address of Institution • Point-of-contact: e.g. Ms Lucy Goh (Manager) • Number of cases • Signs & symptoms

Table 6.38
Number of reported outbreaks in hospitals and institution-based care facilities, 2017

Type of institution	No. of outbreaks
Hospitals (private and public)	9
Community Hospitals	2
Institution-based care facilities	33
Total	44

Table 6.39
Healthcare associated outbreaks by disease condition, 2017

Institution type/ Disease Condition	No. of incidents	Total No. of cases (range)
Hospital (9)		
Respiratory	1	27
Gastrointestinal	1	42
Skin	0	0
Multi-drug resistant organisms (MDRO)	3	13 (3-7)
Others	4 (chickenpox, conjunctivitis)	27 (1-14)
Community Hospitals (2)		
Respiratory	2	10 (2&8)
Gastrointestinal	0	0
Skin	0	0
MDRO	0	0
Others	0	0
Institution-based care facilities (33)		
Respiratory	27	850 (8-86)
Gastrointestinal	4	48 (4-48)
Skin	0	0
MDRO	0	0
Others	2 (chickenpox)	12 (4&8)

Concurrent influenza A and rhinovirus/ enterovirus outbreaks in three Long Term Care Facilities (LTCFs) at Buangkok campus, Singapore, May 2017

Outbreaks of respiratory pathogens are common in long-term care facilities (LTCFs) as the elements for transmission of infection such as infectious agents, susceptible residents and conducive environment for easy spread are all present. Such outbreaks often lead to a substantial morbidity and mortality and are also disruptive and costly.

Influenza and rhinovirus/ enterovirus are common respiratory viruses which are transmitted from one person to another through respiratory droplets during coughing, sneezing or speaking, or via contaminated surfaces. These viruses are commonly implicated in respiratory outbreaks in LTCFs. Surveillance of infectious diseases, infection prevention and control programmes and established outbreak response measures are the key factors for the prevention and control of infectious diseases outbreaks.

On 17 May 2017, MOH was alerted by LTCF A of 21 cases with fever and/ or respiratory symptoms among its residents. While investigations were ongoing, a public acute hospital within the same regional healthcare cluster informed MOH that nine residents from LTCF B were admitted to their hospital and had tested positive for influenza A on 19 May 2017.

Epidemiological investigations were immediately conducted by the HCE team to determine the extent of the outbreak, source of infection, and mode of transmission, and a field visit to six LTCFs in Buangkok campus was conducted on 22 May. A case was defined as any resident or staff who had a fever and two or more of the respiratory symptoms (i.e. cough, runny nose, sore throat, breathlessness) with an onset date on or after 29 Apr 2017 (8 days prior to the onset date of the first case on 7 May). Subsequently, LTCF C reported the 3rd respiratory cluster affecting 13 residents on 24 May 2017.

A total of 138 cases (128 residents and 10 staff) of respiratory illness with onset dates from 7 to 26 May 2017 were reported from the three LTCFs and the activity centre. The highest number of cases and the highest attack rate were observed at LTCF B where 74 cases were affected with an attack rate of 34.6%. LTCF A and LTCF C reported 38 cases with an attack rate of 22.1%, and 22 cases with an attack rate of 9.9% respectively. The highest proportion of cases was observed among residents aged 60-69 years (34.3%), followed by those between 50-59 years old (29.9%). Among the three major ethnic groups, Chinese residents (53%) had the highest proportion of cases. The most common clinical presentation amongst the cases were fever (74.6%), cough (55.1%) and runny nose (52.9%). Of the 138 cases, 10 cases were hospitalised and later discharged well. The remaining cases sought outpatient treatment. The influenza vaccination coverage amongst the resident-cases range from 70% to 96%; and amongst staff-cases range from 0% to 92%.

A total of 34 specimens were collected for respiratory multiplex Polymerase Chain Reaction (PCR) Film Essay. Further analysis was conducted on the positive influenza A isolates via whole genome sequencing (WGS) at the National Public Health laboratory (NPHL). A total of 24 (70.6%) tested positive for influenza A [influenza A(H1N1)pdm2009 (20), influenza A(H3) (1), influenza A (1), influenza A subtype undetermined (2)]; seven (20.6%) tested positive for Human Rhinovirus/ Enterovirus, and one of these seven specimens also tested positive for adenovirus and parainfluenza virus 3. The remaining three (8.8%) specimens tested negative for respiratory pathogens. The 24 influenza positive specimens were from LTCF A (10), LTCF B (13) and LTCF C (1), while the seven rhinovirus/ enterovirus samples were from LTCF C. Of the 24 influenza positive cases, eight (33.3%) attended programmes at the activity centre prior to or during their respiratory illnesses.

In response to the outbreak, the affected LTCFs stepped up temperature and health checks for all well and affected residents, implemented cohort-nursing of affected residents, and enhanced their infection prevention and control measures, including frequent hand washing for both residents and staff, use of the appropriate PPE (surgical mask) for both residents and staff and stepped up environmental cleaning.

Our investigations reported concurrent outbreaks of two respiratory pathogens in the social welfare services complex in May 2017, influenza A outbreaks affecting LTCF A and LTCF B, and a rhinovirus/ enterovirus outbreak affecting LTCF C. Nevertheless, the interventions, i.e. infection control measures, to stop these two diseases transmissions were the same and the outbreaks were eventually controlled with the termination of transmission through multi-pronged infection control approach. No further new cases identified after 26 May 2017.

WGS phylogenetic analysis of positive influenza A isolates showed that the virus from one resident from LTCF A shared high sequence identity with those from LTCF A as well as LTCF B. Taken together with epidemiological findings from the review of cases' attendance at the activity centre and the epidemic curve, this suggested that the source of infection for LTCF B was from a resident-case of LTCF A that attended the workshops at the activity centre. While there were staff from the activity centre who fell ill with respiratory illness between 7 and 19 May 2017, their role in the transmission of viruses in the outbreaks could not be determined as samples were not available for testing at the time of investigations. The sources of infections for LTCF A and LTCF C remained unknown. No Pulsed Field Gel Electrophoresis (PFGE) analysis was conducted for the Rhinovirus/ Enterovirus isolates.

In view of these respiratory outbreaks, MOH together with the LTCFs' licensing authority worked to: (a) improve their protocol for the management of non-emergency cases after office hours, so that the use of emergency medical services for non-emergency conditions (transfer of residents with fever but in stable condition to the emergency department)

could be avoided, and (b) enhance influenza vaccine uptake among residents and staff of LTCFs including those from the activity centre.

This outbreak highlighted the importance of early detection through surveillance, keeping up-to-date influenza vaccination for both staff and residents of LTCFs, and implementation of a multi-pronged infection control approach. Communication and collaboration amongst LTCFs, the regional hospital, the licensing authority of LTCFs and MOH also played a key role in stopping the transmission of the diseases and managing the outbreaks.

SEVERE ILLNESS AND DEATH FROM POSSIBLY INFECTIOUS CAUSES

The SIDPIC (Severe Illness and Death from Possibly Infectious Causes) programme is a hospital-based sentinel surveillance programme which reviews cases of unexplained deaths and critical illnesses 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 operational in six public hospitals with existing programmes in TTSH, NUH, SGH and KKH, and recent extensions to CGH (since 1 April 2016) and NTFGH (since 1 October 2016).

In 2017, a total of 18,089 hospitalised patients were screened by SIDPIC programme coordinators in participating hospitals, an increase of 30.9% compared to 13,820 patients screened in 2016. Of these, 461 SIDPIC cases (including six duplicate cases) that fulfilled the inclusion criteria[3] were identified, an increase of 36.0% compared to 339 cases identified in 2016. Table 6.40 shows the SIDPIC performance indicators at six implementing hospitals for 2017.

The majority of SIDPIC cases (41.5%) had illnesses with respiratory syndromes, followed by cases with neurological illnesses (18.2%) (Table 6.41). Of the 455 cases identified in 2017, 314 were found to have alternate aetiologies, including 161 with causative pathogens detected.

Where causative pathogens were identified, respiratory viruses constituted more than half (55.8%) of all pathogens identified amongst 161 SIDPIC cases, and influenza viruses and respiratory syncytial viruses were most commonly detected. The remaining 153 cases had clinical presentations that were consistent with the clinical diagnosis, e.g. auto-immune disorders. Despite extensive laboratory testing, the aetiology in 141 (31.0%) cases remained unknown. Table 6.42 lists the pathogens which may be tested for under the SIDPIC programme.

Table 6.40
SIDPIC performance indicators, 2017

Surveillance Indicators	CGH	KKH	NTFGH	NUH	SGH	TTSH	TOTAL
No. of cases screened*	2,980	816	617	4,718	873	8,085	18,089
Death	810	115	21	1,347	144	4,175	6,612
Non-death	2,170	701	596	3,371	729	3,910	11,477
No. of SIDPIC cases	**15**	**56**	**22**	**224**	**19**	**125**	**461^**
Aetiology Found	10	42	6	173	8	75	314
Unknown Aetiology	4	14	16	51	10	46	141
Co-morbidity Found	0	1	1	0	0	0	2
No. of missed cases#	**0**	**0**	**0**	**0**	**0**	**0**	**0**

* The total number of cases screened refers to the sum of ICU admissions and death certificates screened.
^ Included 6 duplicate cases who were transferred from one hospital to another.
# Based on surrogate indicator (invasive pneumococcal disease, IPD) notified to MOH that are not identified as SIDPIC cases. There were a total of 134 IPD cases notified to MOH in 2017; none of them fulfilled SDIPIC recruitment criteria and they were not identified as SIDPIC cases.

[3] 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.

Cases with suspected infectious disease, who do not fit the above criteria but are deemed by SIDPIC physicians to be of possible public health importance are also included in the programme.

Table 6.41
Distribution of SIDPIC cases based on syndrome* classification, 2017

Syndrome	Aetiology Found	Unknown Aetiology	Total	%
Cardiac	46	21	67	14.7
Gastrointestinal	22	9	31	6.8
Neurological	60	23	83	18.2
Respiratory	130	59	189	41.6
Others	16	10	26	5.7
Multisystem	40	19	59	13.0
Total	**314**	**141**	**455**	**100**

* Syndrome classification:
Neurological – meningitis or encephalitis
Cardiac – myocarditis, pericarditis, endocarditis
Respiratory – pneumonia, acute respiratory distress syndrome (ARDS), respiratory failure
Gastrointestinal – hepatitis, hepatic failure, severe diarrhoea
Others – syndromes apart from the above four
Multisystem – sepsis, haemorrhagic fever, rash, shock

Table 6.42
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.

Legend:			
AFB	= Acid-fast bacillus	**SLE**	= St Louis encephalitis
Ag	= Antigen	**TB**	= Tuberculosis
CCHF	= Crimean-Congo haemorrhagic fever	**VEE**	= Venezuelan equine encephalitis
CMV	= Cytomegalovirus	**VZV**	= Varicella zoster virus
***E. coli* O157:H7**	= *Escherichia coli* serotype O157:H7	**WEE**	= Western equine encephalitis
EBV	= Epstein-Barr virus	**WNV**	= West Nile 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		