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FEATURE IN FOCUS

Immunisation Coverage for Children Aged Two to Five: Findings of the 2015 Immunisation Survey

Reported by Mr Desmond CHAN, Scientific Officer, Vaccine Preventable Disease Office, Surveillance and Epidemiology Branch, CHP.

Background

Immunisation is one of the most effective public health measures in the prevention and control of infectious diseases. Immunisation coverage is an important indicator for the planning and evaluation of immunisation programmes. Under the Hong Kong Childhood Immunisation Programme (HKCIP), the Government provides a number of vaccines free-of-charge to eligible children in Hong Kong[1]. These vaccines are given at birth in hospitals, during pre-school period by the Department of Health (DH)'s Maternal and Child Health Centres (MCHC), and in primary schools by DH's outreaching School Immunisation Teams (SIT). The Student Health Service (SHS) under the DH also provide catch-up vaccination to secondary school students. Alternatively, parents may opt to have their children vaccinated in private medical sector at their own expenses.

DH conducted territory-wide immunisation surveys to estimate the immunisation coverage among children aged two to five attending pre-primary institutions including kindergartens (KG), childcare centres (CCC) and kindergartens-cum-childcare centres (KG-cum-CCC). Five rounds of immunisation surveys had been conducted in 2001[2], 2003[3], 2006[4], 2009[5] and 2012[6], covering birth cohorts of 1995 to 2009. The surveys' results showed that the overall immunisation coverage for vaccines included in the CIP was consistently high for these children (above 95%). However, it was noted that in the children born or resided outside Hong Kong before two years of age had relatively lower immunisation coverage. A new round of immunisation coverage survey was conducted in 2015, targeting children born between 2009 and 2012.

Methods

We conducted a cross-sectional study. The study population was children aged two to five (defined as children born between 2009 and 2012) attending pre-primary institutions in Hong Kong. Pre-primary institutions included KG, CCC and KG-cum-CCC. We obtained a list of pre-primary institutions from the Education Bureau (EDB) and the Social Welfare Department (SWD) as the sampling frame. We selected 5% of the pre-primary institutions in this list by stratified cluster sampling. We invited all children attending the selected institutions as secondary sampling units. Participation was on a voluntary basis. We obtained written consent from parents. We collected demographic information by asking parents to complete a self-administered questionnaire. The demographic information of children included date of birth, gender, place of birth, place of residence before two years of age and current place. Parents submitted copies of all relevant immunisation records to us through the pre-primary institutions. Trained field workers from the SIT collected the questionnaires and extracted information from the immunisation records to a standardised data recording form. The information included type, date and place of vaccination. In addition to hardcopies of the immunisation records, we also obtained children's immunisation record in DH's MCHCs under the Immunisation Record System. When the immunisation record was incomplete, we asked parents to provide other immunisation documents, if any.

We included only children born within the target birth cohorts i.e. between 2009 and 2012 in our analysis. We defined local children as those who were born in Hong Kong, resided in Hong Kong before two years of age and lived in Hong Kong at the time of survey. All other children were defined as non-local children. We calculated coverage as the proportion of children vaccinated using the total number in each group as a denominator. We calculated the proportion of vaccines received by place of vaccination. We computed the risk ratios of coverage and their 95% confidence intervals (95% CI) among local and non-local children for different vaccines. We compared immunisation coverage of various vaccines in this survey with earlier surveys. We computed the time of vaccination as the duration between date of vaccination and date of birth to study the timeliness of vaccination.

Results

A total of 51 KG, CCC and KG-cum-CCC were successfully recruited. Among 10 727 children enrolled in these 51 institutions, 8 723 participated in the survey. The overall response rate was 81.3%. Immunisation records of 8 522 children (98%) were available and reviewed and analysed as valid respondents of the survey. Children born outside the target birth cohorts of 2009 to 2012 (n=201) were excluded from the analysis. Of these respondents, 65%, 32% and 3% were attendants of KG, KG-cum-CCC and CCC

respectively. Eighty-two percent of valid respondents who were born in Hong Kong, resided in Hong Kong before two years of age and lived in Hong Kong at the time of survey were considered as local children. The remaining 18% were classified as non-local children (Table 1).

In the 2009 to 2012 birth cohorts, the overall routine immunisation coverage reached 95%, except for pneumococcal conjugate vaccines (PCV) (Table 2). Excluding PCV, 96% of surveyed children completed their routine vaccination under HKCIP. Local children had higher coverage (98%) for all HKCIP vaccines when compared to non-local children (87%) and the difference was greatest for PCV. PCV coverage exceeded 95% among local children, except for PCV booster of those born in 2009. Local children were also more likely to complete all HKCIP vaccines than non-local children (risk ratio=2.04, 95% CI: 1.80-2.31) (Table 2).

Regarding the place of vaccination for CIP vaccines, 85% of local children received their vaccines in MCHC and 14% received them in the private health sector (Figure 1). In contrast, 58% of non-local children received their vaccines in MCHC whilst 36% received them in Mainland China.

Both local and non-local children received vaccines included in the HKCIP in a timely manner and the median time of vaccination was comparable to the recommended age of vaccination (Table 3).

Discussion

High coverage for routine childhood vaccines was maintained in Hong Kong. The immunisation coverage of CIP vaccines had been consistently around 95% for most cohorts studied in our surveys[2-6]. As PCV was introduced in September 2009 and only children born after July 1, 2009 were eligible for the standard three-plus-one regimen, it is not unexpected that the PCV coverage for local children of the 2009 cohort was lower than that of the 2010 to 2012 cohorts. High PCV coverage was achieved for local children. The introduction of PCV into the CIP in 2009 was well accepted.

Table 1 - Descriptive characteristics of the survey participants (8 522), Hong Kong Immunisation Coverage Survey 2015.

Characteristics		Number	Percentage
Year of birth	2009	2 276	26.7
	2010	2 488	29.2
	2011	2 831	33.2
	2012	927	10.9
Gender	Male	4 480	52.6
	Female	4 042	47.4
Birth & residential status	Local	6 970	81.8
	Non-local	1 552	18.2
Place of birth	Hong Kong	8 105	95.1
	Mainland China	321	3.8
	Others	96	1.1
Usual place of residence before two years of age	Hong Kong	7 101	83.3
	Mainland China	1 334	15.7
	Others	70	0.8
	Unknown	17	0.2
Current place of residence	Hong Kong	7 983	93.7
	Mainland China	517	6.1
	Hong Kong & Mainland China	1	0.0
	Unknown	21	0.2
Setting	Kindergarten	5 515	64.7
	Child care centres (CCC)	262	3.1
	Kindergarten-cum-CCC	2 745	32.2
Total		8 522	100

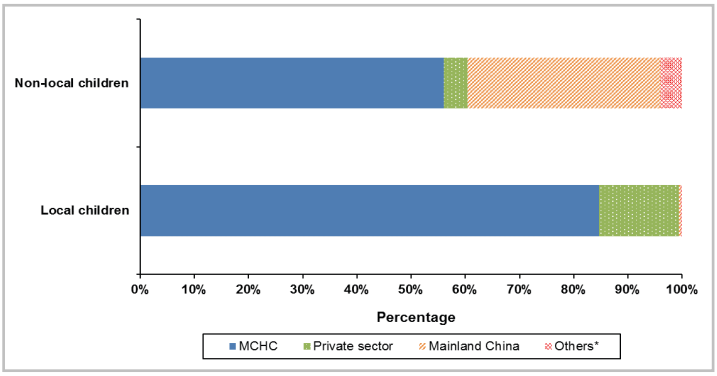

Figure 1 - Proportion of Childhood Immunisation Programme vaccines received in different settings by place of birth/residence, birth cohorts 2009-2012, Hong Kong Immunisation Coverage Survey 2015.
*(Notes: *Others include those vaccinated at facilities under the Hospital Authority, Macau, other overseas places and unknown.)*

Table 2 - Immunisation coverage for vaccines included in HKCIP, of children from birth cohorts 2009-2012, Hong Kong Immunisation Coverage Survey 2015.

Type of vaccine	2009			2010			2011			2012			2009-2012			Risk ratio (95%CI)
	Local (n=1 729)	Non-local (n=547)	Total (n=2 276)	Local (n=2 010)	Non-local (n=478)	Total (n=2 488)	Local (n=2 345)	Non-local (n=486)	Total (n=2 831)	Local (n=886)	Non-local (n=41)	Total (n=927)	Local (n=6 970)	Non-local (n=1 552)	Total (n=8 522)	Local vs Non-local
BCG	100.0	98.8	99.7	99.8	98.8	99.6	99.7	98.4	99.5	99.7	97.6	99.6	99.8	98.7	99.6	1.93 (1.30-2.88)
Hep B 3rd dose	99.7	97.7	99.2	99.4	98.2	99.2	99.5	97.6	99.2	99.4	94.8	99.2	99.5	97.8	99.2	1.67 (1.30-2.13)
Polio Booster	99.0	86.8	96.0	98.8	89.2	96.9	98.4	89.5	96.9	97.7	92.8	97.4	98.6	88.6	96.7	2.30 (1.97-2.69)
DTP Booster	99.1	96.4	98.5	98.9	97.4	98.6	98.5	96.1	98.1	97.7	92.8	97.4	98.7	96.5	98.3	1.29 (1.14-1.46)
Measles*	99.5	97.6	99.1	99.5	98.9	99.3	99.1	98.8	99.0	99.6	100.0	99.6	99.4	98.4	99.2	1.28 (1.07-1.53)
Mumps*	99.5	95.6	98.6	99.4	98.3	99.2	99.1	97.5	98.8	99.6	100.0	99.6	99.4	97.2	99.0	1.64 (1.33-2.02)
Rubella*	99.5	95.6	98.6	99.4	98.5	99.2	99.1	98.4	99.0	99.6	100.0	99.6	99.4	97.5	99.0	1.55 (1.26-1.90)
PCV 1st dose	99.5	75.5	93.8	99.4	82.7	96.2	99.6	88.1	97.7	99.9	95.1	99.7	99.6	82.2	96.4	8.62 (6.13-12.10)
PCV 2nd dose	98.4	64.8	90.3	99.3	73.4	94.3	99.5	78.5	95.9	99.8	82.9	99.0	99.2	72.2	94.3	7.37 (5.77-9.40)
PCV 3rd dose	96.3	58.0	87.1	99.1	68.2	93.1	99.3	75.2	95.2	99.6	82.9	98.8	98.5	67.2	92.8	5.20 (4.36-6.21)
PCV Booster	87.1	47.7	77.7	98.2	61.5	91.1	98.9	69.9	93.9	99.1	75.7	98.0	95.8	59.7	89.2	2.75 (2.50-3.02)
Complete immunisation#	98.3	84.0	94.8	98.2	87.5	96.2	97.8	88.0	96.1	96.7	90.4	96.4	97.9	86.5	95.8	2.04 (1.80-2.31)

*Notes: *In Hong Kong, children received MMR according to HKCIP; #Excluding PCV*

Table 3 - Timeliness of Childhood Immunisation Programme vaccines received by local and non-local children, birth cohorts 2009-2012[1], Hong Kong Immunisation Coverage Survey 2015.

Recommended Age	Vaccines included in HKCIP	Local children		Non-local children	
		Number of children studied	Time of vaccination Median (interquartile range) (months)[2]	Number of children studied	Time of vaccination Median (interquartile range) (months)[2]
Newborn	B.C.G. Vaccine	6 956	1 (1-2) (days)	1532	1 (1-2) (days)
	Hepatitis B Vaccine – 1st dose	6 956	0 (0-0) (days)	1539	0 (0-0) (days)
1 month	Hepatitis B Vaccine – 2nd dose	6 954	1.1 (1.1-1.3)	1536	1.1 (1.1-1.3)
2 months	DTP Vaccine[3] – 1st Dose	6 956	2.1 (2.1-2.3)	1540	2.4 (2.1-3.3)
	Polio Vaccine[3] – 1st Dose	6 956	2.1 (2.1-2.2)	1538	2.2 (2.1-2.4)
	Pneumococcal Conjugate Vaccine[1] – 1st dose	6 155	2.1 (2.1-2.3)	1104	2.3 (2.1-4.5)
4 months	DTP Vaccine[3] - Second Dose	6 956	4.2 (4.1-4.4)	1538	4.3 (4.2-4.7)
	Polio Vaccine[3] – Second Dose	6 956	4.2 (4.1-4.4)	1537	4.2 (3.6-4.4)
	Pneumococcal Conjugate Vaccine[1] – 2nd dose	6 146	4.2 (4.1-4.4)	978	4.4 (4.2-5.2)
6 months	DTP Vaccine[3] – 3rd Dose	6 952	6.3 (6.2-6.6)	1535	6.3 (6.0-6.6)
	Polio Vaccine[3] – 3rd Dose	6 952	6.3 (6.2-6.6)	1531	6.2 (5.0-6.6)
	Pneumococcal Conjugate Vaccine[1] – 3rd Dose	6 133	6.3 (6.2-6.6)	915	6.4 (6.2-7.1)
	Hepatitis B Vaccine – 3rd Dose	6 936	6.3 (6.2-6.6)	1518	6.4 (6.2-6.9)
12 months	Measles vaccine - 1st Dose[4]	6 926	12.3 (12.2-12.6)	1528	12.3 (9.8-12.7)
	Mumps vaccine - 1st Dose[4]	6 925	12.3 (12.2-12.6)	1508	12.7 (12.3-18.6)
	Rubella vaccine - 1st Dose[4]	6 925	12.3 (12.2-12.6)	1513	12.4 (12.2-13.7)
	Pneumococcal Conjugate Vaccine[1] - Booster	6 088	12.3 (12.2-12.6)	832	12.4 (12.2-12.8)
18 months	DTP Vaccine[3] - Booster	6 872	18.4 (18.3-18.8)	1498	18.7 (18.4-19.9)
	Polio Vaccine[3] – Booster	6 865	18.4 (18.3-18.8)	1375	18.5 (18.3-20.2)

Notes:
1. *Children born before July 1, 2009 were excluded from the analysis since they were not eligible for the standard PCV programme.*
2. *Except for BCG and first dose of Hep B vaccine which is presented in day, time of vaccination for other vaccines are presented as months.*
3. *Combined Diphtheria, Tetanus, acellular Pertussis & Inactivated Poliovirus Vaccine is recommended in HKCIP but children receiving any forms of diphtheria, tetanus, pertussis and poliovirus containing vaccines were included in the analysis.*
4. *Combined Measles, Mumps and Rubella (MMR) vaccine is recommended in Hong Kong but children receiving any forms of measles, mumps and rubella containing vaccines were included in the analysis.*

Local children had higher routine immunisation coverage when compared to non-local children and the difference was most prominent for PCV. The coverage of the third dose of Hepatitis B, booster doses of DTP and polio among non-local children fell below 95% is also of concern. When compared to local children, more non-local children received vaccines in Mainland China (35.7% among non-local children vs 0.4% among local children). These children were more mobile and less likely to adhere to the HKCIP compared to local children. As MCHC provided routine PCV catch-up vaccination to children up to two years of age, non-local children who resided in Mainland China before two years of age were less likely to complete their PCV immunisation and hence the coverage was lower.

In addition to high immunisation coverage, preschool children in Hong Kong also adhered well to the recommended age of vaccination. There was only slight delay in receiving CIP vaccines which could be due to appointment issues, sickness of the child and availability of parents and caregivers. Both the health care providers and the parents followed closely the recommended schedule, despite that these children received their vaccines in different sectors.

Limitations

There are limitations to our study. First, Mainland China and the private health sector in Hong Kong recorded vaccinations using systems that differed from the Hong Kong public sector. Some parents in our study might not have submitted all the immunisation records. Despite efforts such as phone calls and letters to remind parents of non-local children to ensure complete sets of immunisation records were collected, our survey may not have captured all the records. Moreover, we could not distinguish between lack of vaccination and lack of documentation of vaccination. Therefore, we may have underestimated the contribution of Mainland China and the private health sector to the immunisation coverage. Second, we selected only children attending pre-primary institutions. In Hong Kong, early childhood education in pre-primary institutions is not mandatory. According to the EDB and SWD, the proportion of children aged two years attending pre-primary institution in Hong Kong was about 50%, compared to 86% for children aged three to five years in the 2014/15 school year. So the findings from this study may not be generalisable to those children who were not attending pre-primary institution.

Conclusion

Our study led to three main conclusions. First, routine immunisation coverage remained high, including the newly launched PCV programme. Second, preschool children in Hong Kong received HKCIP vaccines in a timely manner. Third, non-local children had lower documented coverage of routine vaccination, which is of concern. To protect the public from vaccine preventable diseases, clinicians are advised to take note of the findings of this survey and help to provide childhood immunisation to individual young children, especially those who are not born or residing locally to ensure the overall high coverage in the community.

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Review of Shiga toxin-producing *Escherichia coli* infection in Hong Kong from 2007 to 2016

Reported by Dr YU Wing-man, Medical and Health Officer, Enteric and Vector-borne Disease Office, Surveillance and Epidemiology Branch, CHP.

Escherichia coli (*E. coli*) are Gram-negative bacteria commonly found in the intestinal tract of healthy humans and warm-blooded animals. While most strains are harmless, some can cause severe foodborne disease. In particular, Shiga toxin-producing *E. coli* (STEC) is an important group of *E. coli* that can cause severe diarrhoea and accounts for many foodborne outbreaks worldwide.[1,2] This article reviews the local epidemiology of STEC over the past decade.

From 2007 to 2016, the Centre for Health Protection (CHP) of the Department of Health recorded 32* cases of STEC infection including two cases reported on a voluntary basis prior to July 2008. The annual number of cases ranged from zero to eight (Figure 1). As of March 17, 2017, CHP did not record any case in 2017 so far.

Females comprised 53% of the 32 cases. The ages of the cases ranged between six months to 80 years (median: two years). Sixty-nine percent (22 cases) were children under six years old and two of them had underlying illness before onset of symptoms. On the other hand, four cases were elderly aged 65 or above and all had underlying medical illnesses.

Except two children who were cousins living in the same flat, all cases recorded were sporadic. Four were imported cases, of which three had been to Mainland China and one to Thailand. The other 28 patients acquired the infection locally. Half of the affected persons had symptom onset in the warmer months from May to August (Figure 2).

Most of them (29 cases, 91%) presented with diarrhoea with 10 (34%) of them presented with bloody diarrhoea. More than half (19 cases, 59%) of the patients presented with fever. Other symptoms included vomiting (16 cases, 50%) and abdominal pain (10 cases, 31%). Twenty-seven patients (84%) required in-hospital management for the infection. The length of stay ranged from one to 30 days with a median of three days. None of them developed haemolytic uraemic syndrome and no fatal cases were recorded.

Epidemiological investigations revealed that two patients recalled consumption of high risk foods, namely, undercooked beef. Two children had visited local farms where one of them had contacted sheep, goats and rabbits while the other had fed rabbits. High risk exposure could not be recalled in the rest of the cases.

Facts on STEC

STEC is transmitted to humans primarily through consumption of contaminated foods, such as raw or undercooked ground meat products, contaminated fruits and vegetables, unpasteurised dairy products, contaminated water, and direct contact with animals or their environment. Direct person-to-person transmission through the oral-faecal route can also occur. Moreover, exposure to recreational water sources like swimming in contaminated water is a route of infection.

Symptoms of STEC infection usually start three to four days after consumption of contaminated food. Symptoms include abdominal cramps and diarrhoea that may in some cases progress to bloody diarrhoea. Fever and vomiting may also occur. In serious cases, the infection may lead to a life-threatening complication named haemolytic uraemic syndrome which is a type of kidney failure. People of any age can become infected. Very young children and the elderly are more likely to develop severe illness, but even healthy older children and young adults can become seriously ill. Clinical management for STEC infection is usually supportive while fluid and electrolyte replacement is important when there is severe diarrhoea.

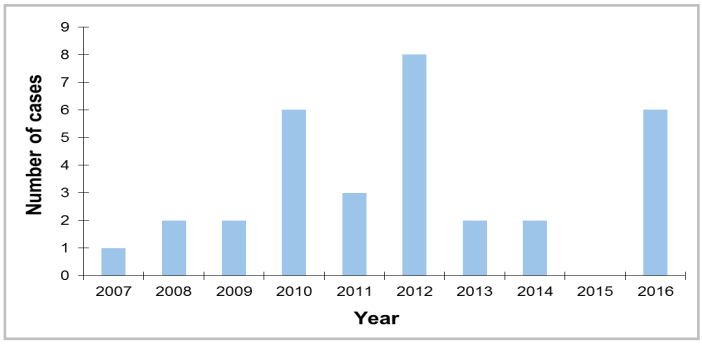

Figure 1 - Annual number of confirmed cases of STEC infection from 2007 to 2016.

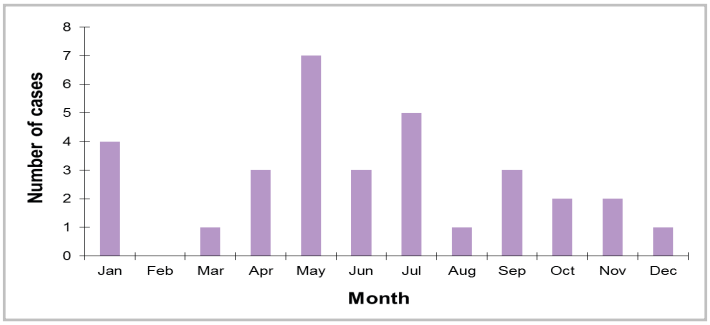

Figure 2 - Number of cases of STEC infection by month of symptom onset from 2007 to 2016.

*In Hong Kong, *E. coli* O157:H7 infection became a notifiable infectious disease in July 2008 and before that, cases were reported on a voluntary basis to the CHP. In view of the occurrence of large-scale non-O157 STEC outbreaks in Europe in mid-2011, the CHP has refined the notification to include all STEC infections to the list of notifiable infectious diseases since June 10, 2011.

Maintaining good food, personal and environmental hygiene is the mainstay of preventing STEC infection. Members of the public are advised to avoid eating or drinking undercooked food and unpasteurised milk. Moreover, the public should cook food and boil water thoroughly before consumption. Hand hygiene is of particular importance for patients with STEC infection, their close contacts and caregivers and for those who visit animal farms or petting zoos. More health information is available in the CHP website: http://www.chp.gov.hk/en/content/9/24/23315.html.

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NEWS IN BRIEF

A local sporadic case of leptospirosis

On March 13, 2017, the Centre for Health Protection (CHP) recorded a local case of leptospirosis affecting a 63-year-old housewife with underlying illnesses. She presented with fever, right loin pain and vomiting on February 19 and was admitted to a public hospital on February 20. She developed respiratory failure, acute kidney injury and septic shock and was admitted to the intensive care unit for further management including mechanical ventilation, renal dialysis and inotropic support. She was treated with antibiotics and her condition improved. She was transferred back to general ward on March 2. Paired sera on February 20 and March 3 showed more than four-fold rise in antibody titre against *Leptospira* by microscopic agglutination test. The patient had no travel history during the incubation period. She denied any water recreation activities, skin wound, or contact with rodents or animals. Investigations are on-going.

A probable case of sporadic Creutzfeldt-Jakob disease

CHP recorded a probable case of sporadic Creutzfeldt-Jakob disease (CJD) on March 16, 2017, affecting an 85 year-old man with underlying illnesses. He presented with sudden onset of left-sided weakness on January 19, 2017. He attended a public hospital on January 22 and was admitted on the same day. Subsequently, he developed rapidly progressive dementia, myoclonus, akinetic mutism, generalised rigidity, dysarthria and dysphagia. Finding of electroencephalography was compatible with CJD. His condition was stable. No risk factors for either iatrogenic or variant CJD were identified. He was classified as a probable case of sporadic CJD.

A local sporadic case of hantavirus infection

On March 22, 2017, CHP recorded a sporadic case of hantavirus infection affecting a 22-year-old man with good past health. He presented with on and off fever, runny nose, abdominal pain and vomiting since March 5. He attended the Accident and Emergency Department of a public hospital on March 11 and was admitted on the same day. He subsequently developed acute renal failure, impaired liver function and reduction in platelet count. His blood collected on March 15 was tested positive for Hantavirus IgM and Hantavirus polyvalent antibody titre was raised to 2 560. He was given antibiotics and his clinical condition was stable all along. Epidemiological investigation revealed that the patient was a student. He lived with his parents and elder brother in Yuen Long who remained asymptomatic. He did not keep pets at home and had no travel history during incubation period. He denied any previous skin wounds and any contacts with rodents or their excreta. He did not report any rodent bites. The Food and Environmental Hygiene Department was informed and investigations are on-going.

CA-MRSA cases in February 2017

In February 2017, CHP recorded a total of 82 cases of community-associated methicillin resistant *Staphylococcus aureus* (CA-MRSA) infection, affecting 44 males and 38 females with ages ranging from 15 months to 88 years (median: 37.5 years). Among them, there were 59 Chinese, 8 Filipinos, 3 Caucasian, 3 Indian, 3 Pakistani, 2 Nepalese, 1 Korean, 1 Singaporean and 2 of unknown ethnicity.

Eighty-one cases presented with uncomplicated skin and soft tissue infections while the remaining case had severe CA-MRSA infection. This case affected a 33-year-old woman who presented with fever, right periorbital pain and swelling since January 19. She was admitted to a public hospital on January 21. Her blood specimen collected on January 21 was cultured positive for CA-MRSA. She was diagnosed to have herpes zoster with ophthalmic involvement, orbital cellulitis and sepsis. She was treated with antibiotics and antivirals and was discharged on February 7. She did not have any close contacts. Separately, among the 82 cases, the isolate of one case affecting a 52-year-old woman was found to be resistant to mupirocin. She presented with finger abscess and recovered after antibiotic treatment.

Among the cases, one was a nurse working in an outpatient clinic. Investigation revealed that this patient was a household contact of a previous confirmed case reported in January 2017. Apart from the above cluster, two other cases were involved in two household clusters epidemiologically linked to one and two previous reported cases respectively. Decolonisation would be provided for their close contacts.

Scarlet fever update (February 1, 2017 - February 28, 2017)

Scarlet fever activity in February was similar to that in January. CHP recorded 168 cases of scarlet fever in February as compared with 176 cases in January. The cases recorded in February included 98 males and 70 females aged between seven months and 31 years (median: six years). There were eight institutional clusters occurring in six kindergartens and two primary schools, affecting a total of 18 children. No fatal cases were reported in February. Of note, there has been an unusual increase in the activity of scarlet fever in March, which was higher than that in the same period in previous years. In view of the increase in scarlet fever activity in the recent few weeks, parents should take extra care of their children in maintaining strict personal, hand and environmental hygiene. People suspected to have scarlet fever should consult a doctor promptly.