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CONTENTS

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HIV/AIDS and other sexually transmitted infections in older adults in Singapore, 1996-2011

Introduction

Sexually transmitted infections (STIs) in persons older than 50 years are rarely studied because STIs occur predominantly in individuals of younger age groups. Most studies on STIs focused on sexually active young people who bear the highest burden of STIs and are at risk for reproductive sequelae such as ectopic pregnancy and infertility.[1] Hence, there are very limited published studies focusing on STIs in older age groups, especially in the context of Singapore.

There are several factors which may place older persons at risk of acquiring STIs. Firstly, with prolonged life expectancy and better quality of life due to advancements in healthcare, men and women can continue to remain sexually active well into advanced ages.[2] In a local survey conducted among 1,081 subjects aged between 30 and 70 years, it was found that the mean coital frequency among men aged 41 to 55 years and 56 to 70 years were 4.9 and 2.9 times per month, respectively. For the female subjects, the mean coital frequency was 4.9 times per month in those aged 41 to 55 years and 2.5 times per month in those aged 56 to 70 years.[3] A prospective study conducted in 2005 among men aged 50 years or older who attended the Department of STI Control clinic in Singapore showed that the number of lifetime sexual partners among those who have had sex ranged from one to more than 10.[4] The study also revealed that risk-taking behaviour in this group of patients was significant, with 80% of patients aged 65 years or older reporting more than 10 lifetime sexual partners, compared to 40% in those aged 50-54 years old, 57.6% in those aged 55-59 years old, and 68.2% in those aged 60-64 years. Condom utilization among the older

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men surveyed varied depending on the type of sexual partners and a higher usage was reported when the sexual activity involved non-regular partners such as commercial sex workers and casual sexual contacts.[4]

Older women are also at risk of acquiring STIs. It has been documented that condom usage among women appeared to decrease with age, possibly due to a lack of concern about pregnancy or misconception among older women that they are not at risk of acquiring STIs, as well as the presence of potential barriers to condom use such as difficulties in communication with their sexual partners, concern that requesting for condom use would be seen as a lack of trust and having the perception that condom use is controlled by the male partner.[5] Furthermore, current scientific evidence indicates that the ageing process can result in biological age-related changes that render older people more susceptible to acquiring STIs. In older women, the increased friability of the vaginal mucosa can lead to tears and microabrasions during sexual intercourse, facilitating disease transmission.[6]

With increased availability of effective pharmacotherapy for erectile dysfunction, it has also been speculated that this could possibly give rise to an increase in the number of STIs in older persons.[1] A recent paper in the urology literature observed that there was a concomitant upward trend in heterosexual transmissions of HIV and gonorrhoea among older men aged above 50 years in the United States as the number of sildenafil prescriptions rose over the last few years. Although the authors acknowledged that there may be multiple contributory factors in their findings, such observations should not be disregarded.[7]

In view of the issue of an ageing population in Singapore, it is crucial that we understand the epidemiology of STIs in the older age groups as this would have potential public health implications, given the anticipated rapid growth of the population of susceptible elderly people in Singapore in the near future. In this study, we aim to describe the epidemiology and trends of all legally notifiable STIs, including HIV/AIDS, among older adults aged 50 years and above in Singapore during the period from 1996 to 2011. A better understanding of disease trends among older persons will provide guidance for the planning of multi-faceted sexual health education and prevention programmes, including specific interventions for the elderly, if necessary.

Materials and methods

Sources of data

In Singapore, STIs which are legally notifiable under the Infectious Disease Act (IDA) comprise human immunodeficiency virus (HIV) infection, acquired immune deficiency syndrome (AIDS), chlamydia, genital herpes, gonorrhoea, non-gonococcal urethritis (NGU) and syphilis.[8]

Data from the National HIV Registry involving subjects who were newly diagnosed and notified between 1996 and 2011, were reviewed. Prior to 2008, the National HIV Registry was maintained by the Department of Clinical Epidemiology at the Communicable Disease Centre in Tan Tock Seng Hospital. This function was subsequently transferred to the National Public Health Unit under the Ministry of Health, Singapore.

For the other notifiable STIs, notifications are collated by the Department of STI Control (DSC), which was established in 1991 and is run by the National Skin Centre for the Ministry of Health.[9] The

sources of these notifications include medical practitioners in institutional and private practice, as well as DSC clinic itself. Information was obtained from DSC's database for all legally notifiable STIs reported between 1996 and 2011, for the purpose of the review. For syphilis, only cases of infectious syphilis were included because latent cases could represent disease acquired in the distant past. Data on non-notifiable STIs such as chancroid, genital warts and vaginal discharges were excluded from the study as majority of the data were from the DSC clinic and hence may not be representative of the general population.

Data analysis

In this study, the term 'older persons' refer to individuals aged 50 years and above. The unit of analysis was based on an episode of infection, thus a patient may be counted more than once if he or she had more than one infection concurrently or multiple infections during the study period. Episode-based rates were utilized in this study as it has been reported that these more accurately reflect the local burden of STIs than person-based rates.[1,10]

Incidence rates of the various STIs were calculated based on the mid-year estimates of the population in Singapore for each year, obtained from the Singapore Department of Statistics. Statistical analyses were performed using SPSS software (PASW Statistics 18). A *p* value of less than 0.05 was considered to be statistically significant (two-tailed tests).

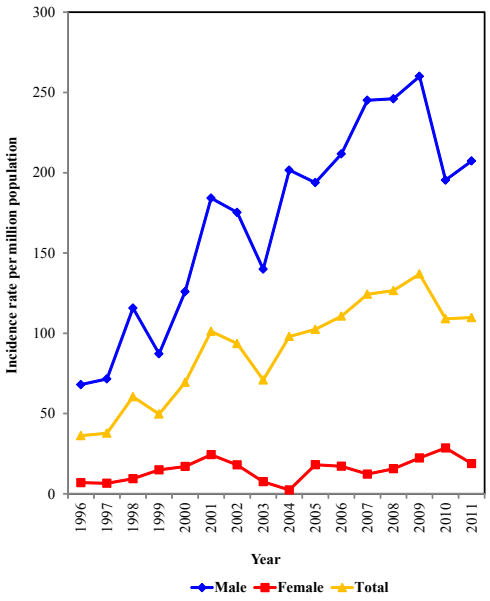
Results

Trends of HIV infection

Between 1996 and 2011, a total of 1,245 Singapore residents aged 50 years and above were diagnosed with HIV/AIDS, accounting for 25.5% of all HIV/AIDS notifications. Among males with HIV/AIDS, 8.9% were in the 50-54 years age group, 6.0% in the 55-59 age group and 9.8% in those aged 60 years and above. For female cases, 6.0% were aged 50-54 years, 7.2% aged 55-59 years and 7.8% aged 60 years and above. Older cases were predominantly male with a male to female ratio of 11:1. This is comparable to the ratio observed for the overall notifications across all age groups.

The incidence of HIV/AIDS among older Singapore residents rose steadily from 36.2 per million population in 1996 to 136.9 per million population in 2009, and subsequently decreased and remained at around 109 per million population in 2010 and 2011 (*Fig. 1*). The increase in incidence of HIV/AIDS among older Singapore residents appeared to be contributed largely by a significant rising trend in incidence among the males, which was apparent

Figure 1
Incidence rate of reported HIV/AIDS among Singapore residents aged ≥ 50 years, 1996 - 2011



across all the older age groups (*Fig. 2*). In contrast, the incidence of HIV/AIDS among females remained low throughout the years.

Trends of legally notifiable STIs

During the study period, there were a total of 9,925 notifications in those aged 50 years and older, which accounted for 9.4% of all mandatory STI notifications received by the DSC. Among the older adults, males outnumbered females for all notifiable STIs diagnoses. Overall, the top three most common STIs notified in older persons was gonorrhoea (2,767 cases), followed by non-infectious syphilis (2,377 cases) and genital herpes (1,939 cases) (*Table 1*). The most commonly reported STI diagnosis among older males was gonorrhoea (2,541 cases), followed by NGU (1,701 cases) and genital herpes (1,617 cases). Among the older females, the three most common STIs were non-infectious syphilis (815 cases), followed by genital herpes (322 cases) and chlamydia (282 cases).

There was an initial upward trend in the overall STI incidence among older adults aged 50 years and above in Singapore from 39.1 per 100,000 population in 1996 to the peak incidence of 96.8 per 100,000

Figure 2
Incidence rate of HIV/AIDS among older male Singapore residents by age group, 1996 - 2011

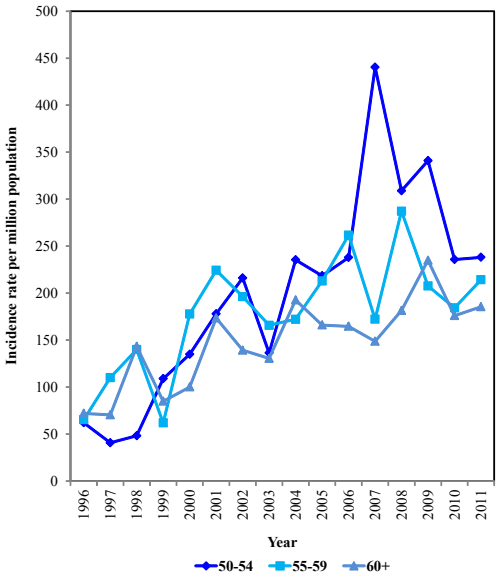


Table 1
Distribution of STIs in persons aged ≥ 50 years in Singapore by diagnosis & gender, 1996-2011

Diagnosis	Older adults n (% of total notifications)					Total notifications (for all age groups)	
	Male		Female		Total	Male	Female
Chlamydia	388	(5.7)	282	(2.7)	670	6,794	10,514
Gonorrhoea	2,541	(9.5)	226	(3.9)	2,767	26,881	5,738
Syphilis (infectious)	406	(17.0)	65	(12.2)	471	2,394	532
Syphilis (non-infectious)	1,562	(16.0)	815	(17.1)	2,377	9,734	4,761
NGU	1,701	(7.2)	NA	-	1,701	23,472	NA
Genital herpes	1,617	(17.2)	322	(6.5)	1,939	9,380	4,983
Total	**8,215**	**(10.4)**	**1,710**	**(6.4)**	**9,925**	**78,655**	**26,528**

NGU: non-gonococcal urethritis; NA: not applicable as NGU occurs only in males

population in 2006. Thereafter, the incidence of STIs declined significantly to 52.1 per 100,000 population in 2010 and exhibited a slight increase to 61.8 per 100,000 population in 2011 (*Fig. 3)*. Similar trends were also observed for both older males and females, though the decline in incidence rate appeared to be more prominent among older males than females.

Since surveillance for chlamydia infection started in 1999, the incidence of chlamydia among older adults aged 50 years and above in Singapore had remained at very low rates of less than 2 per 100,000 population until 2003. Subsequently, the incidence of chlamydia increased by approximately 8-fold from 1.4 per 100,000 population in 2003 to 11 per 100,000 population in 2009. A slight decrease in incidence was observed in 2010 and 2011 (*Fig. 4)*.

Notably, between 1999 and 2006, older females appeared to be predominantly affected with higher incidence rates reported compared to males. However, from 2007 onwards, the data showed a turnaround with a sharp rise in chlamydia incidence among older males and cases aged 50 years and above were predominantly male. The incidence of chlamydia among older males rose steeply from 6.9 per 100,000 population in 2007 to 17.4 per 100,000 population in 2009. In contrast, the incidence of chlamydia among older females exhibited a slight increase from 6.8 per 100,000 population in 2007 to its peak of 8.1 per 100,000 population in 2008, followed by an overall decreasing trend in recent years.

Analysis of the age- and gender-specific incidence rates of chlamydia showed that the trend among males aged 50 to 54 years was similar to that of the overall incidence for older males, suggesting the rise in chlamydia incidence among older males was largely attributed to an increase in incidence in this age group. The incidence of chlamydia in the 55 to

Figure 3
Incidence rate of all legally notifiable STIs (excluding HIV/AIDS) among persons aged ≥ 50 years in Singapore, 1996 - 2011

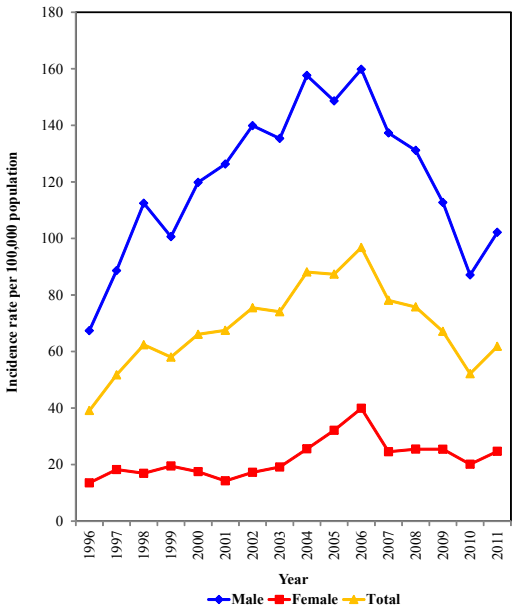
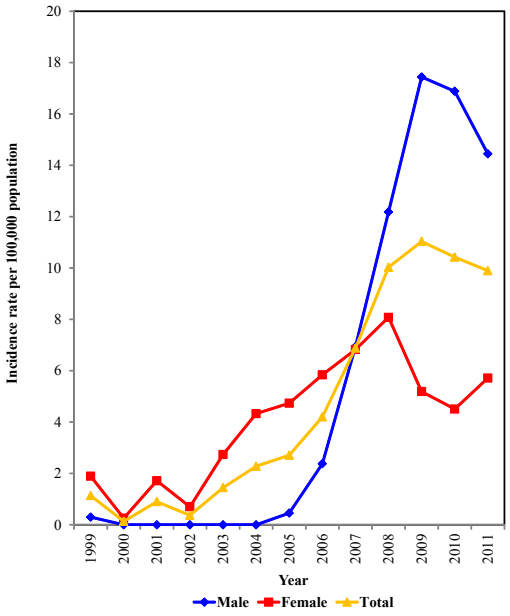


Figure 4
Incidence rate of chlamydia among persons aged ≥ 50 years in Singapore, 1999 - 2011



59 age group also showed an upward trend from 2005 to 2009 but decreased drastically in recent years. In comparison, chlamydia incidence among men aged 60 years and above was lower. There was also an initial increase in incidence in this age group from 2006 to 2008 but it dropped slightly in recent years (*Fig. 5*). In contrast, the upward trend of chlamydia among older females from 2002 to 2008 was largely accounted by the increase in incidence in the 50 to 54 and 55 to 59 age groups (*Fig. 6*).

The incidence rate of gonorrhoea among adults aged 50 years and above approximately tripled from 8.5 per 100,000 population in 1996 to 27.7 per 100,000 population in 2004. The incidence rates then dropped significantly over the years to 10.3 per 100,000 population in 2011. While the incidence rates among older females appeared to be fairly stable and remained less than 5 per 100,000 population throughout the study period, higher incidence rates were observed among the older males which contributed mainly to the fluctuations in the overall trend of gonorrhoea among older adults (*Fig. 7*).

Although there was an initial decline in incidence of infectious syphilis from 1996 to 1999, there appeared to be a resurgence of infectious syphilis with an overall rising trend in incidence from 1.7 per 100,000 population in 1999 to 6.9 per 100,000 population in 2005. From 2005 to 2011, the incidence of infectious syphilis dropped significantly by 80% to 1.4 per 100,000 population in 2011 (*Fig. 8*). Similar to HIV/AIDS and gonorrhoea, higher incidence rates were consistently reported in males compared to females throughout the study period.

There was a significant five-fold reduction in the incidence rate of NGU in recent years from 43.8 per 100,000 population in 2004 to 9.0 per 100,000 population in 2010 but it subsequently increased

Figure 5
Incidence rate of chlamydia among older males by age group in Singapore, 1999 - 2011

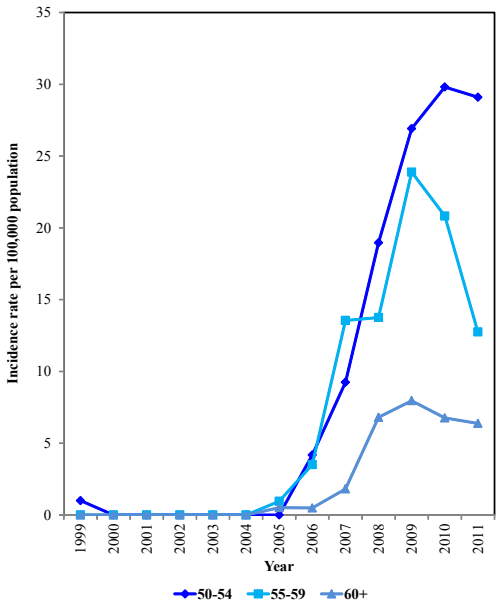
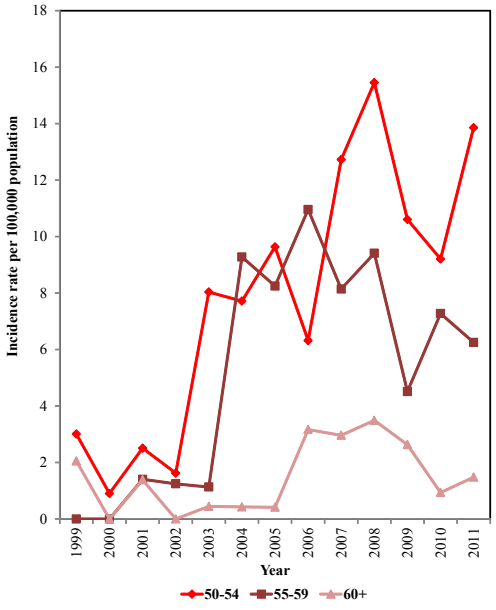


Figure 6
Incidence rate of chlamydia among older females by age group in Singapore, 1999 - 2011



slightly to 13.3 per 100,000 population in 2011. Prior to 2004, a steep upward trend was observed and the incidence rates increased significantly from 10.0 per 100,000 population in 1996. Similar patterns were also observed across the age groups among the older males though the 55-59 year age group appeared to reach its peak incidence slightly later in 2005 compared to the 50-54 and 60+ age groups whose incidence rates peaked in 2004 (*Fig. 9*).

A steady rise in the incidence of genital herpes was observed, from 5.6 per 100,000 population in 1996 to 19.2 per 100,000 population in 2007 ($p < 0.05$). Subsequently, there was a decrease in incidence, remaining fairly stable at around 15 per 100,000 population from 2009 to 2011 (*Fig. 10*). Although higher incidence rates were reported in older males, incidence in both genders displayed similar increasing patterns over the years in general.

Figure 7
Incidence rate of gonorrhoea among persons aged ≥ 50 years in Singapore, 1996 – 2011

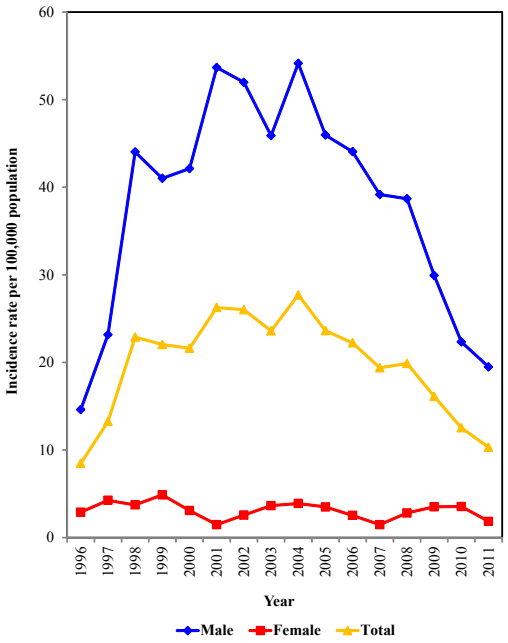


Figure 8
Incidence rate of infectious syphilis among persons aged ≥ 50 years in Singapore, 1996 – 2011

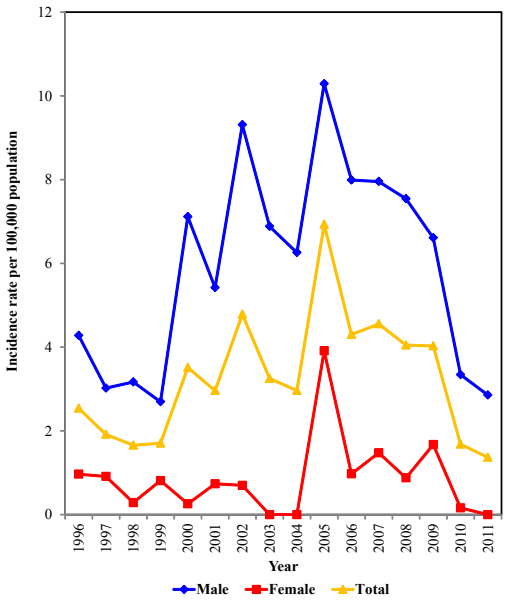
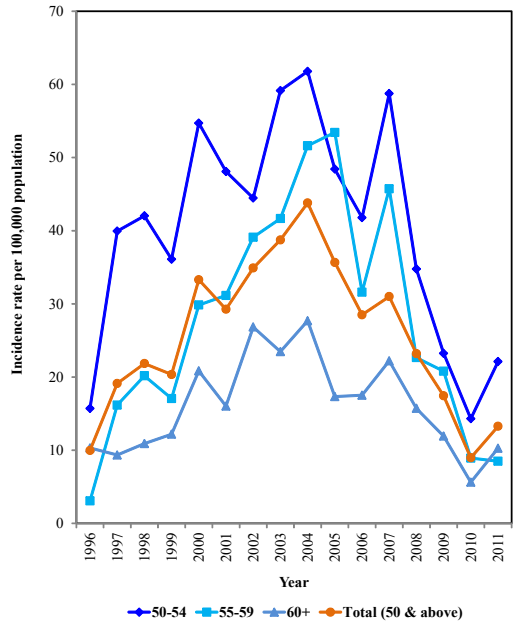


Figure 9
Incidence rate of NGU among older males in Singapore by age group, 1996 – 2011



However, it was observed that the incidence among older females continued to increase from 2007 onwards, albeit it was a slight and gradual increase. In contrast, the incidence of genital herpes in older males decreased by 28% from 34.9 per 100,000 population in 2007 and hovered around 25.0 per 100,000 population between 2009 and 2011.

The general rising trend of incidence of genital herpes was apparent across all age groups among the older males (*Fig. 11*). However, for the older females, it appeared that the increase in incidence was contributed largely by an increase in incidence among females in the 50-54 and 55-59 age groups, whereas the incidence among females aged 60 years and above showed a downward trend from 2007 to 2010 with only a slight increase in 2011 (*Fig. 12*).

Figure 10
Incidence rate of genital herpes among persons aged ≥ 50 years in Singapore, 1996 – 201

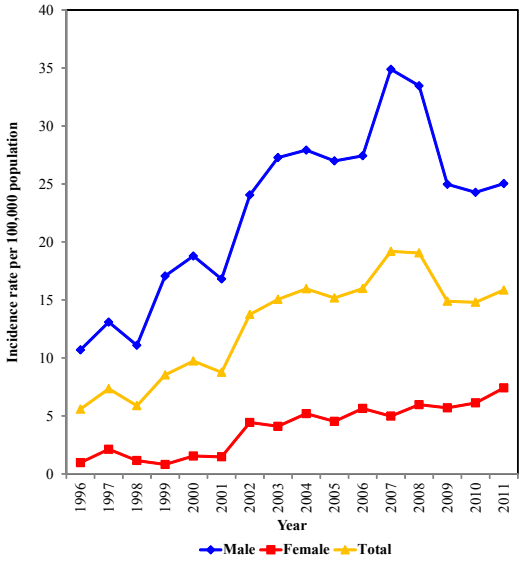


Figure 11
Incidence rate of genital herpes among older males in Singapore by age group, 1996 - 2011

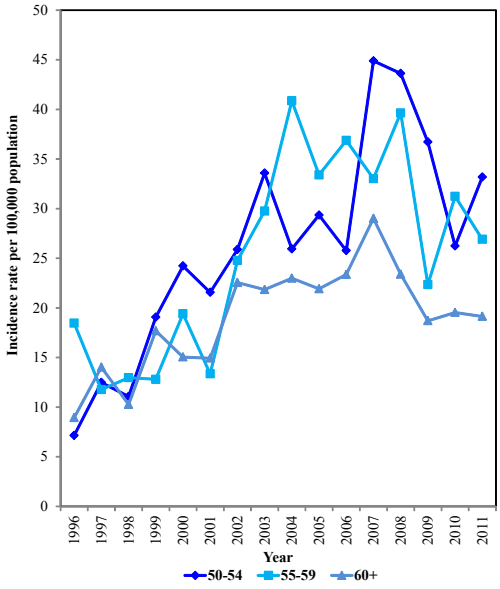
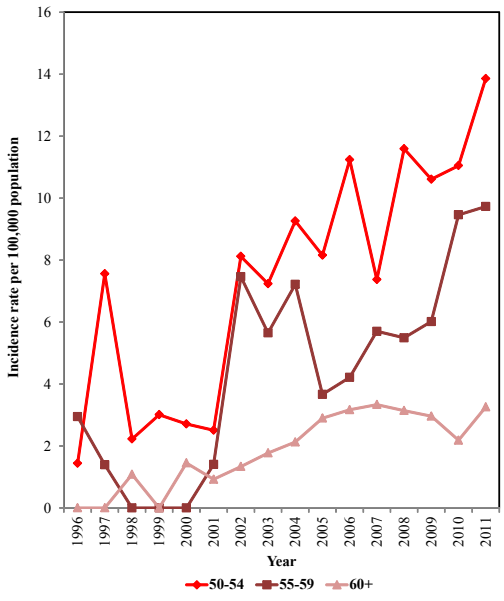


Figure 12
Incidence rate of genital herpes among older females in Singapore by age group, 1996 - 2011



Discussion

For this study, we defined 'older persons' as those aged 50 years and above. Although 50 years of age is not typically used to identify 'older' persons, this age cut-off is often used by the US Centers for Disease Prevention and Control (CDC) for reporting

of HIV/AIDS statistics and a number of studies on STIs in older populations in different geographical regions have similarly adopted the same age cut-off for data comparability.[7,11-13]

Trends of HIV infection

In this study, we found that approximately a quarter of newly diagnosed HIV/AIDS cases notified during the study period were aged 50 years and above, and there was an overall upward trend in the incidence of HIV/AIDS among older Singaporeans from 1996 to 2011. The emergence of HIV infections among the elderly in recent years has garnered the attention of public health agencies and experts worldwide. The US CDC reported a rise in the number of newly diagnosed HIV/AIDS cases among older persons with over 15% in persons aged 50 years and older and nearly 2% in patients over 65 years of age. From 2001 to 2005, the estimated number of AIDS cases by age of diagnosis had elevated by nearly 40% in persons aged 50 years and older.[14] Similarly, studies in the United Kingdom demonstrated that the number of older persons newly diagnosed with HIV had risen in recent years.[15] This rising trend of HIV infections and AIDS among older persons was also observed in Asian populations. A recent study among Taiwanese subjects showed that there had been an increase in the number of elderly subjects (50 years and above) with HIV infections from 47 newly diagnosed HIV cases in 1997 to 152 in 2007.[13] A related study of STIs among older people in China also revealed an increase in the proportion of STI cases among elderly Chinese from 3.8% in 1998 to 9.1% in 2005.[12]

The results of our study also suggest that the increase in incidence of HIV/AIDS among older Singapore residents is likely driven by a significant rising trend in incidence among older males, given that the incidence rates among females remained fairly low throughout the study period. It is well established that males are the predominant group at risk of HIV infections.[9] This is substantiated by the observed male to female ratio of 11:1 among older cases, which was comparable to that observed for the national notifications of HIV/AIDS across all age groups.[16] Furthermore, the overall rising trend in incidence of HIV/AIDS was apparent across all the older age groups, indicating that older males are generally at risk of acquiring HIV/AIDS.

Trends of legally notifiable STIs

For the other legally notifiable STIs, our study showed that among notified cases aged 50 years and above, males outnumbered females in all disease categories. Although the scope of this study does not encompass a comparison with the younger population, a previous study conducted among the older population in Singapore highlighted that there was a higher male predominance in older patients diagnosed with STIs compared to their younger counterparts.[11]

Based on our study, the three most common infections notified in the older population were gonorrhoea, non-infectious syphilis and genital herpes, with NGU also being common among older males. These are consistent with the findings by Tan *et al*.[11] In that study, it was reported that the three most common STIs among older males in Singapore were gonorrhoea, non-infectious syphilis and NGU whereas those among older females were non-infectious syphilis, followed by genital discharge and gonorrhoea. While gonorrhoea and non-infectious syphilis remained as the most commonly notified STIs in older males and females respectively, it appeared that the

incidence of genital herpes among older males had climbed over the years to become one of the top three common STIs in older males in place of non-infectious syphilis. Genital herpes and chlamydia have also replaced genital discharge and gonorrhoea in the list of top three common STIs affecting older females.

With the exception of chlamydia, the incidence of bacterial STIs such as gonorrhoea and infectious syphilis exhibited similar trends during the study period. A similar pattern was also observed in the incidence of NGU. The incidence rates of gonorrhoea, infectious syphilis and NGU generally increased from 1996 to around 2004-2005 before declining thereafter. The decrease in incidence of these STIs likely contributed to the drop in overall STI incidence from 2006 onwards.

The DSC clinic started monitoring for chlamydia infection in 1999 and chlamydia was listed as a notifiable disease under the IDA with effect from 19 December 2008. Although the incidence of chlamydia among older adults aged 50 years and above in Singapore remained very low in the earlier years, it rose drastically between 2003 and 2009 with a slight dip in the past two years. This may represent an apparent rise due to two possible reasons. Firstly, a polymerase chain reaction (PCR) methodology of higher sensitivity for testing of chlamydia was introduced in 2003 in place of the less sensitive enzyme-linked immunosorbent assay (ELISA) method[9], which would likely result in increased detection of cases. The most common cause of NGU is chlamydia.[16] With improved diagnostics for testing, NGU cases which tested positive for chlamydia were classified as chlamydia infection instead of NGU. Hence, this could contribute to the decreasing trend in NGU incidence and a corresponding rising trend in chlamydia incidence. Another plausible explanation accounting for the rise in chlamydia incidence would be the effect of legislation to include chlamydia as one of the legally notifiable diseases. As a result, cases of chlamydia seen in the private clinics and would otherwise be underreported are now being captured in the STI registry database. This is further substantiated by the observation of a rising trend of chlamydia incidence at the national level since 1999. Chlamydia is currently the top most notifiable STI in Singapore.[17]

Another interesting pattern observed in this study was the apparent switch in the predominant gender at risk of chlamydia infection during the study period. Between 1999 and 2006, higher incidence rates were reported among older females compared to their male counterparts. However, from 2007 onwards, older males appeared to be predominantly affected. This may be due to an increased awareness of STIs transmission risks among older males which resulted in changes in the health seeking behaviour of this group of individuals. As more older men seek medical attention and undergo testing for STIs, this could lead to increased detection of chlamydia cases. Alternatively, it has been postulated that older males are turning to commercial sources for sex and having less sexual intercourse with their spouses.[11] Therefore, this may account for the disparity in trends between older males and females, with older males being at an increasingly higher risk of acquiring chlamydia infections.

Similar to the trends of HIV/AIDS among older persons, the incidence of genital herpes in both older males and females exhibited an overall increasing trend throughout the study period, albeit with a reduction in recent years for males and a slight gradual increase for females. It is pertinent to note that STIs,

especially those causing genital ulcer diseases, have been reported to facilitate transmission of HIV.[18] This may occur via a variety of biological mechanisms such as increased shedding of the HIV in the genital tract which promotes HIV infectiousness or recruitment of HIV susceptible inflammatory cells to the genital tract and disruption of the mucosal barriers to infection which would render individuals more susceptible to acquiring HIV infection.[18] A recent meta-analysis by Corey *et al*.[19] highlighted the presence of increasing evidence in support of a substantial link between the epidemics of sexually transmitted HIV-1 and herpes simplex virus (HSV)-2 infections. The review also showed that prevalent HSV-2 was associated with a 2- to 4-fold increased risk of HIV acquisition.[19] Therefore, the concurrent rising trends of HIV/AIDS and genital herpes among older persons in Singapore may be substantiated by the current evidence of an epidemiological synergy between the HIV and HSV though further studies are warranted to examine for potential correlations or associations between cases of HIV/AIDS and genital herpes among older adults in Singapore.

Public health implications

The results of this study contributed to our understanding of the epidemiology and trends of STIs among older persons 50 years of age and above in Singapore over the years from 1996 to 2011. Although it is recognized that STIs predominantly affect younger populations, our findings here provide further evidence in support of the notion that older people are not exempted. While the overall STI incidence in the older population had decreased in recent years, there may be genuine public health concerns of rising trends of specific STIs among the older populations such as HIV/AIDS and genital herpes.

Potential limitations

There are some potential limitations in the current study. One of the limitations of this study is that, since surveillance data were used for the analysis, the findings could have been subjected to inherent bias associated with under-detection of asymptomatic infections and underreporting. Secondly, the diagnosis of NGU and genital herpes may be based solely on clinical impressions. NGU can be caused by a variety of aetiological agents, some of which include microorganisms that are not sexually transmitted.[20] In addition, a clinical diagnosis of genital herpes in an older person may be attributed to an activation of infection acquired in the remote past.[1] Hence, it may not be entirely accurate to infer that all older patients with diagnosis of genital herpes presumably acquire the infection from sexual activities at old age.

Conclusion

The findings of this study reaffirm that STIs, including HIV/AIDS, affect persons aged 50 years and older and provide insights into the epidemiological trends of HIV/AIDS and other notifiable STIs among the older population in Singapore from 1996 to 2011. Specifically, the incidence of viral STIs – HIV/AIDS and genital herpes appeared to be on the rise over the years, suggesting possible evidence of an epidemiological synergy between these two viral diseases. Although sexual health and prevention efforts should continue to be focused on the younger population at highest risk, the older population should not be neglected in light of the rapidly ageing population in Singapore and an anticipated rising proportion of elderly cases of STIs. More information about STI risk in older populations can be provided through various platforms to improve awareness and promote safe sex practices among older persons.

(Contributed by Tang ZC[1], Fong NP[2], Kurupatham L[1], Ooi PL[1] and Cutter J[1];Communicable Diseases Division, Ministry of Health[1], Saw Swee Hock School of Public Health, National University of Singapore[2])

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References

1. *Xu F, Schillinger JA, Aubin MR et al. Sexually transmitted diseases of older persons in Washington State. Sex Transm Dis 2001; 28:287-91.*
2. *Byers JP. Sexuality and the elderly. Geriatr Nurs 1983; 4:293-7.*
3. *Goh VHH, Tain CF, Tong YY et al. Sex and aging in the city: Singapore. The Aging Male 2004; 7: 219-26.*
4. *Tan HH, Wong ML, Chan RKW. An epidemiological and knowledge, attitudes, beliefs and practices study of sexually transmitted infections in older men. Singapore Med J 2006; 47:886-91.*
5. *Zablotsky D, Kennedy M. Risk factors and HIV transmission to midlife and older women: knowledge, options and the initiation of safer sexual practices. J Acquir Immune Defic Syndr 2003; 33:S122-30.*
6. *Drew O, Sherrard J. Sexually transmitted infections in the older women. Menopause Int 2008; 14:134-5.*
7. *Karlovsky M, Lebed B, Mydlo JH. Increasing incidence and importance of HIV/AIDS and gonorrhoea among men aged >=50 years in the US in the era of erectile dysfunction therapy. Scand J Urol Nephrol 2004; 38:247-52.*
8. *Attorney-General's Chambers, Singapore. Infectious Diseases Act (Chapter 137) [online]. Accessed on 11 May 2013. URL: http://statutes.agc.gov.sg/aol/search/display/view.w3p;page=0;query=DocId%3A5e69eb8c-5499-4f83-b096-9747cd9f1fa8%20Depth%3A0%20ValidTime%3A02%2F01%2F2011%20TransactionTime%3A31%2F07%2F2003%20Status%3Ainforce;rec=0;whole=yes.*
9. *Sen P, Chio MTW, Tan HH et al. Rising trends of STIs and HIV infection in Singapore - A review of epidemiology over the last 10 years (1994 to 2003). Ann Acad Med Singapore 2006; 35:229-35.*
10. *Low N, Sterne JA,Barlow D. Inequalities in rates of gonorrhoea and chlamydia between black ethnic groups in south east London: cross sectional study. Sex Transm Infect 2001; 77:15-20.*
11. *Tan HH, Chan RKW,Goh CL. Sexually transmitted diseases in the older population in Singapore. Ann Acad Med Singapore 2002; 31:493-6.*
12. *Pearline RV, Tucker JD, Yuan LF et al. Sexually transmitted infections among individuals over fifty years of age in China. AIDS Patient Care and STDs 2010; 24:345-7.*
13. *Kang SC, Hwang SJ, Wong WW. Characteristics of human immunodeficiency virus infections among the elderly in Taiwan: a nationwide study. J Chinese Med Assoc 2011; 74:215-9.*
14. *US Centers for Disease Control and Prevention. HIV/AIDS surveillance report, 2005 [online]. Accessed on 12 December 2011. URL: http://www.cdc.gov/hiv/surveillance/resources/reports/2005report/.*
15. *Dougan S, Payne LJ, Brown AE et al. Past it? HIV and older people in England, Wales and Northern Ireland. Epidemiol Infect 2004; 132:1151-60.*
16. *Ministry of Health, Singapore. Communicable Diseases Surveillance in Singapore, 2010.*
17. *Department of Sexually Transmitted Infections Control (DSC). Annual Report 2010. DSC, National Skin Centre, Singapore.*
18. *Fleming DT, Wasserheit JN. From epidemiological synergy to public health policy and practice: the contribution of other sexually transmitted diseases to sexual transmission of HIV infection. Sex Transm Inf 1999; 75:3–17.*
19. *Corey L, Wald A, Celum C, Quinn T. The effects of Herpes simplex virus-2 on HIV-1 acquisition and transmission: A review of two overlapping epidemics. J Acquir Immune Defic Syndr 2004; 35: 435-45.*
20. *Madeb R, Nativ O, Benilevi D et al. Need for diagnostic screening of Herpes simplex virus in patients with nongonococcal urethritis. Clin Infect Dis 2000; 30:982-3.*

Epidemiology of rubella among women of reproductive age in Singapore

Introduction

Rubella is a febrile viral exanthematous disease which is transmitted through respiratory droplets or direct contact with nasopharyngeal secretions. In most cases, the symptoms are often mild presenting with fever and rash, and up to 50% of infections may be sub-clinical or inapparent.[1] The public health importance of rubella relates to the teratogenic effects of the virus on the developing foetus in early gestation of pregnancy. Maternal infection with the rubella virus in susceptible women can cause multiple organ defects in the foetus and result in congenital rubella syndrome (CRS), miscarriage or foetal death.[2]

Prevention of CRS is the main objective of rubella vaccination. In Singapore, CRS used to be an important public health problem.[3,4] In November 1976, monovalent rubella vaccine was introduced into the National Childhood Immunisation Programme (NCIP) for pre-adolescent female primary school leavers (aged 11 to 12 years old). In April 1982, vaccination against rubella was extended to male primary school leavers and national service recruits, as periodic outbreaks of rubella with high sickness-absenteeism among national servicemen had affected training schedules.[5] Infected soldiers were also a potential source of infection to susceptible women of reproductive age.[6] In January 1990, the trivalent measles, mumps and rubella (MMR) vaccine was introduced into the NCIP with one dose of the vaccine given to children at 12 months of age.[7] A two-dose schedule with the first dose given at between 1 and 2 years of age and the second dose at 11 to 12 years of age was introduced in 1998.[8] In 2008, the second dose of the MMR vaccine was brought forward from primary 6 (11-12 years old) to primary 1 (6-7 years old) and 'catch-up' vaccination was carried out for students from primary 2 to primary 5. Since December 2011, the first dose of MMR vaccine was brought forward from 15 months to 12 months of age, and the second dose from 6-7 years to between 15 and 18 months of age.[9] With this change in the immunisation schedule, children would have received 2 doses of MMR vaccine by 2 years of age, thus reducing the pool of susceptibles among young children.

The objective of this study was to determine the epidemiology of rubella among women of reproductive age in Singapore and the effectiveness of the NCIP in raising the population immunity against rubella and preventing CRS.

Materials and methods

Serological surveys in adult population

We undertook National Seroprevalence Studies (NSS) in 2005 and 2012 to determine the prevalence of antibody to rubella in the adult Singapore resident population using residual sera obtained during the National Health Surveys (NHS) in 2004[10] and 2010[11]. The NHS was a population-based cross-sectional survey conducted by the Ministry of Health (MOH), Singapore, to determine the prevalence of major non-communicable diseases such as diabetes and their associated risk factors among Singapore adult residents

(Singapore citizens and permanent residents). Ethical approval was given by the Institutional Review Board Ethics Committee of the Health Promotion Board (HPB). We only tested the sera from NHS participants who had consented to the use of their residual sera for further research. Personal identifiers of participants were permanently removed, and new study numbers were tagged to the residual sera to ensure strict anonymity of the NHS participants.

In NSS 2005, the titre of rubella IgG antibody was determined using the Abbott AXSYM system rubella IgG assay (Abbott Park, Illinois), a microparticle enzyme immunoassay, and in NSS 2012, the Abbott Architect i4000 system rubella IgG assay (Abbott Park, Ireland), a chemiluminescent microparticle immunoassay, was used. In both studies, a titre of 10 IU/mL or greater was considered positive.

Case surveillance

We analysed the epidemiological data of all cases of rubella notified to MOH under the Infectious Diseases Act. Cases of congenital rubella and therapeutic abortions performed for rubella infections were identified from a database of the MediClaim System, which captures inpatient discharge information from all public and private hospitals in Singapore.

Vaccination coverage

The annual MMR vaccination coverage for each cohort of all Singapore citizens and permanent residents who completed the first dose by 2 years of age was obtained from the National Immunisation Registry (NIR) of HPB. The coverage of school children who completed the second dose of MMR vaccination was obtained from the School Health Service of Youth Health Division, HPB.

Statistical analysis

For the two NSS, post-stratification weights were computed based on the age, gender and ethnic group of the 2004 Singapore resident population and 2010 census Singapore resident population, respectively, to ensure that the characteristics of the samples for NHS 2004 and NHS 2010 conformed to that of the general population. When comparisons were made with the findings from NSS 2005, the sample for NSS 2012 was confined to Singapore residents who were of ethnic Chinese, Malay and Indian. Other ethnic groups were omitted.

Rubella seronegative rates between any two groups were compared using two-sample independent z-tests, with standard error estimated using pooled value of the two proportions. The Mantel-Haenszel chi-square test for trend was used to evaluate the difference in seronegative rates across age groups. Statistical significance was taken at $p < 0.05$.

For the calculation of annual age-specific incidence rates, the denominators used were the corresponding estimated mid-year populations compiled by the Department of Statistics, Singapore. The annual incidence rates of infants with CRS were calculated based on the number of live-births of the corresponding years obtained from the Registry of Births and Deaths.

Results

Susceptibility to rubella infection

Of the 1,002 women aged 18-44 years in NSS 2012, 11.1% (95% confidence interval, 9.1% – 13.0%) were susceptible to rubella infection (i.e. seronegative). In this reproductive age group, 19.0% of permanent residents were susceptible to rubella infection, which was more than doubled that of Singapore citi-

zens (8.1%) (p < 0.0005). There was a linear trend in the rubella seronegative rate by age ($p < 0.0005$). The proportion susceptible to rubella infection increased slightly from 6.7% among young women 18-24 years of age to 8.0% in those aged 25-34 years, and then doubled to 16.4% in the age group of 35-44 years.

There was a significant reduction in the proportion of women aged 18-44 years who were susceptible to rubella infection from 15.8% in NSS 2005 (n=1,241) to 11.0% in NSS 2012 (n=950, excluding other ethnic groups) ($p = 0.001$). Compared to NSS 2005, there was a significant decrease in rubella seronegative rate in NSS 2012 (excluding other ethnic groups) in the age groups of 18-24 years and 25-34 years (*Fig. 13*). Among women aged 18-24 years, the rubella seronegative rate halved from 14.3% in NSS 2005 to 6.9% in NSS 2012 (p = 0.01). In the age group of 25-34 years, the rubella seronegative rate decreased from 17.6% in NSS 2005 to 7.6% in NSS 2012 (p < 0.0005). The rubella seronegative rate in those 35-44 years of age remained similar at 14.5% in NSS 2005 and 16.6% in NSS 2012 (p = 0.39).

In both seroprevalence studies, there was no significant ethnic difference in susceptibility to rubella infection among women in the reproductive age group. In NSS 2012, the rubella seronegativity rate was 11.0% in Chinese, 9.1% in Malays, 14.0% in Indians and 13.5% in other ethnic groups. In NSS 2005, the rubella seronegativity rate was 15.8% in Chinese, 13.8% in Malays and 16.7% in Indians. There was a significant change in the rubella seronegative rate only among the Chinese during this period ($p = 0.004$).

Incidence of rubella and CRS

The incidence of rubella per 100,000 population among women aged 15-44 years had decreased from a peak of 13.5 in 1996 to 3.7 in 2002 (*Fig. 14*). The lowest incidence per 100,000 population was 0.7 in 2003, and thereafter, it ranged from 1.5 (in 2012) to 3.5 (in 2004).

Figure 13
Age-specific rubella seronegative rate (%) among women aged 18-44 years, NSS 2005 and NSS 2012

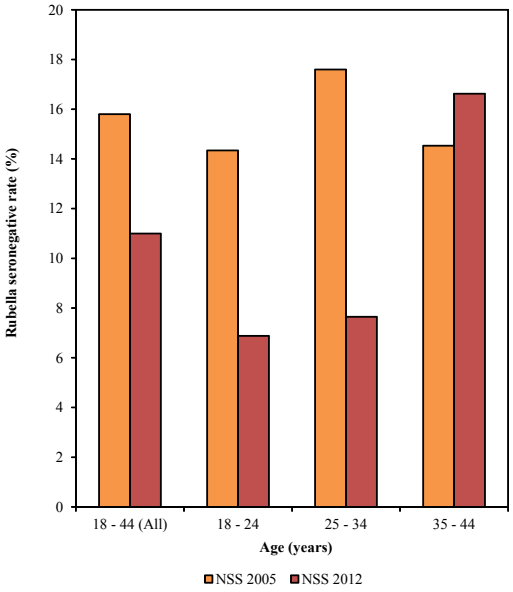
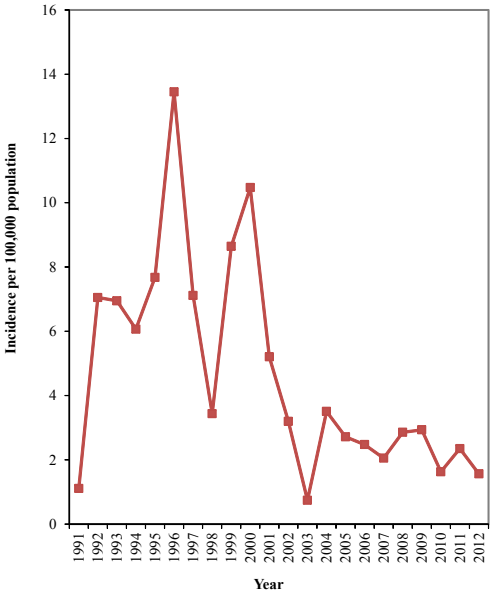


Figure 14
Rubella incidence of women aged 15-44 years (per 100,000 population), 1991-2012



Of the rubella cases among female Singapore residents aged 15-44 years from 2005 to 2012, Chinese comprised more than two-thirds (67.6%), while Malays and other ethnic groups constituted 15.2% and 10.5%, respectively. Indians made up the lowest proportion at 6.7%.

The annual incidence of CRS dropped sharply from 16 cases in 1976 to 10 cases in 1983, 2 cases in 1987 and thereafter, it had not exceeded 2 cases a year. During the past 16 years from 1997 to 2012, a total of 14 cases of CRS were reported. In 2005, one case of CRS was reported. The mother did not have any documented history of MMR or rubella vaccination. She was found to have rubella infection at her 7th week of gestation but she decided not to terminate her pregnancy. No cases of congenital rubella were reported in 2006, 2007 and 2009. In 2008, there were 2 cases of CRS involving babies born to Singapore permanent residents. The mothers were unsure if they had received vaccinations against rubella. There were 2 imported cases of CRS in 2010 and 2012, respectively, and all were foreigners seeking treatment in Singapore. In 2011, there were 2 cases whose mothers were foreign work permit holders.

In the past 2 decades, the annual incidence of CRS was less than 0.1 per 1,000 live-births (*Fig. 15*). The proportion of therapeutic abortions performed due to rubella infections had decreased from a peak of 0.10% in 1996 to 0.01% in 2012. Between 1997 and 2012, 25 therapeutic abortions were performed on account of rubella infections, but there was none from 2008 to 2011. In 2012, there was one termination of pregnancy involving an infected female foreigner working in Singapore.

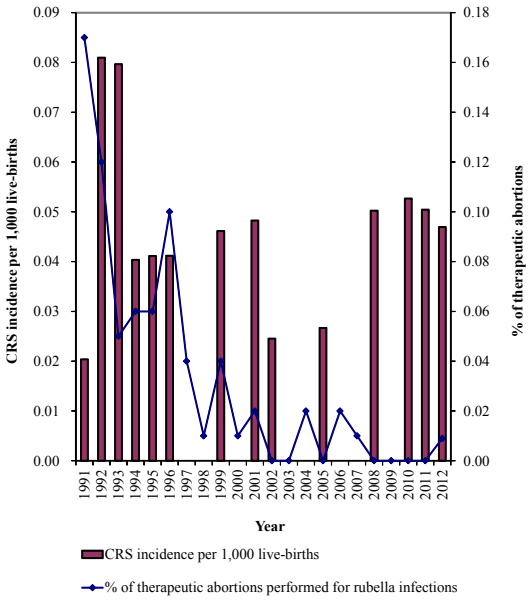
Vaccination coverage

In the past decade, the annual MMR vaccination coverage among Singapore citizens and permanent residents at 2 years of age and primary 6 students (aged 11-12 years) had been maintained at a high level from 93% to 96%. For school entrants (aged 6-7 years) and primary 5 students, the annual coverage rate had been between 92% and 95% during the period from 2008 to 2012.

Comments

Congenital rubella infection can be prevented by ensuring that women of reproductive age are protected through vaccination and by preventing or reducing their exposure to wild circulating rubella virus.[12] The NCIP has been successful in increasing the population immunity against rubella and preventing CRS through concerted efforts.

Figure 15
Incidence of CRS per 1,000 live-births and proportion of therapeutic abortions performed on account of rubella infections, 1991-2012



Past serological surveys showed that the level of susceptibility to rubella in women aged 15-44 years old had decreased from 47% in 1975-1979[13] to 28% in 1985, and maintained at between 10% and 20% from 1987 to 1998.[14] The proportion of women in the reproductive age group of 18-44 years who were susceptible to rubella infection continued to decline significantly from 15.8% in 2004[15] (based on NSS 2005) to 11.0% in 2010 (based on NSS 2012). However, about one-tenth of women in the reproductive age group remained susceptible to rubella infection.

The proportion of women in the reproductive age group susceptible to rubella infection in NSS 2012 was about two and three times higher than that of those aged 15-39 years in England & Wales in 2000 (6.2%), and women aged 15-34 years in Australia in 2002 (2.7%), respectively. Among Asian cities, the rubella seronegative rate varied. In Taipei, the proportion susceptible to rubella infection was 10.9% in women aged 15-44 years in 2004[16], whereas in Seoul, it was much higher at 26.9% in female university students aged 18-26 years in 1996.[17]

In NSS 2012, the proportion susceptible to rubella infection among female permanent residents was found to be significantly higher than Singapore citizens, which could be attributed to increases in the number of immigrants and non-residents from developing countries where immunisation coverage may be lower. In Switzerland, a seroepidemiological study conducted to determine the level of susceptibility to rubella among women who delivered in 1990/1991 revealed that the seronegative rate was significantly higher for those of foreign nationality (9.6%) than in the local population (3.5%) ($p < 0.001$).[18] The growing immigration in developed countries is known to pose a higher risk of rubella virus transmission due to the introduction of unprotected individuals.[19] In Singapore, the annual incidence rate of rubella among women aged 15-44 years was higher in non-residents than residents. Localised transmission are known to occur in institutional settings where unvaccinated susceptible populations congregate[14], such as an outbreak reported in 2009 involving foreign workers staying in dormitory on an off-shore island of Singapore.[20] In the United States, outbreaks of rubella had been reported in offices and prisons.[21,22]

In 2003, the Pan American Health Organization (PAHO) adopted a resolution calling for elimination of rubella and CRS in the Americas by 2010.[23] A review of the epidemiology of rubella in the region of the Americas showed that the elimination initiative was an achievable and cost-effective intervention.[24] In 2005, the World Health Organization (WHO) Regional Committee for Europe expanded the goal of eliminating indigenous measles transmission to include rubella and set a date for the elimination of both diseases in the European Region by 2010. Of the 47 Member States in the European Region which submitted CRS data from 2005 to 2009, 36 Member States reported 0 cases, 7 Member States reported 1 to 2 cases, and 4 Member States reported 3 to 6 cases.[25] Although Member States did make progress, the goal was not achieved. In 2010, the WHO Regional Committee for Europe re-committed to these goals, and changed the target date for elimination from 2010 to 2015.[26]

In 2010, the Technical Advisory Group on Immunization and Vaccination for WHO Western Pacific Region (WPR) endorsed targets of reducing rubella incidence to below 10 cases per million population, excluding imported cases, and CRS incidence of

below 10 cases per million live-births, excluding imported cases, for accelerated rubella control and CRS prevention by 2015.[27] In 2012, WHO and partners in the Measles and Rubella Initiative adopted a new global strategic plan for measles and rubella with goals to reduce global measles deaths by at least 95% compared with 2000 levels and achieve regional measles and rubella/CRS elimination goals by 2015, and to achieve measles and rubella elimination in at least five WHO regions by 2020.[28]

In Singapore, the incidence of indigenous rubella cases per million population decreased from 36.2 in 2008 to 10.7 per million population in 2012, and CRS incidence excluding imported cases was 0 in the past 4 years. Thus, Singapore was on track to meet the two targets set for the WHO WPR.

Screening for rubella susceptibility is part of routine antenatal care for pregnant women in a number of European countries such as the United Kingdom. Those found to be susceptible are offered postpartum immunisation.[29,30] This practice can be reviewed for expansion in Singapore, so that those who are found to be susceptible can be offered postpartum immunisation. Currently, rubella antibody screening is optional for antenatal care in Singapore.

As part of its health education and promotion efforts, the HPB has published and distributed pamphlets to polyclinics for the public, and the Primary Care Academy has conducted talks on rubella and hepatitis B at workplaces. There is a need to continue monitoring the immunity levels to assess if the health education and promotion efforts have been effective and adequate.

(Reported by Ang LW[1], Tiong WW[2], Chua YX[3], Cutter JL[2], James L[1], Epidemiology & Disease Control Division[1], and Communicable Diseases Division[2], Standards and Quality Improvement Division[3], Ministry of Health, Singapore)

References

1. *US Centers for Disease Control and Prevention. Rubella. In: Atkinson W, Wolfe S, Hamborsky J, eds. Epidemiology and Prevention of Vaccine-Preventable Diseases. 12th ed. Washington DC: Public Health Foundation, 2012; pp. 275-90.*
2. *Isaacs D, Menser M. Modern vaccines: measles, mumps, rubella, and varicella. Lancet 1990;335:1384-7.*
3. *Goh KT. Viral diseases surveillance in Singapore. In: Goh KT. Epidemiological surveillance of communicable diseases in Singapore. Tokyo: Southeast Asian Medical Information Center, 1983.*
4. *Tan KL, Wong TTT, Chan MCK et al. Congenital rubella in Singapore. J Sing Paed Soc 1970;12:111-25.*
5. *Ahmad MT, Tan EH, Seet LC et al. Rubella in male Singapore adolescents: incidence and effects of vaccination. Singapore Med J 1984:25:404-7.*
6. *Goh KT. The national immunisation programmes in Singapore. Singapore Med J 1985;26:225-42.*
7. *Committee on Epidemic Diseases, Singapore. Introduction of measles-mumps-rubella (MMR) vaccine into the national childhood immunization programme. Epidemiological News Bulletin 1989;15:66-68.*
8. *Committee on Epidemic Diseases, Singapore. Progress in the elimination of measles from Singapore. Epidemiological News Bulletin 2003;29: 1-5.*
9. *Ministry of Health, Singapore. Children to receive earlier vaccinations for measles, mumps and rubella. Available at: http://www.moh.gov.sg/content/moh_web/home/pressRoom/pressRoomItemRelease/2011/children_to_receiveearliervaccinationsformeaslesmumpsrubella.html (Accessed 5 October 2012).*
10. *Ministry of Health, Singapore. National Health Survey 2004. Singapore: Ministry of Health, 2005.*
11. *Ministry of Health, Singapore. National Health Survey 2010. Singapore: Ministry of Health, 2011.*

12. World Health Organization Regional Office for Europe. Eliminating measles and rubella and preventing congenital rubella infection: WHO European Region strategic plan 2005-2010. WHO; 2005. Available from: http://www.euro.who.int/Document/E87772.pdf (Accessed 9 May 2013).

13. Doraisingham S, Goh KT. The rubella immunity of women of childbearing age in Singapore. Ann Acad Med Singapore 1981;10:238-41.

14. Committee on Epidemic Diseases, Singapore. Serosurveillance of rubella in Singapore. Epidemiological News Bulletin 2001;27: 1-3.

15. Ang LW, Chua LT, James L et al. Epidemiological surveillance and control of rubella in Singapore, 1991 – 2007. Ann Acad Med Singapore 2009;39:95-101.

16. Wang IJ, Huang LM, Chen HH et al. Seroprevalence of rubella infection after national immunization program in Taiwan: vaccination status and immigration impact. J Med Virol 2007;79:97-103.

17. Park KS, Kim HS. Seroprevalence of rubella antibodies and effects of vaccination among healthy university women students in Korea. Yonsei Med J 1996;37:420-6.

18. Zufferey J, Jacquier P, Chappuis S et al. Seroprevalence of rubella among women of childbearing age in Switzerland. Eur J Clin Microbiol Infect Dis 1995;14:691-6.

19. Bloom S, Smith P, Stanwyck C et al. Has the United States population been adequately vaccinated to achieve rubella elimination? Clin Infect Dis 2006:43:S141-5.

20. Chua A, Osman AR, Ang LW et al. Rubella outbreak among foreign workers in an off-shore island, 2009. Epidemiological News Bulletin 2011;37:18—21.

21. US Centers for Disease Control and Prevention (CDC). Rubella outbreak among office workers - New York City. Morb Mortal Wkly Rep 1983; 32: 349-52.

22. US Centers for Disease Control and Prevention (CDC). Rubella outbreaks in prisons - New York City, West Virginia, California. Morb Mortal Wkly Rep 1985; 34: 615-8.

23. Pan American Health Organization. Resolution CD44.R1. Sustaining immunization programs - elimination of rubella and congenital rubella syndrome (CRS). 44th Directing Council; 55th Session of the Regional Committee of the World Health Organization. Washington, DC: Pan American Health Organization, 2003. Available at: http://iris.paho.org/xmlui/handle/123456789/243 (Accessed 10 May 2013).

24. Muscat M, Zimmerman L, Bacci S et al. Toward rubella elimination in Europe: an epidemiological assessment. Vaccine. 2012; 30:1999-2007.

25. Zimmerman LA, Muscat M, Jankovic D et al. Status of rubella and congenital rubella syndrome surveillance, 2005-2009, the World Health Organization European Region. J Infect Dis 2011;204 Suppl 1:S381-8.

26. World Health Organization. Regional Committee for Europe resolution EUR/RC60/R12 on renewed commitment to elimination of measles and rubella and prevention of congenital rubella syndrome by 2015 and sustained support for polio-free status in the WHO European Region. Copenhagen, WHO Regional Office for Europe, 2010. Available at:http://www.euro.who.int/__data/assets/pdf_file/0016/122236/RC60_eRes12.pdf (Accessed 10 May 2013).

27. World Health Organization. Nineteenth meeting of the technical advisory group on immunization and vaccine-preventable diseases in the Western Pacific Region. Regional Office for the Western Pacific, Manila, Philippines, 23–27 August 2010. Available at: http://www.wpro.who.int/immunization/meetings/2010/tag19_mtgrpt.pdf (Accessed 10 May 2013).

28. World Health Organization. Global measles and rubella strategic plan: 2012-2020. Geneva, 2012. Available at: http://whqlibdoc.who.int/publications/2012/9789241503396_eng.pdf (Accessed 10 May 2013).

29. European Centre for Disease Prevention and Control. Surveillance report: European monthly measles monitoring (EMM). Issue 8: 21 February 2012. Available at http://ecdc.europa.eu/en/publications/publications/sur_emmo_european-monthly-measles-monitoring-february-2012.pdf (Accessed 6 December 2012).

30. Health Protection Agency, United Kingdom. Surveillance of Antenatal Screening for Infections. Available at http://www.hpa.org.uk/Topics/InfectiousDiseases/InfectionsAZ/AntenatalScreening/ (Accessed 6 December 2012).

Outbreak of gastroenteritis caused by *Salmonella* Enteritidis associated with the consumption of food from a restaurant in Singapore

Introduction

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

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

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

Notification

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

Methods

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

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

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

Results

A total of five cases that met the case definition were identified. Two of these cases were from the

first incident and the remaining cases were from the second incident. All of them had consumed tiramisu and roast chicken for dinner on 10 May 2013 prior to their onset of symptoms.

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

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

Two of four stool samples obtained from the cases were positive for *Salmonella* Enteritidis, MLVA type J (*Fig. 17*). All the four food handlers from the implicated restaurant tested negative for food-borne pathogens, including norovirus and rotavirus.

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

Food preparation process

Two batches of chickens were cooked each day at 0900hrs and 1500hrs. Preparations for roast chickens began at 0900hrs when fresh chickens were delivered to the restaurant. The chickens were marinated in brine with salt and sugar. The first batch of

Figure 16
Onset of illness of 5 reported food poisoning cases who consumed food at a restaurant on 10 May 2013

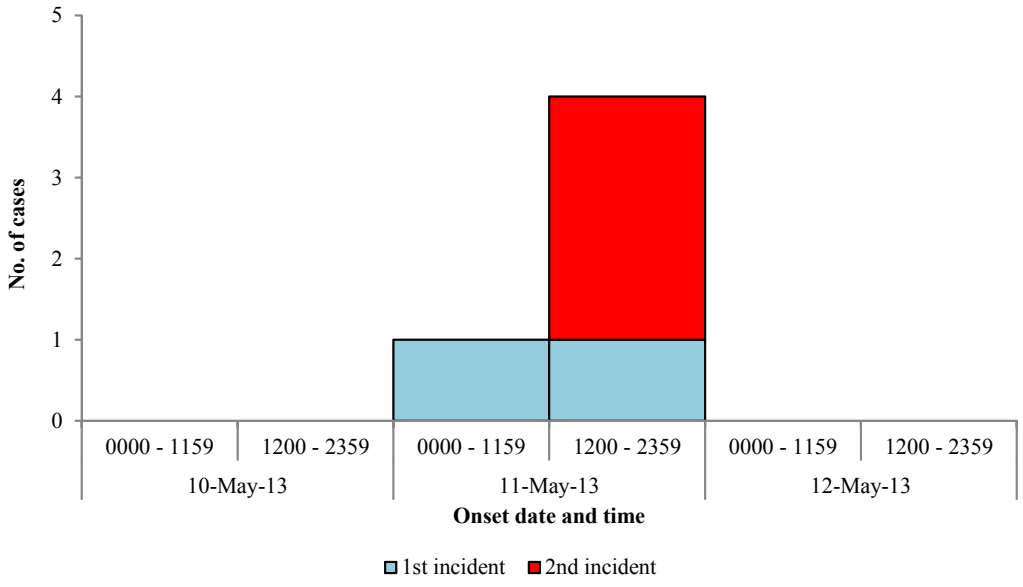
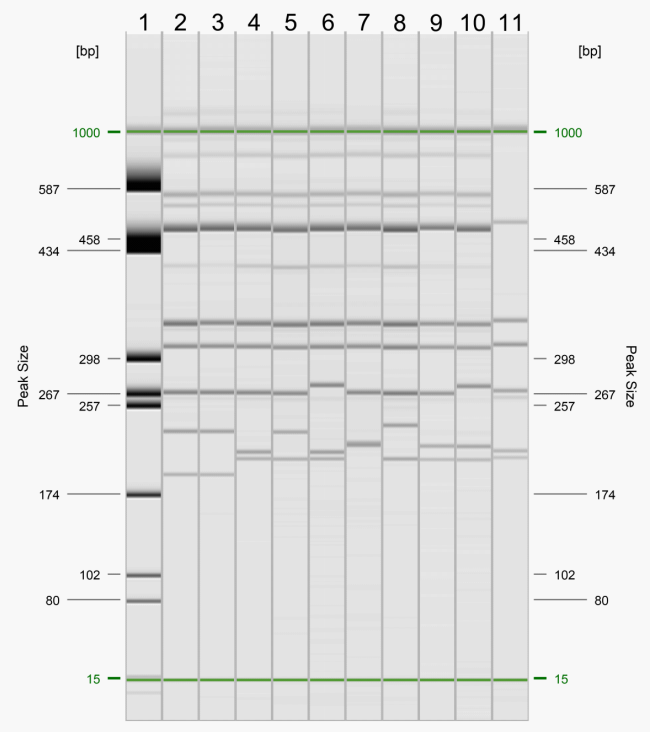


Figure 17
MLVA typing of two *Salmonella*-positive cases



1. DNA ladder
2. Case from first incident
3. Case from second incident
4. MLVA type A control
5. MLVA type B control
6. MLVA type C control
7. MLVA type D control
8. MLVA type E control
9. MLVA type F control
10. MLVA type G control
11. MLVA type I control

chickens was seared before cooking in the combination oven. The remaining chickens were kept in the refrigerator to be cooked at 1500hrs. After cooking in the combination oven, the chickens were transferred to the rolling oven for further roasting. The roast chickens were then transferred to the warmer before serving. Sauces were added to the chickens just before serving to the customers. Precautionary measures were taken throughout the food preparation process to prevent cross-contamination between raw and cooked chickens.

The tiramisu was prepared by the food handlers daily at 1400hrs and it took 20 minutes to complete. There were no specific personnel-in-charge of making the tiramisu. Eggs were a key ingredient used to make the tiramisu. These were supplied daily to the restaurant at 0900hrs. The egg whites and egg yolks were manually separated from whole egg into 2 bowls. Sugar was added to 18 of these pooled egg yolks to be whisked together with rum syrup to make a mousse (sabayon). Mascarpone cheese was then added to the sabayon and this was subsequently chilled in the refrigerator. Similarly, sugar was added to the pooled egg whites and whisked to become a meringue. Fresh cream was mixed with sugar to make a cream mixture. Sponge fingers were separately soaked in rum syrup and coffee mixture. Finally, the meringue, sabayon and cream were mixed together and then layered onto the sponge fingers to make 60

jars of tiramisu. The tiramisu was then chilled for 3 hours before serving. This batch of tiramisu would be served on the same day as well as for lunch on the following day. The preparation process of the tiramisu is depicted in *Fig. 18*.

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

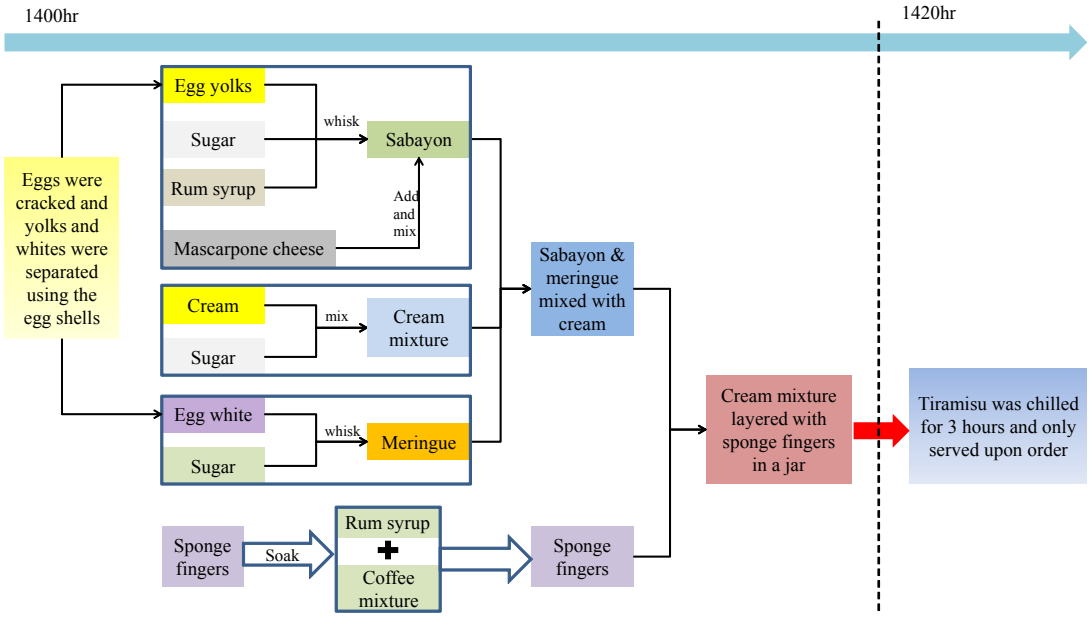
Discussion

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

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

Salmonellosis is a bacterial disease characterized by acute enterocolitis, with sudden onset of abdominal pain, diarrhoea, nausea and vomiting. The incubation period is usually between 12 and 36 hours but it can range from 6 to 72 hours. Infection

Figure 18
Preparation process of tiramisu



can arise from ingestion of the salmonella bacteria in food derived from infected animals or food that is contaminated by faeces of infected animals or humans[7].

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

Outbreaks of *Salmonella* Enteritidis associated with eggs and desserts are not uncommon. In 2010, Wright Country Egg of Galt, Iowa, conducted a nationwide voluntary recall of shell eggs due to *Salmonella* Enteritidis contaminated egg shells. 1,939 reported cases of salmonellosis were associated with this outbreak[8]. In the United States, eggs or egg-containing foods were implicated in 77% of the outbreaks of *Salmonella* Enteritidis infection in which a food vehicle was identified[5]. In the United Kingdom, desserts were implicated in 19% of outbreaks and eggs were used as an ingredient in 70% of these desserts[9]. The high number of eggs-associated outbreaks may be due to the fact that eggs are often eaten raw or undercooked. Foods that contain eggs, such as tiramisu or ice-creams, are often lightly cooked or uncooked. The practice of pooling a large number of eggs for use in commercial settings may also increase the risk of salmonella-associated outbreaks as one or a few contaminated eggs can accelerate and increase the exposure of consumers to *Salmonella* Enteritidis contamination.

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

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

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

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

(Contributed by Tow C, Pang QY, Hishamuddin P, Tay J, Chew S, Seet SK, and La MV, Communicable Disease Division, Ministry of Health)

References

1. *Galanis E, Danilo M.A, Wong L.F et al. World Health Organization Global Salmonella-Surv.Web-based surveillance and global Salmonella distribution, 2000–2002. Emerging Infectious Diseases, 2006, 12:381–388.*
2. *Voetsch AC, Van Gilder TJ, Angulo FJ et al. FoodNet estimate of the burden of illness caused by non-typhoidal Salmonella infections in the United States. Clinical Infectious Disease, 2004; 38(Suppl 3):S127–34.*
3. *Ministry of Health, Singapore. Communicable Disease Surveillance in Singapore 2011.*
4. *European Food Safety Authority (EFSA). The European Union summary report on trends and sources of zoonoses, zoonotic agents and food-borne outbreaks in 2010. EFSA Journal 2012;10:2597.*
5. *Braden CR. Salmonella enterica serotype Enteritidis and eggs: A national epidemic in the United States. Clinical Infectious Disease 2006; 43: 512-7.*
6. *Cho S, Boxrud D, Bartkus JM et al. Multiple-locusvariable-number tandemrepeat analysis of Salmonella Enteritidis isolates from human and non-human sources using a single multiplexPCR. FEMS Microbiol Lett 2007; 275: 16–23.*
7. *Heyman DL (ed). Control of Communicable Diseases Manual. American Public Health Association, 18th Edition, 2004.*
8. *Centers for Disease Control and Prevention. Salmonella serotype Enteritidis http://www.cdc.gov/nczved/divisions/dfbmd/diseases/salmonella_enteritidis, Nov 2010.*
9. *O'Brien S. The "decline and fall" of non-typhoidal Salmonella in the United Kingdom. Clinical Infectious Disease 2013; 56: 705-10.*
10. *Suhana S, Chan PP, Lalitha K et al. An outbreak of gastroenteritis caused by Salmonella enterica serotype Enteritidis traced to cream cakes. Western Pacific Surveillance and Response Journal, 2011; 2(1). doi: 10.5365/wpsar.2010.1.1.001.*
11. *Lu PL, Hwang IJ, Tung YL et al. Molecular and epidemiologic analysis of a country-wide outbreak caused by Salmonella enterica subsp. enterica serovar Enteritidis traced to a bakery. BMC Infectious Disease 2004; 4:48-54.*
12. *Ministry of Health, Singapore. An outbreak of food poisoning caused by Salmonella Enteritidis. Epidemiological News Bulletin1996;22:51–3.*
13. *Messens W, Grijspeerdt K, Herman L. Eggshell penetration by salmonella: a review. World Poultry Science Journal 2005, 61:71–85.*
14. *BarkerJ, Bloomfield SF. Survival of salmonella in bathrooms and toilets in domestic homes following salmonellosis. Journal of Applied Microbiology, 2000; 89: 137-44.*

Outbreak of gastroenteritis in a junior college in Singapore

On 11 Jul 2012, the Ministry of Health (MOH) was notified of a possible incident of food-borne illness involving 26 students at a junior college. The campus is divided into the main school and the boarding school with an estimated population of 1,900 students with 250 teaching and non-teaching staff. There are 10 cooked food and two drinks stalls in the school canteen while the boarding school has a dining hall with food provided by a licensed catering company.

Field investigations were carried out promptly at the junior college on 11 Jul 2012. We report the findings of the outbreak investigation.

Epidemiological investigations

Cases from the college were identified and their details such as age, gender and ethnicity, signs and symptoms, onset of illness and types of medical treatment sought were obtained. A case was defined as an individual studying or working in the junior college and who developed vomiting and/or watery diarrhoea (at least 2 times within 24 hours) from 8 July to 14 July 2012.

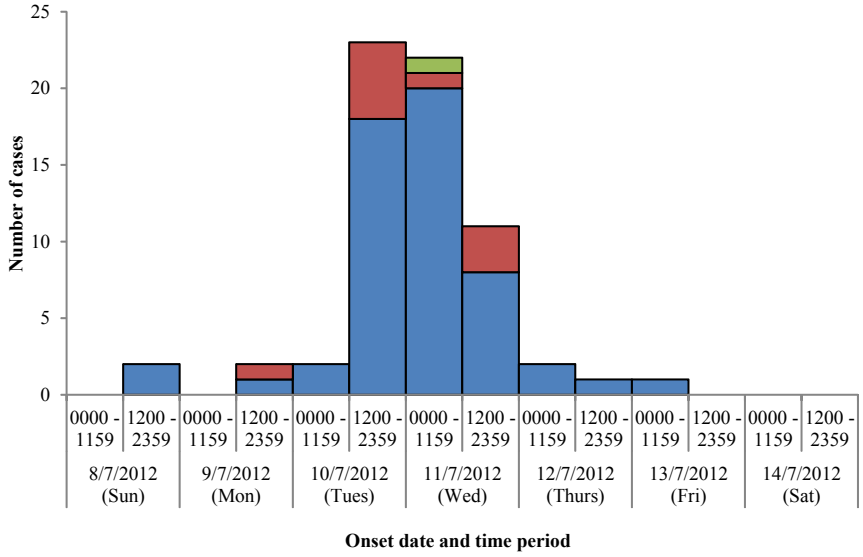
Stools of reported cases, and food, water and environmental samples were collected from the school canteen and sent for detection of bacterial and viral enteropathogens (*Campylobacter, Shigella, Salmonella, Vibrio, rotavirus and norovirus*). Food handlers from the school canteen and dining hall were also screened for enteropathogens.

A case-control study was conducted using a standard set of questionnaires to determine the vehicle of transmission based on food consumed in the college three days prior to the onset of symptoms. Test for significant difference of food-specific attack rates by date of food consumption was by the chi-square or Fisher's exact test We also tested for significant difference in food-stall-specific attack rates using bivariate analyses, with crude odds ratio (OR) and 95% confidence intervals (CI) computed. Statistical analyses were performed using PASW Statistics Version 18.0 (SPSS Chicago, IL). A p-value of <0.05 was considered statistically significant.

Findings

Based on the case definition, a total of 68 cases, which consisted of 67 students (10 boarders and 57 non-boarders) and one 51 year-old female teacher, were identified, giving an overall attack rate of 3.2%. Their onset of illness was between 8 July and 13 July 2012. The age of the affected students ranged from 12 years to 19 years with a male to female ratio of 2.4: 1. The clinical signs and symptoms included vomiting (90%), stomach ache (77.9%), nausea (58.8%), watery diarrhoea (57.4%) and fever (45.6%). Of the reported cases, 41 (60.3%) sought treatment at private clinics and 8 (11.8%) at polyclinics. For the remaining cases, 19 (27.9%) self-medicated or recovered without any medication. No one was hospitalised. The epidemic curve is shown in *Fig 19*.

Figure. 19
Onset of illness of 67 reported cases* of gastrointestinal in a junior college, 8 - 13 July 2012



*excluding one case who was unable to recall

Two stool samples collected from the cases were tested positive for norovirus, genogroup II. Of 25 food handlers from the school canteen screened, two were positive for food-borne pathogens – one for *Salmonella* Group E and another for norovirus, genogroup II. One of nine food handlers from the dining hall was positive *for Campylobacter jejuni*. All the three infected food handlers were asymptomatic before and during the incident.

Six of 17 food samples collected from six different canteen stalls were found to have high total aerobic plate count (>100,000 cfu/g) and total coliforms (>1,100 MPN/g). One food sample taken from one of the canteen food stalls was positive for *Escherichia coli* (>1,100MPN/g). Water samples collected by the Public Utilities Board (PUB) were found to be chemically and bacteriologically safe for consumption.

Case-control analysis

There were a total of 161 respondents to the questionnaires for the case-control study. Of these, 57 were cases while 104, who had remained asymptomatic, served as controls. 9 out of the 57 cases and 22 out of the 104 controls were students who stayed in the boarding school. No specific food item served in the canteen nor any food stall was implicated.

Further investigations

As we could not conclusively associate this outbreak in our preliminary investigation with the con-

sumption of food at the school canteen, we conducted further enquiries into other modes of transmission. When norovirus was detected in the stool samples of two of the cases, we directed our investigations into the contact history and activities of the reported cases. The index case was a 13 year-old female student who stayed at the boarding school. She reported having vomited in a toilet near the school field after her onset of symptoms on 8 Jul 2012 at 2200 hours.

Two female students, one aged 13 years and the other aged 19 years who was exposed to the index case, became ill on 9 July at 1745 hours and 1900 hours, respectively. One of them who had vomited in a toilet near the school field, could have spread the infection to at least 5 other students whose onset of illness was on 10 July. In the initial phase, most of the cases were confined to students in one particular building in the college, with a few sporadic cases among students in the remaining buildings. No common activity or congregation of students from different classes were reported during the week of the outbreak. The infection subsequently spread to the boarders with onset of illness on 11 July when three of the cases reported having vomited in the toilets and the boarding school premises. *Fig 20* is a diagram showing the chain of transmission. The median incubation period was 19.5 hours and ranged from 16 hours to 31 hours

Prevention and control

At the time of investigation, the school management was directed to inform MOH should there be any new cases. In addition, to break the chain of transmission, MOH advised a number of infection control measures:

1) Identify and refer all suspected cases for medical treatment early;

2) Promote frequent hand washing with proper techniques among students, particularly before eating and after toilet visits;

3) Ensure that all the toilets are in a sanitary condition and adequately equipped with soap and toilet papers;

4) Carry out regular disinfection of environmental surfaces in frequent contact such as door handles, knobs, staircase railings and lift buttons;

5) Use bleach to disinfect surfaces and equipment contaminated with vomitus and dispose of the vomitus at a rubbish bin located far away from the students;

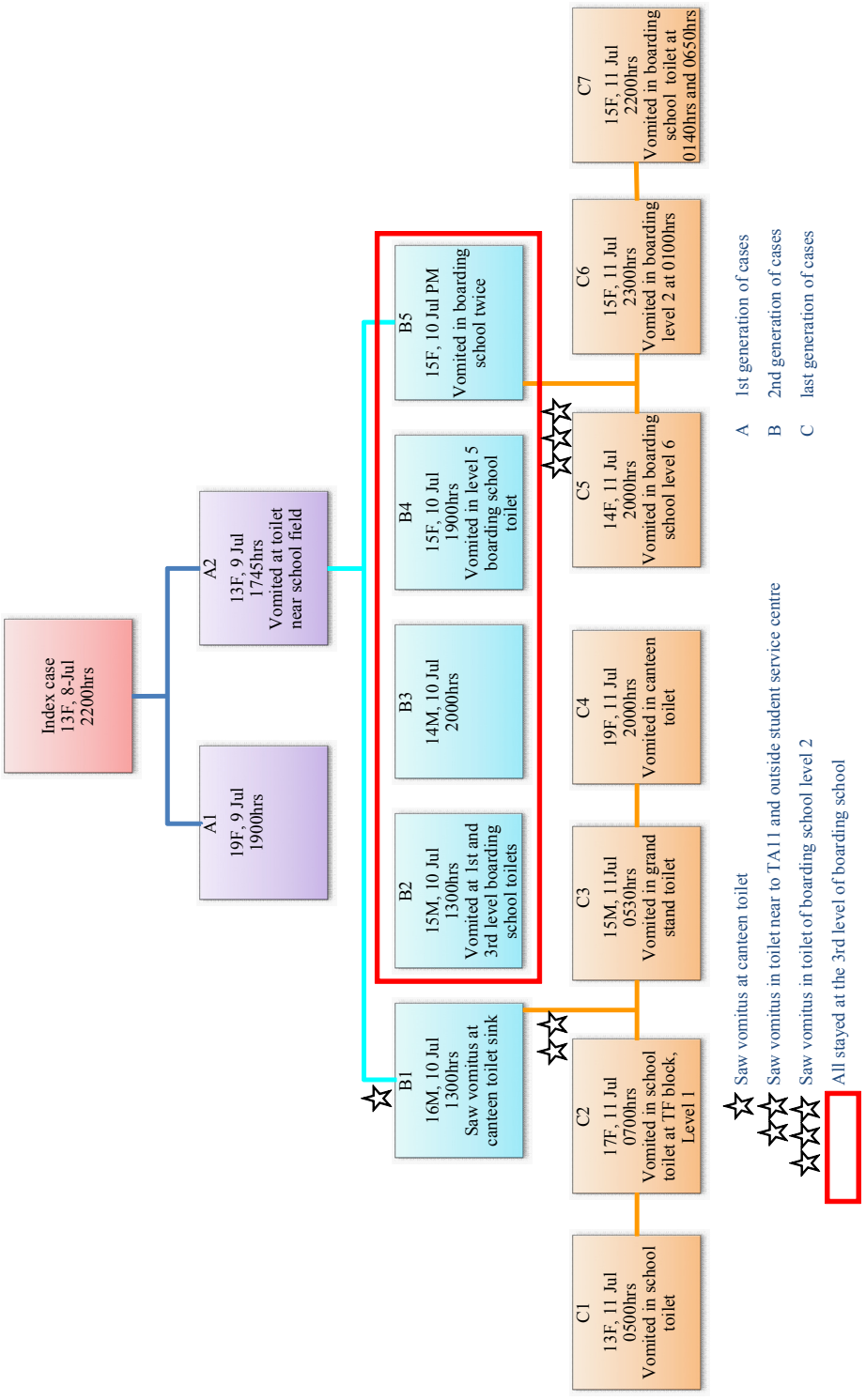
6) Remind food handlers to observe good food and personal hygiene, and to refrain from handling food if they are unwell.

Discussions

The epidemiological and clinical features of this outbreak with 90% of the cases presenting with vomiting and an incubation period of 19.5 hours are quite typical of norovirus gastroenteritis. This was confirmed by the detection of norovirus, genotype II from 2 of the cases.

Norovirus infection usually presents as acute-onset vomiting, watery diarrhoea with abdominal cramps, and nausea[1]. Although the usual incubation period for norovirus is 12 – 24 hours, range of 10 – 50 hours incubation is possible[1]. Norovirus gastroenteritis is highly contagious and usually transmitted directly from person to person through the faecal-oral route, and indirectly through contaminated food and

Figure 20
Chain of transmission in an outbreak of gastroenteritis in a junior college, 8 - 13 July 2012



water, or environmental surfaces[1]. Potential transmission due to aerosolisation of vomitus has been documented[2].

Norovirus is the most common cause of acute gastroenteritis and food-borne disease outbreaks in the United States. Each year, it causes about 21 million illnesses and contributes to about 70,000 hospitalizations and 800 deaths. About 67% of all norovirus outbreaks occur in long-term care facilities such as nursing homes[3].

In Singapore, the number of food poisoning notifications and cases rose by 14 and 17 times, respectively, during the period 1965 to 2011[4]. The first recorded outbreaks of 305 cases of norovirus gastroenteritis associated with the consumption of imported oysters occurred from Dec 2003 to Jan 2004[5]. In 2008, an outbreak of 156 cases of acute norovirus gastroenteritis due to environmental contamination by vomitus was recorded in a military facility in Singapore[6]. Between 2009 and 2011, 28 incidents of norovirus gastroenteritis were investigated; 54% occurred in educational institutions[7], 32% in nursing homes[8,9] and 14% in other settings. The percentage of stool samples tested positive for norovirus doubled from 2.8% in 2009 to 6.3% in 2011[4].

We believe that this outbreak was transmitted from person to person as our case-control study did not implicate any specific food item consumed at the school canteen. The detection of norovirus from an asymptomatic food handler was probably an incidental finding. The explosive nature of the outbreak could be attributed to the predominance of vomiting among the cases. Vomiting can give rise to infectious droplet aerosols and widespread contamination of the surrounding environment. Aerosolisation of vomitus and faecal material was believed to have contributed to a norovirus outbreak in a primary school[7]. Infectious aerosols deposited in the nose or pharynx could be ingested[9]. In addition, during toilet flushing, considerable numbers of virus-laden particles are aerosolised and released into the air[10], eventually settling onto other surfaces in the toilet[11]. As bleach was not used for cleaning and disinfection of vomitus and contaminated surfaces, the virus could have persisted in the school environment.

With strict observation of good personal hygiene practices by the students and implementation of proper methods for cleaning and disinfection by the school management, the chain of transmission was interrupted.

The main limitation of the study is that only 2 stool samples were available for laboratory analyses. Another limitation is that most of the cases were not able to recall specific details of their exposure histories such as which toilet had they visited and whether or not they had noticed any vomitus in the toilets and the school premises.

In conclusion, this was an outbreak of norovirus gastroenteritis probably transmitted from person to person in a setting where aerosolised droplets of vomitus containing the virus contaminated the common toilets and other environmental surfaces that had not been properly cleaned and disinfected.

(Contributed by Tien WS, Hishamuddin P and Tay J, Communicable Diseases Division, Ministry of Health)

References

1. *Heymann DL (ed). Control of communicable diseases manuel. American Public Health Association , 2008: pp. 227-9.*
2. *American Liver Society. Norovirus. Available at: http://www.liversociety.org/html/norovirus.html. Last accessed on 13 Mar 2013.*
3. *US Centers for Disease Control and Prevention. Surveillance for norovirus outbreaks. Available at: http://www.cdc.gov/features/dsnorovirus/. Last accessed on 13 Mar 2013.*
4. *Toh HY, Hishamuddin P, Tay J et al. Epidemiology and control of food poisoning outbreak in Singapore, 2009-2011. Epidemiol News Bull 2012; 38: 62-71.*
5. *Ng TL, Chan PP, Phua TH et al. Oyster-associated outbreak of norovirus gastroenteritis in Singapore. J Infect 2005; 51: 413-8.*
6. *Yap J, Qadir A, Liu I et al. Outbreak of acute norovirus gastroenteritis in a military facility in Singapore: a public health perspective. Singapore Med J 2012; 53:249 - 54.*
7. *Ler SS, Hishamuddin P, Tay J et al. Norovirus outbreak at a primary school in Singapore. Epidemiol News Bull 2011; 37: 94-7.*
8. *Minn T, Low C, Raj P et al. Norovirus gastroenteritis outbreak at a nursing home in Singapore. Epidemiol News Bull 2013; 39: 40-4.*
9. *Minn T, Toh HY, Hishamuddin P et al. Norovirus outbreak at a nursing home in Singapore. Epidemiol News Bull 2012; 38: 72-6.*
10. *Darlow HM, Bale WR. Infective hazards of water-closets. Lancet 1959;* **ii***: 1196–200.*
11. *Goldmann DA. Transmission of viral respiratory infections in the home. Pediatr Infect Dis J 2000; 19(Suppl 10):S97–102.*

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