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CONTENTS

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Asthma in Singapore

Introduction

Asthma has accounted for a significant proportion of medical consultations in Singapore through the decades, and involves every level of medical care from the primary care at the private general practitioner's clinic or government polyclinics through to admission to intensive care units in a tertiary setting, in the most severe of cases.

With improved understanding of asthma pathophysiology, the importance of holistic management has become better understood. The current asthma management practice has undergone a veritable metamorphosis, with the emphasis on control of the disease and preventive measures; adequate education of patients to facilitate better motivation, and thus, compliance; and prompt, sufficient treatment for asthma exacerbations.

And yet, for all of these advances, there is still much more to be done for patients with asthma in Singapore, as evidenced by the findings of various recent studies pertaining to asthma in Singapore.

Epidemiology

In the past few decades, the prevalence of asthma, particularly in children, has been perceived to be on the rise in industrialized countries the world over, Singapore being no exception to this rule. Demographic and social factors play no small part in influencing the epidemiology of the disease.

As a disease which frequently manifests at a young age, the prevalence of asthma in Singapore has been best studied among children. Using questions modified from the standard International Study of

Asthma and Allergy in Childhood (ISAAC) survey, a study conducted in 2001 on children in their second year of life found the cumulative prevalence of wheeze (potentially the herald of asthma) to be 22.9%. Of this group, approximately one-third had non-infectious wheeze, and about one-sixth suffered from recurrent wheezes[1].

A series of ISAAC surveys conducted on schoolchildren in 1994 and 2001 respectively, taking current wheezing as a surrogate measure of the prevalence of the disease, have demonstrated a drop in disease figures from 16.5% to 10.2% in the 6-7 year age group, and a small rise from 9.9 to 11.9% in the 12-15 year age group[2,3].

Among adults, the Singapore Adult Respiratory Health Study[4] conducted in 1992 demonstrated a prevalence of 2.4% in men, and 2% in women. Stratification by ethnicity showed a higher prevalence of asthma in Indians (6.6%) and Malays (6%), which may be accounted for partly by the more frequent ownership of cats/dogs, rugs, and carpets in Indians and Malays.

The price of asthma: disease burden in Singapore

Asthma is a significant cause of morbidity among the population of Singapore; in schoolchildren, it is a major factor in absenteeism from classes and exemption from lessons in physical education[5].

In the general population as a whole, asthma morbidity is evident from the staggering number of medical outpatient and inpatient visits each year attributed to asthma as the primary cause. Differences in prevalence of asthma often showed some correlation with indices of disease morbidity through various studies on asthma in Singapore, with higher indices of disease burden in males compared to females; and in Malays and Indians compared to Chinese. In 1993[6], asthma was ranked second among those below 15 years of age, for both hospital discharges (5.2 per 1,000 population per year) and outpatient consultations (37 per 100 age-adjusted population per year); in the general population, it was ranked 5th for discharges (2.4 per 1,000 population per year), and 6th for outpatient visits (15 per 100 age-adjusted population per year). It should be noted that, from the figures for 1990-1993, adult asthmatics, on admission, tended to stay approximately twice as long as children with asthma (some 33.6 bed-days per 100 current asthmatics per year in adults, compared to a rate of 15.5 in children), reflecting higher levels of disease morbidity in these individuals.

The theory that increasing age may be a risk factor for increased morbidity from asthma is further supported in studies on elderly asthmatics the world over, including one local study[7] which found worse clinical severity and higher numbers of anti-asthmatic medication use per individual in elderly asthmatics, compared to their younger counterparts.

Across the period from 1976 to 1995[8], the trend in mortality from asthma is shown in *Table 1*.

Increased age and male gender were consistently identified as risk factors for mortality during this period. As with disease morbidity, mortality from asthma was also noted to be higher in those of Malay (3-4 times that of age- and sex-matched Chinese) and Indian (about twice that of age- and sex-matched Chinese) ethnicities; considering that the prevalence of asthma is higher in Indians compared to Malays,

Table 1

Trends in asthma mortality rate from 1976 to 1995

Age group	Trend in mortality rate per 100,000 over each 5-year period
5-14 years	Upward trend from 0.21 in 1976-1980 to 0.72 in 1991-1995
15-34 years	No marked change, rate approximately 1
35-59 years	Downward trend from 6.32 in 1976-1980 to 3.99 in 1991-1995
60+ years	No marked change, rate approximately 27-31

the marked difference in morbidity and mortality between Indians and Malays may be attributable to lower levels of utilization of healthcare services in the Malay community, for which factors such as thresholds for symptom recognition, cultural beliefs, therapeutic self-management, and level of understanding of the disease may all play a part[9]. In addition, environmental exposures and genetic factors may contribute to the ethnic differences in asthma prevalence, morbidity and mortality.

The trend in the 1990s was for a fall in asthma hospitalization rates[10], from 21.7 per 10,000 population in 1991, to 15.4 per 10,000 population in 1998. This may be a reflection of the efficacy of programmes implemented at the population level aimed at improvement of asthma care; however, the impact of other factors such as apparent declines in the prevalence of the disease (as suggested in the ISAAC-based studies[2,3] on children in 1994 and 2001), improved preventive and inpatient management, and changes in hospital admission and readmission policies is difficult to measure.

The price of asthma: economics

The economic cost of asthma in developed countries the world over is staggering, numbering in the hundreds of millions to billions of US dollars each year in countries such as the United States and Australia. The cost in Singapore is likewise significant, not only in terms of direct costs – money spent on medical consultation fees, hospitalization stays, and medication costs; but also in terms of indirect costs – time expended by patients and their families in obtaining medical care and recuperation from exacerbations, translating into losses in workforce productivity.

The total cost of asthma in Singapore was estimated to be about US $33.93 million per annum, based on figures from 1992-1993[11]. Of this amount, US$17.22 million was incurred in direct costs (inpatient hospitalization being the biggest contributor, accounting for some US$8.55 million); with US$16.71 million from indirect costs, of which US$12.7 million was attributed to loss in productivity. In terms of cost per head, this translates into approximately US$238 per asthmatic person per annum.

The management of asthma: quality of primary care

Avoidable hospitalization rates (AHRs) for asthma, which may be taken as a surrogate measure of the quality of primary ambulatory care, have

demonstrated a gradual decline from the period 1991 to 1998 across all ethnic groups, the overall drop being 28.9% in those aged below 65 years over the eight-year period[12], suggesting an overall improvement in the level of primary care for asthma in Singapore. However, there was an overall rise in AHRs for common medical conditions (including asthma) over the same period in those aged 65 years and above; this may reflect not only the quality of primary care, but also differences in the efficacy of intervention and accessibility of healthcare services to the elderly. This should be looked into, as the ease of access to health services and level of primary care represent potential barriers to the improvement of overall well-being of elderly asthmatics in Singapore.

International guidelines on management of asthma have long been in place; however, the actual practice in Singapore at the primary care level may be fall somewhat short of the ideal, as was noted in a recent study by Tan et al[13] in 2002. The study showed that most (>90%) doctors were consistent in reviewing the asthma status of their patients based on symptoms and providing patient education. Less than 90%, however, went on to assess inhaler technique and peak expiratory flow rate(PEFR), check for trigger factors, evaluate degree of asthma control via indicators such as frequency of nocturnal symptoms and rescue therapy, or formulate an asthma action plan for each patient; and less than half of the doctors surveyed would use PEFR as a tool for asthma monitoring. Arguably, there is still much room for improvement in these areas of understanding of local doctors involved in primary care, to further improve the quality of primary ambulatory care of asthma.

The management of asthma: medication use

Whereas rescue therapy, in the form of beta-agonists administered via inhaled or oral routes, is used by most asthmatics in local studies, prophylactic medication in the prevention of asthma exacerbations has consistently been reported as being under-utilised[14-16], resulting in poor control of the disease and avoidable admissions to hospital.

In the multicultural society of Singapore where East meets West, it is no surprise that the use of complementary and alternative medicine (CAM) in asthmatics is common. A cross-sectional study[17] of asthmatics in 1993 estimated the use of CAM at 27.2% in the population, with predisposing factors including disease of longer duration or greater severity, Chinese ethnicity, failure of other treatment and consultation of multiple care providers. Clearly, this reflects a need for better care.

Summary

Asthma is a common chronic condition in Singapore, most prevalent in children. It has a major impact on our society, in terms of significant morbidity and mortality as well as time spent and economic costs incurred in dealing with the disease. Though trends in various indicators, including numbers of admissions and mortality rates demonstrate that the standard of care of asthma in Singapore is rising, other studies demonstrate that there is room for further improvement.

Better education of doctors involved at all levels of care, closer adherence to international and local guidelines on areas such as formulation of a definite asthma action plan, ease of access to health serv-

ices, improved patient education and avoidance of trigger factors, appropriate and timely prescription of medications with a mind towards prevention of asthma exacerbations; these are just some of the areas where more can be done, to the benefit of the average sufferer from asthma in Singapore.

(Reported by Soh JY and Lee BW. Department of Paediatrics, National University of Singapore)

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Epidemiology of hepatitis C in Singapore

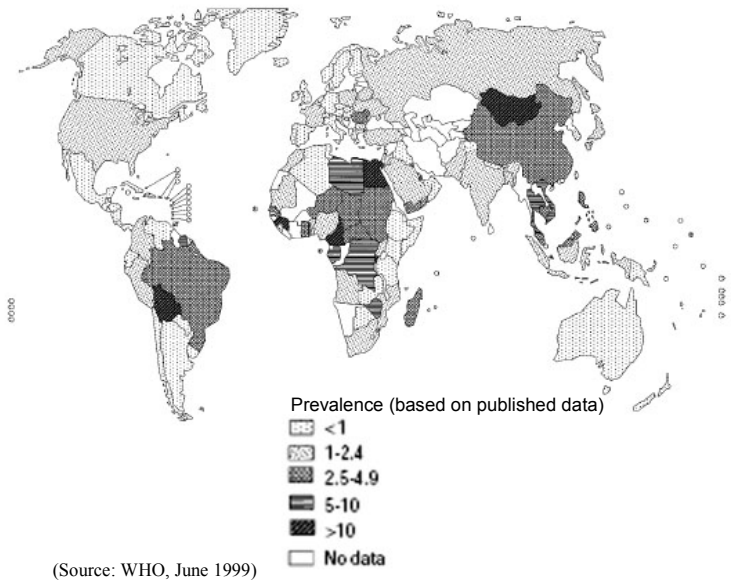
In 1989, the virus responsible for the transfusion-associated non-A, non-B hepatitis was identified and named hepatitis C virus (HCV)[1]. Since then, HCV infection has appeared as an emerging health problem in both developing and developed countries. In 2000, WHO estimated that the global prevalence of HCV infection was approximately 2.2% with the African and Eastern Mediterranean region having the highest prevalence[2]. The prevalence of HCV carriers by country ranged from 0.1% to 10% or more (*Fig 1*)[3].

Studies have also indicated that chronic HCV infection could lead to the development of liver cirrhosis and hepatocellular carcinoma (HCC), thus contributing to significant morbidity and mortality[4].

The key objectives of acute viral hepatitis surveillance are to monitor the burden of disease caused by these infections as well as to design and implement appropriate intervention activities. The surveillance case definition for acute hepatitis C as recommended by the US Centers for Disease Control (CDC) requires both clinical and laboratory evidences[5]. The laboratory criteria include:

- serum alanine aminotransferase (ALT) levels >7 times the upper limit of normal; and
- antibody to HCV (anti-HCV) positive (repeat reactive) by EIA, verified by more specific assay [e.g. recombinant immunoblot assay (RIBA) for anti-HCV or nucleic acid testing for HCV RNA] or anti-HCV positive (repeat reactive) by screen-

Figure 1
Global prevalence of Hepatitis C, June 1999



(Source: WHO, June 1999)

ing immunoassay with a signal to cut-off ratio predictive of a true positive as determined for the particular assay. and

- IgM anti-HAV negative (if done); and
- IgM anti-HBc negative, or if not done, HBsAg negative.

In Singapore, epidemiological information on Hepatitis C is obtained from routine notifications of laboratory-confirmed cases (both acute cases and carriers), and routine screening of blood donors. Acute viral hepatitis due to hepatitis viruses (A, B, C, D and E) has been made legally notifiable diseases in Singapore under Section 6 of the Infectious Diseases Act, Chapter 137 (1977) since 1 June 1976. All medical practitioners are required to notify viral hepatitis to the Ministry of Health within 72 hours from time of diagnosis.

This paper presents all notifications received at the Communicable Diseases Surveillance Branch during the period from Jan 2003 to Sept 2005. Caution should be made in interpreting the data due to inherent limitations of currently available laboratory tests for the diagnosis of HCV infection. Studies have shown that up to 10% of cases of acute hepatitis C will still be anti-HCV negative either due to seroconversion window or lack of seroconversion[5]. In addition, available serological tests for anti-HCV do not distinguish between acute and chronic or past infection and negative HCV RNA by gene amplification techniques does not exclude the possibility of HCV infection.

Acute & non-acute HCV infection

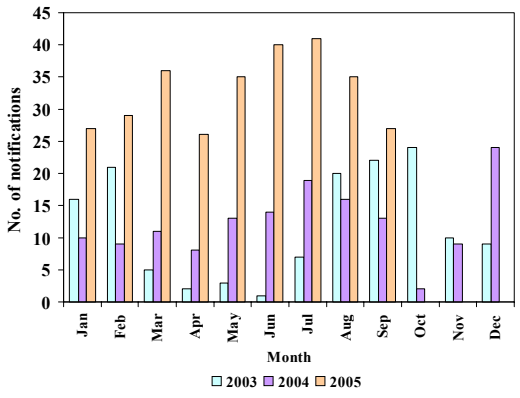
Although clinicians are legally required to notify acute hepatitis C cases, a large number of notified HCV-infected cases, as identified by positive anti-HCV (EIA or more specific RIBA for anti-HCV), have chronic, rather than acute infections. Therefore, additional clinical information and/or ALT levels > 7 times the upper limit of normal are required to identify acute hepatitis C cases.

A total of 584 notifications were received between Jan 2003 and Sept 2005. Of these, 72.3% were males and 27.7% were females. Majority (81%) of the cases notified were local residents (*Table 1*). The number of notifications increased by two-fold from between 140 and 148 in 2003 and 2004 to 296 in 2005 (*Fig 2*).

Table 1
Notifications of hepatitis C cases (acute and non-acute) by gender, residency and year of diagnosis, Jan 2003 – Sep 2005

	2003	2004	2005 (Jan-Sep)	Total (%)
Gender				
Female	48	44	70	162 (27.7)
Male	92	104	226	422 (72.3)
Residency				
Foreigner	24	39	48	111 (19.0)
Resident	116	109	248	473 (81.0)

Figure 2
No. of notified cases of hepatitis C (acute and non-acute) by month and year of diagnosis, Jan 2003 – Sep 2005



The age distribution of the notified cases was observed to shift towards the younger age groups, with the majority of cases notified in 2005 under 45 years old. The highest number of cases was recorded in the age group 45-55 years in 2003 and 2004, while the peak was recorded in the age group 35-44 years in 2005 (*Fig 3*). The trend of gender and age group distribution of hepatitis C reported from Jan 2003 to Sept 2005 is shown in *Figure 4*.

Acute hepatitis C infection

In 2005 (Jan- Sept), a total of 296 notifications were received and all cases were serologically-confirmed by the presence of anti-HCV antibody. Of

Figure 3
Distribution (%) of notified hepatitis C cases (acute and non-acute) by age group, Jan 2003 to Sep 2005

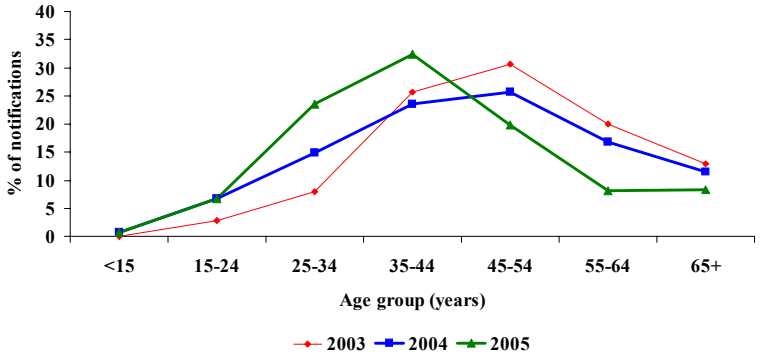
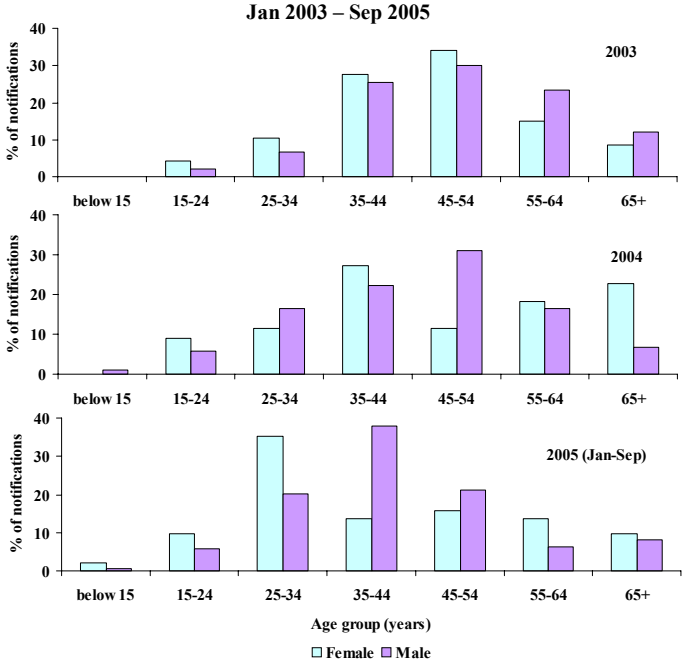


Figure 4
Distribution (%) of notified hepatitis C cases (acute and non-acute) by gender and age group, Jan 2003 – Sep 2005



these, 21 cases were associated with acute clinical presentation while the remainders were identified as chronic carriers (*Fig 5*).

Among the acute hepatitis C cases, two were foreigners seeking medical treatment in Singapore. The remaining 19 cases were local residents, comprising 2 imported and 17 indigenous cases. Majority of the cases were in the 25 – 34 year age group (38.1%) followed by the 35 - 44 year age group (23.8%) (*Fig 6*). The male to female ratio was 2.5: 1. Among the three major ethnic groups, Malays represented the highest number of cases notified (*Fig 7*).

Of all reported cases with acute clinical presentation where risk factor information is obtained, almost half of them had a history of intravenous drug use. However, none had a history of blood transfusion prior to onset of illness.

Figure 5
Notifications of viral hepatitis C, 2005 (Jan - Sep)

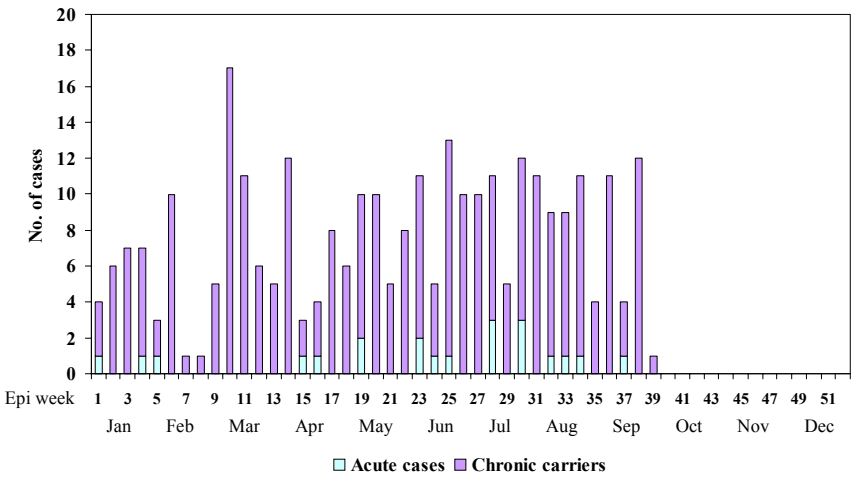


Figure 6
Age-gender distribution of acute hepatitis C infection, 2005 (Jan - Sep)

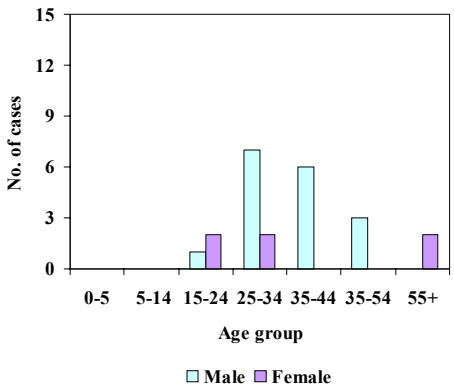
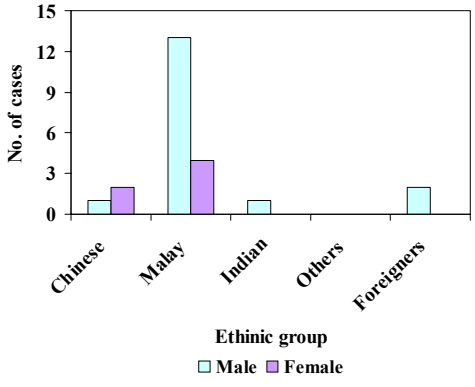


Figure 7
Ethnic-gender distribution of acute hepatitis C infection, 2005 (Jan - Sep)



Comments

Surveillance of acute HCV infection provides an insight into the current transmission pattern. However, estimates on the incidence are usually difficult due to the subclinical presentation of HCV infection. The increase in notifications of hepatitis C cases (both acute and non-acute) in 2005 could be more apparent than real as all serologically positive cases were routinely notified.

HCV is transmitted most efficiently by direct percutaneous exposure to infected blood or intravenous drug abuse. Epidemiological investigations, including assessment of the risk profiles of patients, were conducted for acute hepatitis C cases notified from Jan-Sept 2005. However, it should be noted that risk factor information was available only for some reported cases, reporting a risk factor does not imply causation of infection, and more than one risk factor may be reported for a given individual. Based on the limited investigations conducted, intravenous drug abuse appeared to be the leading risk factor. None of the acute cases acquired the infection through blood transfusion.

In Singapore, screening of blood donors was introduced in Dec 1992[6]. The prevalence of HCV infection among Singapore blood donors was low. Of 65,208 donors tested between Dec 1992 and Aug 1994, 241 (0.37%) were positive. Majority of the HCV-infected donors were males aged 30-39 years[7].

Prior to the routine screening of blood donors, patients with end-stage renal failure undergoing haemodialysis carried an increased risk of HCV infection and it was estimated that they probably formed the largest group of hepatitis C patients seen in public hospitals[8]. In 1991, the highest anti-HCV prevalence was found in patients on regular haemodialysis[9](20% compared to 1.7% in healthy subjects).

As there is no vaccine against HCV infection, prevention and control efforts have to be focused mainly on minimizing transmission through screening of at-risk population, ensuring safe blood supply, enforcing stringent disinfecting procedures at health care facilities, universal precautions, and, most importantly, public education about disease transmission and preventive measures[10].

(Reported by Li H Y, Ang L W, Tun Y, Chow A,Communicable Diseases Surveillance Branch, Ministry of Health)

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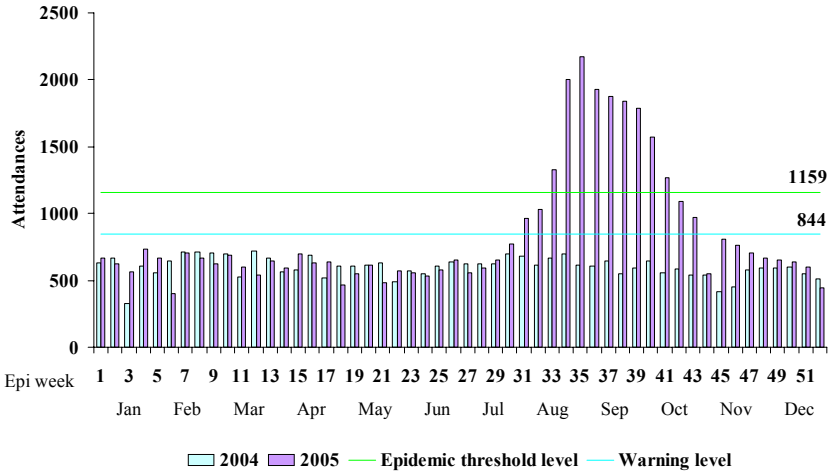
Surveillance of acute viral conjunctivitis

Acute viral conjunctivitis is characterized by inflammation of the conjunctiva of the eye. The commonest complaint is a sudden onset of red, itchy eyes. There may also be fever, headache, runny nose, sore throat, cough and muscle aches. The disease is usually mild but it is highly infectious. It spreads easily from person to person, especially among those living in the same household and in crowded places.

Acute haemorrhagic conjunctivitis is commonly caused by enterovirus 70 and coxsackievirus A24, both of which have been known to cause large outbreaks. It is spread by direct or indirect contact with discharges from the conjunctivae or upper respiratory tracts of infected persons. The incubation period ranges from 12 hours to 3 days. Cases remain infectious for at least 4 days after onset of symptoms.

In Singapore, surveillance of acute viral conjunctivitis is carried out by monitoring the weekly polyclinic attendances for this medical condition (*Fig 8*). In 2004, a total of 31,261 conjunctivitis attendances

Figure 8
Polyclinic attendances for acute conjunctivitis, 2004 and 2005



were seen at the polyclinics with a weekly average of 601 attendances (range 328 to 719). In 2005, a similar trend was observed during the first seven months with a reported weekly average of 609 attendances (range 399 to 775).

A sharp increase in acute conjunctivitis attendances at the polyclinics was noted in the beginning of Aug 2005 (*Fig 8*). The number of weekly attendances rapidly exceeded the warning (mean+ 1 SD, 844) and epidemic threshold levels (mean+2 SD, 1159) and reached a peak of 2171 within 4 weeks. During the period Aug to Oct 2005, the average weekly attendances was 1525.

Based on NHG polyclinics data, majority (59.7%) of the patients were below 25 years of age and those between 10 years and 19 years accounted for 33% of the total weekly attendances reported during the week from 22 to 27 August 2005 (*Fig 9*).

To identify the aetiological agent for the nationwide outbreak, eye swabs were collected from patients presenting with conjunctivitis at polyclinics and nursing homes and submitted to the Virus Laboratory, Dept of Pathology, Singapore General Hospital, for viral isolation. Coxsackievirus A 24 was isolated from 15 samples tested.

During this period, there was a worsening haze situation in the neighbouring countries. However, no association between the surge in conjunctivitis attendances and local pollutants standards index (PSI) levels was observed. (*Fig 10*)

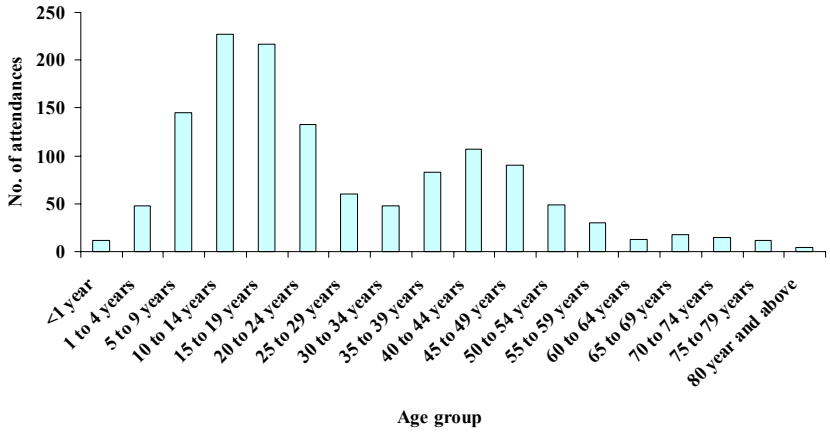
The public was alerted through a press release and advised to practise basic personal hygiene by not sharing face and bath towels, handkerchiefs, pillows or beddings and by proper hand hygiene and disposal of contaminated materials.

Epidemiological investigations were conducted in several institutional outbreaks. The findings of an outbreak in a home for the aged is described below.

Outbreak in an institution for the aged

The institution, licensed by the Ministry of Community Development, Youth and Sports, is a 3-storey

Figure 9
Age distribution of conjunctivitis attendances at NHG polyclinics, 22 – 27 August 2005



building with 7 dormitories in each level and there are 4-15 residents in each dormitory It has 30 staff and 178 residents.

A total of 115 residents and 6 staff came down with acute conjunctivitis between the period 13 and 28 Sept 05, giving an overall attack rate of 58.2%. The ages of the affected persons ranged from 25 to 94 years. The index case was a 79 year-old female resident who had an acute onset of red, itchy eyes accompanied by discharge on 8 Sept. The infection spread rapidly to other residents and staff in two waves, one which peaked on 11 Sept and another on 18 Sept. (*Fig 11*).

Figure 10
Relationship between polyclinics attendances for conjunctivitis and haze, 2005

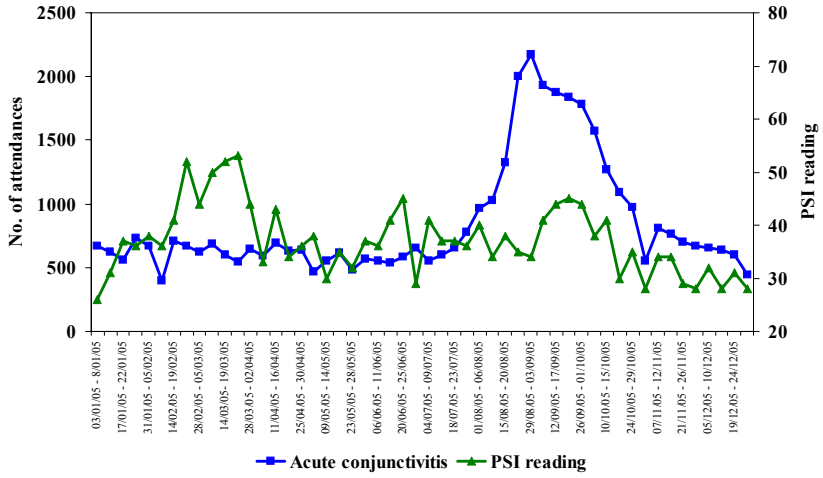
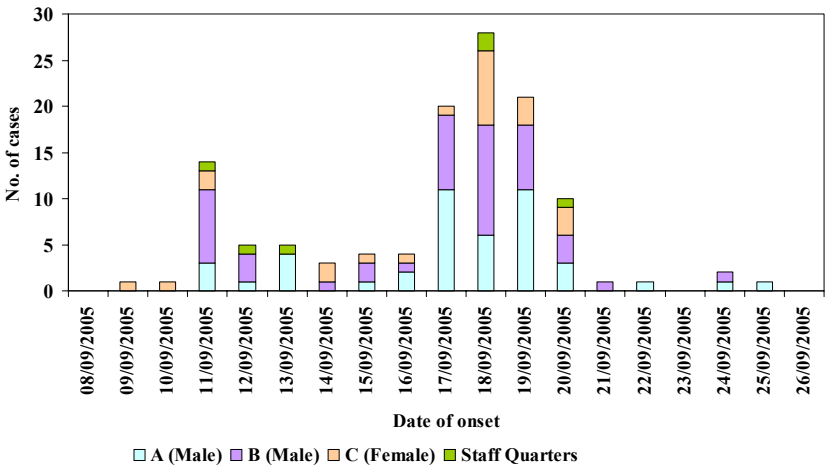


Figure 11
Time distribution of 121 cases of conjunctivitis by dormitory in an institution, Sep 2005



Six eye swabs were obtained from the affected residents when field investigations were carried out on 14 Sept and 22 Sept and sent for laboratory investigations. Coxsackievirus A24 was isolated from 4 of the samples tested.

The management of the institution was advised to take the following infection control measures:

- Advocate strict personal hygiene practices including frequent hand washing and refraining from touching their eyes.
- Discourage sharing of personal items such as face towel, bed linen etc.
- Discontinue communal congregation including mass bathing, exercises, social outings and gatherings. Meal times were alternated for the different dormitories.
- Keep environment clean by frequent sanitization including segregation of used linen and decontamination of common environmental surfaces with a disinfectant.
- Detect and isolate affected residents immediately to minimise further spread of the infection.

Following the intervention, no new cases were reported on 26 Sept and the outbreak was considered over when no new cases were detected for 2 incubation periods.

Comments

Epidemics of acute haemorrahagic conjunctivitis caused by picornaviruses recurred in a five-year cycle in the 1970s and 1980s. The 1970, 1975 and 1985 epidemics were caused by coxasackievirus A 24 and the 1980 epidemic by enterovirus 70[1]. Coxsackievirus A 24 continued to cause outbreaks in 1987, 1992[2] and 2002. Most of the viruses isolated during small outbreaks in the inter-epidemic period were adenoviruses. The clinical features of conjunctivitis caused by coxsackievirus A24, enterovirus 70 and adenovirus are indistinguishable. Laboratory investigations are necessary to confirm the aetiological agent or agents.

(Reported by Goh H and Chua LT, Communicable Diseases Surveillance Branch and Kurupatham L, Disease Control Branch, Ministry of Health)

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Expert panel on dengue: findings and recommendations

Background

During the 2005 dengue outbreak, a seven-member panel comprising local and international experts was appointrd by the Minister for Health to advise the Government on the dengue situation and prevention and control measures.

The panel was tasked to review the current dengue situation in Singapore; identify possible causes for the resurgence; identify gaps in dengue surveillance and control; recommend operational research to address the gaps identified and to recommend both short-term and long-term cost effective strategies in the prevention and control of dengue

The panel has looked into the epidemiological features of the current dengue outbreak, conducted field trips to observe dengue control operations and reviewed the national framework for dengue control.

Key observations

The key observations of the panel are highlighted below:

- Singapore's dengue control programme is recognised as one of the best in the world. This has resulted in sustained suppression of the *Aedes aegypti* mosquitoes for three decades.
- Dengue is a resurgent problem globally; and being endemic to the region, Singapore can expect dengue to recur on a regular basis. The current dengue outbreak in Singapore coincides with the increase in the number of dengue cases in the region.
- The principal vector mosquito, *Aedes aegypti,* is highly adaptable and exploits hard-to-find habitats in the urban environment. The increase in the dengue cases in Singapore may include importation of new strains of dengue virus with greater epidemic potential into a densely populated Singapore population. Prior success of the Singapore dengue control programme has resulted in a highly susceptible human population.
- Public education on dengue prevention and community participation in control activities remain the key to stop dengue transmission

Recommendations

The panel has recommended the following:

Short-term measures:

- Effective prevention and control of epidemic dengue requires an active laboratory-based disease surveillance programme to provide early warning for epidemic transmission. Laboratory methods should include the latest technology in both serologic and virologic diagnosis. Quality control for this programme should be provided by a national reference laboratory for infectious diseases.
- A continuing medical education programme should be implemented to increase the knowledge of physicians on clinical diagnosis, management, prevention and control. They should be encouraged to help educate the population on their responsibilities in dengue control activities. Feedback of surveillance data to the medical community is important.

- It is a common perception that most dengue transmission occurs at home. However, recent epidemiologic evidence indicates that significant transmission also occurs at sites away from the home. Current emphasis on active clusters does not provide an adequate understanding of transmission dynamics. This limits the effectiveness of vector control measures, because in the present situation, it appears that 60-70% of all notifications occur outside of known clusters and in some instances transmission is not reported. Dengue control should be driven by entomological, epidemiological, operational and formative research, and should not rely solely on identification on response to active clusters. In addition, efforts to reduce mosquito population during inter-epidemic periods may be highly effective in preventing epidemic transmission.
- The success of the Singapore programme has reduced *Aedes aegypti* populations to such a low level that conventional methods of assessing populations such as the house index are no longer sufficient. Moreover, an increase in *Aedes aegypti* populations is not always a pre-requisite for increased dengue transmission. Emphasis should now be placed on new and innovative methods of entomologic surveillance to assess the impact of control activities on *Aedes aegypti* populations. For example, ovitraps and/or lethal ovitraps developed by the National Environment Agency (NEA) and others will be used to detect and eliminate low-density *Aedes aegypti* populations in various settings.
- Feedback to the community on mosquito populations should be explored as a mechanism to stimulate community participation in control activities.
- Continued efforts to enhance dengue control by the private sector should be emphasized, including social mobilisation and mosquito control. For example, the NEA's initiative to create community ownership of the control programme by town councils contracting it to the private sector is strongly endorsed by the panel.
- Indoor fogging may be very effective in killing adult *Aedes aegypti*. However, recent evaluation of this approach to stop epidemic transmission, as practised by many dengue-endemic countries, has revealed that it has limited efficacy in stopping epidemic transmission. The effectiveness of ultra-low volume and thermal fogging to control adult *Aedes aegypti* must be evaluated. Mosquito control activities, including those by private pest control operators, must continue to be subjected to stringent and improved quality control measures using new techniques.

Long-term measures

- Maintain *Aedes aegypti* populations at a low level in Singapore that will prevent epidemic dengue transmission.
- Use vaccines and antiviral drugs when they become available.
- Use new validated technologies as they become available.

What the public can do

- Effective long-term control of dengue requires community ownership. Therefore community participation will continue to be an important component of effective *Aedes aegypti* control in Singapore.

- The inclusion of grassroots organisations in surveillance of adult mosquitoes, e.g. by lethal ovitraps, should be explored.
- Regular indoor use of insecticide sprays may prevent dengue transmission in the home.
- Use of personal protection measures such as repellents and mosquito nets may also prevent dengue transmission in the home.

The panel has also examined the need to quarantine dengue patients and biological control methods. Their conclusions are as follows:

- Quarantine of dengue patients is not recommended. Infected people can infect mosquitoes with dengue viruses 24 – 48 hours before showing any symptoms. Infected people, who do not show any symptoms (asymptomatic cases), may also infect mosquitoes. With Singaporeans being highly mobile and the local dispersal of mosquitoes, the virus may be widespread in the community before it is reported.
- Biological approaches to mosquito control eg, fish, dragonflies, copepods are also not applicable in the Singapore environment.

Conclusion

The Government has noted and reviewed the findings and recommendations of the panel. NEA and Ministry of Health will continue to work with the expert panel on improving the dengue control programmes.

As pointed out by the expert panel, community involvement is the key to dengue control in Singapore. The public, business/industry stakeholders are urged to continue to be vigilant in keeping their premises, workplaces and surroundings clean and mosquito-free by practising good habits. These include cleaning blockages from the roof gutters, clearing leaves and stagnant water from potted plants, avoiding the use of pot plates, changing the water in vases daily and keeping the environment litter-free.

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