Influenza surveillance in Hong Kong: results of a trial Physician Sentinel Programme

KA Fitzner, SM McGhee, AJ Hedley, KF Shortridge

The H5N1 influenza outbreak in Hong Kong at the end of 1997 emphasised the need for viral surveillance so that new influenza epidemics can be foreseen. Although South China is regarded as the regional epicentre of influenza epidemics, there has been little epidemiological documentation of the disease there. A sentinel physician network was established in Hong Kong in 1993 to estimate the incidence, severity, and seasonality of influenza-like illnesses and to provide data on the demand for health care that is related to this illness. Influenza-like illness occurred throughout the year of the survey, peaking from March through May and accounting for 15% of doctor visits. The incidence was approximately 117 in 1000 patients and was greatest among children aged 1 to 4 years. Ongoing physician surveillance with appropriate coverage of the general population supported by a laboratory virus isolation capability may help control future influenza outbreaks.

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Key words: Disease outbreaks; Hong Kong; Incidence; Influenza/epidemiology; Influenza/prevention & control; Sentinel surveillance

Introduction

Influenza occurs in global epidemics, sometimes with a high mortality rate, which is mainly due to pneumonia. Curwen et al[1] noted that the Beijing influenza variant may have claimed 26 000 lives, directly or indirectly, in England and Wales during the 1989/1990 influenza epidemic. The disease results in considerable costs that can be measured in terms of illness, resources used, and lost productivity.[2,3] In Hong Kong, respiratory tract infections account for 44% of all government out-patient clinic visits.[4] In Australia, approximately 5% to 7% of all consultations with general practitioners are related to influenza-like illness (ILI) in non-epidemic periods.[5] In the United States, influenza accounts for 10% to 12% of job-related absenteeism.[6]

Influenza surveillance and control is an integral part of the World Health Organization's (WHO's) public health programme. Surveillance is conducted mainly by clinical diagnosis and laboratory virus detection. Although influenza diagnosis is most accurate when verified by laboratory analysis, this is not possible on a wide scale because of the multiplicity of viral agents involved, and the high cost and imprecise nature of the work. Physician-diagnosed ILI is considered to be a widely applicable alternative to influenza virus isolation, and consequently, sentinel physician networks have been established in many countries.[7]

South China is a hypothetical influenza epicentre for the emergence of pandemic strains of influenza that then spread to the rest of the world.[8] Anecdotal information suggests, however, that influenza is a relatively unimportant infection in southern China and Hong Kong compared with northern China and western countries. This apparently incongruous pattern is so far unexplained. Aside from the H5N1 event of 1997, very little epidemiological information has been published about influenza in Hong Kong; the influenza virus is isolated each year as it is in other tropical south-east Asian countries.[9] No territory-wide, primary care data have been systematically collected in Hong Kong to estimate the incidence of influenza, and the distribution and economic

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importance of this common viral infection have not been documented.

There are three established types of influenza virus: A, B, and C; the typing is based on the antigenicity of the internal ribonucleoprotein. Pandemics and large epidemics are caused by the type A virus; smaller, self-limiting epidemics by type B; and sporadic cases, which are usually seen in children, by type C. The influenza A virus is unstable and undergoes minor antigenic changes from year to year. It may also undergo a major change, termed an antigenic shift, which occurs, for example, prior to a pandemic.[10,11]

Virus isolation studies indicate that influenza A occurs throughout the year in Hong Kong. Influenza B also occurs each year, but intermittently. In contrast, influenza cases in temperate climates, such as northern China, arise mostly in the winter months. Dr TH Lam (written communication, 1994) found the self-reported incidence of influenza to be 13% in the Hong Kong population during a 2-week period in 1993. In the United States, the influenza incidence may fall to less than 5% during non-epidemic periods (Braemmer L, written communication, 1994). Influenza pandemics commonly affect a high proportion of the population across age and gender groups. Influenza is more likely to occur in young people because of their limited range of antibodies, which is a consequence of their reduced exposure to different influenza variants. In other parts of the world, morbidity and mortality tend to be higher in the elderly and other risk groups, particularly those with pre-existing respiratory or cardiac problems.[12]

Other countries routinely monitor the incidence of influenza. For example, the United States conducts ILI surveillance during the influenza season, from October through April, using a sentinel network of 130 physicians; this gives a ratio of 0.5 sentinel physicians per 1 million people.[13] In Belgium, approximately 150 sentinel physicians have participated in a monitoring scheme on a voluntary basis since 1980.[7] Physicians in Singapore have conducted prospective influenza surveillance since 1973 at selected out-patient clinics[14] and in Australia, general practitioners and doctors in hospital accident and emergency departments report any diagnoses of influenza.[5]

The Hong Kong Department of Health conducts influenza surveillance within the public health care sector.[15] The department's surveillance includes clinical diagnosis and limited laboratory testing. However, data obtained from this process is likely to be biased because the majority of people seeking primary medical care do so in the private sector.[16] As a result, more than 70% of the population would be excluded from the department's capture of data on ILI.

This study aimed to determine the incidence of ILI in Hong Kong as measured by demand for associated health care and, secondly, to study the variation of ILI incidence over a 24-month period. A further aim was to use the findings of the study to estimate the optimal size of a surveillance sentinel network for Hong Kong.

Subjects and methods

Physician Sentinel Programme

Physicians were recruited with the assistance of the Hong Kong College of Family Physicians (HKCFP) and the Hong Kong Government Department of Health. To obtain support for the trial, letters were sent to the HKCFP and a meeting was held with senior officers from the Department of Health. Each of these sources suggested physicians who might participate in the programme. Of the names proposed, 15 were targeted as potential participants because of their geographic location and practice type, and each was sent a letter explaining the purpose of the PSP along with an invitation to participate. Follow-up telephone contact was made and an introductory influenza surveillance package was mailed to those who agreed to participate. Subsequently, three other physicians who heard about the scheme contacted us and requested to be included in the programme.

The 1993/1994 Physician Sentinel Programme (PSP) was established as one component of a comprehensive influenza surveillance effort. It was based on the American influenza surveillance network model and ran for 12 months, from April 1993 through March 1994. Seventeen of the 18 volunteer physicians participated and the network was supported by a part-time project manager and a research assistant.

The ratio for the 1993/1994 PSP was 2.8 sentinel physicians per 1 million people. Three physicians (18%) were from government out-patient department clinics, two (12%) worked in specialty clinics, and two (12%) practised at university health service out-patient clinics. The remainder (10/17; 59%) worked in private practice—five in Kowloon, three in the New Territories and Outer Islands, and two on Hong Kong Island. Three public sector clinics were in Kowloon, one on Tsing Yi Island, and one on Hong Kong Island. The two university health service out-patient clinics were in Kowloon and Hong Kong Island. These

physicians (Table 1) served patient populations that were not only geographically diverse but were also believed to represent all socio-economic and age groups present in Hong Kong, based on observation and discussions with the group.

The 1994/1995 PSP comprised only four volunteer physicians. The resulting ratio was 0.6 sentinel physicians per 1 million people, which was similar to the American value of 0.5. Three of the PSP physicians were in general practice or family medicine, while the fourth was a paediatrician. Three were in private practice and one worked in a government primary care out-patient department clinic. In both years of the study, sentinel physician practices were located on Hong Kong Island, Kowloon, and the New Territories.

Data reporting

Influenza was diagnosed using the WHO definition of an ILI, which states that "fever ≥100°F (37.8°C), oral or equivalent, and cough or sore throat" must be present.[17] Each day, PSP physicians used ticks to record the number of patients who were diagnosed as having an ILI on standard forms. Physicians also provided the number of total patients seen for any illness. The patient's age-group and the week in which the ILI was diagnosed were also shown. The form was faxed or mailed to the researchers at the end of each month. The reporting process is summarised in Figure 1.

Each sentinel physician was instructed in the use of the reporting form, the WHO definition of ILI, and data submission procedures. The report forms were designed after consultation with physicians to help minimise data entry time. As a result, there were no problems with gathering completed forms from the physicians. However, one physician in each PSP was unable to provide data during a month either because of leave or absence for other reasons, and in one instance, the data were lost in the post. All PSP practices were closed for the Chinese New Year holidays for 1 week in February 1994 and 1995.

Two surveys were sent to the sentinel physicians. The first survey sought information about the physicians' perceptions of ILI severity during 1993 to 1994 and details as to how patients were medicated. These data were used to determine whether 1993 and 1994 were 'typical' years for ILI and to monitor the use of pharmaceuticals during an ILI. The second survey attempted to obtain the patient profiles of each practice so that an estimate of the incidence rate could be calculated. Twelve physicians responded to the first survey and 11 provided practice profile information. Seven were able to provide information about the total size of their patient population.

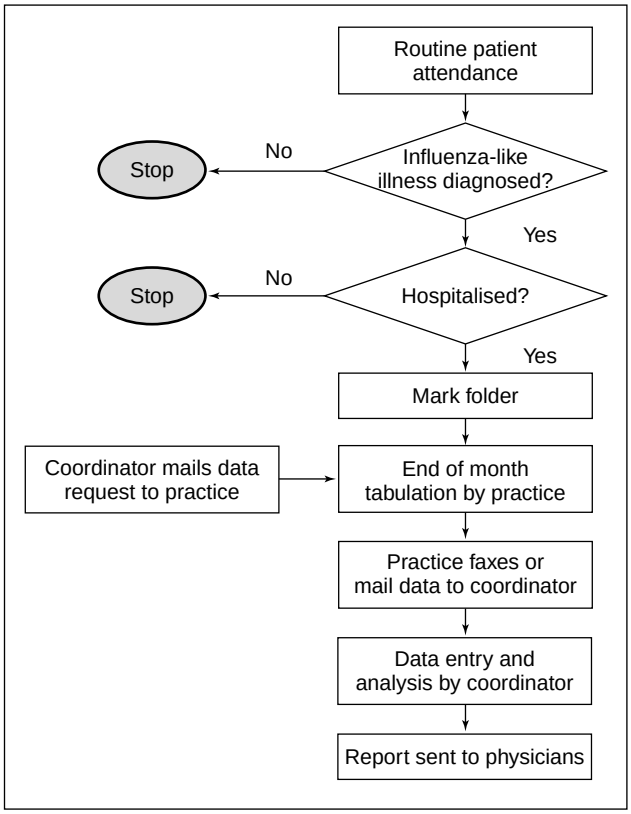


Fig 1. Flowchart showing the data collection process used during the period of influenza surveillance

All data submitted by the physicians were entered into a computer database and spreadsheets using D-Base III (Ashton-Tate Corp., Torrance [CA], US) and Lotus 4.01 for Windows software (Lotus Development Corp., Cambridge [MA], US). The findings were included in the desktop-published *The Sentinel Physician Bulletin* which was sent to the participating physicians each quarter. This publication disseminated information about influenza and recently published studies from other sources on the illness and its prevention. It also gave PSP physicians an opportunity to air their concerns and ideas, and to contribute original articles.

Results

Diagnostic rates and perceived severity

Each doctor's ILI diagnostic rates are presented in Table 1. Diagnostic rates ranged from 0.6 ILI diagnoses per 1000 patient visits for general practitioner 100, who specialised in expatriate women's health, to 760/1000 visits for general practitioner 110, who provided care to individuals living in a housing estate. The ILI diagnostic rate was 31/1000 visits in government out-

Table 1. Profile of sentinel physicians and the rate of diagnosis of influenza-like illness per 1000 visits (1993-1994)

Physician No.	Practice type	Location	No. of patients seen
100	Private Women's Health Clinic	Hong Kong	5345
101	Private Hospital-based Family Practice	Kowloon	7447
102	University Clinic	Hong Kong	2842
103*	Government Specialty Clinic	Kowloon	2485
104	Private Family Practice‡	Outer Island	8382
105	Private Family Practice	New Territories	10 124
106	Private Paediatric Practice‡	Kowloon	25 342
107†	University Clinic	Kowloon	5319
108	Government Out-patient Clinic	Hong Kong	18 884
110	Private Family Practice	New Territories	12 546
111	Private Family Practice	Kowloon	14 408
112	Private Family Practice and Travel Medicine	Kowloon	3474
113	Government Specialty Clinic	Kowloon	2663
114	Private Family Practice	Hong Kong	6567
115	Private Family Practice	Kowloon	21 688
116	Government Out-patient Clinic‡	Kowloon	21 836
117	Government Out-patient Clinic	Kowloon	20 437

* Original No. was 113A
† Original No. was 140
‡ Also participated in 1994/1995 Physician Sentinel Programme, as did a private hospital-based family practitioner from Hong Kong (No. 118), who did not participate in 1993/1994

patient department clinics and 16/1000 in the two specialty clinics. The overall public sector rate was 30/1000 patient visits, which contrasts with the much greater private sector rate of 219/1000 patient visits. The varying confidence intervals in Table 1 indicate significant differences in physician diagnostic rates.

Overall, ILI patients accounted for 15% of the sentinel physicians' total consultations in each year. However, the magnitude of the numbers changed from the first PSP when there were 189 789 patient visits and 29 055 ILI cases diagnosed, to the second PSP when there were 57 664 patient visits and 8616 ILI cases diagnosed. There was considerable variation in the number of ILI cases diagnosed by the sentinel physicians.

In both years, the severity of ILI was rated from mild to moderate. In the 1994 to 1995 survey, 34 patients or 4/1000 of those diagnosed with ILI were hospitalised because of their illness. In both the 1993/1994 and the 1994/1995 PSPs, most of those hospitalised were young—between the ages of 1 and 4 years. The highest rate of hospitalisation occurred in December 1994, when 11 patients with ILI were hospitalised. No seasonal hospitalisation pattern emerged during the 2 years.

Population incidence estimates

Incidence could only be calculated for seven physician practices because the others were not able to supply information about the number of patients in the practice (ie denominator data). ILI incidence was 117/1000 patient visits in the 1993/1994 PSP, with a wide range of estimated incidence rates. The lowest rate was 33/1000 visits and the highest was 269/1000 visits. (Table 1).

Monthly variation in health care demand

In both data collection periods, ILI cases occurred fairly steadily throughout the year, with a peak period in March through May and a low in February (Table 2). Influenza virus isolation studies conducted at the Queen Mary Hospital in 1993 and 1994 detected influenza viruses during each month of the year, with peak periods occurring in late winter and early spring (February/March); a pattern that differed from that of prior years when peaks occurred in the summer months (June through August).

Differences in the proportion of each age group diagnosed with ILI were noted across the two PSPs. The 1- to 24-year-old age-group accounted for the greatest number of ILI-related visits during the reporting periods. From 1994 to 1995, very young children (aged 1 to 4 years) accounted for 37% of ILI cases during the year and the 5- to 24-year-old age-group for 31%. In both years, those older than 45 years had the fewest number of ILI cases diagnosed (Table 3).

According to a survey of the PSP physicians, most

No. of patients with ILI[§] (hospitalised)	Disease rate/1000 patient visits (95% CI)[‖]	Incidence[¶]
3	0.6	-
332	45 (39-49)	33
33	12 (7-15)	165
52	21 (15-26)	-
2688	320 (311-331)	269
740	73 (68-78)	-
7093	280 (274-285)	-
874	164 (154-174)	146
100	5 (4-6)	-
9538	760 (753-766)	-
3886	270 (259-273)	78
70	20 (15-24)	47
30	11 (7-15)	-
745	113 (91-105)	-
1047	48 (45-51)	-
588	27 (24-29)	-
1236	60 (57-63)	82

[§] ILI influenza-like illness
[‖] Confidence intervals of proportion, which define the range of values within which the true population rate will lie for 95% of samples of similar size in which a similar rate is observed
[¶] Per 1000 visits; blanks indicate that no practice population data were available for incidence calculation

Table 2. Number of cases of influenza-like illness diagnosed and hospitalisations in each calendar month*

Month[†]	Cases of influenza-like illness No. (%)		Disease rate/1000 patient visits		Hospitalisations No. (%)	
	1993-1994	1994-1995	1993-1994	1994-1995	1993-1994	1994-1995
April	2437 (8)	640 (7)	201	197	6 (15)	1 (3)
May	3242 (11)	527 (6)	164	122	6 (15)	4 (12)
June	1551 (5)	554 (6)	116	142	3 (8)	3 (9)
July	2081 (7)	926 (11)	119	152	2 (5)	3 (9)
August	1601 (6)	591 (7)	123	142	1 (2)	2 (6)
September	1863 (6)	624 (7)	136	142	7 (18)	1 (3)
October	3133 (11)	831 (10)	174	141	2 (5)	2 (6)
November	2639 (9)	610 (7)	168	133	1 (2)	2 (6)
December	2687 (9)	832 (10)	159	153	1 (2)	11 (32)
January	3326 (11)	778 (9)	163	160	4 (10)	0
February	1242 (4)	531 (6)	107	139	4 (10)	2 (6)
March	3253 (11)	1172 (14)	184	170	3 (8)	3 (9)
Total	29 055	8616			40	34

* Seventeen physicians' data included for 1993-1994; four physicians' data included for 1994-1995
[†] First PSP programme year ran from April 1993 to March 1994 and the second from April 1994 to March 1995; one physician's report was lost in the post in June 1993 and one practice was closed during April 1994

patients that were diagnosed as having ILI were not very ill at presentation. The occurrence of the illness was estimated by the PSP physicians to be less than typical of previous years. No patients in the PSP received antiviral agents, such as amantadine or rimantadine, which are accepted antiviral prophylactics for infection with influenza A virus but not influenza B. In general, both the vaccine and chemoprophylaxis are considered to be approximately 50% to 70% effective in preventing influenza in healthy young people and somewhat less effective in the elderly.[18,19]

Discussion

Hong Kong is noted for having given its name to the pandemic virus that was first isolated here in 1968 following its emergence from southern China. The Hong Kong influenza era continues through to today,

Table 3. Occurrence of influenza-like illness in different age groups in 1993-1994 and 1994-1995

Age group (years)	Cases of influenza-like illness No. (%)		Hospitalisations No. (%)	
	1993-1994	1994-1995	1993-1994	1994-1995
<1	2137 (7)	906 (11)	5 (13)	3 (9)
1-4	7507 (26)	3213 (37)	19 (48)	25 (74)
5-24	8689 (30)	2673 (31)	7 (18)	4 (12)
25-44	5945 (20)	1153 (13)	4 (10)	2 (6)
45-64	2833 (11)	465 (5)	2 (5)	0
>64	1944 (7)	206 (2)	3 (8)	0
Total	29 055	8616	40	34

although current variants bear little resemblance to the 1968 virus and have lower pathogenicity, with the exception of the new strain identified in Hong Kong in 1997. The recent H5N1 'bird flu' outbreak emphasises the need to be on the alert for new influenza infections in the general population.

Over 24 months, 18 physicians voluntarily engaged in ILI surveillance through the PSP. From 1993 to 1994, when 17 physicians participated, the network was geographically diverse and incorporated patients from all socio-economic backgrounds. The 1994/1995 PSP was conducted with only four sentinel physicians to approximate the American sentinel doctor to population ratio and surveryed a more restricted, possibly non-representative population. There was wide variation in diagnostic rates in both PSPs, which is possibly explained by differences in the patient populations. The variation may be due to differences in diagnostic criteria, social and demographic characteristics of attending patients, and possibly geographical and environmental factors.

Because the networks were small, it was inevitable that variation in some of the physicians' practices would lead to heterogeneous patterns in the data set. This was particularly evident in the relatively higher rate of visits by children and differences in hospitalisation rates between the 1994/1995 PSP and the 1993/1994 PSP. The distortion was partly attributable to the participation of a paediatrician in each PSP. Although his ILI diagnostic rate and case-specific hospitalisation rates were similar within each of the two different PSP years, his patient population accounted for 25% of the 1994/1995 PSP but only 6% of the 1993/1994 PSP. Hence, the influence of his data on the overall findings was considerably greater in the second PSP. Thus, under these or similar circumstances, more than four physicians are required for any PSP but the optimal number will depend on the estimated variation in patient populations and their subgroups. The design of future PSP programmes could take these factors into account in the selection and recruitment of sentinel practices.

An outreach programme was maintained throughout the study. This programme proved to be important to the PSP as measured by the zero drop-out rate during each period. All elements of the programme, site visits, routine dissemination of educational materials, and feedback appear to have been important to its success. Although efforts were made to reduce any bias introduced by the non-random physician recruitment method used, it is possible that that the high rate of compliance by PSP physicians could be due to selection bias. Another key success factor was the physicians' ability to obtain continuing education credits from the HKCFP.

Influenza surveillance is always hampered by the presence of other respiratory infectious agents which mimic influenza. The symptoms described in the WHO ILI definition could be from other respiratory causes and this might result in overreporting of ILI. However, this concern is offset by the benefits of using the WHO definition that allows intercountry and year-to-year comparisons to be made, provided that the criteria are adhered to. A recent study in Hong Kong (Pieris JS, written communication, 1998) showed that many respiratory viruses that could be misdiagnosed as ILI circulate throughout the year. For example, the respiratory syncitial virus (RSV) is very active in April to October, adenoviruses are generally active all year, with increased activity in the cooler months, and para-influenza viruses are prevalent throughout the year.

The sentinel physician approach to the assessment of demand for ILI-related healthcare indicates that, in Hong Kong, ILI occurs year round with the greatest ILI-related demand for health care (approximately 200/1000 visits) occurring in April, as previously reported.[10,20]

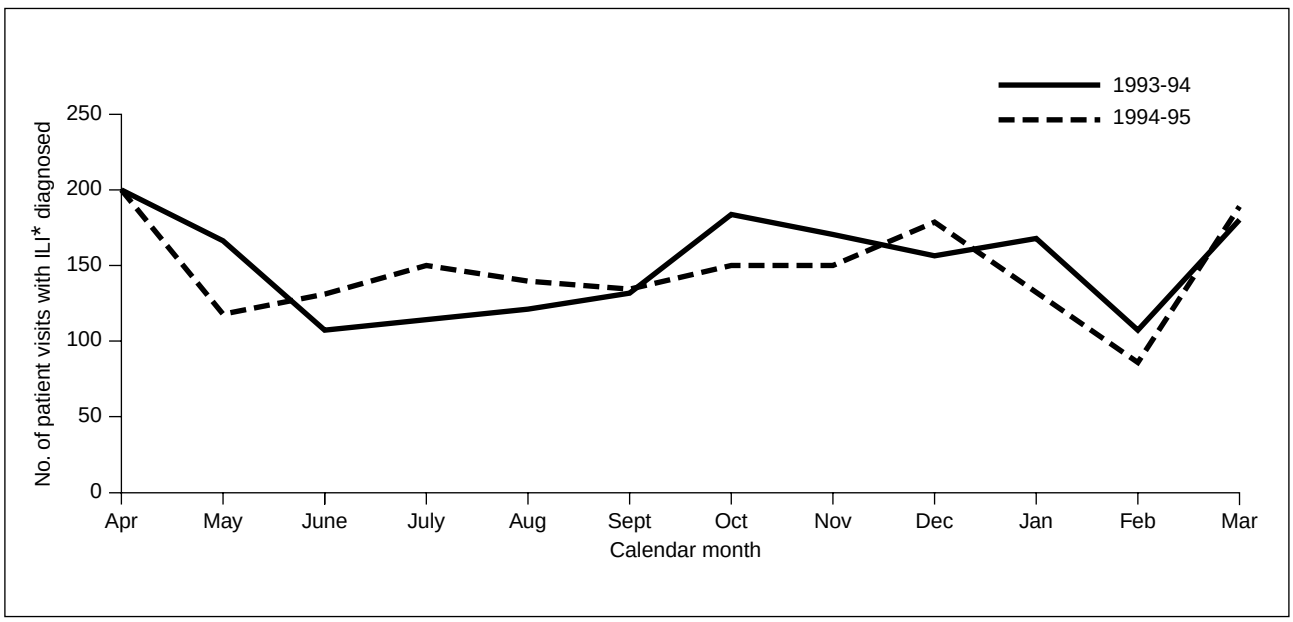
Unfortunately, denominator data are not routinely available from the PSPs and thus, age-specific year-to-year differences in the data remain unexplained.

Government virus isolation shows that influenza A peaked twice in 1996, first in February to April and then in June to August, which may have been a result of the new influenza A variant identified in 1995/1996. Government data also show an influenza B cluster in January through March 1997. This recent pattern was similar to that found by the authors of the PSP studies from 1993/1994 through 1994/1995. Although influenza diagnosis is most accurate when verified by laboratory analysis, this was not practical for the PSP because of the high cost attached to such a limited programme. However, any future influenza (or ILI) surveillance programmes would benefit from the inclusion of laboratory validation of clinically diagnosed ILI cases and would clarify which cases are truly attributable to influenza and which are not.

Throughout the 24 months of surveillance, approximately 15 of every 100 ILI patients seen by primary care physicians had mild to moderate symptoms, and the hospitalisation rate was low. The monthly occurrence of ILI was similar across the two data collection periods (Fig 2). It can be concluded that in Hong Kong, the occurrence of ILI in an interpandemic period does not vary greatly from year to year although the severity may change. However, this study was conducted during an interpandemic period when the circulating viruses remained antigenically stable.

Incidence rates express the average frequency of occurrence of an event in a population. Their calculation entails dividing the number of new cases in a population by the number of individuals in that population. For the PSP, the numerator was the number of diagnosed cases of ILI, and the denominator was the number of total patients in a physician's practice. The lack of a patient registration system in most primary services means that defined denominators are not readily available to estimate incidence rates, and the calculation of ILI incidence was hampered by this lack. This situation is likely to be typical of all mixed medical care systems in which the members of the population can freely seek health care from a wide spectrum of providers. Physicians with registered or otherwise definable populations of patients could make an important contribution to the estimation of valid incidence rates. While effecting positive change is difficult, particularly in the private sector, the capture of morbidity data at the primary care level on a long-term basis should be considered a priority. The information gained would be available to augment needs-based health services planning and evaluation.

The PSP highlights the important role that both private and public sector physicians can play in disease surveillance and the advancement of understanding about the patterns of common diseases in a population. By observing trends in events over time, new patterns can be detected or anticipated and appropriate investigations and control measures taken. Ongoing surveillance conducted by a sentinel phy-



* ILI influenza-like illness

Fig 2. Monthly rate of influenza-like illness per 1000 patient visits reported by Physician Sentinel Programme physicians

sician network with appropriate coverage of the population and supported by laboratory isolation of viruses is feasible and could make an important contribution to the control of influenza. In addition, a network may yield information that could be used to control other infectious diseases. Effective surveillance might assist the evaluation of interventions such as the vaccination of high-risk individuals in addition to well populations. As the recent H5N1 influenza outbreak indicates, it is important to develop a better understanding of the occurrence of ILI in Hong Kong.

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