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Burden of influenza infection in hospitalised children below 6 months of age and above in Hong Kong from 2005 to 2011☆

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ABSTRACT

The World Health Organization recommends vaccination of pregnant women for seasonal influenza that can also protect infants aged below 6 months. We estimated incidence and disease burden of influenza in hospitalised children below and above 6 months of age in Hong Kong during a 6 year period. Discharge diagnoses for all admissions to public Hong Kong Hospital Authority hospitals, recorded in a central computerised database (Clinical Management System, CMS), were analysed for the period April 2005 to March 2011. Incidence estimates of influenza disease by age group were derived from CMS ICD codes 487–487.99. Laboratory-confirmed influenza infections from a single surveillance hospital were then linked to the CMS entries to assess possible over- and under-diagnosis of influenza based on CMS codes alone. Influenza was recorded as any primary or any secondary diagnosis in 1.3% (1158/86,582) of infants aged above 6 days to below 6 months and 4.3% (20,230/471,482) of children above 6 days to below 18 years. The unadjusted incidence rates per 100,000 person-years based on any CMS diagnosis of influenza in all admission to Hong Kong public hospitals were 627 in the below 2 months of age group and 1762 in the 2 month to below 6 month group. Incidence of hospitalisation for influenza in children was highest from 2 months to below 6 months. In the absence of vaccines for children below 6 months of age, effective vaccination of pregnant women may have a significant impact on reducing influenza hospitalisations in this age group.

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1. Background

Influenza is a burden to the Hong Kong healthcare system and a significant cause for hospitalisation among the paediatric population. Discharge diagnoses for all admissions to publicly funded government (Hospital Authority, HA) hospitals in Hong Kong are recorded in a central computerised database (Clinical Management System, CMS) [1,2]. A 2002 study using the CMS data showed hospitalisation rates in Hong Kong for influenza to be 3–10 times higher than those reported for children in the United States, equating to nearly 3% of children under 1 year old being hospitalised each year due to influenza [3]. An analysis of the CMS database for July 1997 through June 1999 for children aged less than 15 years reported a primary diagnosis of a respiratory disorder in 37.5% of general paediatric admissions [1]. CMS diagnosis incidence rates of influenza

Abbreviations: CMS, Clinical Management System; HA, Hospital Authority; ICD9-CM, International Classification of Diseases; NPA, nasopharyngeal aspirates; A(H1N1)pdm09, 2009 pandemic influenza A (H1NI) virus; PWH, Prince of Wales Hospital; WHO, World Health Organization.

☆ The authors alone are responsible for the views expressed in this publication, which does not necessarily reflect the views of the World Health Organization.

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during this 2-year period were 222–381 per 100,000 children under 5 years and 415–528 per 100,000 children under the age of 1 year.

Following the outbreak of severe acute respiratory syndrome in 2003, infection control measures in Hong Kong hospitals were enhanced and many hospitals routinely collect nasopharyngeal aspirates (NPA) for all children with suspected respiratory infections. This situation has enabled us to analyse data collected routinely through the CMS system and combine this with enhanced laboratory surveillance activities from one hospital to make estimates of influenza disease burden in hospitalised children in Hong Kong. The current analysis compares data for infants aged below 6 months with children below 18 years over a 6-year period (April 2005–March 2011).

2. Methods

This study protocol was approved by the Joint The Chinese University of Hong Kong and New Territories East Cluster Clinical Research Ethics Committee.

2.1. CMS data

Information collected by the CMS includes patient identifiers, date of birth, sex, a maximum of 15 diagnoses and 15 procedures (classified by International Classification of Diseases ICD9 and ICD9-CM codes), and admission and discharge dates [1]. The CMS was rolled out from 1996, and by mid-1997 this information was available for all HA hospitals. Prior to 2000, the majority of HA hospitals only coded the primary diagnosis for most hospital admissions. A database of all paediatric patients admitted to general paediatric and neonatal wards from 1 April 2005 to 31 March 2011 was provided by the HA. Respiratory-associated admissions for children aged above 6 days to below 6 months and above 6 days to below 18 years were assessed by these ICD diagnostic groups and by hospital of admission, outcome status (died, discharged home with or without follow-up and transferred to another hospital) and severity as measured by the length of stay. Infants below 7 days of age were excluded from these initial analyses as the large majority of these infants were admitted during the immediate post-partum period due perinatal and neonatal problems.

2.2. Laboratory methods for influenza diagnosis at Prince of Wales Hospital

Since 2003 NPA are collected for all children with suspected respiratory infections at PWH as a standard procedure as part of routine care. At PWH during the periods March 2005 to March 2006 [4], and October 2008 to March 2011 enhanced diagnostics were available to document additional viral and bacterial pathogens. All specimens are subjected to respiratory virus detection by the immunofluorescence (IF) test and/or conventional virus culture as described previously [5].

2.3. Linking of CMS with laboratory data for Prince of Wales Hospital

Laboratory data for all paediatric admissions from PWH were matched on the unique hospital number with the CMS data. Age-related analyses were based on the CMS calculated *dayage* (date of admission minus date of birth in days) and *monthage* (*dayage* divided by 30.4). The laboratory dataset used for analysis only included a single hospital number and a single laboratory request number i.e. a single entry with a positive result was chosen if more than two NPA specimens were sent during the admission.

2.4. Calculation of influenza hospitalisation incidence rates by age group from CMS discharge diagnosis

Incidence rates of hospitalisation for influenza for all HA hospitals in Hong Kong were first estimated from the total number of children with any CMS diagnosis of influenza (ICD-CM 487–487.9) (CMS flu+). Infants below 7 days of age were included in this incidence analysis. These initial unadjusted CMS flu incidence rates for each year by age were calculated with the following formula:

$$\left(\frac{x/y}{z}\right) \times 100,000$$

where x, number of admissions by age with any CMS influenza diagnosis (ICD-CM 487–487.9); y, admissions to public HA hospitals as a percentage of total admissions by age (Appendix 1).

Table 1
Any influenza diagnosis reported from Clinical Management System (CMS) compared with actual results from the virology laboratory of the Prince of Wales Hospital for all patients aged below 18 years who had specimens sent for testing (1 April 2005 to 31 March 2011).

Year	Total admissions	LAB flu+/CMS flu+[a]	LAB flu+/CMS flu−[a]	LAB flu−/CMS flu+[a]	Primary respiratory[b]	Primary respiratory[b] NPA[c] NOT sent	AF1 [d] calculated	AF1 [d] mean value used	AF2[e] calculated	AF2[e] mean value used	AF3[f] calculated value weighted by age group	AF3[f] smoothed value weighted by age group
0 to <2m	19,883	9	7	5	267	124	1.14	1.05	1.48	1.13	0.0008	–
2 to <6m	3211	110	9	6	813	47	1.03	1.05	1.05	1.13	0.0371	0.0351
6m to <1y	4000	131	23	20	1228	129	1.02	1.05	1.07	1.13	0.0385	0.0427
1 to <2y	5221	266	40	42	1728	284	0.99	1.05	1.09	1.13	0.0586	0.0552
2 to <5y	10,000	611	128	67	3465	354	1.09	1.05	1.16	1.13	0.0739	0.0739
5 to <10y	7604	568	104	62	2294	308	1.07	1.05	1.18	1.13	0.0884	0.0880
10–14y	4987	205	27	22	824	120	1.02	1.05	1.14	1.13	0.0465	0.0474
14 to <18y	5031	93	21	29	444	124	0.93	1.05	1.12	1.13	0.0227	0.0230
<5y	42,315	1127	207	140	7501	938	1.05	1.05	1.13	1.13	0.0315	0.0348
Total	59,937	1993	359	253	11,063	1490	1.05	1.05	1.13	1.13	0.0392	0.0422

[a] LAB flu+ = laboratory test positive for influenza (Influenza A and B); LAB flu− = laboratory test negative for influenza (Influenza A and B); CMS flu+ = Clinical Management System diagnosis of influenza (ICD = 487–487.99); CMS flu− = Clinical Management System diagnosis NOT influenza (not ICD = 487–487.99).
[b] Primary respiratory = Clinical Management System diagnosis reports a primary respiratory-associated diagnosis (upper respiratory infection [460–461.9, 465–465.9, 786.2]; tonsillitis/pharyngitis [462–463.9, 034.0, 474.11]; croup/laryngitis [464–464.9, 786.1]; acute otitis media [381–382.9]; bronchitis/chest infection [466–466.09, 490–490.9, 519.8]; bronchiolitis [466.1–466.9]; pneumonia [480–486.9, 507.0]; influenza [487–487.9]; asthma/allergic rhinitis [493–493.9, 477–477.9]).
[c] NPA: nasopharyngeal aspirate.
[d] Adjustment factor 1 = LAB flu+/CMS flu+.
[e] Adjustment factor 2 = [LAB flu+] + [primary respiratory associated diagnosis and NPA NOT sent * (LAB flu+/NPA sent)]/CMS flu+.
[f] Adjustment factor 3 = LAB flu+/total admissions by age group.

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