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Impact of childhood pneumococcal conjugate vaccine immunisation on all-cause pneumonia admissions: a 14-year population-based interrupted time series analysis

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Introduction

Nine years after its first introduction in the United States, Hong Kong introduced the pneumococcal conjugate vaccine (PCV) to its universal childhood immunisation programme in 2009. This study aimed to assess the impact of childhood PCV immunisation on all-cause pneumonia (ACP) admission among the overall population of HK.

Methods

An interrupted time series (ITS) analysis using segmented Poisson regression was applied to evaluate the gradual change in the monthly incidence of ACP admissions between pre- and post-vaccination periods. Hospitalised patients with a diagnosis of pneumonia of any cause between 2004 and 2017 were identified in Clinical Data Analysis and Reporting System (CDARS).

Table 1. Annual incidence of all-cause pneumonia and pneumococcal pneumonia (per 100,000-persons) between 2004-2017

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
All-cause *pneumonia*														
Overall*	633	754	658	677	699	661	812	726	769	712	692	660	742	679
0-19 y	232	388	424	272	270	257	548	334	443	527	436	364	626	478
20-64 y	77.3	96.2	94.2	88.9	89.9	98.1	142	127	134	136	134	133	167	149
≥ 65 y	2664	3166	2732	3059	3282	3148	3661	3501	3671	3276	3261	3144	3252	3059
Pneumococcal *pneumonia*														
Overall*	17.4	18.5	16.5	16.3	15.9	13.7	13.1	15.4	14.8	14.1	13.4	13.0	12.6	12.2
0-19 y	11.4	11.8	12.2	10.2	9.87	8.34	9.67	10.6	12.4	13.9	13.9	14.6	15.5	13.7
20-64 y	4.16	4.44	3.87	3.97	4.03	3.70	3.89	5.26	4.25	5.04	4.98	5.47	5.48	5.12
≥ 65 y	64.8	71.5	63.0	65.7	67.2	58.9	53.2	61.2	60.7	52.6	47.8	42.8	39.5	39.9

*Age-standardised incidence using HK census population in 2017 as reference

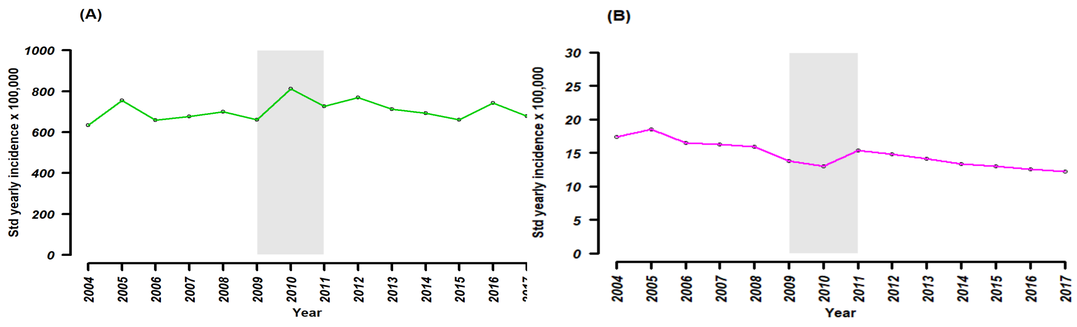

Figure 1. The age-standardised annual incidence of (A) all-cause pneumonia and (B) pneumococcal pneumonia. Grey areas: transition period of PCV implementation

Reference:
Naghavi M, Abajobir AA, Abbafati C, et al. Global, regional, and national age-sex specific mortality for 264 causes of death, 1980–2016: a systematic analysis for the Global Burden of Disease Study 2016. 2017; 390(10100): 1151-210.

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Results

- Over the 14-year study period, a total of 587 607 ACP episodes were identified among 357 950 patients.
- The monthly age-standardised incidence of ACP fluctuated between 33.4 and 87.4 per 100 000-persons.
- There was a marginal decreasing trend of pneumonia admission among the overall population (incidence rate ratio: 0.9965, 95% CI: 0.9932-0.9998) and older adults (≥65 years, incidence rate ratio: 0.9928, 95% CI: 0.9898-0.9959), but not in the younger age-groups.

Table 2. Slope change effect of childhood PCV immunisation, overall and by age-group

Age groups	IRR	95% CI	P-value
All-cause pneumonia			
Overall	0.9965	0.9932-0.9998	**< 0.05**
0-19 y	1.0016	0.9922-1.0111	0.7432
20-64 y	0.9995	0.9964-1.0026	0.7677
≥ 65 y	0.9928	0.9898-0.9959	**< 0.05**
Pneumococcal pneumonia			
Overall	0.9977	0.9945-1.0009	0.1540
0-19 y	1·0053	0·9998-1·0108	0·0604
20-64 y	1·0011	0·9964-1·0058	0·6491
≥ 65 y	0·9911	0·9875-0·9948	**< 0.05**
Fracture			
Overall	1.0036	1.0028-1.0044	**< 0.05**
0-19 y	1·0047	1·0029-1·0065	**< 0.05**
20-64 y	1·0042	1·0033-1·0050	**< 0.05**
≥ 65 y	1·0003	0·9989-1·0016	0·6914

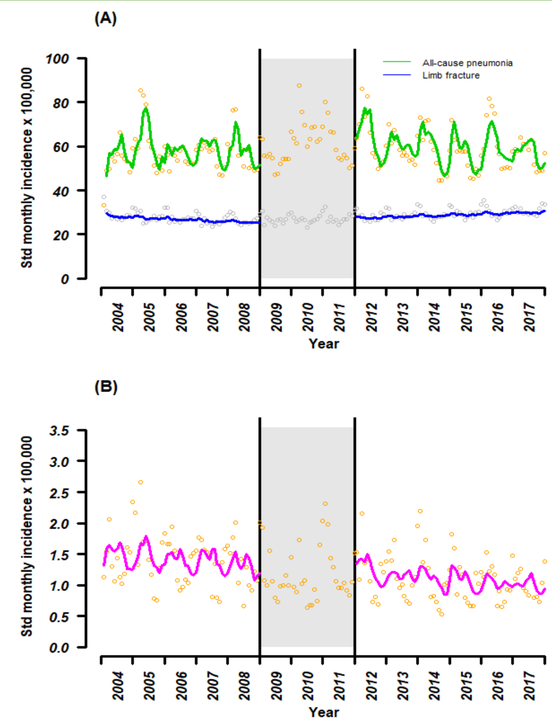

Figure 2. The estimated monthly incidence of overall (A) all-cause pneumonia and limb fracture and (B) pneumococcal pneumonia

Conclusion

- There was a marginal significant trend change in overall ACP admission in Hong Kong, up to eight years after the PCV introduction.
- The results imply the complexity of using a non-specific endpoint to measure the vaccine effect and the necessity of enhancing serotype surveillance systems for replacement monitoring.

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