

Population-level impact of infant 10-valent pneumococcal conjugate vaccination on adult pneumonia hospitalisations, Finland

Revised Supplementary File

Supplementary Tabel 1. Pneumonia-Related Codes According to the International Classification of Diseases, 10th revision (ICD-10)

ICD-10 codes	Description	ICD-10 codes	Description
J13	Pneumococcal pneumonia	J15.8	Other bacterial pneumonia
J10.0	Influenza with pneumonia, influenza virus identified	J15.7	Pneumonia due to <i>Mycoplasma pneumoniae</i>
J11.0	Influenza with pneumonia, virus not identified	J16.0	Chlamydial pneumonia
J12.0	Pneumonia due to adenovirus	J16.8	Pneumonia due to other specified infectious organisms
J12.1	Pneumonia due to respiratory syncytial virus	J17.0	Pneumonia in bacterial diseases classified elsewhere
J12.2	Pneumonia due to parainfluenza virus	J17.1	Pneumonia in viral diseases classified elsewhere
J12.8	Pneumonia due to other virus not elsewhere classified	J17.2	Pneumonia in mycoses
J12.9	Viral pneumonia, unspecified	J17.3	Pneumonia in parasitic diseases
J14	Pneumonia due to <i>Hemophilus influenzae</i>	J17.8	Pneumonia in other infectious diseases classified elsewhere
J15.0	Pneumonia due to <i>Klebsiella pneumoniae</i>	J15.9	Bacterial pneumonia, unspecified
J15.1	Pneumonia due to Pseudomonas	J18.0	Bronchopneumonia, unspecified
J15.2	Pneumonia due to Staphylococcus	J18.2	Hypostatic pneumonia, unspecified
J15.3	Pneumonia due to Streptococcus, group B	J18.8	Other pneumonia, organism unspecified
J15.4	Pneumonia due to other Streptococci	J18.9	Pneumonia, organism unspecified
J15.5	Pneumonia due to Escherichia coli	J18.1	Lobar pneumonia, unspecified
J15.6	Pneumonia due to other aerobic Gram-negative bacteria	J86	Empyema

Supplementary Table 2. Case Definitions

Case definition	Description	ICD-10 codes
All-cause pneumonia hospitalisation*	This definition includes hospitalised patients (at least overnight) who had pneumonia ICD-10 codes as primary discharge diagnoses.	J10-J18, J86
Pneumococcal pneumonia *	This includes patients who had pneumococcal pneumonia ICD-10 code - not restricted as the primary discharge diagnosis - who may or may not had been hospitalised.	J13
Empyema*	This includes patients who had empyema ICD-10 code - not restricted as the primary discharge diagnosis - who may or may not had been hospitalised.	J86
All-cause hospitalisation (control group)	This definition includes hospitalised patients (at least overnight) who had any ICD-10 code other than pneumonia-related codes.	All ICD-10 codes except J10-J18, and J86

*All care notifications within 90 days of the date of the first discharge notification (usually from ER) in the index pneumonia admission were combined into one episode.

Table 1. Trends in hospitalisations for Hospital Diagnosed Pneumonia* in adults ≥ 18 years of age before and after Introduction of ten-valent pneumococcal conjugate vaccine (PCV10) in the national infant vaccination program, Finland

Hospital Diagnosed Pneumonia*	Baseline Rate in 2004-05 (per 100,000 population)	Adjusted annual trends using interrupted time-series analysis					
		Period before PCV10 (2004-05 to 2009-10 ^a)			Period after PCV10, (2011-12 to 2014-15 ^a)		
		Adjusted annual trend			Adjusted annual trend		
		IRR	95% CI	p^b	IRR	95% CI	p^b
Age (years)							
18-49	260.9	1.049	1.037, 1.062	<0.001	0.919	0.886, 0.953	<0.001
50-64	544.0	1.062	1.049, 1.067	<0.001	0.919	0.897, 0.942	<0.001
$\geq 65^c$	2581.5	1.024	1.012, 1.027	<0.001	0.976	0.965, 0.988	<0.001
65-74	1341.2	1.024	1.012, 1.037	<0.001	0.965	0.942, 0.988	0.001
75-84	3257.7	1.012	1.011, 1.024	<0.001	0.976	0.965, 0.988	0.039
≥ 85	6703.9	1.024	1.012, 1.024	<0.001	0.976	0.965, 1.004	0.111
Total^c	804.2	1.037	1.024, 1.037	<0.001	0.953	0.942, 0.965	<0.001

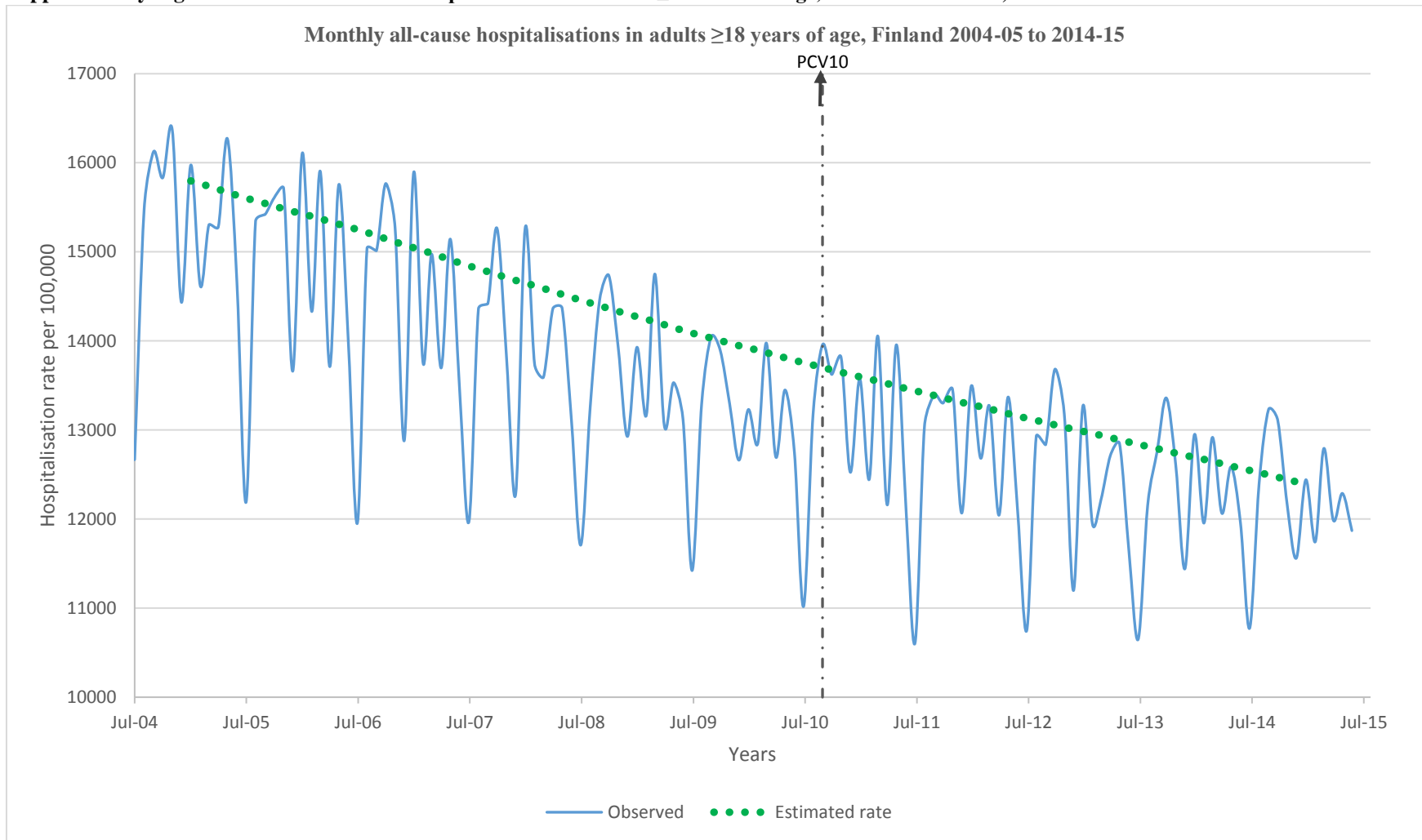
* This definition includes patients who had pneumonia ICD-10 codes J10-J18 and J86 - not restricted as the primary discharge diagnoses - who may or may not had been hospitalised. IRR: Incidence rate ratio. IRRs are adjusted for sex and seasonality, with the natural log of the population size as the offset variable. The IRR of the trend before-PCV10 is estimated as the change in annual hospitalisation rates in the years 2004-05 to 2009-10. The IRR of the trend after-PCV10 is estimated as the comparison of the annual trend in the years 2011-12 to 2013-14 to the trend in the period before. ^a PCV10 was introduced in the Finnish NVP in September 2010. The year 2010-11 was defined as a transitional period and was excluded from the analysis. ^b Two-tailed P value. ^c Analyses for the aggregate age-groups (i.e. the total ≥ 18 years of age] and the ≥ 65 years of age) were age-adjusted using the following age groups: all age groups in the analyses for the total, and the 65-74, 75-84, and ≥ 85 years of age in the analyses for the ≥ 65 years of age group.

Table 2. Estimated and expected hospitalisation rates of Hospital Diagnosed Pneumonia* in adults ≥18 years of age, 2014-15

Hospital Diagnosed Pneumonia* Age (years)	Estimated rate per 100,000 population ^a	Expected rate per 100,000 population ^b	Expected versus estimated hospitalisation rates in 2014-15		
			Rate difference per 100,000 population	95% CI ^c per 100,000 population	Percent reduction (%)
18-49	262.6	350.3	87.6	71.1, 104.1	25.0
50-64	670.6	900.2	229.7	202.3, 257.1	25.5
≥65	2936.9	3193.4	256.5	219.5, 293.4	8.0
65-74	1523.1	1726.3	203.2	163.9, 242.5	11.8
75-84	3622.9	3880.5	257.6	187.9, 327.2	6.6
≥85	7739.0	8222.2	483.2	312.0, 654.3	5.9
Total	1041.5	1234.5	193.1	173.1, 213.0	15.6

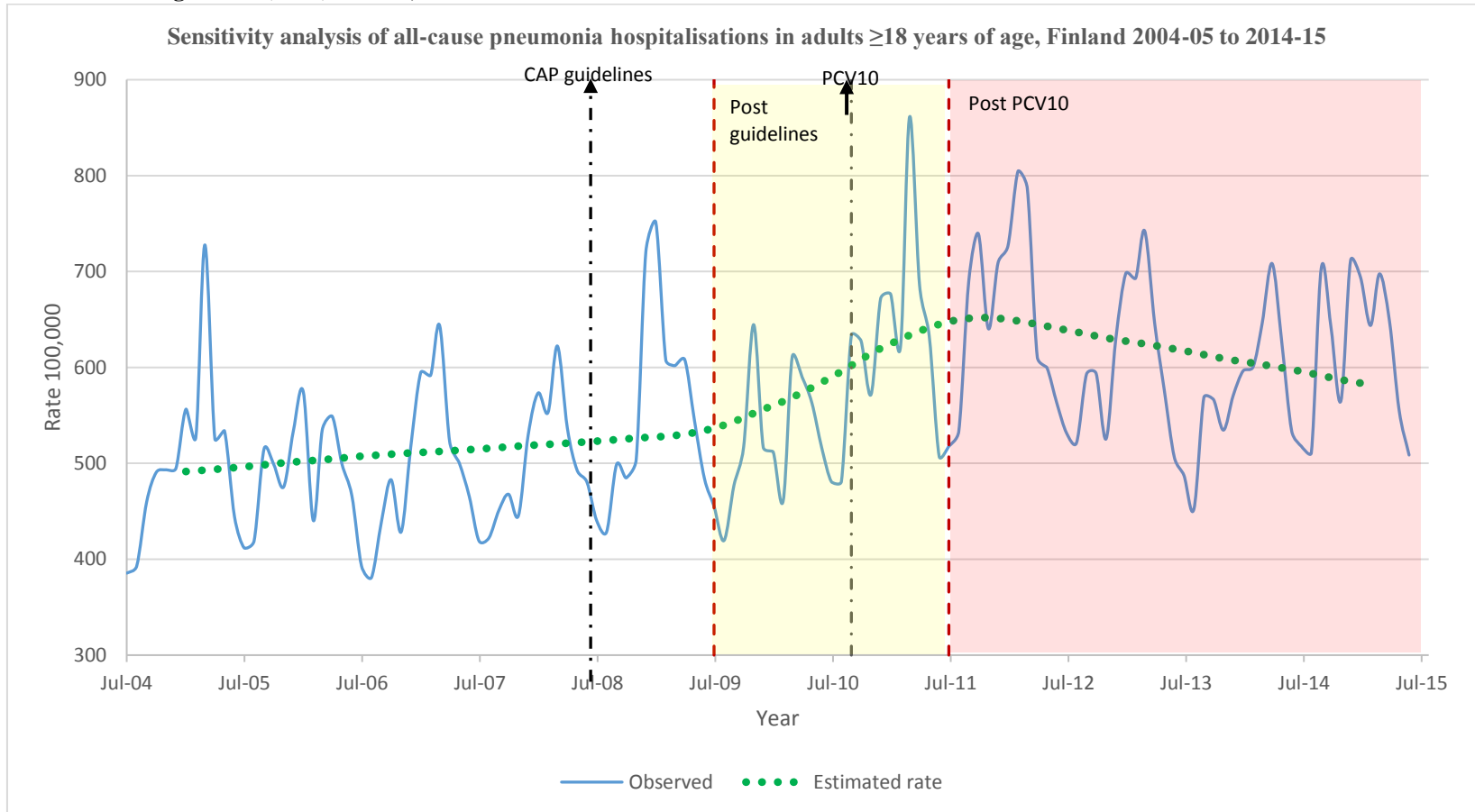
*This definition includes patients who had pneumonia ICD-10 codes J10-J18 and J86 - not restricted as the primary discharge diagnoses - who may or may not have been hospitalised. ^a Estimated rate is the average hospitalisation rate estimated from the adjusted negative binomial regression model, which included as independent variables the time since the beginning of the study and time since the start of the intervention period. The year 2010-11 was considered a transitional period and excluded from the analysis. ^b Expected rate is the average hospitalisation rate estimated from the adjusted model with the time since the beginning of the study as the independent variable. ^c 95% Confidence Intervals are estimated using Delta method, and were considered significant if they did not include zero. ^d Analyses for the aggregate age-groups (i.e. the total [≥18 years of age] and the ≥65 years of age) were age-adjusted using the following age groups: all age groups in the analyses for the total, and the 65-74, 75-84, and ≥85 years of age in the analyses for the ≥65 years of age group.

Supplementary Figure 1. Trend in all-cause hospitalisations in Adults ≥ 18 Years of Age, 2004-05 to 2014-15, Finland



All-cause hospitalisations denote hospitalised patients (at least overnight) who had any ICD-10 codes other than J10-J18 and J86 as primary discharge diagnoses. PCV10: 10-valent pneumococcal conjugate vaccine. The black vertical dashed line marks the introduction of PCV10 in September 2010. The solid line represents the observed rate (i.e. unadjusted monthly hospitalisation rate). The green dots represent the rate estimated from the adjusted negative binomial regression model. 12-month moving average filter was applied to estimated rates.

Supplementary Figure 2. Trend in all-cause pneumonia hospitalisations in adults ≥ 18 years of age, relative to the introduction of the guidelines for the management of community acquired pneumonia (CAP) in 2008, and the ten-valent pneumococcal conjugate vaccine (PCV10) in the National Vaccination Programme (NVP) in 2010, Finland



All-cause pneumonia hospitalisations denote hospitalised patients (at least overnight) who had any of the ICD-10 codes J10-J18, or J86 as primary discharge diagnoses. CAP: community acquired pneumonia. PCV10: 10-valent pneumococcal conjugate vaccine. The black vertical dash-dot lines mark the introduction of the Finnish guidelines for the management of CAP and PCV10 in the National Vaccination Programme in mid-2008 and September 2010, respectively. The red vertical dash lines mark the start of the period following the two interventions. The solid line represents the observed rate (i.e. unadjusted monthly hospitalisation rate). The green dots represent the rate estimated from the adjusted negative binomial regression model. 12-month moving average filter was applied to the estimated rate.