



Incidence, direct costs and duration of hospitalization of patients hospitalized with community acquired pneumonia: A nationwide retrospective claims database analysis



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ABSTRACT

Background: Community-acquired pneumonia (CAP) is one of the most common acute infections associated with a substantial clinical and economic burden. There have been few studies assessing incidence rate, duration of hospitalization, and costs of hospitalized CAP by age and care-setting.

Methods: A retrospective study was conducted using a nationwide Dutch database containing healthcare claims data of 16.7 million inhabitants. Patients with at least one claim with a discharge diagnosis of CAP between January 2008 and December 2011 were selected. The main outcome measures considered were the incidence rate, duration of hospitalization, and the direct costs of hospitalized CAP stratified by age and care-setting.

Results: In total, 195,372 CAP cases were included in the analysis resulting in an average incidence of 295 per 100,000 population per year. Sixty-three percent (123,357) of the included patients were hospitalized for 1 or more nights, of which 5.9% ($n = 7241$) spent at least one night in the Intensive Care Unit (ICU). Overall, these 123,357 patients spent 824,985 days in the hospital of which 48,324 were spent on the ICU. The mean duration of hospitalization of ICU patients and general ward patients was 15.2 days and 6.2 days, respectively. The total costs related to all 195,372 CAP episodes during these 4 years were €711 million, with the majority (76%) occurring among those aged 50 years and older. Median (and mean) costs were dependent on age and type of care with costs ranging from €344 (€482) per episode for 0–9 year olds treated in the outpatient hospital setting up to €10,284 (€16,374) per episode for 50–64 year olds admitted to the ICU.

Conclusion: There is a large variation in terms of incidence, disease burden and costs across different age groups and the treatment setting. Effective interventions, targeted at older adults, to prevent pneumonia could reduce the (financial) burden due to pneumonia.

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1. Introduction

Community-acquired pneumonia (CAP) is one of the most common acute infections necessitating hospitalization resulting in a considerable clinical and economic burden [1,2]. In the USA, for example, the estimated annual number of CAP episodes in adults is

approximately 5.2 million, with the highest incidence among those aged 65 years and older (4200 per 100,000 population) [3]. For most countries, recent data on the (financial) burden of pneumonia are lacking. Although a few large database studies have been published recently focusing on the clinical burden of CAP in (older) adults [4–7], only one study focused on both the clinical and economic burden of CAP [8]. The latter study focused specifically on patients aged 50 years and older. To our knowledge, there are no published studies focusing on the incidence, the duration of hospitalization and the direct cost of hospitalized CAP simultaneously using a national dataset which covers an entire population. These

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data are, however, important in order to accurately estimate the total burden of disease due to CAP. Furthermore, it was previously shown that both the incidence and CAP related costs are important drivers of the cost-effectiveness of pneumococcal vaccination programs targeting adults [9,10]. Therefore, accurate estimates of these parameters are crucial to estimate the cost-effectiveness of such programs especially now that the results of the CAPiTA trial have shown that the 13-valent polysaccharide conjugate vaccine (PCV13) appeared effective in preventing vaccine-type pneumococcal, bacteremic, and nonbacteremic community-acquired pneumonia and vaccine-type invasive pneumococcal disease in adults aged 65 years and older [11].

To address this gap in the literature, the present study evaluated the incidence rate, the duration of hospitalizations and the direct hospitalization cost of CAP stratified by age and setting of care using a nationwide database covering the entire population of the Netherlands.

2. Methods

2.1. Background

2.1.1. Current pneumococcal vaccination programs in the Netherlands

In the Netherlands, an infant pneumococcal vaccination program was introduced for all infants born after March 31, 2006. Infant received 3 doses of PCV7 at ages 2–4, and an additional booster dose at 11 months (i.e. 3+1). As of 2011, PCV10 replaced PCV7 in the infant pneumococcal vaccination schedule.

For older individuals a 23-valent pneumococcal polysaccharide vaccine (PPV23) is available. However, PPV23 is not recommended for universal use among the elderly [13,14] as there is no convincing evidence that it prevents non-invasive pneumococcal pneumonia, where the vast majority of disease burden lies [15,16]. Consequently, the uptake of PPV23 is very low (i.e. less than 1% of those aged ≥ 65) [9] compared to, for example, the influenza vaccination uptake of approximately 75% [17].

2.1.2. Database

In the Netherlands, hospitals are reimbursed based on a combination of diagnosis and treatment: a DBC (Dutch: Diagnose Behandeling Combinatie). This DBC system is accompanied by an extensive registration, which is gathered in a national database: the DIS (DBC Information System). This DIS database includes all data relevant to the hospitals' reimbursement of their bed occupancy and activities. It contains all diagnoses and activities performed by all hospitals in the Netherlands ($n = 104$) covering a population of 16.7 million inhabitants. Furthermore, it contains some basic information on patient characteristics (e.g. unique identifiers, gender and year of birth) and information on the derived care product which was reimbursed by the insurance company, like site of care (Intensive Care Unit [ICU] or ward) and length of stay (see also below). The database does not contain survival information and "discharge" includes death. For the current study, data from the DIS database were used which were extracted and aggregated by the Dutch case-mix office DBC-Onderhoud, Utrecht, The Netherlands. Further, analyses were performed by the authors.

2.1.3. Case selection

Patients with at least one medical claim with a final discharge diagnosis of pneumonia between January 2008 and December 2011 were retrospectively selected. Pneumonia was identified using specific diagnostic codes which were mapped to International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes (480, 481, 482.xx-483.xx, 484.xx, 485, and 486). Diagnostic codes in the database are classified according to

the medical specialization. The following diagnosis codes were included to select CAP cases in the analysis: (i) 0313. Internal medicine: 401. Pneumonia, unspecified and 402. Interstitial pneumonia; (iii) 0316. Pediatrics: 3028. Lower respiratory infections; (iv) 0322. Pulmonology: 1401. Pneumonia; (v) 0335. Geriatrics: 273. Pneumonia. Only patients with a final diagnosis code were selected. To exclude potential hospital acquired pneumonia (HAP) episodes, patients were excluded if they had been treated clinically for any other final diagnosis than those mentioned above, in a parallel DBC in the same hospital.

We differentiated between the following type of care: ICU (hospitalized CAP admitted for at least one night to the ICU), general ward (hospitalized CAP only admitted to the general ward) and outpatient hospital setting (ED and outpatient hospital visits without an overnight stay and therefore not counted as a hospitalization day). Please note that outpatient CAP in the current study only include patients treated in the hospital and that cases only treated by the general practitioner are not collected in the database.

2.1.4. Data and outcome measures

The following data from the DIS database were collected per case: date of presentation (month, year), age at presentation, type of care (see above), length of hospital stay separated into those spent in general ward, ICU, hospital costs, and the specialists' fees which are claimed separately.

The outcome measures considered in this study are the incidence rate, duration of hospitalization, and the direct costs of hospitalized CAP stratified by age and care-setting. In order to calculate incidence rates, Dutch population data from Statistics Netherlands were extracted from the electronic databank Statline [12].

2.2. Analyses

All above mentioned study variables were analyzed using Microsoft Excel (Microsoft, Redmond, WA, USA). Descriptive statistics (mean, standard deviation (SD), median, and inter quartile range (IQR)) were calculated. Depending on the outcome measure (i.e. sample size) the study population was either divided into (i): age bands of 5 years with the exception of those aged less than 5 years which were divided into 1 year age bands and those aged 85 years and over who were aggregated into a single group, (ii) or into the following age groups 0–9, 10–17, 18–49, 50–64, 65–74, 75–84 and 85 years and older if the sample size (< 50 cases per age class) was not sufficient to provide finer age grouping.

3. Results

3.1. Incidence

A total of 195,372 CAP episodes were included in the analysis between January 2008 and December 2011. The overall number of CAP episodes were stable throughout the first 3 years (47,119; 48,522; 46,994 for 2008, 2009, 2010 respectively) while a small increase was observed in 2011 ($n = 52,737$). The mean annual number of CAP episodes throughout the entire study period was 48,843 resulting in an average incidence of 295 per 100,000 inhabitants per year. Across treatment settings, the highest incidence rate was found for treatment episodes in the general ward (176 per 100,000 inhabitants per year), followed by those treated in the outpatient setting (109 per 100,000 inhabitants per year) and in the ICU (11 per 100,000 inhabitants per year). Approximately 45% and 64% of all CAP episodes occurred in individuals aged 65 years (incidence of 881 per 100,000 inhabitants per year) and 50 years and older (incidence of 535 per 100,000 inhabitants per year), respectively. Within the more severe episodes (i.e. excluding outpatient cases)

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