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Burton, Louise A.; Price, Rosemary ; Barr, Karen E.; McAuley, Sean M.; Allen, Jennifer B.; Clinton, Aoibhinn M.; Phillips, Gabby; Marwick, Charis; McMurdo, Marion; Witham, Miles

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## **Hospital Acquired Pneumonia incidence and diagnosis in older patients**

Louise A Burton<sup>1</sup>, Rosemary J G Price<sup>1</sup>, Karen E Barr<sup>1</sup>, Sean M McAuley<sup>1</sup>, Jennifer B Allen<sup>1</sup>, Aoibhinn M Clinton<sup>1</sup>, Gabby Phillips<sup>2</sup>, Charis A Marwick<sup>1</sup>, Marion E T McMurdo<sup>1</sup>,  
Miles D Witham<sup>1</sup>

<sup>1</sup>Medical Research Institute, University of Dundee, Ninewells Hospital, Dundee DD1 9SY;

<sup>2</sup>Department of Microbiology, NHS Tayside, Ninewells Hospital, Dundee DD1 9SY

Correspondence to: Dr Miles D Witham ([m.witham@dundee.ac.uk](mailto:m.witham@dundee.ac.uk)). Tel: +44 (0) 1382 383086

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## **Hospital Acquired Pneumonia incidence and diagnosis in older patients**

### **ABSTRACT**

#### **Background**

Hospital-acquired pneumonia poses a hazard to older people who are hospitalized, yet few data exist on the incidence or risk factors in non-intensive care patients. This study aimed to determine the incidence of, and risk markers for, Hospital Acquired Pneumonia (HAP) in a sample of hospitalized older people.

#### **Methods**

Prospective survey of hospitalized older patients (>65 years) at a single centre over a 12 month period. Casenote and chart data were collected on acute medical, orthopaedic and Medicine for the Elderly wards. Hospital-acquired pneumonia was defined in accordance with the European and Scottish National Prevalence Survey 2011 definition. Key analyses were incidence of clinically suspected and case-definition clinically confirmed HAP.

#### **Results**

1302 patients were included in the analysis. 539 (41%) were male, mean age was 82 years (SD 8). Median length of hospital stay was 14 days (IQR 20). 157 episodes of HAP were clinically suspected in 143 patients (10.9% of admissions), but only 83 episodes in 76 patients met the diagnostic criteria (5.8% of admissions). The risk of HAP was 0.3% per day in hospital. Reasons for failure to meet the diagnostic criteria in 75 cases were lack of radiographic evidence in 60/75; lack of evidence of inflammation in 42/75, and lack of respiratory signs or symptoms in 13/75; 35/75 (47%) of cases lacked evidence in 2 or more domains.

**Conclusion**

HAP is common but over-diagnosed in older hospitalised patients.

**Key words:**

Older; diagnosis; hospital-acquired pneumonia; incidence

## **Introduction**

The incidence of hospital-acquired pneumonia (HAP) is not well studied outside the Intensive Care Unit, but estimates range from less than 1% of all hospital admissions[1-4] to between 8% and 10% of patients admitted to medicine for the elderly units[5-8]. Older people spend longer in hospital, have relative immune compromise, and are commonly exposed to multiple courses of antibiotics. They are more likely to have swallowing dysfunction leading to aspiration of oropharyngeal material, which in older hospitalized patients includes pathogenic bacteria in 45% of cases; such bacteria are associated with an increased risk of HAP[9,10]

Studies of HAP to date have focused mainly on ventilator-associated pneumonia in Intensive Care Units; patient characteristics, risk factors and preventative approaches may be very different in older, ward-based patients[11-13]. Few studies have attempted to estimate the incidence of, or risk factors for HAP among the general population of older hospitalised patients. In addition, clinical experience suggests that a diagnosis of HAP is often made without reference to standardised diagnostic criteria, potentially overestimating the incidence. We therefore conducted a prospective survey to determine the incidence of HAP and to determine how often clinically diagnosed HAP meets standardized diagnostic criteria in older hospitalized patients.

## **Methods**

### *Study design, setting and population*

We surveyed older people admitted to Ninewells Hospital and Royal Victoria Hospital, NHS Tayside, Dundee, from 1<sup>st</sup> August 2012 to 31<sup>st</sup> July 2013. We capped the number of consecutive admissions sampled during each quarter (400 for first quarter, 300 for subsequent quarters) to allow follow up from medical notes to be completed. We studied the first admission for each

patient during the study period; subsequent admissions were not included, but readmissions for pneumonia within 28 days of discharge were counted as episodes of suspected or clinically confirmed HAP. We selected four Acute Medical and Medicine for the Elderly wards at Ninewells Hospital, four subacute Medicine for the Elderly wards at Royal Victoria Hospital, Dundee and three Orthopaedic wards at Ninewells Hospital, Dundee. The admission window for each patient was taken as the date of admission to any acute hospital ward to the date of discharge from either the acute or subacute hospital (thus discharge to home, care home, intermediate care or community hospital was taken as the date of discharge).

To avoid selection bias resulting from the requirement to obtain consent, we did not approach patients directly as part of this survey; instead we used routinely collected data from medical notes, nursing notes and prescribing charts. We gained approval from the local Caldicott Guardian (data protection officer) prior to commencing data collection. All patients aged  $\geq 65$  years admitted to the targeted hospital wards were included in the survey. Ethics committee approval was not required as the only data used were routinely collected healthcare data without additional patient contact.

#### *Data collection*

Data on baseline demographics, medication use at admission, comorbid disease recorded in the hospital and primary care medical notes, pre-hospital antibiotic use noted on the GP admission letter (in the 14 days prior to hospital admission) and all episodes of in-hospital antibiotic use for prophylaxis or treatment were collected. We recorded swallowing problems (noted by the patient or by nursing staff without formal testing) and the presence or absence of dentures from hospital nursing notes. We ascertained new episodes of infection by scrutinizing the prescription charts of all admitted patients for new antibiotic prescriptions. These patients then

underwent notes review by medically qualified researchers to ascertain the clinical indication for prescription, and to ascertain whether the case definition for clinically confirmed hospital-acquired pneumonia was met.

The case definition of clinically confirmed hospital-acquired pneumonia[14] was: onset >48 hrs after admission, plus a) two or more serial chest radiograph or computed tomography (CT) scans with a suggestive image of pneumonia for patients with underlying cardiac/pulmonary disease (or one definitive chest radiograph or CT scan if no underlying disease) as noted by either the attending clinician or reporting radiologist; and b) a fever >38°C with no other cause or white cell count <4x10<sup>9</sup>/L or >12x10<sup>9</sup>/L; and c) at least one of: new onset purulent sputum or change in character of sputum, cough/dyspnoea/tachypnoea, suggestive auscultation (crepitations or bronchial breath sounds), rhonchi or wheezing, worsening gas exchange. Suspected but not clinically confirmed episodes were defined as episodes where the clinical team had at any point recorded a diagnosis of ‘pneumonia’ or ‘respiratory tract infection’ or ‘chest infection’ and started antibiotic therapy, but which did not fulfil the case definition above.

#### *Data Analysis*

All data analyses were performed using SPSS v21 (IBM, New York, USA). We calculated the percentage of patients with suspected HAP, the percentage of those with clinically confirmed HAP and the cumulative risk of HAP by duration of admission as well as the risk of HAP event per day of hospital admission. We determined the case fatality rate (i.e. the percentage of those who died prior to hospital discharge) in those with suspected and clinically confirmed HAP episodes. We generated descriptive statistics for the reasons leading to failure to confirm the diagnosis of HAP in suspected, but not clinically confirmed cases.

## **Results**

We studied a total of 1307 patients, of whom 1302 had complete data and are included in this analysis. Baseline characteristics are given in Supplementary Table 1 (appendix 1). Medical records were not available for scrutiny for the five patients excluded from analysis.

The number of HAP episodes per patient group is shown in Table 1. There were a total of 157 episodes of suspected HAP in 143 patients (10.9% of all studied admissions) but only 83 episodes in 76 patients met the diagnostic criteria (5.8% of all studied admissions). The overall risk of clinically confirmed HAP per day of admission was 0.3% and remained constant through to at least 80 days after admission. The in-hospital death rate was 22/76 (29%) in patients with clinically confirmed HAP, 13/67 (19%) in patients with suspected but not clinically confirmed HAP cases and 97/1159 (8%) in patients with no episodes of suspected HAP. Of the patients with clinically confirmed HAP, 72 (87%) had a single episode. Only 9 (6.3%) of patients with suspected HAP and 4 (5.3%) of patients with clinically confirmed HAP had multiple episodes of HAP.

For the 75 suspected cases not meeting the diagnostic criteria for HAP, the reasons for failing to meet the criteria were lack of radiographic evidence, lack of inflammatory evidence, or lack of respiratory evidence (Figure 1). No significant differences in reasons were noted between different ward types.

## **Discussion**

Our estimate of HAP incidence is at the upper end of previous estimates[5,15]. Some previous studies with high reported incidence included intensive care settings, which our study did not.



Previous studies found that HAP incidence rates were higher in patients in intermediate (8.3%) and long term care (5.3%) compared to short term care (0.5%) [5]. The high mortality that we found in clinically confirmed cases of HAP is both expected and consistent with other studies[2,15].

Previous studies have shown that in non-ICU settings HAP was more common in postoperative patients[10,16], contrary to our findings. This may be due in part to the longer length of stay and greater co-morbidities of the patients admitted to Medicine for the Elderly wards compared to those on orthopaedic wards, many of whom were elective patients undergoing surgery with spinal anaesthesia. Of note, older patients with lower limb fracture (a frailer group with multiple comorbidity) had a HAP rate of 10% in a recent study[10].

Almost half of suspected HAP cases did not fulfil the diagnostic criteria used in this survey. The criteria may be overly rigorous, and hence miss atypical presentations of genuine pneumonia in this population. However, in approximately half of cases not reaching the criteria, two or three domains of evidence were lacking, making a diagnosis of HAP unlikely. Potentially large numbers of patients may thus receive inappropriate antibiotic therapy or have an alternative, treatable diagnosis overlooked. Even in those patients where antibiotic therapy might still have been appropriate, an alternative diagnosis may have altered the choice, duration or dose of antibiotic therapy.

Using routinely collected ward data allowed us to include patients with delirium and dementia, enhancing the generalizability of our findings. We used pre-defined criteria for identifying HAP which allowed more accurate diagnosis than relying on hospital episode statistics. The criteria used have not been validated specifically for older people so some genuine cases of

HAP may have been coded as suspected but not confirmed; for instance some changes may have been missed by plain chest radiography, but might have been detectable on CT. Microbiological data were not available for the vast majority of patients, and we were unable to collect a formal measure of frailty. Patients were not followed up after discharge; hence the HAP rate and mortality following HAP may be underestimated. Similarly, a lack of data on pneumonia rates amongst this cohort in the community makes it impossible to calculate the excess risk of pneumonia attributable to hospitalization, rather than to the presence of other risk factors.

Our findings suggest that further work is needed: incidence studies in other populations, exploration of the reasons for misdiagnosis, refinement of diagnostic criteria for use in older patients, development of risk scores to identify low or high risk subgroups of patients, and finally development and evaluation in trials of multicomponent interventions to prevent this common and dangerous condition,

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Conflict of interest: None to declare

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**Table 1. Incidence of hospital-acquired pneumonia (HAP)**

Parameter	Acute (n=729)	Subacute (n=235)	Orthopaedic (n=338)	All (n=1302)
No. of patients with suspected HAP (%)	77 (10.6)	35 (14.9)	31 (9.2)	143 (10.9)
Suspected HAP episodes	84	42	31	157
No. of patients with clinically confirmed HAP (%)	43 (5.9)	23 (9.8)	10 (3.0)	76 (5.8)
Clinically confirmed HAP episodes	47	26	10	83
% suspected cases confirmed clinically	56%	62%	32%	53%
Total days spent in hospital	14753	8177	4833	27763
Risk of HAP per day in hospital	0.32%	0.32%	0.21%	0.30%

HAP: Hospital-acquired pneumonia

**Fig 1. Reasons for failure to meet diagnostic criteria in patients with suspected, but unconfirmed Hospital-Acquired pneumonia (n=75)**



