RESEARCH AND GUIDELINE UPDATES

Adults miscoded and misdiagnosed as having pneumonia: results from the British Thoracic Society pneumonia audit

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ABSTRACT

A key objective of the British Thoracic Society national community-acquired pneumonia (CAP) audit was to determine the clinical characteristics and outcomes of hospitalised adults given a primary discharge code of pneumonia but who did not fulfil accepted diagnostic criteria for pneumonia. Adults miscoded as having pneumonia (n=1251) were older compared with adults with CAP (n=6660) (median 80 vs 78 years, p<0.001) and had more comorbid disease, significantly fewer respiratory symptoms (fever, cough, dyspnoea, pleuritic pain), more constitutional symptoms (general deterioration, falls) and significantly lower 30-day inpatient mortality (14.3% vs 17.0%, adjusted OR 0.75, p=0.003).

INTRODUCTION

Clinical coding data are increasingly being used nationally to compare pneumonia-related outcomes across institutions in the UK. Furthermore, data derived from pneumonia codes are used as a method for retrospectively identifying cases of community-acquired pneumonia (CAP). However, considerable heterogeneity and variation in diagnostic and coding practices has been described across the UK.[1] Possible reasons for observed variations in coding include local differences in coding practices and, specifically with regard to pneumonia, inherent difficulties in making a definitive diagnosis due to varied clinical presentations, lack of a diagnostic laboratory test and the limitations of chest X-rays (CXR). The extent of miscoding and misdiagnosis nationally and the effect of miscoding on reported patient outcomes are not known.

The British Thoracic Society (BTS) conducted a national audit to compare the clinical characteristics and outcomes of adults miscoded as having pneumonia versus adults with CAP.

METHODS

Study design

National Health Service (NHS) institutions in England, Wales and Northern Ireland were invited to participate in the BTS CAP audit for adults hospitalised to acute trusts between 1 December 2014 and 31 January 2015. Institutions were required to identify adult patients admitted over this period, with International Classification of Diseases, 10th Revision primary discharge codes that included any of J12–J18. Medical notes of identified patients were reviewed by investigators at each participating site and entered into either one of two groups within the audit. Eligibility criteria for entry to the CAP group were the following: (1) age ≥16 years with new infiltrates on chest radiograph (determined by the auditing team), (2) the presence of signs and symptoms of a lower respiratory tract infection (LRTI), (3) no hospital discharge within the preceding 10 days of index admission and (4) not immunocompromised. All cases ineligible for inclusion to the CAP group were included in the non-CAP group. Demographic and clinical data were extracted using a standardised pro-forma and entered onto a secure website. The BTS Quality Improvement Committee determined that ethical approval was not required for the conduct of this audit.

Study population

The CAP group comprised immunocompetent patients with a clinicoradiographic diagnosis of CAP as defined by accepted international criteria. Patients miscoded as having pneumonia comprised immunocompetent patients in the non-CAP group, who did not have nosocomial pneumonia; the latter defined as preceding hospitalisation within 10 days of index admission with pneumonia or pneumonia arising during hospitalisation. For the comparative analysis, patients miscoded as having pneumonia were compared with those with CAP.

Statistical considerations

Statistical analyses were performed using Stata/IC V.13.1 (Stata, 2013). Pearson's χ^2 test was used to compare categorical variables. The Mann-Whitney U-test was used to compare continuous variables. Baseline demographics and clinical features of adults with miscoded pneumonia were compared with those with CAP. The independent association between diagnosis (miscoded pneumonia or CAP) and 30-day inpatient (IP) mortality was examined using a multivariable logistic regression model. Likelihood ratio tests were used to determine the best fit of continuous variables, and accordingly, age was fitted in the model as a categorical variable. Explanatory variables were examined to determine which covariates were significantly associated ($p \leq 0.05$) with the outcome of 30-day IP mortality. Forward regression was subsequently conducted with the remaining covariates; covariates that led to a ≥10% change in the regression coefficient

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between coded diagnosis and mortality were retained. A sensitivity analysis was performed to compare mortality in institutions that had submitted data for both the CAP and non-CAP groups.

RESULTS

Overall study population

One hundred and fifty-eight institutions submitted data towards the CAP group (n=6786), and 115 institutions submitted data towards the non-CAP group (n=2211). In the CAP group, 30-day mortality data were missing in 126 cases, leaving 6660 patients for analysis. In the non-CAP group, data to determine immune status or treatment for nosocomial infection were unavailable for 278 patients and 30-day mortality data were missing in a further 7 patients; of the remaining 1926 patients, 675 (35.0%) had nosocomial pneumonia and/or were immunocompromised, leaving 1251 (65.0%) patients who were miscoded as having pneumonia.

Patients miscoded as having pneumonia

Almost all patients miscoded as having pneumonia (1189 of 1251 (95.0%)) received antibiotic treatment on admission; 656 (55.2%) for the treatment of presumed CAP, 373 (31.4%) for other LRTIs and 135 (11.4%) for other diagnoses. Symptoms consistent with a LRTI were present in 933 (74.6%) of miscoded patients at admission, while the CXR was normal in 487 (38.9%) patients. Abnormal CXR findings included pleural effusions, cardiomegaly and chronic lung changes.

'Miscoded pneumonia' versus CAP

Patients miscoded as having pneumonia were significantly older than those with CAP (median 80 vs 78 years, p<0.001). They were also significantly more likely to have major comorbid conditions (0–1 comorbidities, 61.3% vs 68.9%, 2–4 comorbidities, 38.0% vs 30.6% and ≥5 comorbidities 0.7% vs 0.5%; p for trend <0.001) including more chronic heart disease (excluding hypertension), congestive heart failure, dementia, diabetes and cerebrovascular disease (table 1). Symptoms at presentation were significantly different between both groups; patients with miscoded pneumonia had significantly fewer respiratory symptoms including fever, cough, dyspnoea and pleuritic chest pain but significantly more non-specific constitutional symptoms including general deterioration, falls and altered conscious levels compared with those with CAP.

Outcomes

Patients with miscoded pneumonia were less likely to be admitted to critical care compared with patients with CAP (1.9% vs 5.1%, respectively, OR 0.36, 95% CI 0.23 to 0.54, p<0.001) and had a lower 30-day IP mortality (14.3% vs 17.0% respectively, adjusted OR (aOR) 0.75, 95% CI 0.62 to 0.91, p=0.003; model adjusted for age, admission through emergency department, admission from a care home, comorbid disease and critical care admission).

DISCUSSION

This is the first multicentre analysis in the UK of hospitalised adults miscoded as having pneumonia. We found that such patients were older, had more comorbid illnesses, fewer symptoms consistent with an acute respiratory infection and more non-specific constitutional symptoms at presentation compared with patients with clinicoradiographic evidence of CAP. Miscoded cases had a 25% lower odds of IP death at 30 days compared with those with CAP (similar mortality effect observed in sensitivity analysis; data not shown).

Miscoding of pneumonia may occur because of coder-related error or physician-related misdiagnosis. Coder-related error mainly occurs during (1) data abstraction from medical notes or (2) interpretation of data for coding; coders may (1) assign generic codes when information exists for more specific codes (mis-specification error) or (2) resequence codes for a spell hence altering the primary diagnosis for that spell. In this study, 52% of patients miscoded as having pneumonia were treated as having CAP by their attending clinicians, although on subsequent review these patients did not fulfil criteria for CAP; these constitute cases of miscoding due to misdiagnosis rather than coder-related error. This observation reflects the widely recognised difficulties with making an early diagnosis of pneumonia at the time of hospital admission based on clinical and chest radiographic features alone; non-pneumonic comorbidities, such as congestive heart failure, may be misdiagnosed as pneumonia. Pressures to administer antibiotics as rapidly as possible in patients with CAP further increase the risk of misdiagnosis.

Many patients miscoded as having pneumonia had symptoms of an acute respiratory infection but did not have radiographic changes consistent with pneumonia. This clinical syndrome would be consistent with a diagnosis of acute bronchitis, as would the lower mortality observed in miscoded cases of pneumonia compared with patients with CAP. In a community-based US study of elderly patients, a lower mortality in those with non-pneumonic LRTI compared with pneumonia was also observed (7% vs 13%), though no statistically significant difference was observed in a US study of hospitalised patients (8% vs 10%, p=0.09).[2 3] The crude IP mortality of 14.3% in patients miscoded as having pneumonia is nevertheless high, underlining the vulnerability of older adults (mean age 80 years) with multiple comorbid illnesses to even non-pneumonic LRTIs.

Strengths and limitations of this study

Due to the study methodology, cases of CAP that were miscoded to an alternative diagnosis, such as LRTI, would not have been captured. However, there is no reason to expect this represents a large proportion of patients, nor for the characteristics of such patients to be different from patients correctly coded, as reported elsewhere.[4] In particular, this limitation is not expected to have a significant impact on the comparative analysis.

Studies of CT imaging in the investigation of patients admitted to hospital with suspected CAP have revealed the limitations of the CXR in identifying the full range of pneumonias.[5] Therefore, it is possible that some cases in the 'miscoded pneumonia' group may have been misassigned based on a normal CXR (CT imaging may have revealed pneumonic changes). The effect of such misclassification is that the observed differences between patients with CAP and those with 'miscoded pneumonia' are likely to be conservative.

The participation of a large number of NHS institutions across the UK is an important strength of this study. The findings from this study reflect current management and coding practices in relation to pneumonia in the NHS.

Implications of this study

Institutional variation in reported pneumonia outcomes derived from interrogation of clinical coding datasets may be confounded by variations in coding. Efforts directed at measuring and reducing the degree of miscoding and misdiagnosis of

Table 1 Baseline demographics, clinical characteristics and outcomes of hospitalised adults with miscoded pneumonia compared with those with CAP

	Miscoded pneumonia group (n=1251)	CAP group (n=6660)	OR (95% CI)	p Value
Age (years)*	80 (69–87)	78 (65–87)	1.01 (1.01 to 1.01)	**<0.001**
Male	585 (46.8)	3114 (46.8)	1.02 (0.91 to 1.16)	0.711
Care home resident†	230 (18.8)	1044 (16.6)	1.17 (1.00 to 1.37)	0.057
Admission route				
Accident and Emergency	925 (73.9)	5030 (75.5)	0.90 (0.78 to 1.04)	0.142
Comorbid disease				
Congestive heart failure	148 (11.8)	635 (9.5)	1.27 (1.05 to 1.54)	**0.013**
COPD	279 (22.3)	1552 (23.3)	0.94 (0.82 to 1.09)	0.441
Chronic lung disease (excluding COPD)	138 (11.0)	807 (12.1)	0.90 (0.74 to 1.09)	0.277
Chronic heart diseases (excluding hypertension)	328 (26.2)	1422 (21.4)	1.31 (1.14 to 1.50)	**<0.001**
Active malignancy	79 (6.3)	448 (6.7)	0.93 (0.73 to 1.20)	0.592
Chronic renal disease	131 (10.5)	593 (8.9)	1.20 (0.98 to 1.46)	0.078
Liver disease	10 (0.8)	47 (0.7)	1.13 (0.57 to 2.25)	0.719
Dementia	207 (16.6)	609 (9.1)	1.97 (1.66 to 2.34)	**<0.001**
Diabetes	207 (16.6)	662 (9.9)	1.80 (1.52 to 2.13)	**<0.001**
Cerebrovascular disease	172 (13.8)	690 (10.4)	1.38 (1.15 to 1.65)	**<0.001**
Number of comorbid diseases				
0–1	767 (61.3)	4589 (68.9)	Reference	**<0.001‡**
2–4	475 (38.0)	2040 (30.6)	1.39 (1.23 to 1.58)	
≥5	9 (0.7)	31 (0.5)	1.74 (0.82 to 3.66)	
Clinical features at admission				
Respiratory symptoms				
Fever	473 (42.8)[a]	2953 (51.4)[b]	0.71 (0.62 to 0.81)	**<0.001**
Cough	839 (74.5)[c]	4887 (82.9)[d]	0.60 (0.52 to 0.70)	**<0.001**
Dyspnoea	747 (66.6)[e]	4629 (78.5)[f]	0.55 (0.48 to 0.63)	**<0.001**
Pleuritic chest pain	181 (17.8)[g]	1284 (24.9)[h]	0.65 (0.55 to 0.78)	**<0.001**
Wheeze	235 (24.6)[i]	1147 (23.9)[j]	1.04 (0.89 to 1.22)	0.629
Haemoptysis	11 (0.9)	76 (1.1)	0.77 (0.41 to 1.45)	0.415
Constitutional symptoms				
General deterioration from premorbid state	67 (5.4)	263 (4.0)	1.38 (1.05 to 1.81)	**0.022**
Altered consciousness	49 (3.9)	183 (2.8)	1.44 (1.05 to 1.99)	**0.025**
Fall	132 (10.6)	465 (7.0)	1.57 (1.28 to 1.93)	**<0.001**
Abdominal symptoms§	61 (4.9)	253 (3.8)	1.30 (0.97 to 1.73)	0.073
Severity features				
Confusion	362 (28.9)	1648 (24.7)	1.52 (1.33 to 1.75)	**<0.001**
Urea >7 mmol/L	664 (53.1)	3235 (48.6)	1.29 (1.14 to 1.46)	**<0.001**
Respiratory rate ≥30/min	156 (12.5)	1185 (17.8)	0.69 (0.57 to 0.82)	**<0.001**
Blood pressure <90 mm Hg systolic and/or ≤60 mm Hg diastolic	321 (25.7)	1185 (17.8)	1.66 (1.44 to 1.92)	**<0.001**
Outcomes				
Critical care admission	24 (1.9)	340 (5.1)	0.36 (0.23 to 0.54)	**<0.001**
30-day IP mortality	179 (14.3)	1132 (17.0)	0.82 (0.69 to 0.97)	**0.019**

Symptom data available for 'n' adults as described: [a]n=1105; [b]5746; [c]1126; [d]5893; [e]1122; [f]5899; [g]1016; [h]5157; [i]956; [j]4809. Figures in **bold** are those with p<0.05.
*All values given as n (%) unless stated otherwise; median (IQR).
†Care home data available for 7523 adults in total.
‡All values given as n (%) unless stated otherwise; p for trend.
§Composite of vomiting, diarrhoea, abdominal pain and/or non-specific abdominal complaint.
CAP, community-acquired pneumonia; COPD, chronic obstructive pulmonary disease; IP, inpatient.

pneumonia are needed if such datasets are to be used to assess quality improvement initiatives in pneumonia, or for high-level management purposes. At a clinical level, better diagnostics to help confidently identify patients with non-pneumonic conditions from among those presenting with suspected pneumonia may allow improved targeted treatment strategies and reduce unwarranted antibiotic use.

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Competing interests PD reports grants from Pfizer, other from Boehringer-Ingelheim, outside the submitted work. WSL reports that his institution has received unrestricted investigator initiated research funding from Pfizer for a pneumonia cohort study.

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