UK National COPD Resources and Outcomes Project 2008: Patients with Chronic Obstructive Pulmonary Disease Exacerbations Who Present with Radiological Pneumonia Have Worse Outcome Compared to Those with Non-Pneumonic Chronic Obstructive Pulmonary Disease Exacerbations

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Key Words

Chronic obstructive pulmonary disease, exacerbations · Pneumonia · Chest X-ray, admission

Abstract

Background: Limited comparative data exist on the outcomes of patients presenting with chronic obstructive pulmonary disease (COPD) exacerbations with or without radiological pneumonia. **Objective:** To examine the outcome differences amongst these patients. **Methods:** We analysed 2008 UK National COPD audit data to examine the characteristics, management and outcomes, inpatient- and 90-day mortality and length of stay of patients admitted with COPD exacerbations. **Results:** Of 9,338 admissions, 16% (1,505) had changes consistent with pneumonia indicated on the admission chest X-ray. They tended to be older (mean ages 75 vs. 72 years), male (53 vs. 50%), more likely to come from care

homes, with more disability, higher BMI and co-morbidity, lower albumin but higher urea levels, and less likely to be current smokers. COPD exacerbations with pneumonia were associated with worse outcomes: inpatient mortality was 11 and 7% and 90-day mortality was 17 and 13% for pneumonia and non-pneumonia patients, respectively ($p < 0.001$). After adjusting for factors that are significantly different between the 2 groups, including age, sex, place of residence, level of disability, co-morbidity, albumin and urea levels, estimated risk ratios for inpatient and 90-day mortality for pneumonia compared to non-pneumonia cases in this series were 1.19 (1.01, 1.42) and 1.09 (0.96, 1.23), respectively. The adjusted risk ratio of a prolonged acute hospital stay of more than 7 days was 1.15 (1.07, 1.23). **Conclusions:** Patients who present with radiological pneumonia have worse outcomes compared to those admitted without pneumonia in exacerbation of COPD.

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Introduction

Chronic obstructive pulmonary disease (COPD) is a common cause of chronic disability and death, there being approximately 25,000 COPD-related deaths annually in the UK [1]. It is the second most common cause of hospital emergency admissions with approximately 100,000 admissions in 2000 [2], associated with 1 million hospital-bed days in England alone. Previous Royal College of Physicians/British Thoracic Society national audits of COPD have already highlighted that COPD patients usually present to hospital with acute exacerbations: these are serious (14% of these patients die during admission) and nearly a third will be readmitted within 90 days of the initial admission [3–5].

Community-acquired pneumonia (CAP) is also a common cause of hospital admission, and one of the leading causes of death in the UK [6]. In a subanalysis of a randomised clinical trial, where a total of 262 patients with CAP included 95 (36.3%) who had COPD, it was recently reported that COPD patients do not differ from non-COPD patients in terms of 30-day mortality outcome in CAP [7]. However, there is a distinct paucity of information with regard to the outcome of pneumonia among COPD patients. Data on how patients with COPD exacerbation presenting with pneumonia are managed compared to those without pneumonia is limited, as is comparative data about prognosis adjusting for case mix and individual prognostic indicators.

In this study, we set out to examine the characteristics of patients with COPD exacerbation who presented with radiological pneumonia compared to other COPD admissions using national audit 2008 data [8]. We were interested in comparing the management and outcome between those with and without pneumonia in COPD exacerbation (as opposed to pneumonia patients with COPD) with regard to mortality (inpatient and 90-day) and length of stay, controlling as far as possible for case mix and individual prognostic factors.

Methods

The 2008 audit-collected data in 5 different areas of COPD care and all details can be viewed at the Royal College of Physicians' website (<http://www.rcplondon.ac.uk/clinical-standards/ceeu/Current-work/ncrop/Pages/audit.aspx>). All UK and island acute trusts admitting COPD exacerbation patients were invited to participate in the audit programme and to collect data as acute units. The term 'unit' was used to describe each participating organisation and was defined as 'a hospital that admits acute un-

selected emergency admissions'. Thus, where a whole trust participated in the audit, the term 'unit' refers to that trust. Where a hospital participated as part of a trust, the term 'unit' refers only to that hospital within the trust. Participants were asked to define 'units' in terms of the functionality of their respiratory medicine departments.

Each participating unit completed a retrospective case note audit of up to 60 consecutive patients with admissions identified prospectively between March and May 2008. The audit-collected items related to patient characteristics, clinical features at the time of admission and the process of care and clinical outcomes within 90 days of the index admission. The reliability of the clinical case data was assessed by asking units to double-enter data on the first 5 cases using a different auditor. The levels of reliability for 952 submitted cases were generally good, with kappa values of 0.60 and higher dominating, with many over 0.80 (very good). Data were entered onto a bespoke web-based programme and collated centrally at the Royal College of Physicians, London.

Eligible patients were divided into 2 groups, those with a chest X-ray (CXR) shadow consistent with pneumonia associated with COPD exacerbation and those without. The audit data relevant to this classification came from an audit question relating to the CXR appearance within the first 24 h. The precise instruction to the auditor was as follows: 'Where the patient has had more than one chest X-ray within the first 24 h please refer to the first X-ray. Record all abnormalities detected in the patient's chest X-ray as documented by the most senior member of staff commenting on the X-ray. Where comments are made describing a number of potential problems NOT seen e.g. no evidence of pneumothorax, then please enter "no abnormalities". Any comment about chest X-ray not included within current options should be recorded as "other abnormality"'. The 8 coding options open to the auditor were: (1) CXR – no abnormality, (2) changes consistent with COPD, (3) changes consistent with pneumonia, (4) suspected or definite cancer, (5) other abnormalities, (6) X-ray – poor quality and unhelpful, (7) no comment made, (8) not taken.

For the purpose of this study, cases were excluded from analysis if a CXR had not been taken, if cancer was suspected or definitely indicated by the X-ray, or if lung cancer was stated as a comorbidity. Missing data values affect patient denominators and results presented as percentages will vary in their denominators accordingly. Data were analysed using SPSS version 15.0 and STATA 8.0. The χ^2 test was used to indicate the statistical association of the patient and the clinical features with pneumonia (tables 1, 2). Binary regression methods (STATA 'binreg' software) were used to adjust for hospital clustering effects, to obtain p values for pneumonia in relation to outcomes (table 3) and to obtain risk ratios and 95% confidence intervals for pneumonia (table 4). Ethics approval was given by the University College Hospital/ University College London Multicentre Research Ethics Committee.

Results

Clinical data for 9,716 patients were received from 232 acute units within 177 acute NHS hospital trusts (96% of 184 eligible trusts). The median number of cases contributed by units was 46, inter-quartile range 29–58. A total

Table 1. Characteristics of COPD patients with and without pneumonia as reported in the National COPD Resources and Outcomes Project 2008

		Pneumonia		Non-pneumonia		p value (χ^2 test)
		patients	%	patients	%	
Age group	<65 years	213/1,505	14	1,847/7,833	24	<0.001
	65–74 years	426/1,505	28	2,421/7,833	31	
	75–84 years	626/1,505	42	2,637/7,833	34	
	≥85 years	240/1,505	16	928/7,833	12	
Sex	Male	799/1,505	53	3,911/7,833	50	0.03
	Female	706/1,505	47	3,922/7,833	50	
Place of residence	House/flat (alone)	512/1,505	34	2,855/7,833	36	0.001
	House/flat (not alone)	811/1,505	54	4,265/7,833	54	
	Sheltered accommodation	74/1,505	5	339/7,833	4	
	Residential placement	108/1,505	7	374/7,833	5	
Disability level (8,410)	Normal activity	118/1,347	9	663/7,063	9	<0.001
	Strenuous activity (limited)	186/1,347	14	1,100/7,063	16	
	Limited activity but self-care	614/1,347	46	3,438/7,063	49	
	Limited self-care	305/1,347	23	1,432/7,063	20	
	Bed/chair-bound	124/1,347	9	430/7,063	6	
BMI	<20	71/556	13	562/3,027	19	0.004
	20–24	147/556	26	745/3,027	25	
	25–39	196/556	35	936/3,027	31	
	≥40	142/556	26	784/3,027	26	
Albumin	<34 g/dl	319/1,153	28	904/5,694	16	<0.001
	≥34 g/dl	834/1,153	72	4,790/5,694	84	
Urea	≤7.1 mmol/l	747/1,387	54	4,579/7,221	63	<0.001
	>7.1 mmol/l	640/1,387	46	2,642/7,221	37	
Most recent FEV ₁ ^a	Tertile 1 (≤0.70)	240/775	31	1,487/4,361	34	0.14
	Tertile 2 (0.71–1.07)	279/775	36	1,431/4,361	33	
	Tertile 3 (1.08+)	256/775	33	1,443/4,361	33	
FEV ₁ predicted	<50%	533/754	71	3,007/4,221	71	0.95
	50–74%	174/754	23	960/4,221	23	
	≥75%	47/754	6	254/4,221	6	
Symptoms (increasing shortness of breath)	Yes	39/1,467	2.7	184/7,696	2.4	0.54
	No	1,428/1,467	97.3	7,512/7,696	97.6	
Symptoms (increasing sputum)	Yes	365/1,155	32	2,132/6,188	34	0.06
	No	790/1,155	68	4,056/6,188	66	
Previous admission	Yes	752/1,428	53	3,960/7,479	53	0.84
	No	676/1,428	47	3,519/7,479	47	
Co-morbidities	None	282/1,492	19	1,835/7,745	24	<0.001
	One	474/1,492	32	2,503/7,745	32	
	Two	400/1,492	27	1,970/7,745	25	
	Three or more	336/1,492	23	1,437/7,745	19	
Smoking status	Current	407/1,401	29	2,519/7,372	34	0.001
	Ex-smoker	954/1,401	68	4,626/7,372	63	
	Never	40/1,401	3	227/7,372	3	

χ^2 test.

^a Spirometry values are based on the most recently recorded at any time in the 5 years before admission or in the 90 days following admission.

Table 2. Management and course of illness for COPD patients with or without pneumonia in the National COPD Resources and Outcomes Project 2008

	Pneumonia		Non-pneumonia		p value (χ^2 test)
	patients	%	patients	%	
Management					
Treated with systemic corticosteroids >24 h as inpatient	1,257/1,488	84	6,758/7,754	87	0.006
Received antibiotics within first 24 h	1,427/1,496	95	6,083/7,743	79	<0.001
O ₂ prescribed on drug chart	242/1,505	16	1,247/7,833	16	0.88
Arterial blood gases done on admission	1,336/1,491	90	6,698/7,731	87	0.002
Course of illness					
Acidotic (pH <7.35) at time of admission	278/1,326	21	1,341/6,589	20	0.61
Bicarbonate					<0.001
<23 mmol/l	234/1,264	19	827/6,280	13	
23–30 mmol/l	767/1,264	61	4,175/6,280	66	
>30 mmol/l	263/1,264	21	1,278/6,280	20	
PaCO ₂					0.001
≤6.0 kPa	797/1,321	60	3,671/6,604	56	
>6.0 kPa	524/1,321	40	2,933/6,604	44	
PaO ₂					<0.001
<7.3 kPa	334/1,322	25	1,293/6,606	20	
7.3–8.0 kPa	171/1,322	13	903/6,606	14	
>8.0 kPa	817/1,322	62	4,410/6,606	67	
Admission pH vs. the lowest pH					<0.001
Acidotic → worse acidotic	83/1,326	6	357/6,589	5	
Acidotic → improved pH	195/1,326	15	984/6,589	15	
Non-acidotic → became acidotic	101/1,326	8	356/6,589	5	
Non-acidotic → remained non-acidotic but lower pH	172/1,326	13	552/6,589	8	
Non-acidotic → improved pH	775/1,326	58	4,340/6,589	66	
Ventilated during the admission					<0.001
Yes	236/1,489	16	903/7,710	12	
No	1,253/1,489	84	6,807/7,710	88	
Combinations of step-up management (if ventilated)					0.83
Doxapram only	0/236	–	3/903	0.3	
Non-invasive only	210/236	89	795/903	88	
Invasive only	15/236	6	71/903	8	
NIV + doxapram	3/236	1	8/903	1	
NIV + invasive	8/236	3	25/903	3	
NIV + invasive + doxapram	0/236	–	1/903	0.1	
DNR order signed within 24 h	235/1,239	19	800/6,373	13	<0.001
Seen by respiratory specialist (nurse/physiotherapist/physician)	1,156/1,492	77	6,144/7,735	79	0.09

of 378 patients were excluded either because a CXR had not been taken, cancer was suspected or definitely indicated by the X-ray, or lung cancer was stated as a co-morbid condition. Therefore, a total of 9,338 patients were included in the current report.

Within 24 h of admission, 16% (1,505) had changes consistent with pneumonia indicated on CXR, unit median 14% inter-quartile range 9–23%. The overall mean (SD) patient age was 73 (10) years and half (n = 4,710) were male. The mean (SD) FEV₁ % predicted was 41% (19%) for the 5,045/9,338 for whom it was recorded. Where indi-

cated, 98% (8,343/8,517) of the patients were described as 'white'. Four percent (413) lived in sheltered accommodation and 5% (482) in a residential home, whilst 90% (8,443) lived alone or with someone else in a flat or house. Thirty-nine percent (3,597) received some form of personal care. In-hospital mortality was 7.5% (702/9,338) and mortality within 90 days of the admission date was 13.4% (1,198/8,945).

Baseline characteristics of COPD patients with and without radiological pneumonia are shown in table 1. As a consequence of the large audit sample, small clinical

Table 3. Outcome for COPD patients admitted with or without pneumonia in the National COPD Resources and Outcomes Project 2008

	Pneumonia		Non-pneumonia		p value ^a
	patients	%	patients	%	
In-hospital death	160/1,505	11	542/7,833	7	<0.001
Death within 90 days of admission	247/1,441	17	951/7,504	13	<0.001
Alive at discharge: length of stay					
≥7 days	672/1,345	50	2,925/7,286	40	<0.001
0–3 days	342/1,345	25	2,595/7,286	36	
4–7 days	424/1,345	32	2,231/7,286	31	
8–14 days	332/1,345	25	1,443/7,286	20	
≥15 days	247/1,345	18	1,017/7,286	14	
Discharged on O ₂	373/1,276	29	1,739/6,910	25	0.002
Discharged on O ₂ for the first time	89/373	24	347/1,739	20	0.10
O ₂ concentrator for first-time O ₂	59/89	66	247/347	71	0.42
Accepted by ESD	221/1,296	17	1,348/7,000	19	0.19
If ESD stay in the scheme					
0–3 days	38/215	18	264/1,333	20	
4–7 days	69/215	32	409/1,333	31	
8–14 days	63/215	29	413/1,333	31	
≥15 days	45/215	21	247/1,333	19	
Readmission/accepted by ESD within 90 days of admission	425/1,287	33	2,412/7,071	34	0.49

ESD = Early supported discharge.

^a Using binary regression methods (STATA 'binreg' software) to adjust for within-hospital clustering effects.

Table 4. Estimates of risk ratio and corresponding 95% confidence interval (CI) of poor outcome in those with pneumonia compared to no evidence of pneumonia in COPD patients admitted to hospital

	Risk ratio	95% CI ^a	p value ^a
Inpatient death			
Model A	1.54	1.28–1.84	<0.001
Model B (age group- and sex-adjusted)	1.37	1.15–1.64	0.001
Model C (as B + residence-, disability-adjusted)	1.29	1.09–1.53	0.003
Model D (as C + co-morbidity count-adjusted)	1.30	1.10–1.55	0.002
Model E (as C + albumin and urea data-adjusted)	1.19	1.01–1.42	0.04
90-day death			
Model A	1.35	1.19–1.54	<0.001
Model B (age group- and sex-adjusted)	1.22	1.07–1.38	0.003
Model C (as B + residence-, disability-adjusted)	1.13	1.00–1.28	0.06
Model D (as C + co-morbidity count-adjusted)	1.14	1.01–1.29	0.04
Model E (as C + albumin and urea data-adjusted)	1.09	0.96–1.23	0.18
Length of stay (>7 days)			
Model A	1.24	1.16–1.34	<0.001
Model B (age group- and sex-adjusted)	1.19	1.11–1.28	<0.001
Model C (as B + residence-, disability-adjusted)	1.17	1.09–1.25	<0.001
Model D (as C + co-morbidity count-adjusted)	1.17	1.09–1.25	<0.001
Model E (as C + albumin and urea data-adjusted)	1.15	1.07–1.23	<0.001

^a Using binary regression methods (STATA 'binreg' software) to adjust for within-hospital clustering effects. Patient characteristics were categorised as in table 1. Missing value categories for albumin and urea were included to maintain patient numbers in the analyses.

Fig. 1. Kaplan-Meier survival distributions for up to 90 days from admission for those with and without X-ray changes consistent with pneumonia. Log-rank test $\chi^2 = 22.2$, d.f. = 1, $p < 0.001$. The upper dashed line represents patients without X-ray changes consistent with pneumonia. The lower solid line represents patients with X-ray changes consistent with pneumonia.

differences reach statistical significance. The strongest correlates ($p < 0.001$) with pneumonia were age, disability, albumin and urea levels, and the number of co-morbidities. Patients with pneumonia were older and had more limited levels of activity overall, with lower blood albumin and higher blood urea, with a higher prevalence of multiple co-morbidity (≥ 3 co-morbidities, 23 vs. 19%).

In terms of clinical management (table 2), pneumonia patients were much more likely to receive antibiotics within 24 h ($p < 0.001$). There were lesser marginal differences in regard to treating with steroids, oxygen prescription and taking arterial blood gases. Pneumonia patients were more likely ($p < 0.001$) to have a lower bicarbonate level and PaO_2 of < 7.3 , but no significant differences were observed between the 2 groups with regard to the prevalence of acidosis ($\text{pH} < 7.35$) at the time of admission. A significantly higher proportion of pneumonia patients were ventilated ($p < 0.001$); there were no significant differences between the 2 groups in management strategy for those who were ventilated. No significant difference was observed in terms of respiratory-team in-

volvement in their care. A higher proportion of patients with pneumonia had their 'do not resuscitate' (DNR) orders issued within 24 h of admission.

Pneumonia per se was associated with poor outcome (table 3), in terms of inpatient and 90-day mortality, increased length of stay and being discharged on oxygen. There were minimal differences with regard to being accepted by early discharge schemes, or in being re-admitted within 90 days of the audit index admission. Progressive adjustment (table 4) for age, sex and other variables that were significantly different between the groups including residence, disability, co-morbidity, albumin and urea levels gradually attenuated the association of pneumonia with mortality and to a lesser extent with a length of stay of at least 7 days. Figure 1 shows the survival comparison between the 2 groups for up to 90 days after admission.

Discussion

Our study provides a useful insight into the prognosis of COPD exacerbations which are associated with pneumonia compared to non-pneumonic COPD exacerbations.

To be included in this audit there needed to be a clinician-made diagnosis of COPD exacerbation and that would normally have taken into account the CXR appearance in the making of the primary diagnosis.

We found that COPD exacerbations associated with radiological pneumonia have worse outcomes in terms of inpatient mortality and length of stay after taking into account potential confounding factors. The major strengths of the study are: the large sample size, prospective identification of COPD exacerbations, radiological evidence of pneumonia in the presence of pneumonia symptoms, exclusion of suspicious or confirmed malignant cases, a sample distribution across all ages and an ability to take account of case mix and individual prognostic indicators including social factors. Furthermore, this study provides a useful insight in a UK setting into the management of COPD exacerbations when someone presents with pneumonia compared to COPD exacerbation without pneumonia.

In this study, we reported the characteristics of COPD exacerbations which are associated with radiological pneumonia compared to other non-pneumonic exacerbations. This approach is in contrast to that of Pifarre et al. [9], who studied pneumonia patients to gain insight into the characteristics of CAP in patients with COPD. To

date, little data is available on the management and course of COPD patients with exacerbations who present acutely with or without pneumonia. As a nationwide evaluation audit project, we were able to gain deeper insight into the management and course of the disease comparison between these 2 groups of patients. There also appeared to be some differences, although minor and perhaps with good reason, between the management of those with pneumonia and those without. Although we found statistical differences between the 2 groups in the clinical course and management, the material differences were not huge apart from a significantly ($p < 0.001$) higher proportion of patients with pneumonia who were ventilated (16 vs. 12%) and those who had DNR orders within the first 24 h of admission (19 vs. 13%). The DNR orders were more likely to be in place within 24 h of hospital admission for a higher proportion of pneumonia patients. Therefore, it may be interpreted that less intensive therapy is intended in COPD patients with pneumonia compared to those with non-pneumonic exacerbation. However, the fact that a higher proportion of patients with pneumonia also received ventilation (i.e. active intensive management) perhaps indicates that management plans were tailored to the individual's need rather than to systematic differential treatment. Furthermore, this finding could merely be a reflection of the severity of the disease.

Patients with pneumonia had poorer outcomes, both for mortality and a prolonged length of stay (longer than 7 days) when compared to patients with no evidence of pneumonia in COPD exacerbation. It has been reported that COPD patients hospitalised with CAP had higher 30- and 90-day mortality than patients without COPD [10]. However, the evidence is conflicting, with Snijders et al. [7] more recently reporting no differences in 30-day mortality. Dewan et al. [11] reported that patient host factors may determine treatment outcome in acute exacerbation of COPD. They found that host factors such as $FEV_1 < 35\%$, the use of home oxygen, frequency of exacerbation, a history of previous pneumonia and sinusitis, and the use of maintenance steroids were independently associated with treatment failure (defined as a return visit for persistent respiratory symptoms that required a change of antibiotic in < 4 weeks). However, they did not specifically examine differences in COPD exacerbation with or without pneumonia.

More recently, it was reported that COPD exacerbations were associated with impaired lung function and increased sputum neutrophilia. Papi et al. [12] reported that a high proportion of patients in their small series (78% of 64 patients included in the study) were associated

with viral and/or bacterial infections. Again, they did not differentiate between infective exacerbation due to lower respiratory tract infection and pneumonia. They concluded that respiratory infections are associated with most COPD exacerbations and the severity thereof, especially those with viral/bacterial co-infection.

Holguin et al. [13], in a nationally representative sample of hospitalisations in the USA between 1979 and 2001, reported that any mention of COPD in the discharge diagnosis is associated with higher hospitalisation prevalence and in-hospital mortality from other co-morbidities, including pneumonia. In contrast to our study, their study focused on the presence of COPD as a co-morbidity in patients with other conditions. In the UK, we found that patients with COPD who presented with pneumonia had higher numbers of co-morbidities and also had a higher mortality rate. We were able to examine the extent to which co-morbidity can explain differences in mortality between COPD patients with and without pneumonia (table 4). Interestingly, adjusting for the number of co-morbidities did not attenuate the results further, after adjusting for disability and place of residence. It may be that people with more co-morbidity are likely to have greater disability and are more likely to live in institutional settings.

Our study has limitations. The pneumonia diagnosis was based on radiological appearance rather than on the aetiological diagnosis. However, previous attempts to examine the aetiological diagnosis of pneumonia in COPD patients had several limitations. In a sample of COPD patients ($n = 124$), the aetiological diagnosis was achieved only in 59% of cases based on valid techniques to identify aetiological diagnosis [14]. One of the limitations of our study is the possible misclassification of some pneumonia cases as non-pneumonia (e.g. atypical) where there may be a mismatch between clinical presentation and radiology. Nevertheless, it is more likely to be the other way round, i.e. the presence of radiological shadow in the absence of clinical signs and symptoms. Furthermore, misclassification of a few cases of radiologically negative pneumonia (i.e. no CXR shadow) is very unlikely to influence the overall outcome in a study of this size; Melbye et al. [15] reported that while there are some patients where CXR may be negative, their findings supported the view that patients with radiological pneumonia as a rule present more serious manifestations of lower respiratory tract pathology than patients with a normal radiograph. Furthermore, CXR is regarded as a reference standard for pneumonia [16], due to multiple factors including a lack of reliability among physicians to elicit physical signs in

chest examinations [17], and the over-diagnosis of pneumonia based on chest signs alone [18].

There has been some concern about the increased risk of non-fatal pneumonia with high-dose inhaled steroids in COPD [19]. However, the clinical trial evidence is weak, mainly due to the lack of definition of pneumonia being reported as adverse events in a trial setting, and thus the risk involved is thought to be minimal, judged by the National Institute of Health and Clinical Excellence (NICE) Guideline Development Group expert panel [19]. Our findings suggest that the older people with COPD who have multiple co-morbidities and poor performance status appear to be at higher risk of pneumonia, so clinicians should be aware of this when making decisions about initiating long-term high-dose steroids in this age group. There appears to be a consistent finding that patients with pneumonia in COPD have more co-morbid conditions and are more likely to die or have longer stays

in hospital, which is another objective valid outcome measure used by NICE in the UK.

In summary, we found an additional risk for COPD exacerbation outcome in terms of mortality, length of stay >7 days and a 90-day readmission rate in those with a radiological finding of pneumonia. These patients also received antibiotics and ventilation significantly more often. The results are clinically relevant, according to them treatment standards such as CXR for hospital-admitted COPD exacerbation should be obligatory in order to identify patients with radiological pneumonia and to commence appropriate treatment as soon as possible. While severity assessment tools for pneumonia exist, less is researched in the area of prognostic rules in COPD with pneumonia. Risk stratification of COPD patients with pneumonia requires further evaluation in future studies.

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