ORIGINAL ARTICLE

Clinical audit indicators of outcome following admission to hospital with acute exacerbation of chronic obstructive pulmonary disease

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Thorax 2002;**57**:137–141

Further details of the variables analysed and found not to add significantly to the identified predictors of outcome are available on the journal website.

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Revised version received 20 September 2001
Accepted for publication 9 October 2001

Background: The 1997 BTS/RCP national audit of acute chronic obstructive pulmonary disease (COPD) in terms of process of care has previously been reported. This paper describes from the same cases the outcomes of death, readmission rates within 3 months of initial admission, and length of stay. Identification of the main pre-admission predictors of outcome may be used to control for confounding factors in population characteristics when comparing performance between units.
Methods: Data on 74 variables were collected retrospectively using an audit proforma from patients admitted to UK hospitals with acute COPD. Important prognostic variables for the three outcome measures were identified by relative risk and logistic regression was used to place these in order of predictive value.
Results: 1400 admissions from 38 acute hospitals were collated. 14% of cases died within 3 months of admission with variation between hospitals of 0–50%. Poor performance status, acidosis, and the presence of leg oedema were the best significant independent predictors of death. Age above 65, poor performance status, and lowest forced expiratory volume in 1 second (FEV_1) tertile were the best predictors of length of stay (median 8 days). 34% of patients were readmitted (range 5–65%); lowest FEV_1 tertile, previous admission, and readmission with five or more medications were the best predictors for readmission.
Conclusions: Important predictors of outcome have been identified and formal recording of these may assist in accounting for confounding patient characteristics when making comparisons between hospitals. There is still wide variation in outcome between hospitals that remains unexplained by these factors. While some of this variance may be explained by incomplete recording of data or patient factors as yet unidentified, it seems likely that deficiencies in the process of care previously identified are responsible for poor outcomes in some units.

Chronic obstructive pulmonary disease (COPD) is one of the most common respiratory causes of acute hospital admission within the UK.[1 2] Patients with this condition have a high morbidity and mortality resulting in a significant financial cost and socioeconomic burden to society.[3–5] Evidence from audit studies has suggested variable outcomes in the management of acute medical conditions dependent upon patient characteristics and medical care received.[6 7] The introduction of clinical governance, the national agenda for improved care quality, and the pressure to ensure equality of health care together provide a stimulus for medical units to assess performance. Identifying meaningful outcome measures and process standards is not simple.

There is an ongoing debate as to whether it is better to measure the process of care or the outcome of care.[8 9] Process based studies are relatively easy to perform but the measures chosen must be robust and important. It is harder to acquire data for outcome studies since there is a longitudinal element and outcomes must take account of confounding factors. Sometimes well chosen process measures can be a proxy for outcome,[10] and the eight point asthma process measure is included in the recommendations on the outcome indicators of asthma and has been used to benchmark asthma care.[11] Benchmarking compares units with the attainments of their peers rather than the perfect standards set out in guideline documents, and is often more acceptable to clinical units.

Defining important associations of outcomes is an important step towards comparing standards of COPD care being delivered in different hospitals. There are no published standards at all for acute COPD exacerbations. This study looked at three identifiable outcomes for patients admitted acutely with COPD—length of stay, readmission rate, and death—and sought to identify factors related to these outcomes. Such knowledge could help target resources most appropriately and might allow units to collect data that could be used to measure performance in a more meaningful way. Identifying confounding factors that could be corrected for when comparing outcomes between units or in year on year comparisons within units is an important step towards delivering clinically valuable audit.

METHODS

This audit programme has previously been described in some detail.[12] Briefly, 43 UK hospitals were asked to detail the process of care and outcome of 40 consecutive admissions with the diagnosis of acute COPD from 1 September 1997. Patients with COPD as admission diagnosis were identified from the hospital patient administration system or equivalent. If subsequently on examination of the case notes the clinical discharge diagnosis made by the physician in charge was not COPD, the case was discarded. If the clinical diagnosis was of COPD although subsequent spirometric tests showed that the patient did not have significant COPD, the case was included in the study on the basis that guidelines for the management of COPD would have been followed by clinical staff and that

Table 1 Main prognostic factors for death due to COPD within 3 months of admission in 1342 patients with known outcomes

	No of patients	No of deaths	% dead	Relative risk	95% CI
Background and history:					
Age					
<65	279	19	6.8	1.0	
65–9	211	21	10.0	1.5	0.8 to 2.7
70–4	311	50	16.1	2.4	1.4 to 3.9
75–9	276	41	14.9	2.2	1.3 to 3.7
80+	259	52	20.1	3.0	1.8 to 4.9
NK	6	1			
Performance status					
Normal activity	104	2	1.9	1.0	
Strenuous activity limited	143	10	7.0	3.6	0.8 to 16.1
Limited but self-care	419	46	11.0	5.7	1.4 to 23.1
Limited self-care	358	77	21.5	11.2	2.8 to 44.8
Bed care, no self-care	39	15	38.5	20.0	4.8 to 83.5
NK	279	34	12.2		
Home circumstances					
Alone no support	187	17	9.1	1.0	
Spouse/close relative	754	99	13.1	1.4	0.9 to 2.4
Alone with support	271	48	17.7	1.9	1.2 to 3.3
Nursing home	54	13	24.1	2.7	1.4 to 5.1
Other and NK	76	7	9.2	1.0	0.4 to 2.3
Assessment and measurements on admission:					
Bilateral leg oedema					
Yes	338	71	21.0	2.4	1.7 to 3.3
No	552	49	8.9	1.0	
NK	452	64	14.2		
Admission PEF (l/min)					
Not done	653	107	16.4	2.7	1.5 to 4.9
Unrecordable	109	22	20.2	3.3	1.7 to 6.5
⩽150	336	29	8.6	1.4	0.7 to 2.7
>150	179	11	6.1	1.0	
NK	65	15	23.1		
Sa_{O_2} (%)					
<86	166	44	26.5	2.3	1.6 to 3.2
86–92	256	36	14.1	1.2	0.8 to 1.8
>92	590	68	11.5	1.0	
NK	330	36	10.9		
pH					
<7.26	68	28	41.2	3.8	2.7 to 5.4
7.26–7.34	146	30	20.5	1.9	1.3 to 2.8
7.35+	831	89	10.7	1.0	
NK	297	37	12.5		
Initial management (within the first 24 hours):					
Repeat of blood gas measurements					
Yes	430	84	19.5	2.0	1.5 to 2.7
No	603	59	9.8	1.0	
NK	34	5	14.7		
No record of test on admission	275	36	13.1		
IPPV or NIPPV					
Yes	39	17	43.6	3.4	2.3 to 5.0
No	1303	167	12.8	1.0	

PEF=peak expiratory flow; Sa_{O_2}=oxygen saturation; IPPV=invasive positive pressure ventilation; NIPPV=non-invasive positive pressure ventilation; NK=not known.

such cases would normally be included in hospital mortality statistics. Data were collected retrospectively by medical staff of SHO or SpR grade according to a standardised protocol using a three page questionnaire examining progressive phases of the admission. Seventy four different variables were collated, including demographic data, a modified version of performance score as defined by the ECOG,[13] symptoms, assessment and measurements on admission, management in the first 24 hours, continuing management, and discharge plans. Outcomes of death, length of stay, and readmission at 3 months after initial admission were recorded. Thirty eight hospitals provided data within the specified time period and form the constituents of this study.

The data were summarised into tables giving the numbers and percentage of recorded cases after excluding those few cases where no outcome status was recorded. The main prognostic variables for each outcome were identified in terms of relative risk with 95% confidence intervals. (These more significant results are given in the tables included here while data relating to all other variables considered are available on the *Thorax* website, www.thoraxjnl.com.) Logistic regression methods were used to find the most important predictors of outcome. The R^2 statistic described by Nagelkerke[14] was used to quantify the proportion of the explained variation in the logistic regression model. SPSS version 10 was used for the statistical analyses.

RESULTS

Audit forms from 1400 acute episodes involving 1373 patients were received. The median age was 72 years (interquartile range (IQR) 66–78, range 34–97). Just over half were men (54%). Forced expiratory volume in 1 second (FEV_1) values were available for 53%, median 0.83 l (IQR 0.6–1.16). Further information on demographic data and disease severity have

Table 2 Main prognostic factors for length of stay of 8 days or more from admission in 1362 patients

	No of patients	No staying 8+ days	% staying 8+ days	Relative risk	95% CI
Background and history:					
Age					
<65	282	103	36.5	1.0	
65–69	214	94	43.9	1.2	1.0 to 1.5
70–74	318	168	52.8	1.4	1.2 to 1.7
75–79	279	159	57.0	1.6	1.3 to 1.9
80+	264	159	60.2	1.7	1.4 to 2.0
NK	5	2			
FEV_1 tertiles*					
Lower third	242	146	60.3	1.5	1.3 to 1.9
Middle third	221	112	50.7	1.3	1.1 to 1.6
Upper third	236	93	39.4	1.0	
NK	663	334	50.4		
Performance status					
Normal activity	106	37	34.9	1.0	
Strenuous activity limited	145	65	44.8	1.3	0.9 to 1.8
Limited but self-care	424	208	49.1	1.4	1.1 to 1.9
Limited self-care	364	222	61.0	1.8	1.3 to 2.3
Bed care, no self-care	39	26	66.7	1.9	1.4 to 2.7
NK	284	127	44.7		
Assessment and measurements on admission:					
Admission PEF (l/min)					
Not done	665	377	56.7	1.8	1.4 to 2.2
Unrecordable	112	60	53.6	1.7	1.3 to 2.2
⩽150	338	157	46.4	1.4	1.1 to 1.8
>150	180	58	32.2	1.0	
NK	67	33	49.3		
SaO_2 (%)					
<86	170	112	65.9	1.4	1.2 to 1.6
86–92	264	133	50.4	1.1	0.9 to 1.2
>92	589	281	47.7	1.0	
NK	339	159	46.9		
Initial management (within first 24 hours)					
IPPV or NIPPV					
Yes	40	33	82.5	1.7	1.4 to 2.0
No	1322	652	49.3	1.0	

FEV_1=forced expiratory volume in 1 second; PEF=peak expiratory flow; SaO_2=oxygen saturation; IPPV=invasive positive pressure ventilation; NIPPV=non-invasive positive pressure ventilation; NK=not known. *Lower, middle and upper thirds of FEV_1 values in litres derived separately for men (lower ⩽0.75, middle 0.76–1.16, upper >1.6) and women (lower ⩽0.60, middle 0.61–0.89, upper >0.89).

been presented elsewhere[12] but can also be discerned from the tables presented here.

Results are expressed both in absolute numbers as a fraction of the number of recorded cases and as a percentage to account for the instances of missing data.

Death

Death resulting from COPD was recorded in 14% of cases (184/1342) within 3 months of admission. Interhospital variation in mortality was 0–50%, median 13% (IQR 9–20).

The most important prognostic factors for death are given in table 1. Predictors of mortality were a poor performance status, low arterial pH on admission, the presence of bilateral leg oedema, home circumstances particularly placement in a nursing home, age 70 years or more, an unrecordable peak expiratory flow (PEF) on admission, arterial oxygen saturation <86% determined by pulse oximetry, and intervention with assisted ventilation. A further 22 factors collected on the proformas but not included in table 1 were also considered but were found not significantly to predict death. Logistic regression analyses gave the three major independent predictors as performance status, arterial pH on admission, and bilateral leg oedema. These three together explained 15% of the variation in mortality.

A further analysis was performed to examine whether variability in outcome between hospitals could be accounted for by variability in the population characteristics at admission—that is, higher death rate in units with patients having poorer performance status, lower pH, and greater prevalence of oedema. Using the logistic regression model involving performance status, pH, and oedema, an expected (or predicted) number of deaths for each hospital was computed. Hospitals were divided into three groups with observed death rates of <10%, 10–20%, and >20%. There were only marginal differences between these three groups with respect to the patient characteristics (data not shown) of the three hospital groups, whereas the observed/predicted death ratio varied markedly from 0.36 (<10% death rate) to 0.97 (10–20%) to 1.80 (>20%).

Length of stay

The median length of stay was 8 days, and an increased length of stay was defined as a stay of at least 8 days. The variation between hospitals was considerable ranging from one hospital where 21% stayed 8 days or longer to another where 82% had an increased length of stay. The IQR for hospitals was much narrower at 45–57%. The important predictors of increased length of stay are given in table 2: age 65 or more, poor performance status, lowest FEV_1 tertile, intervention with assisted ventilation, oxygen saturation at admission of <86%, and admission PEF of <150 l/min. Logistic regression identified age, performance status, and FEV_1 tertile as the key independent predictors, but together they accounted for only 8% of the variation in outcome. Twenty eight further data items included in the proforma were also examined and were not found significantly to predict this outcome measure.

Readmission

Four hundred and seventeen of the 1221 patients (34%) included in the audit were readmitted within 3 months of the

Table 3 Main prognostic factors for readmission within 3 months of admission to study in 1221 patients after excluding 139 inapplicable (including dead) and 13 not known

	No of patients	No readmitted	% readmitted	Relative risk	95% CI
Background and history:					
First time COPD or readmission					
First time	356	61	17.1	1.0	
Readmission	802	341	42.5	2.5	2.0 to 3.2
NK	63	15	23.8		
FEV_1 tertiles*					
Lower third	223	104	46.6	1.8	1.4 to 2.3
Middle third	202	84	41.6	1.6	1.2 to 2.1
Upper third	225	60	26.7	1.0	
NK	571	169	29.6		
FEV_1 % predicted (tertiles)					
Lower third <28.8%	143	63	44.1	1.6	1.2 to 2.2
Middle third 28.9–44.8%	162	68	42.0	1.5	1.1 to 2.1
Upper third >44.8%	154	43	27.9	1.0	
NK	762	243	31.9		
Performance status					
Normal activity	101	21	20.8	1.0	
Strenuous activity limited	138	33	23.9	1.2	0.7 to 1.9
Limited but self-care	388	145	37.4	1.8	1.2 to 2.7
Limited self-care	314	131	41.7	2.0	1.3 to 3.0
Bed care, no self-care	27	9	33.3	1.6	0.8 to 3.1
NK	253	78	30.8		
Known medications on admission					
0–1	210	39	18.6	1.0	
2–4	822	283	34.4	1.9	1.4 to 2.5
5+	189	95	50.3	2.7	2.0 to 3.7
On discharge:					
Discharge medication: home nebuliser					
Yes	505	225	44.6	1.7	1.4 to 1.9
No	716	192	26.8	1.0	

FEV_1=forced expiratory volume in 1 second; NK=not known. *Lower, middle and upper thirds of FEV_1 values in litres derived separately for men (lower ≤0.75, middle 0.76–1.16, upper >1.6) and women (lower ≤0.60, middle 0.61–0.89, upper >0.89).

initial inpatient episode. Hospital variation ranged from 5% to 65% with an IQR of 25–44. In 139 cases readmission was recorded as inapplicable which included those patients who were deceased and those who remained in hospital throughout the 3 month period following initial admission. In an additional 13 cases this outcome was not recorded. The main predictor variables are given in table 3. Twenty two other variables considered did not significantly predict readmission and are not included further. The major independent predictors of readmission determined by logistic regression analyses were previous admission, lowest FEV_1 tertile, and more than five medications at the time of readmission. These three variables together explained 13% of the variation in outcome.

DISCUSSION

The clinical outcomes of death, readmission rate within 90 days, and length of stay are easily recorded and could be used for comparisons of individual hospital performance year on year or against national standards. Death and readmission are clearly adverse features for the patient, but the length of stay is an outcome of greater interest to the hospital than to the patient. It is frequently recorded in routine NHS statistics and, as an index of resource use, cannot be ignored. The variation between hospitals for each of the process indicators described previously was very wide,[12] suggesting that care standards vary widely. Similar variability in the three outcomes described here has been shown and, although important associations have been identified, these explain only a small proportion of the variation.

The drive for improved and more uniform clinical care requires that interhospital performance comparisons be made. This implies that good practice can be defined and poorly performing units identified and targeted with constructive interventions. It is important to ensure that the definition of poor performance not only includes comparison with national guidelines[15] but also sets achievable standards. Benchmarking presents comparative data in a non-confrontational manner, but comparison of outcomes will require correcting for confounding variables.

Overall mortality rates were high, in keeping with results from previous studies,[4] but the wide variation in death rates between hospitals is difficult to explain on the basis of adverse predictors alone and suggests that other unidentified factors are operating. We have identified a number of factors that can be used to select those at greatest risk of death.

Some of the predictors identified are not amenable to clinical influence—for example, premorbid performance status. Nevertheless, this variable alone increases the relative risk of death from 1 (normal activity) to 20 times (bed bound, no self-care) (table 1), equivalent to 38.5% mortality at 3 months. Performance status is well established as a predictor of outcome in cancer studies and is easy to measure but is not usually recorded in a formal way in the hospital case notes. In this study the performance score data were derived by the audit assessor from other data within the case record. Direct recording would probably improve the reliability and, since it has such a powerful predictive value, it would seem to justify a change in routine clinical practice of physicians. By comparison, other expected predictors of death such as increasing age or worsening lung function had much less effect.

Some factors such as arterial blood gas pH on admission can be influenced positively by medical intervention, although they reflect the stage at which the patient presents; nevertheless, they are acted on variably. Reduced pH of arterial blood has previously been identified as a poor prognostic factor[4] and, in the present study, admissions with a value of <7.26 suffered a 41.2% mortality rate. The BTS guidelines recommend that patients with a pH of <7.26 should be considered for assisted ventilation which is known to improve outcome in these circumstances.[16 17] This audit was conducted before the evidence for the effectiveness of non-invasive ventilation was published;

only half of the hospitals gave any form of ventilatory support to patients with COPD and only 13% of potentially eligible patients received support.[12] Non-invasive ventilation offers significant benefits to patients[18] but is still not available in all hospitals. Oedema as a surrogate of cor pulmonale has been noted as a predictor of mortality in long term survival studies but has not been previously included in studies of acute admissions, often because of inadequate recording of this item.[19]

Predictors of length of stay reflect pre-admission debility with low FEV_1 indicating the severity of the COPD, and performance status and age being co-factors applicable to patients with other medical conditions too. All the factors that were statistically important are known to be associated with longer stays. Most are beyond the immediate control of the physician and thus one might argue that length of stay is an irrelevant outcome measure as an assessment of the quality of medical care. However, the wide variability between hospitals suggests that there is reason to study the organisation of care for COPD. The economic consequences of length of stay on hospital costs are substantial, but must be balanced by the potential to increase costs in the community following early discharge.[20]

Readmission rates were extremely high and best predicted by previous admission, with additional predictors being the markers of readmission severity of low FEV_1 and multiple medications on readmission. The high readmission rates are of the same order as those reported in the East London study[21] and are recognisable in the clinical setting as the "revolving door" patients. It is interesting to note that readmission is predicted by a greater number of drugs prescribed previously, including greater use of a home nebuliser. Clearly both could be an effect of confounding by severity, as suggested by the greater likelihood of readmission in those with the lowest FEV_1. If pharmacotherapy is not the answer, then other methods of breaking the dependency on hospital are needed and may come from the ongoing study of hospital at home services.[22–24] Such services aim to prevent/minimise admission and are targeted at those identified as low risk. The audit indicators predicting death that have been identified in this study are not dissimilar from the exclusion criteria for early discharge previously noted[23] and should be considered in the analysis of hospital at home schemes and when selecting patients for potential early discharge

Having identified significant predictors, it may at first appear disappointing that only 15% of the variability in death rate is explained by them. Despite this, there is no doubt that these factors are very important as judged by the relative risk of outcome statistics. There are several possible explanations for this apparent anomaly. It may be that there are other important factors that relate to death that were not considered in this study. Other factors that have been shown to predict outcome are serum albumin levels, blood urea, and the single breath nitrogen washout test.[19 25] The logistic regression result may reflect the number of unrecorded values in some cases, and the accuracy in recording in case notes of some variables which are open to subjective interpretation—for example, performance status when not recorded in a formal fashion—may also have had an impact. Nevertheless, we suggest that some of the unexplained outcome may be due to the previously identified variable process of care.[12]

The results of this study can be used in two ways. Firstly, they identify possible opportunities for improving the quality and organisation of COPD care. Secondly, the outcome predictors may help clinicians to identify those patients who require admission and intensive treatment and, in others, the characteristics that make them suitable for early discharge programmes.

Routine recording of the indicators of pre-admission patient characteristics should help control for factors of severity that may confound comparisons of hospital performance and may help an individual unit interpret its own audit data against national standards. This analysis provides the basis on which to construct a prospective audit tool for routine clinical evaluation of the process and outcome of acute care for patients admitted with COPD.

ACKNOWLEDGEMENTS

This study was funded by an unrestricted educational grant from GlaxoWellcome Ltd and by the Fazakerley Foundation for Respiratory Research. The authors are grateful to the members of the audit subcommittee and the hospital staff at each participating centre for their immense contribution to the study.

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Conflict of interest: none.

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The following tables provide further details of the variables that were analysed and found not to add significantly to the already identified predictors of outcome.

It is suggested that if accepted these be included on the web site but not within the full published text for the sake of brevity. They are not referred to in the current text document for this reason.

Table 1a: Death due to COPD within 3 months of admission: summary of other variables considered – Each cell is in the format "Variable being considered: no of cases: % of deaths for patients in that cell"

BACKGROUND AND HISTORY					
Gender	Males: 716: 15%	Females: 597: 12%			NK: 29: 3%
Previous admission	First time: 389: 9%	Readmission: 879: 16%			NK: 74: 14%
Smoking status	Current: 429: 11%	EX: 751: 15%	Never: 74: 8%		NK: 88: 24%
FEV1 tertiles *	Lower: 243: 18%	Middle: 218: 12%	Upper: 232: 9%		NK: 649: 15%
FEV1 % Predicted tertiles	<29% pred: 164: 21%	29-45% pred: 169: 9%	>45% pred: 159: 12%		NK: 850: 14%
Comorbidity **	Yes: 865: 15%	No: 477: 12%			
Comorbidity: Heart Disease	Yes: 548: 16%	No: 794: 12%			
On Oral Steroids	Yes: 455: 17%	No/NK: 887: 12%			
On Antibiotics	Yes: 263: 12%	No/NK: 1079: 14%			
Known Medications count	0-1:238: 13%	2-4: 903: 13%	5+: 201: 17%		
ASSESSMENT AND MEASUREMENTS ON ADMISSION					
Increased breathlessness	Yes: 1248: 14%	No: 44: 18%			NK: 50: 16%
Increased volume of sputum	Yes: 551: 10%	No: 394: 14%			NK: 397: 19%
Change in colour of sputum	Yes: 482: 10%	No: 432: 14%	NK: 428: 18%		
Colour of sputum	White/grey: 298: 10%	Yellow: 216: 14%	Green: 300: 12%		NK: 528: 17%
Respiratory rate	<20: 94: 10%	20-29: 561: 11%	30+: 289: 18%		NK: 398: 15%
Temperature	<37: 723: 16%	37.0-37.4: 228: 12%	37.5+: 209: 8%		NK: 182: 14%
PaO2	<7.3: 238: 18%	7.3-8.0: 118: 10%	>8.0: 700: 13%		NK: 286: 14%
PaCO2	≤6.0: 616: 10%	>6.0: 440: 19%			NK: 286: 14%
Comments on Chest X ray	Infiltrates: 231: 14%	Other comment: 653: 13%	No comment: 426: 13%		
INITIAL MANAGEMENT – WITHIN THE FIRST 24 HOURS					
Formally prescribed oxygen	Yes: 848: 15%	No: 471: 11%	NK: 23: 30%		
Oral steroids	Oral / IV: 651: 14%	Inhaled: 116: 19%	Both: 341: 11%	Yes but NK: 30: 7%	No/NK: 204: 14%
Antibiotics	IV: 208: 22%	Oral: 619: 10%	Both: 187: 12%	Yes but NK: 55: 13%	No/NK: 273: 17%

* Lower, middle and upper thirds of FEV1 values in litres were derived separately for males and females:

	Lower tertile	Middle tertile	Upper tertile
Males	≤ 0.75	0.76 – 1.16	> 1.16
Females	≤ 0.60	0.61 – 0.89	> 0.89

**Comorbidity: Any record of Heart disease, Stroke, Diabetes, Locomotor problems, Other chest problems, Visual impairment

Table 2a: Length of stay of 8 days or more : summary of other variables considered

BACKGROUND AND HISTORY					
Gender	Males: 727: 49%	Females: 607: 52%	NK: 28: 43%		
Previous admission	First time: 399: 47%	Readmission: 883: 51%	NK: 80: 54%		
Smoking status	Current: 439: 43%	EX: 757: 53%	Never: 74: 55%	NK: 92: 62%	
FEV1 % Predicted tertiles	<29% pred: 162: 59%	29-45% pred: 169: 49%	>45% pred: 164: 48%	NK: 867: 49%	
Home circumstances	Alone no support: 191: 52%	Spouse or relative: 762: 47%	Alone + support: 274: 59%	Nursing home: 57: 61%	Other & NK: 78: 45%
Comorbidity **	Yes: 876: 53%	No: 486: 45%			
Comorbidity: Heart Disease	Yes: 558: 55%	No: 804: 47%			
On Oral Steroids	Yes: 459: 53%	No/NK: 903: 49%			
On Antibiotics	Yes: 265: 49%	No/NK: 1097: 51%			
Known Medications count	0-1: 243: 48%	2-4: 919: 51%	5+: 200: 50%		
ASSESSMENT AND MEASUREMENTS ON ADMISSION					
Increased breathlessness	Yes: 1264: 50%	No: 47: 53%	NK: 51: 47%		
Increased volume of sputum	Yes: 554: 50%	No: 408: 51%	NK: 400: 50%		
Change in colour of sputum	Yes: 486: 51%	No: 441: 50%	NK: 435: 50%		
Colour of sputum	White/grey: 301: 41%	Yellow: 215: 52%	Green: 304: 52%	NK: 542: 54%	
Bilateral leg oedema	Yes: 341: 60%	No: 557: 47%	NK: 464: 47%		
Respiratory rate	<20: 95: 41%	20-29: 567: 49%	30+: 294: 52%	NK: 406: 53%	
Temperature	<37: 734: 50%	37.0-37.4: 229: 53%	37.5+: 213: 47%	NK: 186: 51%	
PaO2	<7.3: 242: 58%	7.3-8.0: 119: 40%	>8.0: 703: 50%	NK: 298: 49%	
PaCO2	≤6.0: 623: 46%	>6.0: 441: 57%	NK: 289: 48%		
PH	<7.26: 70: 59%	7.26 – 7.34: 147: 55%	7.35+: 836: 49%	NK: 309: 49%	
Comments on Chest X ray	Infiltrates: 237: 55%	Other comment: 659: 49%	No comment: 431: 51%	NK: 35: 40%	
INITIAL MANAGEMENT – WITHIN THE FIRST 24 HOURS					
Formally prescribed oxygen	Yes: 857: 53%	No: 481: 46%	NK: 24: 46%		
Repeat of blood gases	Yes: 433: 59%	No: 607: 46%	NK: 35: 37%	NA: 287: 48%	
Oral steroids	Oral / IV: 658: 49%	Inhaled: 119: 66%	Both: 340: 48%	Yes but NK: 31: 45%	No/NK: 214: 50%
Antibiotics	IV: 213: 59%	Oral: 627: 48%	Both: 188: 51%	Yes but NK: 55: 44%	No/NK: 279: 50%
CONTINUING MANAGEMENT					
PaO2>7.3 at anytime	Yes: 445: 52%	No: 224: 58%	NK: 693: 47%		
PEF	Un-recordable: 18: 67%	≤150: 181: 49%	>150: 396: 44%	Done but NK: 95: 71%	Not Done/NK: 672: 51%
Inhaler technique	Yes: 234: 58%	No/NK: 950: 48%	NA: 178: 53%		

**Comorbidity: Any record of Heart disease, Stroke, Diabetes, Locomotor problems, Other chest problems, Visual impairment

Table 3a: Readmission within 3 months of study admission: summary of other variables considered

BACKGROUND AND HISTORY				
Gender	Males: 643: 34%	Females: 551: 35%	NK: 27: 22%	
Age	<65: 266: 36%	65-69: 204: 37%	70-74: 288: 37%	75-79: 242: 33%
Smoking status	Current: 404: 36%	EX: 674: 34%	Never: 67: 33%	NK: 76: 25%
Home circumstances	Alone no support: 176: 30%	Spouse or relative: 692: 35%	Alone + support: 238: 38%	Nursing home: 48: 25%
Comorbidity **	Yes: 784: 34%	No: 437: 35%		
Comorbidity: Heart Disease	Yes: 495: 34%	No: 726: 34%		
On Oral Steroids	Yes: 409: 42%	No/NK: 812: 30%		
On Antibiotics	Yes: 236: 39%	No/NK: 985: 33%		
ASSESSMENT AND MEASUREMENTS ON ADMISSION				
Bilateral leg oedema	Yes: 293: 36%	No: 517: 38%	NK: 411: 28%	
Temperature	<37: 655: 36%	37.0-37.4: 208: 39%	37.5+: 197: 27%	NK: 161: 30%
PaO2	<7.3: 213: 28%	7.3-8.0: 107: 36%	>8.0: 638: 38%	NK: 263: 29%
PaCO2	≤6.0: 579: 34%	>6.0: 379: 39%	NK: 263: 29%	
PH	<7.26: 44: 50%	7.26 – 7.34: 120: 37%	7.35+: 782: 35%	NK: 265: 30%
Comments on Chest X ray	Infiltrates: 210: 34%	Other comment: 597: 35%	No comment: 385: 32%	NK: 29: 41%
CONTINUING MANAGEMENT				
PaO2>7.3 at anytime	Yes: 420: 35%	No: 192: 33%	NK: 609: 34%	
PEF	Un-recordable: 14: 29%	≤150: 175: 38%	>150: 386: 33%	Done but NK: 76: 37%
Inhaler technique	Yes: 221: 30%	No/NK: 868: 35%	NA: 132: 33%	
ON DISCHARGE				
Inhaled steroids	Yes: 744: 36%	No/NK: 477: 32%		
Oral steroids	Yes: 757: 37%	No/NK: 464: 29%		
Antibiotics	Yes: 463: 30%	No/NK: 758: 37%		
Home oxygen	Yes: 236: 41%	No/NK: 985: 33%		
Outpatient follow-up arranged	Yes: 764: 34%	No: 391: 33%	NK: 66: 42%	

**Comorbidity: Any record of Heart disease, Stroke, Diabetes, Locomotor problems, Other chest problems, Visual impairment