

Physician Judgment Is A Crucial Adjunct To Pneumonia Severity Scores In Low Risk Patients.

G Choudhury¹, JD Chalmers¹, P Mandal¹, AR Akram¹, MP Murray¹, P Short², A Singanayagam¹, AT Hill¹

¹Department of Respiratory Medicine
Royal Infirmary of Edinburgh
51, Little France Crescent
Edinburgh EH16 4SA
United Kingdom
Phone number: 0044 131 2421921
Fax number: 0044 131 2421870

²Department of Respiratory Medicine
Ninewells Hospital and Medical School
Dundee DD1 9SY
United Kingdom

Corresponding Author:

Dr Gourab Choudhury¹
Email: gourab19@hotmail.com

Other contributing authors:

Dr James D Chalmers¹
Email: jamesdchalmers@googlemail.com

Dr Pallavi Mandal¹
Email: pallavimandal@gmail.com

Dr Ahsan R Akram¹
Email: ahsan.akram@hotmail.co.uk

Dr Maeve P Murray¹
Email: maevemurray@hotmail.com

Dr Phil Short²
Email: philipshort@nhs.net

Dr Adam T Hill¹
Email: adam.hill2@nhs.net

ABSTRACT

Introduction

Our study investigates the reasons for hospitalization in patients with low-risk (CURB65 score 0-1) community acquired pneumonia (CAP), with a view to identify the potential for increasing outpatient management.

Methods

As a part of a prospective observational study of CAP, we evaluated reasons for hospitalization in these low-risk patients.

Results

565 patients had low-risk CAP. 420 of these were admitted (>12 hours). 39.3% had additional markers of severity justifying admission. 29.5% of the admissions were required for further management that could not be provided rapidly in the community. 11.9% had unsafe social circumstances. 19.3% had no clinical reason justifying hospitalization.

30-day mortality was increased in patients with additional severity markers (6.7%), significantly higher compared to 0% for patients awaiting investigations ($p=0.009$) and 0%, without a clear indication for hospitalization ($p=0.04$). In a logistic regression analysis, parameters associated with 30-day mortality were chronic cardiac co-morbidity (AOR 5.73 95% CI 1.52-21.6, $p=0.01$) acidosis (AOR 5.14, 95% CI 1.44-18.3, $p=0.01$), hypoxia (AOR 9.86, 95% CI 2.39-40.7, $p=0.002$) and multilobar chest x-ray shadowing (AOR 4.54, 95% CI 1.21-17.1, $p=0.03$),

Conclusion

This study supports recommendations from international guidelines that pneumonia severity scores should be used as an adjunct to clinical judgment, while deciding hospitalization.

Background

Community Acquired Pneumonia (CAP), the most common infectious disease requiring hospitalization in western countries accounts for approximately 100,000 hospital admissions each year in England.¹ Admissions for pneumonia are rising, particularly in elderly patients and is a major burden on the health care resources.²

Guest *et al*³ in 1997 had shown that patients hospitalized with CAP represent only 32% of the total burden of pneumonia but 96% of the annual costs, with average cost of £1,700-£5,100 per patient per hospital admission as compared to £100 per episode in the community. Therefore, the cost of inpatient care is much higher than outpatient care and accounts for majority of the resources spent annually, irrespective of pneumonia severity.

CAP was estimated to cost NHS around £440.7 million per year at 1992-93 healthcare assessment.³ Intervention studies consistently show that applying objective criteria for admission, many hospitalizations are inappropriate and can be avoided.⁴ Inappropriate admissions contribute to problems such as *Clostridium difficile* and methicillin resistant *Staphylococcus aureus* (MRSA) infection in addition to increasing hospital costs.⁵ Due to these costs and the possible hazards, it is important to admit only those that will benefit from inpatient care.

The Infectious Disease Society of America/ American Thoracic Society as well as British Thoracic Society recommends the use of prognostic scoring tools such as Pneumonia Severity Index and CURB65 scoring for severity assessment for hospital admission.⁶⁻¹⁰ The Pneumonia Severity Index (PSI) is the most widely used severity assessment tool, and is composed of 20 patient variables including demographics, co-morbidities, clinical, laboratory and radiological variables.⁶ CURB65 is an alternative severity score proposed by the British Thoracic Society.^{7,11} It is significantly simpler to calculate, being composed of only 5 variables and has been shown to perform similarly to the PSI in predicting 30-day mortality.¹²⁻¹⁵ The British Thoracic Society CAP guidelines recommend that patients in low risk categories using the CURB65 score (0-1) are at low risk of mortality and therefore, could be managed as outpatients.⁷

Despite the availability of these scores and the finding that outpatient management for selected patients is both safe and acceptable to patients, studies continue to show a majority of low risk patients presenting to hospital are admitted.^{4, 16-23}

The reasons for this and the potential for increasing outpatient management using the CURB65 score have not been extensively studied.

The aim of our study was to investigate the reasons for hospital admission in patients with low CURB65 scores (0-1) and identify the potential for increasing outpatient management of low risk patients with CAP.

Methods

We retrospectively reviewed case records for CAP patients admitted with low CURB65 scores (0-1) enrolled in a prospective observational study of CAP conducted from 2005-2008. CURB65 was part of the hospitalization protocol for patients admitted to the study hospitals. The study was conducted in NHS Lothian, Edinburgh, UK. Patients were considered for inclusion in the study if they had a primary diagnosis of community acquired pneumonia.

Inclusion and Exclusion Criteria

Patients were included in the study if they presented with a new infiltrate on a chest radiograph and had 3 or more symptoms or signs consistent with pneumonia (incorporating new or increased shortness of breath, cough, sputum production, sputum purulence, haemoptysis, chest pain, fever/rigors, or signs consistent with pneumonia on chest auscultation), along with a CURB65 score of 0-1. [CURB65 score: 1 point for each of the following, on admission: new onset confusion (AMT 8 or less), raised urea >7 mmol/L, respiratory rate \geq 30/min, systolic blood pressure < 90 mm Hg and/or diastolic blood pressure \leq 60 mm Hg and age \geq 65 years].

Exclusion criteria included: hospital acquired pneumonia (development of symptoms >48 hours following admission or discharge from an acute care facility < 2 weeks prior to admission); age <18 years; active thoracic malignancy; immunosuppression (including maintenance corticosteroid therapy at any dose); pulmonary embolism; active tuberculosis; patients in

whom active treatment was not considered appropriate at the time of admission (palliative care).

Retrospective records review

We reviewed all cases of CAP with a CURB65 score of 0 or 1 enrolled in the observational study. 2 investigators reviewed each case independently. In the case of disagreement between reviewers, a third independent reviewer had the casting vote. None of the reviewers were involved in the initial care of these patients. Reviewers were blinded to patient outcome at the time of review and were only provided with information available at the time of the initial admission decision. The investigators were asked to determine if, provided with the available information, they would have hospitalized the patient or considered them for outpatient care. Where reviewers felt the patient should be hospitalized they were asked to provide a reason. Once this process was complete, patients were classified into the following categories

- Patients who were discharged from hospital (for the purposes of this study, any patient spending <12 hours in the emergency department or medical admissions unit before being discharged was regarded as discharged from hospital).
- Those who were admitted because of clinician concern, where additional markers of severity were identified that may increase the risk of mortality and therefore necessitate inpatient care.

- Patients hospitalized without any additional markers of severity, but requiring additional investigations (for example to exclude an alternative diagnosis or investigate abnormal results identified on admission) where such investigations could not be provided quickly as an outpatient.
- Those admitted because unsafe or inadequate social circumstances made discharge inappropriate (unmet social needs).
- Patients where no clinical reason for hospitalization could be identified.

Outcomes

The aim of the study was to determine reasons for hospitalization in low risk patients with CAP. We assessed 30-day mortality for all patients in the study. Follow up was conducted by outpatient clinic review or by phone call to the patients' general practitioner in patients not attending for outpatient review. Survival status was confirmed in 100% of patients.

Statistical analysis

All data were analysed using SPSS version 13 for windows (SPSS inc., Chicago, IL). Descriptive statistics of demographic and clinical variables are presented as median (IQR) unless otherwise stated. The Chi-squared test was used to compare categorical data between groups, with Fishers exact test used where any cell contained less than 10. The Mann-Whitney *U* test was used for comparison of 2 groups of continuous data. Multivariable logistic regression was used to identify markers of severity associated with 30-day mortality in this low risk group. The aim was to identify markers additional to

the CURB65 criteria to predict mortality in this group. All clinical, laboratory and demographic variables were included in a logistic regression model. All patients had mild CURB65 score (0-1). Model adequacy was assessed using the Hosner-Lemeshow goodness of fit test. For all analyses a p value <0.05 was considered statistically significant.

Results

The authors studied 1472 patients with community-acquired pneumonia over a 3-year period. After exclusion of patients in CURB65 groups 2-5, 565 patients were classified into CURB65 score 0-1. 145 patients were discharged within 12 hours of admission to hospital and 420 patients admitted to hospital with mild CAP (CURB65 score 0-1).

The demographic characteristics of the study groups are shown in Table 1. There were a greater proportion of patients with COPD and chronic cardiac disease (COPD 21.2% vs. 9.0%, $p=0.01$ and chronic cardiac disease 13.1% vs.4.8%, $p=0.02$) in those admitted to the hospital for more than 12 hours.

BASELINE CHARACTERISTICS AND CO-MORBIDITIES	Study population	CURB65 0-1 Discharged from hospital Within 12 hours	CURB65 0-1 Admitted to hospital (>12 hours)	p-value
N	1472	145	420	
Age (years)	69 (54-79)	50 (38-68)	58 (41-68)	0.2
Gender (% male)	49.9%	52.3%	53.6%	0.9
Chronic Cardiac Disease	20.6%	4.8%	13.1%	0.01
Liver Disease	5.1%	3.4%	6.7%	0.2
Neurological Disease	11.8%	3.4%	7.1%	0.2
Chronic Renal Failure	6.3%	1.4%	1.4%	0.9
Diabetes Mellitus	10.9%	5.5%	4.5%	0.8
COPD	22.3%	9.0%	21.2%	0.02
Current Smokers	34.2%	38.6%	35.7%	0.6

Table1: Baseline characteristics of the study population; p value refers to comparison between CURB65 0-1 groups.

Table 2 compares parameters of CURB65 between the 2 groups. The only significant difference was that patients admitted to the hospital for more than 12 hours had a respiratory rate ≥ 30 /min. Small numbers of patients were discharged having had abnormal values for respiratory rate and systolic blood pressure on admission(table 2). In the majority of cases, these values improved with initial treatment (such as fluid management, nebuliser, analgesia and reassurance). 3 of the 5 patients' respiratory rate ≥ 30 on admission had a diagnosis of COPD and received initial bronchodilator treatment. Of those patients with low systolic blood pressure <90 mmHg, 2 were young female patients with no other markers of systemic illness and 1 further patient's blood pressure improved over a few hours with initial treatment.

Clinical Variables	Discharged within 12 hours from the emergency department % patients N=145	Admitted to hospital (>12 hours) % Patients N=420	p-value
Confusion	0%	2.9%	0.08
Respiratory Rate \geq 30/min	3.4%	15.0%	0.0004
Systolic Blood Pressure <90mmHg	2.1%	2.9%	0.1
Diastolic Blood Pressure <60mmHg	9.7%	12.1%	0.8
Urea > 7mmol/l	6.9%	8.6%	0.6

Table 2 comparing parameters described in CURB65 scoring system between the 2 groups

Despite similar CURB65 scores, hospitalized patients often had multiple additional markers of severity. Table 3 compares other clinical and investigative parameters in both the groups. Patients admitted to the hospital for greater than 12 hours, had an increased frequency of hypo/hyperthermia, multilobar chest x-ray involvement, hyponatraemia, hypo/hyperkalaemia, low albumin, acidosis, raised C reactive protein levels and were more hypoxemic.

Clinical Variables	Discharged from the emergency department % Patients N=145	Admitted to hospital (>12 hours) % Patients N=420	p-value
Temperature <36°C or >38°C	24.8%	37.9%	0.006
Pulse \geq 125/min	7.6%	9.3%	0.7
Multilobar chest x-ray involvement	0%	10.5%	<0.0001
Laboratory Investigations			
Haematocrit <30%	1.4%	3.1%	0.4
White Blood Cell Count <4 or >20 x 10 ⁹ /L	11.7%	13.6%	0.4
Na ⁺ <130mmol/l	1.4%	6.7%	0.04
K ⁺ <3.5 or >5mmol/l	7.6%	15.0%	0.03
ALT >50iu/l	10.8%	8.6%	0.6
Alkaline Phosphatase (ALP) >147 iu/l	10.3%	11.4%	0.8
Albumin <30g/L	1.4%	7.1%	0.02
Arterial pH <7.35	0%	8.1%	0.0009
C-Reactive Protein>100mg/L	35.2%	61.9%	<0.0001
Hypoxaemia ¹	0.7%	31.4%	<0.0001
Glucose \geq 14mmol/L	0%	2.1%	0.2

Table 3 comparing various other clinical parameters between patients admitted and discharged with low CURB65 score 0 or 1. Hypoxaemia was defined as an arterial PaO₂ <8kpa on room air, or an oxygen saturation <92% on air in patients not undergoing arterial blood gas sampling.¹

Reasons for hospitalization of low risk patients

A consensus among the reviewers was achieved in 100% of cases for assigning reasons for hospitalization. The proportion of patients in each category is shown in figure 1.

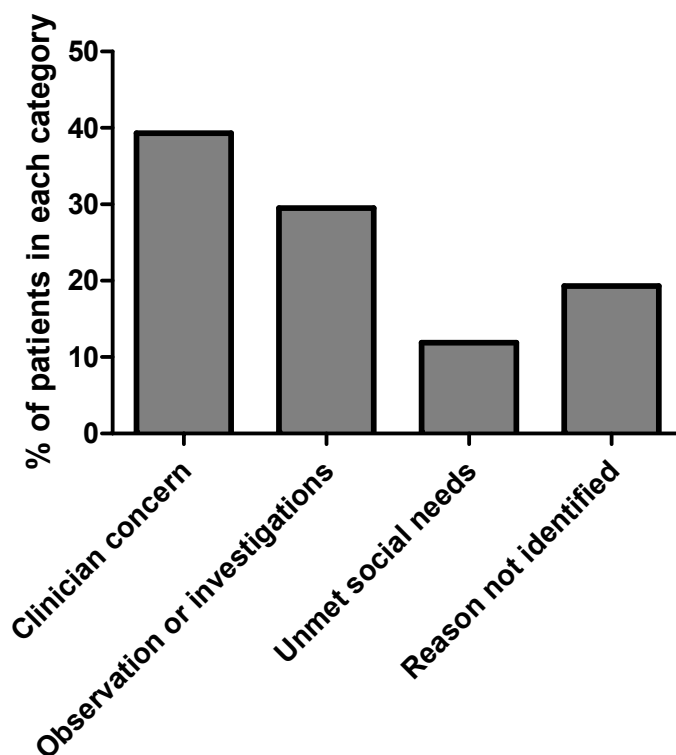


Figure 1: Reasons for hospital admission in patients with low CURB65 scores.

Clinician concern

A significant proportion of hospitalized patients (39.3%) were classified as having high risk clinical features requiring observation in hospital (Clinician concern). Hypoxia requiring oxygen therapy was most common (31.4%) but other common reasons were unstable co-morbidities (16.4%). These included ischaemic heart disease, (acute coronary syndrome, arrhythmia and unstable

angina), COPD, diabetic emergencies, severe anaemia, alcohol withdrawal and urinary retention.

5.2% had a secondary pneumonia complication such as parapneumonic effusion or lung abscess and 5.0% had metabolic abnormalities such as severe hyponatraemia ($\text{Na}^+ < 130 \text{mmol/L}$), hypo or hyperkalaemia ($\text{K}^+ < 3.5$ or $> 5 \text{mmol/L}$) or acute kidney injury requiring intravenous fluid therapy or inpatient hospital monitoring. (Note that percentages are expressed as a proportion of the overall cohort of hospitalized patients $n=420$. Percentages add up to more than 39.3% because some patients had more than 1 high risk feature requiring hospitalization).

Requiring additional investigations or treatment not related to severity of pneumonia

This group comprised 29.5% of the overall cohort and included patients that were hospitalized with none of the adverse features of severity. This group included patients requiring further investigations such as CT scanning, ultrasound or bronchoscopy, where these investigations were not available rapidly as an outpatient service. 87.1% of these patients were discharged within 48 hours of admission.

Unmet social needs

In 11.9% of cases, the reviewers could not identify any adverse clinical parameters to necessitate admission to hospital, but social circumstances were reported that would have made discharge from hospital inappropriate. This included elderly patients living alone without social support, patients

whose home circumstances were unsafe or unsuitable and patients that were homeless.

No clear reason for hospitalization

In 19.3% of cases, the reviewers could not identify a medical or social reason for the patient to be hospitalized.

CURB65 was documented in 17.6% of patients admitted to hospital, compared to 26.9% of patients discharged from hospital (p value 0.02). Of those where no clear reason could be established for hospitalisation, the CURB65 was documented in 17.2% of patients, p=0.1 when compared to patients discharged from hospital.

Secondary Outcomes:

Overall 30-day mortality was found to be 3.1% in those that were admitted (>12 hours) compared with 0.7% in those that were discharged (\leq 12 hours), p=0.1. The 1 patient that died following discharge was readmitted and died on day 24 for a cause unrelated to CAP.

In patients classified by the reviewers as “clinical concern”, mortality was 6.7%. This was significantly higher compared to 0% for patients awaiting investigations (p=0.009) and 0% for patients without a clear indication for hospitalization (p=0.04). Mortality for patients with unmet social needs was 4.0% (2 patients).

In a logistic regression analysis, parameters associated with 30-day mortality were chronic cardiac co-morbidity (AOR 5.73 95% CI 1.52-21.6, p=0.01)

acidosis (pH<7.35) (AOR 5.14, 95% CI 1.44-18.3, p=0.01), hypoxia (AOR 9.86, 95% CI 2.39-40.7, p=0.002) and multilobar chest x-ray shadowing (AOR 4.54, 95% CI 1.21-17.1, p=0.03), Hosner-Lemeshow goodness of fit test p=0.8.

Mortality increased in low risk patients according to the number of these additional adverse features (no additional adverse features= 0.3% 30-day mortality (359 patients), 1 adverse feature (151 patients)= 2.6%, 2 adverse features (45 patients)= 11.1% and 3 adverse features (10 patients)= 33.3%. No patient had all 4 additional adverse features. The mortality data are shown in figure 2.

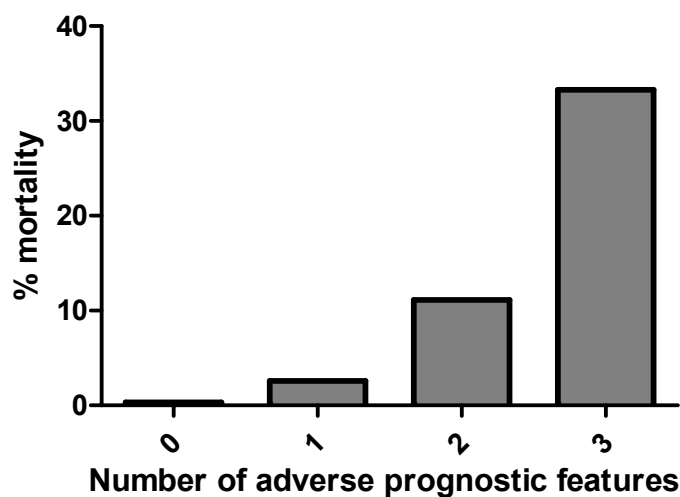


Figure 2- Additional severity markers and risk of mortality in “low risk” patients with community acquired pneumonia.

Discussion

This is the first study to investigate reasons for hospitalization among low risk patients with CAP in an institution using the CURB65 score. In this study, 74.3% of the patients reviewed with low risk pneumonia were admitted to the hospital. Most frequently, the reasons for hospitalization were due to additional markers of severity, such as hypoxia or unstable co-morbidities. Similar proportions were not severely ill, but required additional investigations. It is possible that this group of patients could have been managed, as outpatients if additional resources, such as rapid access to outpatient investigations, early clinic review or “hospital at home” style support were available. We did, however, identify 19.3% of patients that independent reviewers felt could have been safely managed as outpatients. Our results are similar to a US study using the Pneumonia Severity Index, where 82% of low risk CAP patients admitted had clinically justified reasons for hospital admission.²³ Potentially therefore, by encouraging greater use of outpatient management and by providing additional resources for patients managed in the community, a significant number of hospital admissions for CAP could be avoided. Outpatient management of selected patients with CAP is safe, acceptable to patients and may be associated with significantly reduced hospital costs and complications.⁴

In this study, where clinicians identified additional risk factors for mortality, such as hypoxia, acidosis, multilobar chest x-ray involvement or cardiac co-morbidities, mortality was increased. The mortality rates for patients where

clinicians identified additional risk factors (6.7%) are similar to those quoted for CURB65 score 2 in some studies.¹² A small proportion of patients had more than 1 of these severity markers and had mortality rates equivalent to those of severe CAP.

CURB65 score is one of the most widely used pneumonia prediction scoring system in the world. It was validated primarily to predict 30-day mortality but is recently being recommended by national guidelines to help clinicians guide the need for hospital admission.¹¹ Although this study is the first to investigate reasons for hospitalization using the CURB65 score, other have studied reasons for hospitalization of low risk patients using the Pneumonia Severity Index. Aujesky et al studied 689 low risk patients during a clinical trial aiming to increase the proportion of patients treated in the community.¹⁶ In this study, the major reasons for hospitalization were related to co-morbidities (71.5%) while patients with additional markers of severity (similar to the “clinician concern” category in this study) accounted for 29.3% of cases. *Arnold et al* showed that the majority of patients admitted with CAP with a Pneumonia Severity Index of I or II had extenuating clinical circumstances to justify their admission.²³ Disease co morbidities (43%) and unmet social needs (18%) were the major categories of clinical factors justifying hospital admission for these patients. Used as the sole indicator for inappropriate hospitalization, the Pneumonia Severity Index had a poor positive predictive value of only 16%. The corresponding value for the present study is very similar at 19.3%. Hypoxia was not a major contributory factor in the *Arnold et al* study perhaps because the Pneumonia Severity Index already incorporates oxygenation as a

prognostically important factor to predict disease outcome. The study by *Aujesky et al* excluded patients with arterial hypoxaemia. In addition, because age >65 years contributes 1 point to the CURB65 score, only 1 more abnormal variable is required to classify an elderly patient as requiring inpatient care. This may explain why our low risk cohort was relatively young and why studies consistently show that the PSI identifies a high proportion of patients as low risk.⁴

Part of the objective of this study was to study the role of clinical judgment in applying the CURB65 score in clinical practice. Our study suggests that the CURB65 score may be under-utilized in clinical practice, as it was not documented in most of these low risk patients. Out of the 19.3% patients hospitalized with no obvious justified reasons, only 17.2% had documented CURB65 score in the notes. Had it been utilized more in this group in conjunction with clinical judgment, we anticipate most of these patients could have been discharged.

In most cases clinicians, however, appeared to appropriately identify patients with additional risk factors not included in the CURB65 score and these patients were justifiably admitted to hospital. Where clinicians identified a cause for concern, mortality was significantly increased above the level predicted by the CURB65 score, to a level that requires hospital treatment based on current guidelines.

This study however, has its limitations. Although patients were prospectively recruited, we determined reasons for hospitalization retrospectively and this approach has inherent difficulties. We accounted for potential bias by using 2-blinded reviewers

with a third independent reviewer where consensus was not reached. A similar study using a prospective design is desirable.

Conclusion

This study supports international guideline recommendations that pneumonia severity scores should be used as an adjunct to clinical judgment, while deciding the need for hospital admission. There is, however, the potential to significantly increase the proportion of patients with CAP currently managed in the community.

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