Determining need for hospitalisation: Evaluation of the utility of the CRB-65 score in patients with community-acquired pneumonia presenting to an emergency department

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Background. The CRB-65 severity of illness score, used for assessing patients with community-acquired pneumonia (CAP), may be of particular benefit in resource-constrained areas, since it relies purely on clinical parameters.

Objective. To assess the potential accuracy of the CRB-65 score when used in deciding whether to hospitalise patients with CAP presenting to an emergency department (ED).

Methods. Prospective, observational study in an academic hospital in Johannesburg, South Africa. Data from adult patients with radiologically confirmed CAP were analysed.

Results. Overall, 152 patients were enrolled (79 females, 73 males; median age 36.5 years). Several diverse criteria had been used by the ED doctors in admission decisions, while the CRB-65 score had been used in only 3/152 patients (1.6%). Overall, 68/152 patients (44.7%) had been managed as inpatients and 84/152 (55.3%) as outpatients. If the CRB-65 had been used as the sole criterion for site-of-care decisions, 107/152 patients (70.4%) would potentially have been managed as outpatients and 45/152 (29.6%) as inpatients. Achieving a stable clinical condition took longer ($p=0.037$) and mortality was higher ($p<0.001$) in patients with higher than lower CRB-65 scores. All five patients who died were inpatients. Of these, three (60.0%) would have been classified by the CRB-65 as having an intermediate mortality risk and two (40.0%) as having a high mortality risk.

Conclusions. This study demonstrates the utility of the CRB-65 score in accurately determining the need for admission of patients with CAP presenting to an ED in a resource-constrained environment.


Despite recent advances in the management of community-acquired pneumonia (CAP), it remains a common and potentially lethal infectious disease. CAP mortality is variable, depending on the site of care. It is <1% in the outpatient setting, about 5 - 15% in inpatients not requiring intensive care unit (ICU) care, up to 25% in intubated patients, and nearly 50% in ICU patients requiring vasopressors. Determination of disease severity is crucial in the assessment and management of patients with CAP in the emergency department (ED), since it guides various interventions and decisions, including the optimal site of care (i.e. need for hospital or ICU admission or suitability for home care).

Several tools have been developed to assist in the prediction of severity of CAP, including the CRB-65 score. This scoring system was developed from the CURB-65 score and derived from the British Thoracic Society rule, but is simpler to use. It has been recommended for use in the community setting in the UK, and has an accuracy similar to that of the CURB-65 score and the Pneumonia Severity Index (PSI). However, since it does not require measurement of the blood urea level, it may be of particular value in areas with limited resources.

We wished to assess the potential accuracy of the CRB-65 score used to determine the need for admission to hospital of patients with CAP presenting to the ED at Helen Joseph Hospital (HJH), Johannesburg, South Africa (SA), in an area with a high prevalence of HIV infection.

Materials and methods

Study design and population

This was a prospective, observational, hospital-based study of a consecutive sample of 152 adult patients aged ≥18 years with CAP seen in the ED at HJH between February 2011 and April 2011. It was purely an observational study and the researchers did not play any role in clinical management of the patients, including decisions regarding severity of illness or need for hospital admission. Once the ED doctors had diagnosed a patient as having CAP and personally managed the case (including determining, by whatever criteria they used, whether the patient needed to be admitted to hospital or not), they informed the primary study investigator (DMK) about the patient. After obtaining written informed consent from the patient, DMK evaluated each case for purposes of the study, in the first instance confirming that the patient actually had CAP.

For the purposes of the study the following criteria were used for the definition of CAP, as described previously: altered breath sounds and/or signs of lung consolidation, fever, rigors, sweats and cough, with or without sputum production,
pleuritic chest pain, cyanosis, shortness of breath and tachypnoea, together with radiological confirmation of the diagnosis of pneumonia. Chest radiographs (CXRs) were initially evaluated by the attending ED doctors or registrars, and confirmed for study purposes as demonstrating pneumonia by DMK. Excluded were cases of suspected or confirmed aspiration pneumonia, chemical pneumonitis, *Pneumocystis jirovecii* pneumonia and pulmonary tuberculosis. Patients with any acute or active comorbid illness such as diabetes mellitus, renal failure, cardiac failure or end-stage AIDS were similarly excluded.

Thereafter, DMK found out from the ED doctors what criteria they had used to assess the severity of illness and/or determine the need or not for hospital admission of the patients. The CRB-65 severity of illness score was then evaluated in each CAP study patient by the primary researcher. In this scoring system, one point is assigned for each of the following parameters, if present: confusion, respiratory rate (RR) ≥30/min, systolic blood pressure (BP) <90 mmHg and/or diastolic PB ≤60 mmHg, and age ≥65 years.[3,5] The abbreviated mental test, modified for SA conditions (AMTMSA), was used for objective assessment of the presence/absence of confusion. Confusion was further defined as an AMTMSA score of ≥8. The abbreviated mental test, modified for SA conditions (AMTMSA), was used for objective assessment of the presence/absence of confusion. Confusion was further defined as an AMTMSA score of ≥8. It has previously been suggested that patients with a CRB-65 score of 0 are at low risk of mortality and may be suitable for management as outpatients. Patients with a score of 1 or 2 are at intermediate risk of mortality and should be considered for hospital-supervised treatment, while those with scores of 3 or 4 are at high risk of mortality and may require high care or ICU care. The study patients were therefore classified into low, moderate and high mortality risk groups.

DMK documented demographic and clinical features, including age, gender, the AMTMSA score, systolic and diastolic blood pressure, heart rate, respiratory rate, body temperature, site of care (outpatient or inpatient) and outcome. These parameters were used to determine the CRB-65 score, as well as the time to clinical stability and the mortality rate. Time to clinical stability was determined according to a validated rule, described previously, that defined clinical stability as the first day on which most of the following criteria were simultaneously achieved: systolic BP ≥90 mmHg; RR ≤24/ min; heart rate ≤100 bpm, oxygen saturation (on room air) ≥92%, temperature ≤37.2°C.
The main findings of this study, which we believe is the first in a resource-constrained environment, were as follows: (i) the CRB-65 score was used very infrequently by the ED doctors at this hospital; (ii) had the CRB-65 score been used as the criterion for hospital admission, far fewer patients would have been admitted (all the additional patients who were admitted to hospital having had a good outcome), (iii) all the discharged patients had a CRB-65 score confirming that they could indeed be considered for treatment safely at home (notably, all survived); (iv) the patients admitted to hospital with a lower CRB-65 score had a shorter time to clinical stability and a lower mortality compared with patients with a higher CRB-65 score; and (v) all the patients who ultimately died would have been admitted on the basis of their CRB-65 scores.

**Interpretation of findings in relation to previously published work**

The CRB-65 score was used very infrequently by the ED doctors, being utilised in only 4/152 cases (2.6%), whereas had the CRB-65 score been used for admission decisions, a total of 107/152 patients (70.4%) – all classified as at low mortality risk – would have been admitted as inpatients, while 45/152 (29.6% – 42 classified as at intermediate mortality risk and three as at high mortality risk) would have been managed as inpatients. Similarly, in the study described above documenting that ED providers did not rely on the PSI for determining the initial site of care for patients with CAP, many low-risk cases (258/689; 37.4%) were admitted to hospital. Evidence suggests that ED physicians tend to overestimate the risk of death among patients with CAP, consequently leading to hospitalisation of many patients at low risk of mortality. Importantly, in the current study the outcome of all these additional low-risk patients who had been hospitalised was good, and there were no deaths among them. It is clear that this may have considerable cost implications, as demonstrated in many studies. In their study of the cost of treating patients with CAP, Lave et al. concluded that hospital admission of low-risk patients with CAP is far more costly than outpatient treatment. A documented example given was $264 for outpatients and $7 500 for inpatients (including hospital and physician care and follow-up care). In a study of preferences of home v. hospital care among low-risk patients with CAP, Coley et al. came to a similar conclusion.

Among the patients admitted to hospital, those with a lower CRB-65 score had a significantly shorter time to clinical stability ($p=0.037$) and lower mortality. All the deaths were of inpatients: 3/5 (60.0%) would have been classified by the CRB-65 score as having an intermediate mortality risk, with the remaining 2/5 (40.0%) having a high mortality risk. If the CRB-65 score had been used as the

| Table 2. Association between time to clinical stability and CRB-65 scores among the CAP patients |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| CRB-65 score    | 1 (days)        | 2 (days)        | 3 (days)        | Total, n        |
| 0               | 16 (47.0)       | 17 (50.0)       | 1 (3.0)         | 34              |
| 1 - 2           | 6 (21.5)        | 16 (57.0)       | 6 (21.5)        | 28              |
| 3 - 4           | –               | 1 (100.0)       | –               | 1               |
| Total           | 22 (35.0)       | 34 (54.0)       | 7 (11.0)        | 63              |

| Table 3. CRB-65 scores in patients stratified according to outcome (alive/dead) |
|-----------------|-----------------|-----------------|-----------------|-----------------|
| CRB-65 score    | Alive, n (%)    | Dead, n (%)     | Total, n        |
| 0               | 107 (100.0)     | –               | 107             |
| 1 - 2           | 39 (93.0)       | 3 (7.0)         | 42              |
| 3 - 4           | 3 (3.0)         | 2 (67.0)        | 3               |
| Total           | 147 (97.0)      | 5 (3.0)         | 152             |

CAP = community-acquired pneumonia.

**Discussion**

**Main study findings**

The CXR was the most frequently used radiographic feature among the patients who had been admitted were bilateral infiltration, multilobar consolidation and significant pleural effusion. Interestingly, in the study by Espana et al., abnormal haemodynamic parameters (systolic BP <90 mmHg, RR >30/min and altered mental status) were among eight independent predictive factors for severe CAP.

Had the CRB-65 score been used, fewer patients would have been admitted to hospital. ED doctors admitted 68/152 patients (44.7%) and discharged 84/152 (55.3%), whereas had the CRB-65 score been used for admission decisions, a total of 107/152 patients (70.4% – all classified as at low mortality risk) would potentially have been managed as outpatients, while 45/152 (29.6% – 42 classified as at intermediate mortality risk and three as at high mortality risk) would have been managed as inpatients.
sole criterion for hospital admission, all the deaths would have occurred among patients who would have been assessed as needing hospital, and possibly even high-care or ICU, admission. The CRB-65 score would therefore have appeared to perform well, being able to predict the time to clinical stability and the risk of death for hospitalised patients with CAP. Others have arrived at the same conclusion. For example, in their study of predictive accuracy of the PSI versus the CRB-65 for time to clinical stability, Arnold et al.\[^{11}\] found that the CRB-65 score was a powerful yet simple tool for predicting time to clinical stability and death among patients with CAP. In a study of 338 406 patients with CAP from Germany, Ewig et al.\[^{12}\] came to a similar conclusion.

As international studies have done, our study therefore showed that the CRB-65 severity of illness score, which is based exclusively on three bedside clinical signs and age, appears to accurately predict the time to clinical stability and the risk of death in patients with CAP. Importantly, this scoring tool worked well in a resource-constrained environment that is also an area of high HIV prevalence.

**Limitations and strengths of the study**

The study has limitations. While undertaken in SA, a country with a high prevalence of HIV and resource constraints, it encompassed only one institution. The findings may therefore not be generalisable to other countries or other institutions. Furthermore, the ethnic origin of the patients, their socioeconomic status and home circumstances, and their habits (with regard to alcohol consumption, drug use and cigarette smoking) were not recorded. It is possible that these factors may have impacted on our findings.

The study has strengths. It was a prospective investigation, and therefore all the information that was required for the study analysis was collected. It is also the first study we are aware of that used the CRB-65 score in a resource-constrained environment.

**Conclusion**

In conclusion, this study demonstrates the potential ability of the CRB-65 severity of illness scoring system to assist ED physicians with decisions regarding the optimal site of care of patients with CAP in a resource-constrained environment. Further studies are required, in particular an interventional study in which the CRB-65 score is implemented for decision-making in some patients, and required, in particular an interventional study in which the CRB-65 score is implemented for decision-making in some patients, and particularly in ICUs.

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**Authors’ contributions.** DMK planned the study, wrote the protocol, performed data processing, evaluated and interpreted the results and wrote the article. AM performed the statistical analysis and assisted in the writing up of the statistical methods and results. He also assisted in the writing of the article. MM assisted in the writing of the protocol and the article. CF conceived the study, and assisted in the writing up of the protocol, in evaluation and interpretation of the results, and in the writing of the article.

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**References**


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