PostScript

LETTERS

Mortality predictors are not triage scores

Barlow *et al*[1] have shown effectively that CURB-65 outperforms generic early warning scores in the prediction of 30-day mortality from community acquired pneumonia (CAP). We are concerned, however, that stratification of 30-day mortality is taken without reflection to be an indicator of requirement for higher levels of care. In our own institution 5 of 40 patients presenting with CAP and an initial CURB-65 score of 1 required admission to high dependency or intensive care, and it has been recognised previously that a CURB-65 score may be misleadingly low in the young and otherwise fit.[2] Early warning scores were initially developed based on unexpected admissions to intensive care rather than mortality,[3] and it could in fact be argued that the better an early warning score is applied, the less it will relate to mortality as more deaths will be prevented. We have shown that a modified early warning score may not compare with CURB-65 for mortality prediction but outperforms it significantly in terms of prospectively predicting the need for hospital admission and for a higher level of care,[4] while Bynd *et al* have demonstrated the value of the original medical early warning score in predicting hospital admission.[5] Using simple physiology, emergency department research has demonstrated the ability to identify at first presentation those patients who are likely to deteriorate.[6]

We would suggest that mortality predictors and early warning scores are in fact different entities, developed from different cohorts and with different aims, and that conflation of the two should be avoided.

Kirsty Challen, Andrew Bentley
University Hospital of South Manchester, Manchester, UK

John Bright
Salford Royal Hospitals NHS Trust, Manchester, UK

Darren Walter
University Hospital of South Manchester, Manchester, UK

Correspondence to: Dr Kirsty Challen, University Hospital of South Manchester, Southmoor Road, Manchester M23 9LT, UK; kirsty.challen@smtr.nhs.uk

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Author's reply

We agree with Challen and colleagues that mortality prediction tools and early warning scores should only be used to predict what they have been validated to predict. It is important to recognise, however, that early warning scores have been widely implemented in acute medicine in the UK, and it is therefore inevitable that junior and inexperienced physicians will use these as prognostic tools and to guide the intensity of intervention required in community acquired pneumonia (CAP). The need for higher level care, albeit important, is not the only clinical decision that needs to be taken when a patient with CAP is admitted to hospital. For example, the physician also needs to decide about the intensity of antibiotic therapy and other supportive measures, and prognostic assessment may also be useful in discussions with patients and their relatives. In order to decide on what tool to use, the key question for the physician at the frontline is: ''What do I want to predict?'' As the performance characteristics of all decision support tools are dependent on the context in which they are used, the answer to this question will partly depend on the environment in which the physician finds her/himself. This is likely to explain the different performance characteristics of CURB-65 and its predecessors in different patient cohorts. In a recent study by Capelastegui and colleagues, CURB-65 was as good as the pneumonia severity index in predicting mortality and also appeared usefully to stratify the need for mechanical ventilation (0.74% (11/1480) of non-severe patients vs 2.36% (7/296) of severe patients) and hospital admission in a mixed cohort of outpatients and inpatients with CAP.[1]

In the National Health Service in the UK, relatively few patients hospitalised with CAP are admitted to higher level care. Of 433 patients with full data to calculate a CURB-65 score in our own database, 14 (3%) were admitted to intensive care, although 38% had a CURB-65 score of ⩾3. In addition, those who were admitted were younger (mean age 54 years in those admitted to intensive care vs 70 years in the whole cohort) and had less co-morbidity (36% of those admitted to intensive care had a chronic illness vs 65% in the whole cohort). In this context, it is unsurprising that a tool that includes age as one of the criteria will perform less well than a tool that does not in predicting the need for admission to higher level care. Mortality, in contrast, is an outcome that applies to all patients regardless of age, co-morbidity or other patient characteristics. In a different environment such as in a country that admits a higher proportion of patients (eg, North America) or very few patients (eg, a developing country) with CAP to higher level care, or in the event of an influenza pandemic when higher level care is likely to be tightly rationed, the performance characteristics of both tools and what one wants to predict may change notably. Interestingly, in our own cohort, of the patients admitted to intensive care, CURB-65 still appeared to usefully stratify mortality (0/3 patients with a score of 0 or 1 died vs 2/5 (40%) with a score of 2 and 4/6 (66%) with a score of ⩾3). It is also worth noting that early warning scores have not been validated to predict mortality in patients with either sepsis or specific infections. In contrast, CURB-65 may predict mortality in a wider range of infections.[2] As we state in our paper,[3] there may be a case for using CURB-65 on admission to hospital to guide the initial intensity of management, and thereafter or at the same time, an early warning score to identify the small number of patients who will require higher level care. Research to derive and validate better and simple prognostic tools that predict a range of patient outcomes is clearly required.

Gavin Barlow
Castle Hill Hospital, Cottingham, East Yorkshire HU16 5JQ, UK; gavin.barlow@tesco.net

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Simple modification of CURB-65 better identifies patients including the elderly with severe CAP

We read with interest the article by Barlow *et al*.[1] The CURB-65 criteria currently recommended by the British Thoracic Society (BTS) based on the study by Lim *et al*[2] are useful and more pragmatic than other criteria, as shown in their study. However, CURB has a lower specificity in older patients and addition of the age 65 criterion to CURB adds nothing to the sensitivity and little to the specificity in hospitalised patients.[3] Increasing the urea cut off point by 2 units produces better specificity but at the expense of reduced sensitivity.[4] Recently proposed SOAR criteria (systolic BP, oxygenation, age and respiratory rate) are at least as useful as CURB-65 in older patients[3] but require additional information on arterial and inspired gas oxygen tensions. Better rules are therefore required for populations that include elderly patients. We hypothesised that using (1) age 85 as another cut off level and (2) two levels of urea cut off points at 7 mmol/l and 11 mmol/l in the scoring system would

Table 1 Sensitivity, specificity, PPV and NPV for CURB-65 and CURB-age criteria in 189 patients with CAP

	CURB-65 estimate (95% CI)	CURB-age estimate (95% CI)
Sensitivity	81.5% (61.9 to 93.7)	81.5% (61.9 to 93.7)
Specificity	64.2% (56.3 to 71.6)	74.1% (66.6 to 80.6)
PPV	27.5% (18.1 to 38.6)	34.4% (22.9 to 47.3)
NPV	95.4% (89.6 to 98.5)	96.0% (90.9 to 98.7)

PPV, positive predictive value; NPV, negative positive value; CAP, community acquired pneumonia.

improve the assessment of severity in community acquired pneumonia (CAP).

We therefore modified CURB-65 and formulated a new rule (CURB-age) where:

- the presence of new confusion scores 1;
- urea >7 mmol/l but ⩽11 mmol/l scores 1;
- urea >11 mmol/l scores 2;
- respiratory rate ⩾30/min scores 1;
- either diastolic blood pressure ⩽60 mm Hg or systolic blood pressure <90 mm Hg scores 1;
- age ⩾65 and <85 scores 1;
- age ⩾85 scores 2.

Since the maximum possible score becomes 7, we defined severe pneumonia as a score ⩾4 for the CURB-age criteria compared with ⩾3 for CURB-65.

The subjects were 189 patients (median age 75 years, range 17–96, 56.1% men) who were included in two prospective observational studies of CAP.[3] Detailed methodology has been reported previously.[3 5] Using CURB-65 there were 109 non-severe cases (57.7%) and 80 severe cases (42.3%) and by CURB-age criteria there were 125 non-severe cases (66.1%) and 64 severe cases (33.9%). There were 5 deaths in each of the non-severe groups and 22 deaths in each of the severe groups. We examined the sensitivity, specificity, positive predictive values (PPV) and negative predictive values (NPV) of 6 week mortality and their corresponding 95% Pearson-Clopper exact confidence intervals for both CURB-65 and CURB-age criteria (table 1). The CURB-age criteria showed a significantly higher specificity ($p = 0.0001$, McNemar test).

A simple modification improves the specificity and PPV without losing the sensitivity of CURB-65 criteria and without requiring any additional information. It is as simple as CURB-65 and provides higher accuracy in identifying those who died over SOAR and CURB-65 criteria with significantly higher specificity. We combined the data from two cohorts of patients with CAP from two time periods, with the second cohort being elderly patients only (⩾65 years). It is reassuring that the CURB-age criteria better identified severe pneumonia in this older cohort. In the study in which the CURB-65 criteria were developed and validated, the median age of patients was 64 years.[2]

Our findings have important clinical implications. The current BTS guidelines recommend that severe CAP should be treated with intravenous antibiotics. These are more likely to produce untoward side effects such as antibiotic-associated diarrhoea than oral antibiotics, especially in older adults, and their use should be limited to truly severe CAP in older patients. Although the number of patients in our study is comparable to the original validation cohort reported by Lim *et al*[2] (189 vs 214), larger studies are needed to test the validity of these modified criteria.

Phyo K Myint
Department of Medicine, Queen Elizabeth Hospital, King's Lynn, School of Medicine, Health Policy and Practice, University of East Anglia, and Department of Medicine for the Elderly, Norfolk and Norwich University Hospital, Norwich, Norfolk, UK

Ajay V Kamath
Department of Respiratory Medicine, Norfolk and Norwich University Hospital, Norwich, Norfolk, UK

Sarah L Vowler
Centre for Applied Medical Statistics, Department of Public Health and Primary Care, University of Cambridge, Cambridge, UK

Brian D W Harrison
School of Medicine, Health Policy and Practice, University of East Anglia and Department of Respiratory Medicine, Norfolk and Norwich University Hospital, Norwich, Norfolk, UK

Correspondence to: Dr Phyo Kyaw Myint, Clinical Gerontology Unit, Addenbrooke's Hospital, Hills Road, Cambridge CB2 0QQ, UK; Pkyawmyint@aol.com

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Author's reply

We agree with Myint and colleagues that CURB-65 will not perform equally in all cohorts of patients. We have previously shown, however, that knowledge among junior and middle grade medical staff about how to perform and apply severity assessment criteria in patients with community acquired pneumonia (CAP) is poor.[1 2] This may have improved since the inclusion of CURB-65 in the British Thoracic Society (BTS) guidelines in 2004, but it is our anecdotal experience that severity assessment remains suboptimal. When implementing guidelines, there is a widely accepted paradigm that increasing complexity results in decreased adherence. While the modification proposed by Myint and colleagues may be a statistical improvement, the key question is: Will the improved performance characteristics outweigh the inevitable increased confusion and decreased use as a result of the increased complexity and yet another change to the recommended prognostic criteria for CAP?

Gavin Barlow
Castle Hill Hospital, Cottingham, East Yorkshire HU16 5JQ, UK; gavin.barlow@tesco.net

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Birth weight and adult lung function

In a recent paper published in *Thorax* Canoy and co-workers[1] concluded that babies with lower birth weight and poor infant growth may be at a higher risk of developing impaired adult pulmonary function. In contradiction to these findings, no association was found between birth weight and adult lung function or between birth weight and asthma symptoms in a Nordic-Baltic population studied by Laerum *et al*.[2] Studies of birth characteristics and respiratory outcomes give contradictory results as methods used in different studies vary. Although Canoy *et al*[1] showed some interesting findings in a large cohort study, it raises some methodological questions and thereby interpretation of the findings.

The authors state that data on potential confounders and mediating factors operating throughout the life course were prospectively collected. Many of the known early life variables and adult variables were taken into consideration in logistic regression analyses. Canoy *et al* have focused on the nutritional status of the mother and birth weight. However, I wonder whether some relevant factors known to influence weight during the first year of life were missing. For example, it is a known fact that children of diabetic mothers often have heavier babies (large for gestational age) at birth compared with other term babies. This has not been discussed in the paper. Furthermore, have the authors taken into account factors that could influence the development of weight during the first year? What about the nutritional status of the children or conditions that may lead to nutritional disorders during the first year? Did the authors consider other chronic childhood disorders that may impair growth? Only two measurements of weight (at birth and around 12 months of age) during the first year will hardly reflect the natural growth of the child over time.

The authors mention that weight gain during the first year was positively associated with lung function later in life, which remained significant after adjustments for