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# Predicting mortality in the elderly with community-acquired pneumonia: should we design a new car or set a new 'speed limit'?

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Community-acquired pneumonia (CAP) is a common illness associated with increasing mortality rates that parallel the site of care. While outpatients have a risk of dying of <5%, those in hospital have a mortality rate of 12% and those managed in the ICU can have a chance of dying that exceeds 30%.[1] In addition, delayed recognition of severe illness can add to mortality, with those admitted to the ICU late in the course of disease having a higher mortality than those admitted early.[2] Thus, patient outcome is dependent on making an accurate assessment about where patients should be initially managed and the intensity of care that they should receive. To this end, a number of prognostic scoring systems have been developed for patients with CAP that can predict the mortality risk, which is then often applied as a surrogate for deciding the initial site of care.[1 3 4] Unfortunately, the risk of death is not always correlated with the need for a high level of care including need for ICU admission. In fact, patients who are young and otherwise healthy may benefit from ICU admission yet have a much lower predicted mortality risk than older patients with multiple medical comorbidities who may benefit little from admission to a hospital unit that provides a high level of care. Accurate definition of the site of care not only impacts mortality, but also the cost of care which rises incrementally from outpatient to inpatient to ICU management.

The most commonly used tools for predicting mortality—the CURB-65 (confusion, elevated blood urea nitrogen, elevated respiratory rate, low blood pressure and age >65 years), derived from the British Thoracic Society rule,[5] and the Pneumonia Severity Index (PSI)[1]—predict mortality by giving a point score to a number of acute and chronic disease variables, but both incorporate age into the scoring system. With CURB-65, age is a categorical variable (≥ or <65 years) while, with the PSI, it is a continuous linear variable. The implication from this approach is that age independently adds to the risk of death, but this is a complex issue since patients generally have more comorbid illnesses with advancing age and the independent contribution of age itself to mortality is uncertain. Kothe *et al*[6] studied >2000 patients with CAP, 75% of whom were managed in hospital, and found that those aged ≥65 years had a higher mortality than younger patients and that age was an independent risk factor for death, even after controlling for comorbid illness, severity of illness, site of residence (nursing home or not) and treatment-related factors.[6] Similarly, Marrie *et al*,[7] studying >3000 admitted patients with CAP, found that age was an independent mortality risk factor over and above the risk that could be attributed to disease severity using the PSI.[7]

Why should age be an independent risk factor for death from pneumonia? Elderly patients may present later in the course of illness than younger patients because the classic clinical symptoms of pneumonia are not always present, the vital sign parameters may be less abnormal than in younger patients, and both family members and physicians may initially overlook the diagnosis of pneumonia. In addition, even 'healthy ageing' may be associated with impairments in immunity and lung function, even in the absence of comorbid illness. Also, multiple chronic diseases are more prevalent in elderly patients than in younger patients, and it is possible that there is a synergy between multiple comorbidities in these older individuals that is not accounted for by prognostic scoring systems.

It is likely that existing scoring systems for CAP have limitations in patients with advancing age, but the extent of these limitations is unclear. The PSI was developed and validated as a way to identify patients with a low mortality risk who could be safely managed out of hospital, but it can potentially underestimate severity of illness, especially in young patients without comorbid illness who have acute abnormalities of vital signs, while overestimating the mortality risk in older patients with minimal acute disease processes but a high frequency of stable comorbid disease processes. Not all patients in a high PSI risk class need to be managed in the ICU. In a Spanish study of 457 patients with CAP in the highest mortality risk group (PSI class V), only 92 were admitted to the ICU.[8] When patients were admitted to the ICU they tended to get more of their PSI points from acute rather than chronic illness, while the reverse was true for those patients in PSI risk class V who were not admitted to the ICU. On the other hand, a retrospective analysis comparing patients admitted to wards and to the ICU showed that, while the patients in the ICU had a higher PSI score than the ward patients, the cohort admitted to the ICU included patients in all PSI classes with 30% falling into low PSI risk groups (I–III).[9]

The CURB-65 approach may be ideal for identifying patients with a high mortality risk because of acute vital sign

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abnormalities who might otherwise be overlooked, but it can underestimate disease severity in older patients with more subtle vital sign abnormalities and decompensated comorbid illness. In studies of CURB-65, Lim *et al* showed that this rule did not work as well in older patients as in younger patients.[5 10] In one study the rule had a 66% sensitivity and a 73% specificity for predicting mortality in a population that included half who were at least 75 years of age, and age was an independent predictor of mortality.[5] In this study, although the CURB criteria were not ideal in the elderly patients, the approach had a higher sensitivity for predicting mortality than the PSI. One alternative approach for elderly patients is to use the SOAR criteria which omit elevated blood urea nitrogen and confusion, findings that are commonly present in elderly people. With this tool the mortality risk is increased in the presence of two of the four SOAR criteria (systolic blood pressure <90 mm Hg, ratio of arterial oxygen tension to fraction of inspired oxygen ($Pa_{O_2}/Fi_{O_2}$) <250, age ≥65 years, respiratory rate ≥30/min).[11] When this approach was applied and two criteria were present, the sensitivity for predicting mortality was 81%, specificity 60%, positive predictive value 27% and negative predictive value 94%.[11] Other scoring tools that have been studied include A-DROP (a Japanese variation of CURB-65),[12] SMART-COP[13] and a severe CAP system developed in Spain,[14] which have been reviewed elsewhere.[4]

In this issue of *Thorax*, Chen *et al* (***see page 971***) from Taiwan report a prospective study of 987 inpatients and outpatients with CAP subdivided into three different age groups—namely, adults (age 18–64, n=348), elderly (age 65–84, n=438) and very elderly (age ≥85, n=201).[15] They found a progressive decline in the predictive power for 30-day mortality of both the PSI and CURB-65 as the groups got older. This may relate in part to the finding that the elderly patients had less tachycardia and fever than the younger patients but more comorbid illnesses. Interestingly, although these tools did not work as well in older patients as in younger populations, the authors found that age itself had little impact on mortality after correcting for disease severity variables using the PSI. In fact, if age was removed from the calculation of PSI and CURB-65, the predictive value of the tools was not affected. The authors argue that age is inappropriately weighted in elderly patients and that a solution would be to choose higher cut-off values to define high-risk patients in the very elderly population compared with the thresholds used in younger individuals. When this was done, the PSI had a greater specificity and negative predictive value for mortality than the current cut-off point.

Treatment may also have an impact on outcome, and older patients with CAP may be at increased risk for infection with multidrug resistant (MDR) pathogens than younger patients, necessitating a different approach to antibiotic choice. Identifying and appropriately treating those at risk for MDR organisms is an important intervention that can decrease mortality.[6] In institutionalised elderly people with severe pneumonia, the presence of poor functional status and recent antibiotic exposure have been associated with the presence of MDR organisms.[16] It is also important to understand that some elderly and very elderly patients have healthcare-associated pneumonia[17] that includes those with exposure to the healthcare environment such as skilled nursing facilities, dialysis, chemotherapy or recent hospital stay. Patients with healthcare-associated pneumonia have also been shown to have a high PSI on admission to hospital and may benefit from a therapeutic approach that is not the same as that used in younger patients.[18 19]

If one needs to drive on a different terrain, coming from a paved highway onto a dirt road, one does not necessarily need to change the vehicle. Chen *et al*[15] suggest that, with regard to pneumonia severity scores for elderly people, we do not need to create a 'new car' but rather set new 'limits' by applying the principles that we already have, recognising their limitations and considering a more flexible definition to define mortality risk. They found that, while age could impact the accuracy of prognostic scoring systems in CAP, unlike other studies they did not find that it was a direct contributor to mortality risk. Thus, it should be possible to modify existing scoring systems and get accurate data, and it is not necessary to create new tools for elderly patients. Observations such as these help clear the path for moving forward, even on an unsteady road.

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