Severity assessment in melioidosis pneumonia: what is the most appropriate score or factor?

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Research Article

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Abstract

Background and objective

Pneumonia induced by *Burkholderia pseudomallei* is a common clinical entity of melioidosis. Along with the development of melioidosis rapid tests, prognostic assessment for melioidosis pneumonia (MP) patients at admission is essential. Our study aims to evaluate the validity of the mortality prognostic score for acute melioidosis and pneumonic scores in predicting MP patients.

Methods

A prospective study was conducted from the late 2019 to the early 2022 at the respiratory department of the largest hospital in Southern Vietnam.

Results

Of 66 MP patients, mean age 51.17 ± 11.02, male/female ratio 57/9, and 89.39% presented with acute pulmonary melioidosis. The rate of need for intensive respiratory or vasopressor support (IRVS) was 34.8% and the mortality at discharged time was 25.80%. The areas under ROC curve (AUCs) of PSI, CURB-65, and SMART-COP in predicting the IRVS need were 0.813 (p < 0.001), 0.868 (p < 0.001), and 0.910 (p < 0.001), respectively. The AUCs of PSI, CURB-65, SMART-COP, and the mortality score of acute melioidosis in predicting the death outcome were 0.698 (p = 0.017), 0.797 (p < 0.001), 0.797 (p < 0.001), and 0.663 (p = 0.047), respectively. The sensitivity, specificity, and positive likelihood ratio for CURB-65 score $\geq 2$ in predicting the IRVS need and the mortality were 69.57% and 70.59%, 90.70% and 83.67%, 7.48 and 11.53, respectively.

Conclusions

MP could present mild to severe clinical scenario with high mortality among severe MP cases. The simple CURB-65 score could be useful in predicting severe MP.

Summary At A Glance

Along with the development of melioidosis rapid tests, prognostic assessment for melioidosis pneumonia patients at admission is essential. All pneumonia scores including PSI, CURB-65, and SMART-COP are useful in predicting severe melioidosis pneumonia, particularly to CURB-65 score $\geq 2$ which is simple in clinical practice.

Introduction

Melioidosis, called as Whitmore disease, caused by *Burkholderia pseudomallei* (an environmental gram-negative bacterium) is an endemic disease in tropical countries, especially in Southeast Asia and Northern Australia. The number of melioidosis patients have increased recently in Vietnam,
predominantly in the raining season. Its mortality rate has still been high, varying from 9% to 70% based on previously published studies. A score for predicting mortality in acute melioidosis patients included features such as age, presence of pneumonia, lymphocyte count, serum bicarbonate, urea, creatinine, and serum bilirubin was proposed. Besides, thrombocytopenia occurred frequently in severe melioidosis patients and even associated with death outcome. Identifying early severe melioidosis patients has significantly clinical impacts such as choosing appropriately caring unit (general ward or intensive care unit), early resuscitation support in the combination with aggressive antibiotic therapy. However, this issue was concerned inadequately in previous time because it was difficult to confirm a melioidosis case immediately at the admission (diagnosis of melioidosis was established on the basis of culture result which took 3-5 days to isolate \( B. \ pseuodmallei \)). There are many melioidosis rapid tests in clinical practice so far, for instance the active melioidosis detection plus test, to result in the essential need of melioidosis prognosis.

Pulmonary melioidosis (symptom duration < 2 months as acute/sub-acute and ≥ 2 months as chronic) is the most common clinical entity, accounted for ≥ 50% melioidosis cases. The evidence showed that acute/sub-acute pulmonary melioidosis had worse outcomes than chronic pulmonary melioidosis and melioidosis without pulmonary abnormality. In this article, we used the term “melioidosis pneumonia” with the meaning of acute/sub-acute pulmonary melioidosis, excluding chronic melioidosis. Prognostic assessment for patients with melioidosis pneumonia (MP) is an urgent requirement in clinical practice. Addition to the general mortality prognostic score for acute melioidosis, we believe that SMART-COP, PSI, and CURB-65 scores, and American Thoracic Society (ATS)/Infectious Diseases Society of America (IDSA) 2007 criteria for severe pneumonia could be useful in severity assessment of MP patients.

Methods

A prospective study was conducted from the late 2019 to the early 2022 at the respiratory department, Cho Ray’s hospital, Ho Chi Minh, Vietnam (the largest central hospital in Southern Vietnam). MP case was determined on the basis of following criteria:

- The patient had clinical symptoms associated with pneumonia (fever, productive cough, pleuritic chest pain, dyspnea, hemoptysis).
- Findings on radiology were consistent with pneumonia.
- Isolating \( B. \ pseuodmallei \) from any biomedical specimens (sputum, blood, lesion fluid, pleural fluid, bronchial lavage fluid, joint fluid, cerebrospinal fluid, etc.).
Findings on chest X-ray (CXR) were evaluated independently by the radiologist and the pulmonologist with more than five years of experience and they made the agreement in the final conclusion. The culture and isolation process of \textit{B. pseudomallei} was suggested in the article of Nguyen-Ho Lam et al.\textsuperscript{13} We collected all following features: demographic characteristics, co-morbidities, the initial vital signs, and others to calculate the score for PSI, CURB-65, SMART-COP, pneumonia severity according to ATS/IDSA criteria\textsuperscript{14}, and score for predicting mortality in acute melioidosis. Clinical signs and the results of laboratory tests at the admission time were used to calculate these scores. Two researchers calculated them separately and made the agreement in the final score. SMART-COP score was calculated via the website https://www.mdcalc.com/calc/3914/smart-cop-score-pneumonia-severity. PSI score was calculated via the website https://www.mdcalc.com/calc/33/psi-port-score-pneumonia-severity-index-cap. CURB-65 score was calculated via the website https://www.mdcalc.com/calc/324/curb-65-score-pneumonia-severity. Score for predicting melioidosis mortality was calculated with the reference of Allen C. Cheng et al.\textsuperscript{2}

Two important outcomes to analyze the validity of these scores included (1) the IRVS need and (2) the outcome at discharged time (improvement or death). The area under ROC curve (AUC) was used to determine the validity of these scores in predicting these outcomes. The Chi square test or Fisher’s test was used to compare qualitative variables between two groups. The Student’s T test was used to compare the mean values between two groups. A p-value < 0.05 was considered statistically significant. IBM software was used to enter and analyze the data.

This study was performed in accordance with the Declaration of Helsinki. This human study was approved by the ethics committee of University of Medicine and Pharmacy at Ho Chi Minh City. All adult participants provided written informed consent to participate in this study.

\section*{Results}

1. \textit{Demographic and clinical characteristics and the results of laboratory tests:}

We enrolled 66 hospitalized MP cases, mean age 51.17 ± 11.02, male/female ratio 57/9. The majority (56.06\%) were freelance workers and 16.67\% were farmers. Subjects in our study have been living widespread southern provinces, Vietnam, especially in Ho Chi Minh city 9 cases (13.63\%), Binh Thuan province 9 cases (13.63\%), Binh Phuoc province 5 cases (7.58\%), Tay Ninh province 5 cases (7.58\%), Dong Nai province 4 cases (6.06\%), Long An province 4 cases (6.06\%), and Kien Giang province 4 cases (6.06\%). Clinical manifestation of acute pulmonary melioidosis (symptom duration < one month) recorded in 89.39\% cases. Patients who had extra-pulmonary lesion (liver abscess, spleen abscess, adrenal abscess, parotid abscess, soft tissue or joint infections) accounted for 43.94\%. Clinical features and the results of laboratory tests of 66 subjects were presented in table 1. Lymphopenia (< 0.8 K/mm\textsuperscript{3}), thrombocytopenia (< 150 K/mm\textsuperscript{3}), and hyponatremia (< 135 mmol/L) were documented in 53.84\%, 30.30\%, and 84.85\%, respectively.
2. Pneumonia scores, score for predicting mortality in acute melioidosis patient, and the outcomes:

Based on ATS/IDSA 2007 criteria, we had 33.33% melioidosis cases with severe pneumonia. Medium scores and interquartile ranges (IQR) for CURB-65, SMART-COP, and PSI were 1 (0-2), 3.0 (1.0 – 4.25), and 91.50 (73.75 – 116.50), respectively. Medium score and IQR for score for predicting mortality was 4 (3-6). There was no significant difference when comparing scores (including CURB-65, SMART-COP, PSI, and score for predicting mortality) between two MP groups with and without extra-pulmonary lesion (all p-values > 0.05). The rate for the IRVS need was 34.8% and the mortality at the discharged time was 25.80% in our study. The numbers of total patients, patients requiring IRVS, and death patients for each level of pneumonia severity according to the respective score were showed in figure 1. There was also no significant difference between the two MP groups with and without extra-pulmonary lesion for the IRVS need (p = 0.106) and the mortality (p = 0.161).

3. Factors associated with the outcomes of melioidosis pneumonia patients:

CURB-65, SMART-COP, and PSI showed the validity in predicting the IRVS need and the mortality at the discharged time among MP patients. The areas under ROC curve (AUCs) of PSI, CURB-65, and SMART-COP in predicting the IRVS need were 0.813 (p < 0.001), 0.868 (p < 0.001), and 0.910 (p < 0.001), respectively. The AUCs of PSI, CURB-65, SMART COP, and the mortality score of acute melioidosis in predicting the death outcome were 0.698 (p = 0.017), 0.797 (p < 0.001), 0.797 (p < 0.001), and 0.663 (p = 0.047), respectively. Figure 2 describes the ROC curves for CURB-65 and SMART-COP scores. Sensitivity, specificity, positive predictive value, negative predictive value, and positive likelihood ratio for CURB-65 score with the cut-off ≥ 2 and SMART-COP score with the cut-off ≥ 3 were presented in table 2.

Neutrophil-lymphocyte ratio (NLR) showed no association with the IRVS need and the death outcome (p = 0.927 and p = 0.625), likewise to the lymphocyte count (p = 0.200 and p = 0.731). These outcomes were also unaffected by the appropriate initiation of antibiotics for B. pseudomallei during the first 48 hours after admission (p = 0.958 and p = 0.407). However, the platelets count was correlated to the IRVS need (p = 0.010) but not to the death outcome (p = 0.091). Hypoxemia at admission was also associated with the IRVS need (47.50% vs 15.38%, p = 0.007) and the death outcome (35.0% vs 11.54%, p = 0.033). Hyponatremia was common in MP patients but those with the IRVS need or the death outcome had the higher level of serum sodium (132.87 ± 7.01 vs 127.33 ± 3.93, p < 0.001 and 133.18 ± 7.09 vs 127.90 ± 4.64, p = 0.001).

Discussion

MP in our study developed commonly in patients with the age 40-60, predominance in male gender, and the underlying diabetes mellitus. Fever is the most common symptom and MP patients often had hypoxic respiratory failure. Radiological abnormalities occurred frequently in the upper lobe and diffuse (affecting more than two lobes or both lung fields) with findings such nodules, mass, infiltration, cavity, and pleural effusion. These features were similar to those of MP studies from Thailand\textsuperscript{10}, Cambodia\textsuperscript{12}, Malaysia\textsuperscript{15},
Taiwan\textsuperscript{16}, India\textsuperscript{17}, and Australia\textsuperscript{9}. Primary MP caused the abnormality at the upper lobe more frequently than secondary pneumonia in the melioidosis study in Australia. Our study divided into two groups with and without extra-pulmonary lesion and showed not this difference. Small sample size can be a reason for this result.

\textit{B. pseudomallei} is one of pathogens causing severe community-acquired pneumonia (CAP), especially in endemic regions.\textsuperscript{6,11} Our study documented 33.33\% of severe pneumonia consistent with ATS/IDSA 2007 criteria. Through evaluating pneumonia scores, 21.21\% with CURB-65 score \( \geq 3 \), 24.24\% with SMART-COP score \( \geq 5 \), and 51.51\% with PSI class IV and V were recorded. The study of Wipa Reechaipichitkul at Thailand also showed the rate of severe MP 43.37\% according to ATS/IDSA 2007 criteria.\textsuperscript{10} The mortality in the published studies of MP ranged from 20.0\% to 66.7\%.\textsuperscript{9,10,12,16,17} This is similar to our study (25.8\%) and independent to the appropriate antibiotic initiation during first 48 hours admission. All aforementioned features emphasized that MP is a severe condition which requires comprehensively personal therapy rather than only with the early appropriate antibiotics. In detail, timely interventional measures during first 24 hours admission including hemodynamic support, respiratory support, corticosteroid, and multidiscipline cooperation (respiratory department, emergency department, and intensive care unit) in the combination with appropriate antibiotic treatment help to reduce the mortality\textsuperscript{18}, which need to apply for severe MP.

There are many previous studies to compare pneumonia scores but no study on MP subjects was carried out. Our study showed that CURB-65, SMART-COP, and PSI had the validity in predicting the IRVS need and the discharged death outcome among MP patients. Although the score for predicting mortality in acute melioidosis was established separately for melioidosis patients but had less validity than pneumonia scores in our study. Moreover, another study conducted in Australia showed that SMART-COP was a simple useful tool to determine CAP patients requiring IRVS.\textsuperscript{19} Our study also showed that it was more useful in predicting the IRVS need and the mortality. Australia is an endemic country for melioidosis condition\textsuperscript{11}, this can be potential reason for the same conclusion.

CURB-65 score is simple and advantage to evaluate CAP patients in clinical practice. Our study proved its validity on MP patients. It showed non-inferior to SMART-COP and ATS/IDSA criteria in predicting the IRVS need and mortality. Based on the CAP recommendations, patients with CURB-65 \( \geq 3 \) should be concerned as a case of severe pneumonia\textsuperscript{20}, our study found out that MP patients with this score \( \geq 2 \) should be treated as a severe condition. On the other hand, recent evidence revealed adding the hypoxia status at admission to help improvement of the validity of CURB-65 in evaluating mild CAP patients.\textsuperscript{21} This hypoxia status had associated significantly with the IRVS need and the death outcome in our study. Therefore, this factor should be considered in combination with CURB-65 for predicting the outcomes of MP.

The results of previously published studies showed that platelets count, lymphocyte count, and NLR had associated with the outcomes of melioidosis patients.\textsuperscript{4,22,23} Thrombocytopenia is associated with
decreasing the immune response against *B. pseudomallei* to result in the more severe condition and melioidosis patients with lymphopenia have the higher mortality. However, these factors showed no correlation with the outcomes of MP patients in our study. MP is a severe clinical entity with higher rates of bacteremia, septic shock, and death from the study of Ella M. Meumann et al. This can be a plausible reason for no significant difference when analyzing in only the severe group. The same reason explained for less usefulness of the score for predicting mortality in acute melioidosis in our study.

Hyponatremia is common in patients with infection status, accounted for 84.85% in our study. It has the impact on the mortality and the long-term hospital stay among infectious patients, including melioidosis patients. Our study showed the significant association between the level of serum sodium and the outcomes of MP patient but the higher level of serum sodium at admission was recorded among the group with the IRVS need and the death outcome. The study of Indu Ramachandra Rao et al concluded that the severe hyponatremia (< 120 mmol/L) associated with the death outcome, ICU admission, and mechanical ventilation. This discrepancy could relate to different study populations (general melioidosis vs melioidosis pneumonia) and the time point evaluating the level of serum sodium.

Our study had several following limitations. (1) The sample size was small. (2) This study only focused on the hospitalized MP patients which can cause bias in evaluating comprehensively all levels of severity. Nonetheless, this study was conducted at the largest central hospital in Southern Vietnam where many MP patients were transferred from provincial hospitals (86.36% patients not living at Ho Chi Minh city) because of non-responsive treatment or failure in diagnosing the nature of lung mass. Moreover, 39.39% with non-hypoxia pneumonia was documented in our study. We believed that this study could evaluate all levels of severity. (3) This study only focused on the death outcome at the discharged time but not the 30-day mortality. The treatment duration for MP is different to common CAP, the intensive stage sometimes requiring 6 weeks and the eradicating stage able to prolong to 6 months. MP should be considered as a special entity of CAP.

**Conclusion**

MP could present mild to severe clinical scenario with high mortality among severe MP cases. The exact assessment of pneumonia severity at admission is essential to combine timely therapeutic measures (hemodynamic support, respiratory support, corticosteroid, multidiscipline collaboration) along with early appropriate initiation of antibiotics to reduce the mortality. The simple CURB-65 score could be useful in predicting severe MP when score ≥ 2.

**Declarations**

**Author contribution:**

Conceptualization: Lam Nguyen-Ho, Hong-Linh Hoang-Thi, Vu Le-Thuong, Ngoc Tran-Van
Data curation - Formal analysis: Lam Nguyen-Ho, Hong-Linh Hoang-Thi, Vu Le-Thuong

Investigation: Lam Nguyen-Ho, Ngoc Duong-Minh, Mai Le-Phuong, Phu Truong-Thien

Methodology: Lam Nguyen-Ho, Thong Dang-Vu, Ngoc Tran-Van

Writing - original draft: all authors

Writing – review & editing: all authors

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**Conflict of interest:** None declared

**Data availability statement:** The data that support the findings of this study are not publicly available and were used with permission for the current study. Data are however available upon reasonable request and with permission of Cho Ray hospital, Vietnam.

**References**


**Tables**

**Table 1:** Differences between melioidosis pneumonia with and without extra-pulmonary lesion
<table>
<thead>
<tr>
<th>Features</th>
<th>Total (66)</th>
<th>Melioidosis pneumonia without extra-pulmonary lesion (37)</th>
<th>Melioidosis pneumonia with extra-pulmonary lesion (29)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong> (mean ± SD, year)</td>
<td>51.17 ± 11.03</td>
<td>51.76 ± 10.57</td>
<td>50.41 ± 11.73</td>
<td>0.627‡</td>
</tr>
<tr>
<td><strong>Male</strong> (%)</td>
<td>86.4</td>
<td>89.19</td>
<td>82.76</td>
<td>0.450*</td>
</tr>
<tr>
<td><strong>Chief complaint</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fever (%)</td>
<td>57.58</td>
<td>56.76</td>
<td>58.62</td>
<td>0.319*</td>
</tr>
<tr>
<td>Dyspnea (%)</td>
<td>24.24</td>
<td>29.73</td>
<td>17.24</td>
<td></td>
</tr>
<tr>
<td>Others: cough, chest pain, soft tissue or joint infection (%)</td>
<td>18.18</td>
<td>13.51</td>
<td>24.14</td>
<td></td>
</tr>
<tr>
<td><strong>Symptom duration</strong> (median, IQR, day)</td>
<td>12 (7-21)</td>
<td>12 (7-20)</td>
<td>13.0 (8.5 – 30.0)</td>
<td>0.224§</td>
</tr>
<tr>
<td><strong>Comorbidities</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diabetes mellitus (%)</td>
<td>75.76</td>
<td>72.97</td>
<td>79.31</td>
<td>0.551*</td>
</tr>
<tr>
<td>Alcohol abuse (%)</td>
<td>12.12</td>
<td>10.81</td>
<td>13.79</td>
<td>0.713*</td>
</tr>
<tr>
<td>Long-term corticosteroid use (%)</td>
<td>16.67</td>
<td>10.81</td>
<td>24.14</td>
<td>0.149*</td>
</tr>
<tr>
<td>Respiratory failure (%)</td>
<td>60.61</td>
<td>59.46</td>
<td>62.07</td>
<td>0.830*</td>
</tr>
<tr>
<td>Septic shock (%)</td>
<td>22.72</td>
<td>29.73</td>
<td>13.79</td>
<td>0.125*</td>
</tr>
<tr>
<td><strong>WBC</strong> (median, IQR, K/mm$^3$)</td>
<td>11.72 (8.30 – 16.02)</td>
<td>12.60 (7.81 – 18.90)</td>
<td>11.63 (9.71 – 14.43)</td>
<td>0.831§</td>
</tr>
<tr>
<td><strong>LYM</strong> (median, IQR, K/mm$^3$)</td>
<td>0.77 (0.49 – 1.40)</td>
<td>0.78 (0.46 – 1.41)</td>
<td>0.71 (0.52 – 1.32)</td>
<td>0.937§</td>
</tr>
<tr>
<td><strong>PLT</strong> (median, IQR, K/mm$^3$)</td>
<td>209.0 (129.25 -293.0)</td>
<td>222.0 (119.0 – 313.5)</td>
<td>194.0 (143.5 - 280.5)</td>
<td>0.660§</td>
</tr>
<tr>
<td><strong>BUN</strong> (median, IQR, mg)</td>
<td>21.0 (12.50 –35.50)</td>
<td>21.0 (13.0 – 31.5)</td>
<td>20.0 (10.5 – 36.0)</td>
<td>0.952§</td>
</tr>
<tr>
<td><strong>Creatinine</strong> (median, IQR, mg)</td>
<td>0.90 (0.72 – 1.31)</td>
<td>1.15 (0.76 – 1.35)</td>
<td>0.82 (0.65 – 1.19)</td>
<td>0.068§</td>
</tr>
<tr>
<td><strong>AST</strong> (median, IQR, U/L)</td>
<td>67.0 (45.75 –112.50)</td>
<td>64.0 (41.75 – 108.75)</td>
<td>76.0 (53.25 – 124.75)</td>
<td>0.193§</td>
</tr>
<tr>
<td><strong>ALT</strong> (median, IQR, U/L)</td>
<td>58.50 (32.50 – 86.50)</td>
<td>48.0 (28.75 – 85.25)</td>
<td>67.50 (40.0 – 133.75)</td>
<td>0.205§</td>
</tr>
<tr>
<td><strong>Na</strong> (mean ± SD, mmol/L)</td>
<td>129.33 ± 5.94</td>
<td>129.46 ± 5.09</td>
<td>129.0 ± 6.70</td>
<td>0.752‡</td>
</tr>
<tr>
<td><strong>Abnormal patterns on chest X-ray</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Nodule (%)</td>
<td>29.39</td>
<td>27.03</td>
<td>55.17</td>
<td>0.020*</td>
</tr>
<tr>
<td>Mass/ Infiltration (%)</td>
<td>75.76</td>
<td>91.89</td>
<td>55.17</td>
<td>0.001*</td>
</tr>
<tr>
<td>Cavity (%)</td>
<td>36.36</td>
<td>37.84</td>
<td>34.48</td>
<td>0.779*</td>
</tr>
<tr>
<td>Pleural effusion (%)</td>
<td>10.61</td>
<td>8.11</td>
<td>13.79</td>
<td>0.457*</td>
</tr>
<tr>
<td>Upper lobe (%)</td>
<td>69.70</td>
<td>70.27</td>
<td>68.97</td>
<td>0.909*</td>
</tr>
<tr>
<td>≥ 2 lobes (%)</td>
<td>72.73</td>
<td>67.57</td>
<td>79.31</td>
<td>0.288*</td>
</tr>
<tr>
<td>Specimens</td>
<td>Blood (n)</td>
<td>Sputum/bronchial lavage (n)</td>
<td>Others: wound pus, pleural fluid (n)</td>
<td>0.127*</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-----------</td>
<td>-----------------------------</td>
<td>--------------------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>Blood (n)</td>
<td>47</td>
<td>26</td>
<td>21</td>
<td>N/A</td>
</tr>
<tr>
<td>Sputum/bronchial lavage (n)</td>
<td>15</td>
<td>11</td>
<td>4</td>
<td></td>
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<tr>
<td>Others: wound pus, pleural fluid (n)</td>
<td>10</td>
<td>2</td>
<td>8</td>
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</tbody>
</table>

ALT: Alanine aminotransferase; AST: Aspartate aminotransferase; IQR: Interquartile range; LYM: Lymphocyte; PLT: Platelet; SD: Standard deviation; WBC: White blood cell

Table 2: CURB-65 with the cut-off ≥ 2, SMART-COP with the cut-off ≥ 3, and the ATS/IDSA 2007 criteria for predicting outcome in patients with melioidosis pneumonia

<table>
<thead>
<tr>
<th></th>
<th>CURB-65</th>
<th>SMART COP</th>
<th>ATS/IDSA 2007</th>
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</thead>
<tbody>
<tr>
<td>IRVS</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Mortality (%)</td>
<td>69.57</td>
<td>95.65</td>
<td>70.59</td>
</tr>
<tr>
<td>Sensitivity (%)</td>
<td>90.70</td>
<td>69.77</td>
<td>61.22</td>
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<td>Specificity (%)</td>
<td>80.0</td>
<td>62.86</td>
<td>45.71</td>
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<tr>
<td>Positive predictive value (%)</td>
<td>84.78</td>
<td>96.77</td>
<td>88.64</td>
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<tr>
<td>Negative predictive value (%)</td>
<td>7.48</td>
<td>3.16</td>
<td>2.43</td>
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<tr>
<td>Likelihood ratio positive</td>
<td>11.53</td>
<td>2.43</td>
<td>3.46</td>
</tr>
</tbody>
</table>

IRVS: Intensive respiratory or vasopressor support

Figures
Figure 1

Numbers of patients requiring intensive respiratory or vasopressor support and death patients for each level of pneumonia severity

Figure 2
ROC curve for prediction of IRVS and mortality using CURB-65 and SMART-COP in patients with melioidosis pneumonia.