

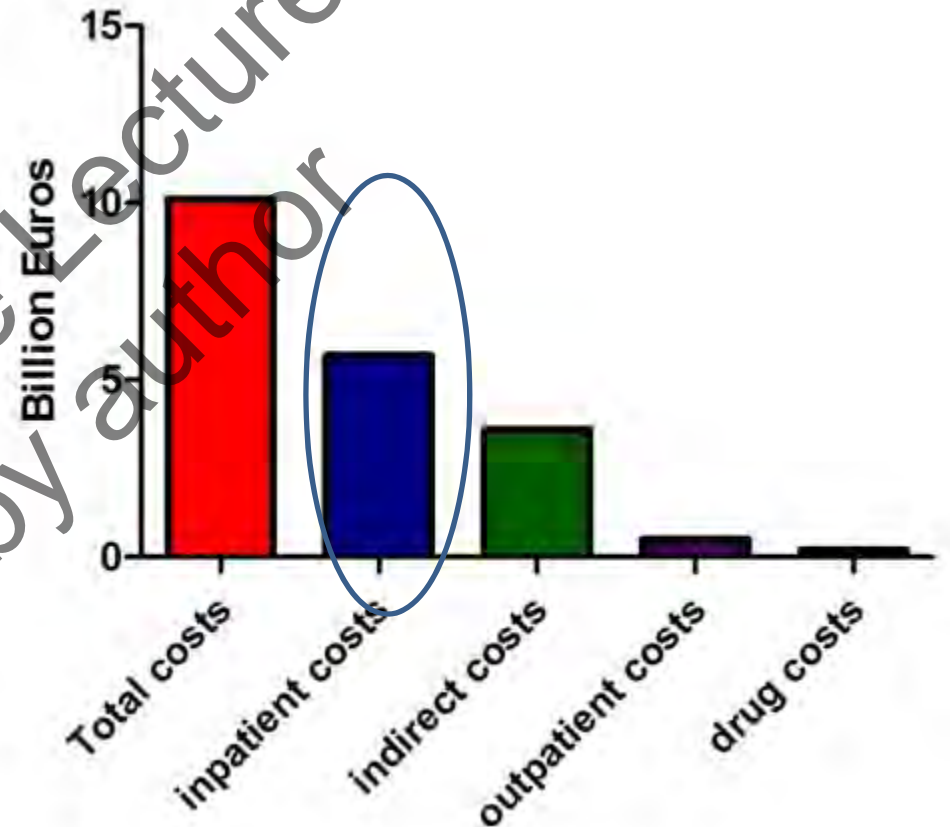
Risk stratification and site of care decisions



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Why do we need risk stratification tools?

- Evidence suggests that patients both under and over-estimate the severity of CAP when relying on clinical judgement alone.
- Inpatient care accounts for >50% of healthcare costs
- Hospitalised patients are at increased risk of hospital acquired infections
- Mortality from CAP varies from <1% in outpatients to >40% in ICU admitted patients



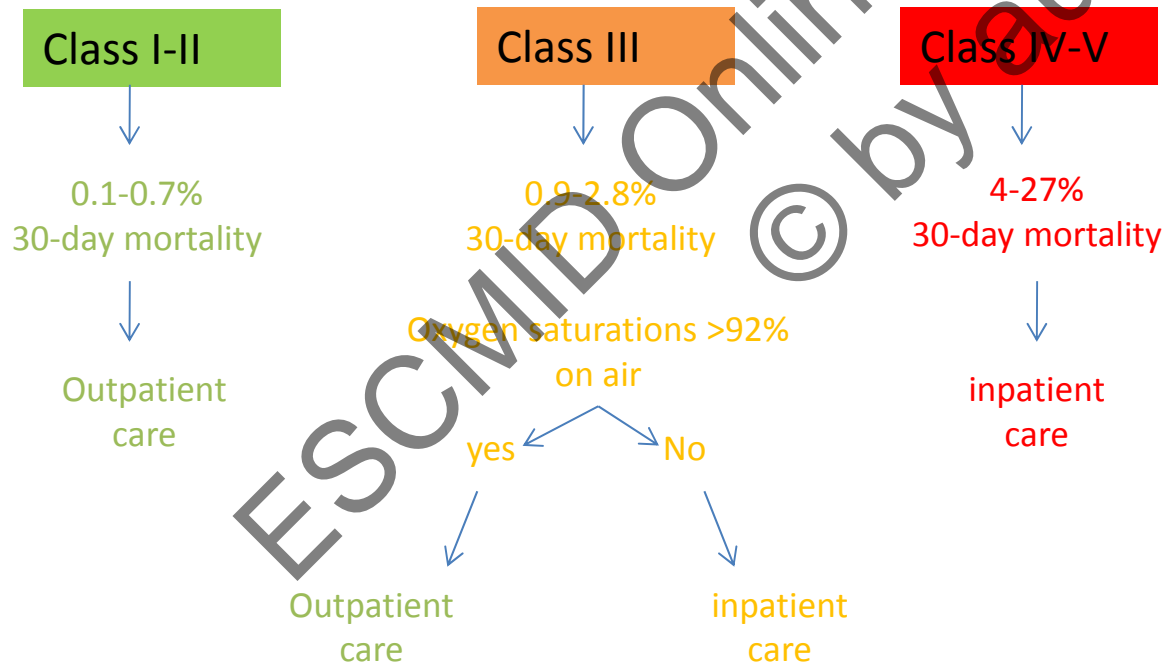


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Confirmed diagnosis of community-acquired pneumonia

Calculate Pneumonia severity index (PSI)



PSI CALCULATION- STEP 1

If patient is aged <50 years with none of the Co-morbid illnesses or clinical features listed below, assign to PSI class I. If aged >50 years or presence of 1 or more adverse features, proceed to step 2.

PSI CALCULATION- STEP 2

Demographics

Age (1 point/year, -10 if female)
Nursing home resident (10 points)

Co-morbid illnesses

Neoplastic disease (30 points)
Liver disease (20 points)
Congestive heart failure (10 points)
Cerebrovascular disease (10 points)
Renal disease (10 points)

Clinical features

Altered mental status (20 points)
Pulse ≥ 125 /min (10 points)
Respiratory rate > 30 /min (20 points)
Systolic blood pressure < 90 mmHg (20 points)
Temperature < 35 or $\geq 40^\circ\text{C}$ (15 points)

Laboratory results

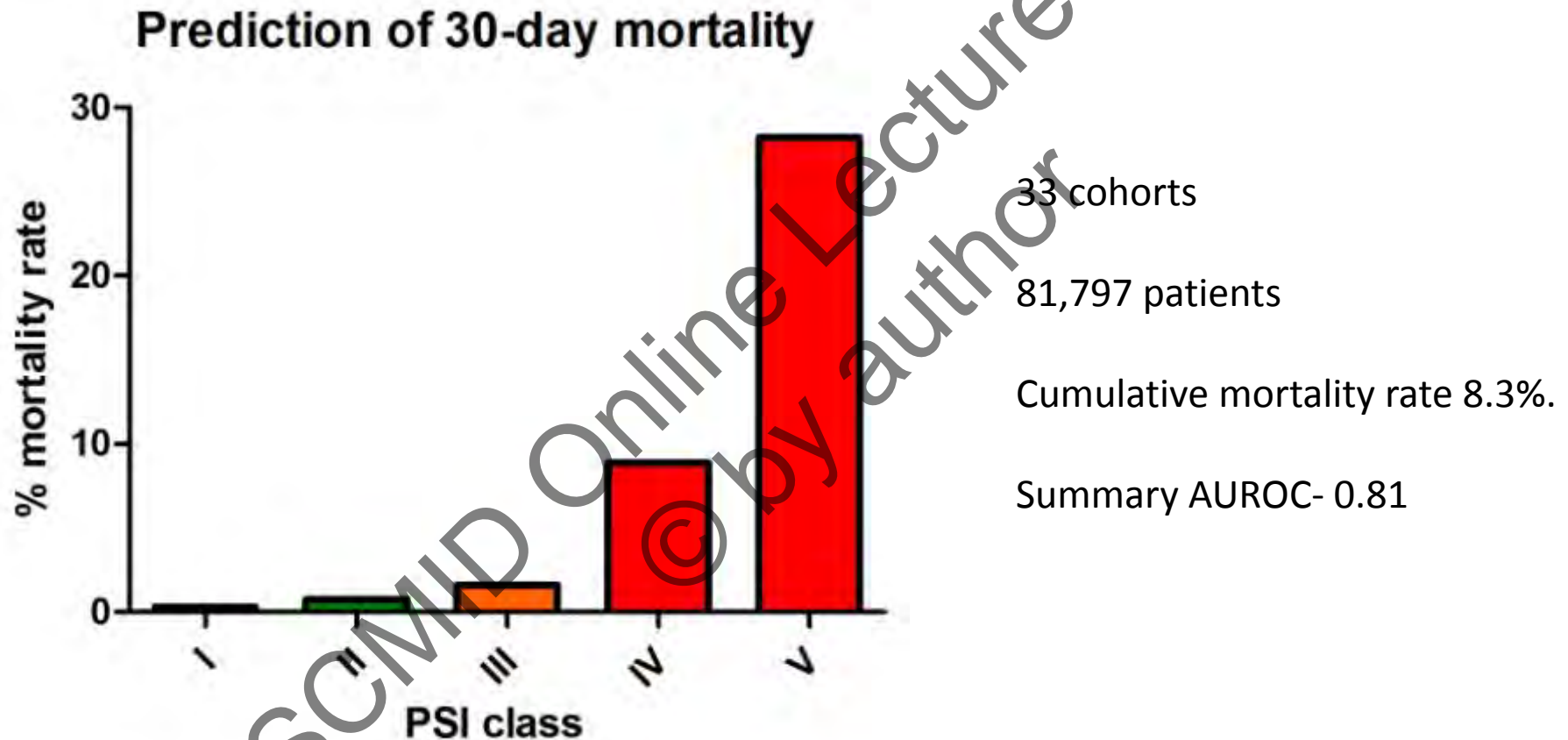
Arterial pH < 7.35 (30 points)
Urea ≥ 30 mg/dl (20 points)
Sodium < 30 mmol/L (20 points)
Glucose ≥ 250 mg/dl (10 points)
Haematocrit $< 30\%$ (10 points)
PaO₂ < 60 mmHg (10 points)

Radiology

Pleural effusion (10 points)

<70 points=Class II 71-90points=Class III
91-130points=Class IV >130points=Class V

Pneumonia severity index



Confirmed diagnosis of community-acquired pneumonia

CURB65 (1 point for each of the below)
New onset confusion
Urea >7mmol/L
Respiratory rate ≥ 30 /min
Systolic blood pressure <90mmHg or diastolic blood pressure ≤ 60 mmHg
Age ≥ 65 years

CRB65 (1 point for each of the below)
New onset confusion
Respiratory rate ≥ 30 /min
Systolic blood pressure <90mmHg or diastolic blood pressure ≤ 60 mmHg
Age ≥ 65 years

CURB65 0-1
<3% 30-day mortality

CURB65 2
9% 30-day mortality

CURB65 3-5
15-40% 30-day mortality

CRB65 0
0.9% 30-day mortality

CRB65 1-2
8% 30-day mortality

CRB65 3-4
31% 30-day mortality

Outpatient care

Short inpatient stay

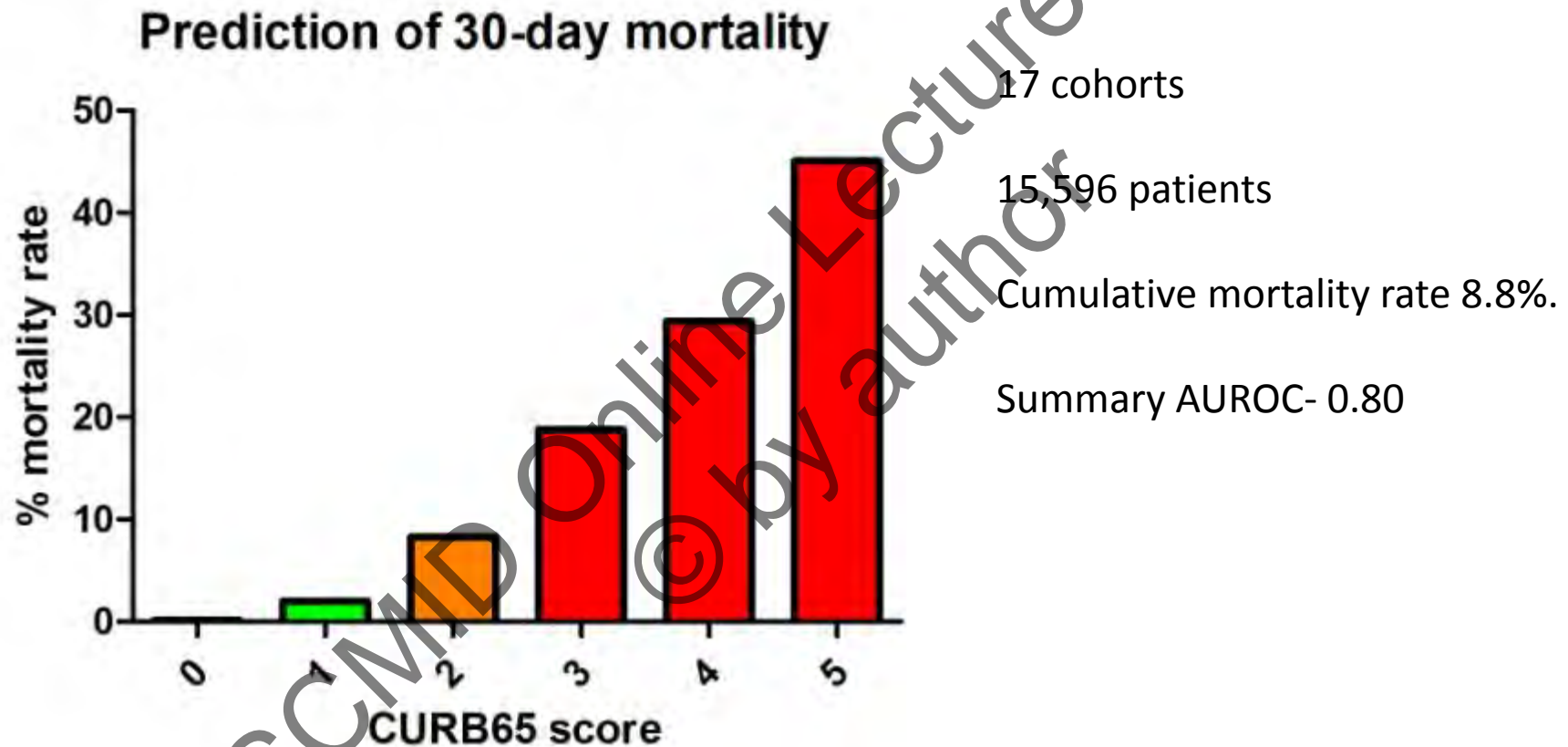
Inpatient care

Outpatient care

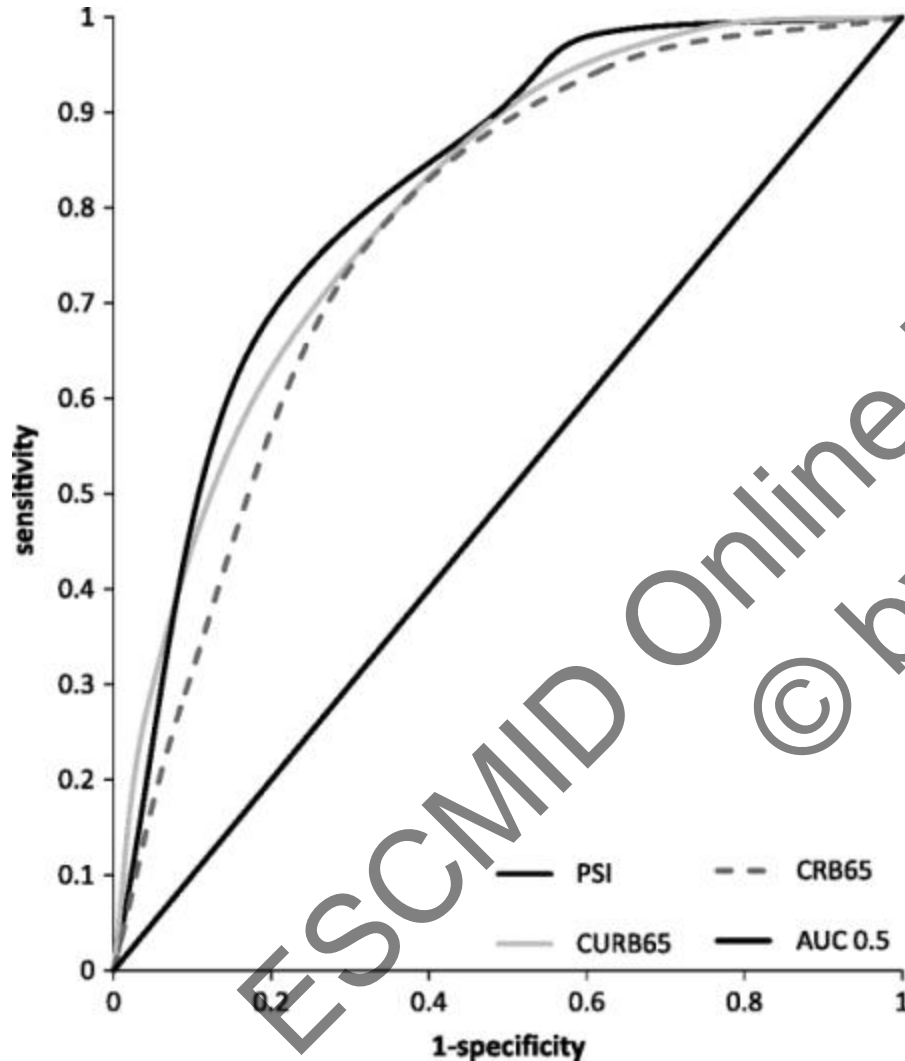
Short inpatient stay

Inpatient care

CURB65



Meta-analysis



CURB65 and PSI have equivalent predictive accuracy

PSI identifies a higher proportion of low risk patients

CURB65 more accurately identifies high risk patients (i.e higher positive predictive value)

Can site of care tools increase outpatient management?

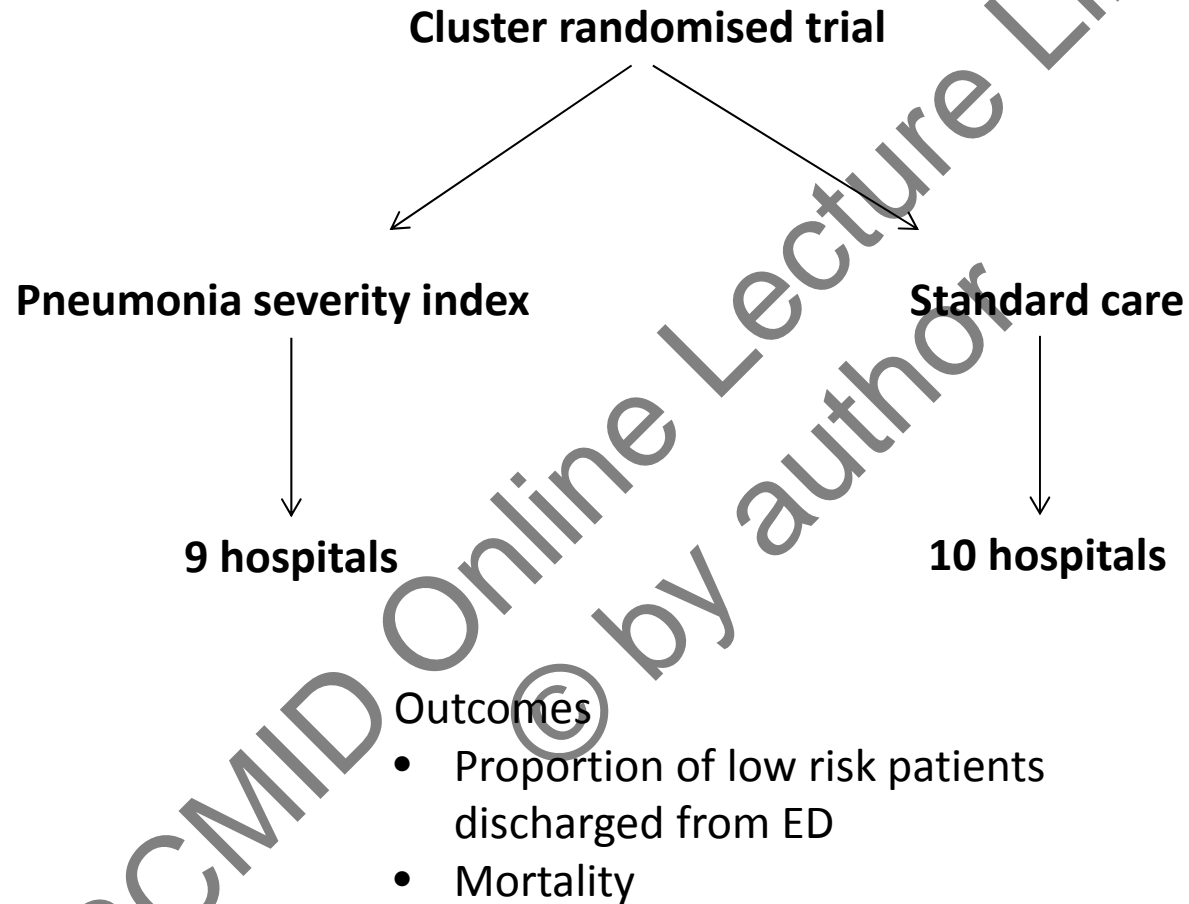


Table 2. Measures of Institutional Resource Utilization*

	Critical Pathway Institutions (n = 9)									Overall Mean (SD)	P Value†	
	T1 (n = 87)	T2 (n = 55)	T3 (n = 135)	T4 (n = 37)	T5 (n = 85)	C1 (n = 62)	C2 (n = 58)	C3 (n = 66)	C4 (n = 131)			
Admission rate, %‡												
PSI classes I-III	43	48	29	27	36	40	10	18	27	31 (12)	.01	
PSI classes IV-V	95	76	75	100	93	100	85	81	78	87 (10)	.70	
Overall	67	58	56	49	55	61	45	44	45	53 (8)	.11	
Inpatient measures												
Length of stay, median, d	6.0	5.0	5.0	4.0	6.0	7.0	4.0	4.0	4.0	5.0 (1.1)	.01	
Length of stay, average, d	8.3	8.3	8.4	7.2	7.6	12.0	7.0	5.2	9.8	8.2 (1.9)	.16	
Duration of intravenous antibiotics, mean, d	5.3	5.5	3.5	3.6	4.9	6.0	4.8	3.6	4.3	4.6 (0.9)	.01	
Receiving antibiotic monotherapy, %	69	53	82	39	41	63	89	76	63	64 (17)	<.001	
BDPM	5.6	4.9	4.7	3.5	4.2	7.4	3.2	2.3	4.4	4.4 (1.5)	.04	
	Conventional Management Institutions (n = 10)									Overall Mean (SD)	P Value†	
	T6 (n = 205)	T7 (n = 37)	T8 (n = 151)	T9 (n = 37)	T10 (n = 93)	C5 (n = 135)	C6 (n = 92)	C7 (n = 51)	C8 (n = 156)			C9 (n = 70)
Admission rate, %‡												
PSI classes I-III	46	85	27	45	44	45	55	38	61	46	49 (16)	.01
PSI classes IV-V	90	100	58	100	91	91	96	74	96	88	85 (13)	.70
Overall	70	92	37	54	65	61	66	51	73	60	63 (15)	.11
Inpatient measures												
Length of stay, median, d	8.0	6.5	4.0	6.5	4.5	7.0	7.0	8.5	8.0	6.5	6.7 (1.5)	.01
Length of stay, average, d	11.9	9.5	5.1	7.9	10.1	8.3	8.9	11.6	10.4	12.0	9.6 (2.1)	.16
Duration of intravenous antibiotics, mean, d	6.0	5.2	4.6	5.9	5.2	5.6	6.0	6.9	8.2	9.1	6.3 (1.4)	.01
Receiving antibiotic monotherapy, %	23	18	41	25	40	13	25	23	14	45	27 (12)	<.001
BDPM	8.3	8.8	1.9	4.2	6.5	5.0	5.9	5.9	7.6	7.2	6.1 (2.1)	.04

*T indicates teaching hospital; C, community hospital; and BDPM, average number of bed-days per patient managed. See footnote to Table 1 for institution identification.

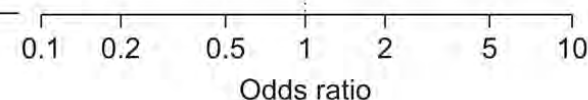
†P values are for comparison of critical pathway with conventional management institutions by Mann-Whitney test.

‡PSI indicates Pneumonia Severity Index. Scores range from approximately 10 to 250; higher scores indicate more severe disease. Patients with PSI scores of 90 or fewer points are classified as classes I to III.

Can site of care tools increase outpatient management?

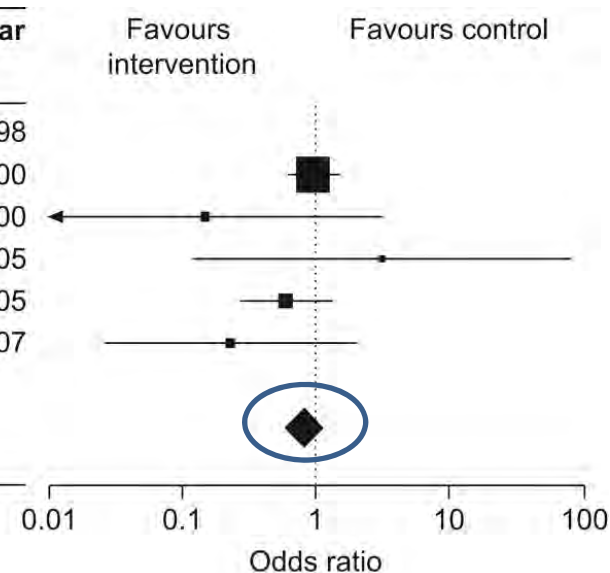
First author [ref.]	Intervention		Control		Weight %	OR (95% CI)	Year	Favours control	Favours intervention
	Events n	Total n	Events n	Total n					
ATLAS [10]	94	166	61	147	9.2	1.84 (1.17–2.88)	1998		
DEAN [12]	247	264	172	199	4.2	2.28 (1.21–4.31)	2000		
MARRIE [11]	494	716	524	1027	44.0	2.14 (1.75–2.64)	2000		
YEALY [14]	894	1456	167	445	32.5	2.65 (2.13–3.30)	2005		
RENAUD [15]	92	215	56	234	10.1	2.38 (1.59–3.56)	2007		
Total	1821	2817	980	2052	100.0	2.31 (2.03–2.63)			

Heterogeneity: Chi-squared=3.08, df=4 (p=0.54); I²=0%
 Test for overall effect: Z=12.62 (p<0.00001)



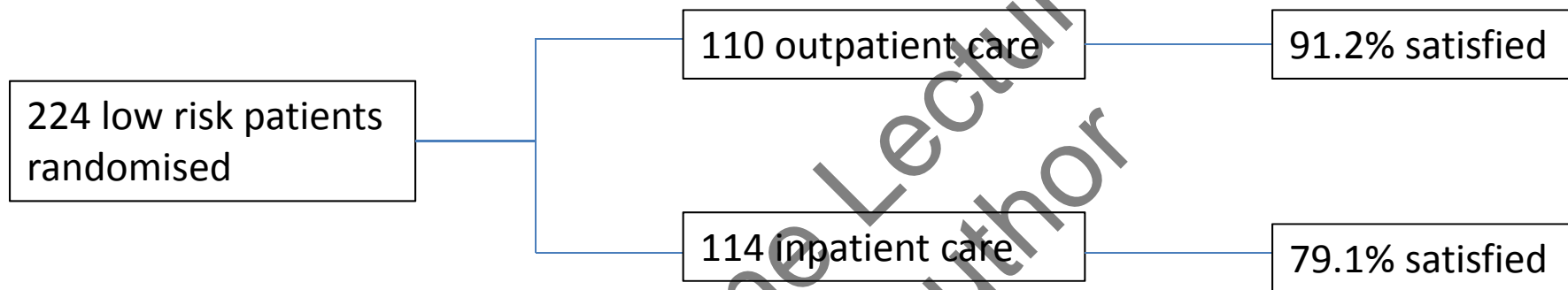
First author [ref.]	Intervention		Control		Weight %	OR (95% CI)	Year	Favours intervention	Favours control
	Events n	Total n	Events n	Total n					
ATLAS [10]	0	129	0	77		Not estimable	1998		
MARRIE [11]	43	716	63	1027	67.6	0.98 (0.66–1.46)	2000		
DEAN [12]	0	264	2	199	4.0	0.15 (0.01–3.13)	2000		
CARRATALA [13]	1	109	0	114	0.7	3.17 (0.13–78.55)	2005		
YEALY [14]	20	1456	10	445	21.0	0.61 (0.28–1.30)	2005		
RENAUD [15]	1	123	6	178	6.8	0.23 (0.03–1.98)	2007		
Total	65	2797	81	2040	100.0	0.83 (0.59–1.17)			

Heterogeneity: Chi-squared=4.53, df=4 (p=0.34); I²=12%
 Test for overall effect: Z=1.05 (p=0.29)



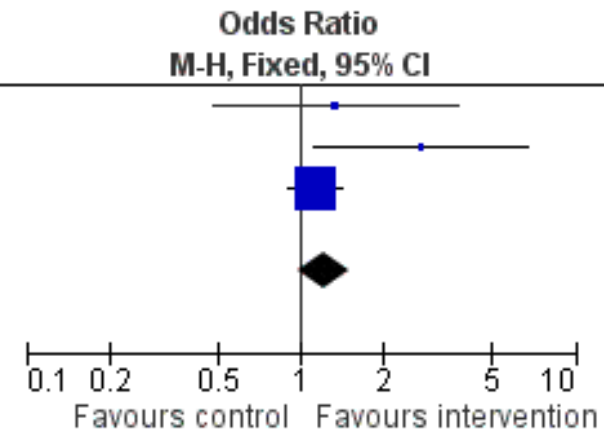
Satisfaction with care

Carratala et al *Ann Intern Med.* 2005;142:165-172



Study or Subgroup	Intervention		Control		Weight	Odds Ratio M-H, Fixed, 95% CI	Year	Odds Ratio M-H, Fixed, 95% CI
	Events	Total	Events	Total				
Atlas	120	128	70	77	4.1%	1.33 [0.48, 3.74]	1998	
Carratala	83	91	68	86	4.1%	2.75 [1.13, 6.70]	2005	
Yealy	1014	1456	298	445	91.9%	1.13 [0.90, 1.42]	2005	
Total (95% CI)		1676		608	100.0%	1.21 [0.97, 1.49]		
Total events	1217		436					

Heterogeneity: $\text{Chi}^2 = 3.60$, $\text{df} = 2$ ($P = 0.16$); $I^2 = 45\%$
 Test for overall effect: $Z = 1.72$ ($P = 0.09$)

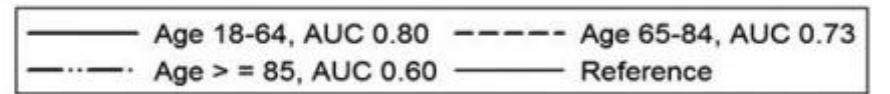
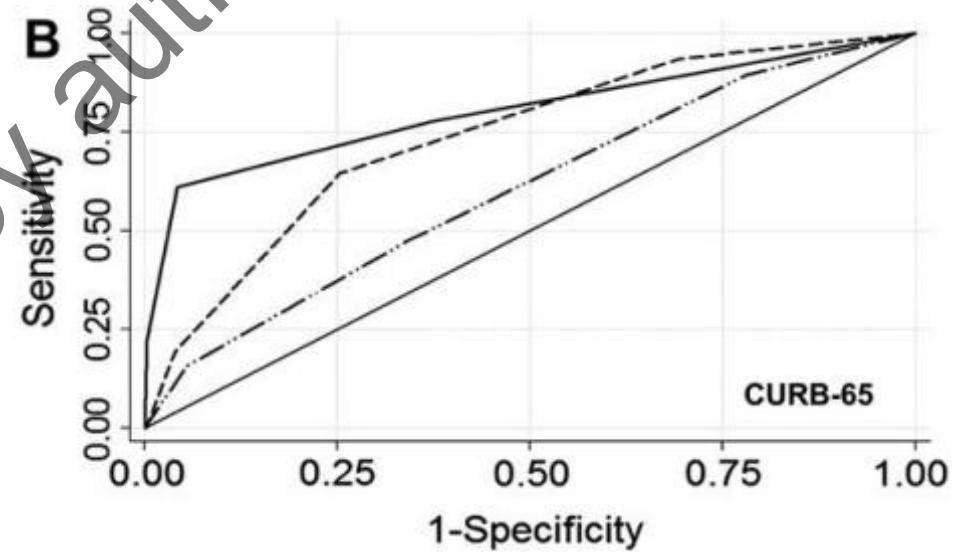
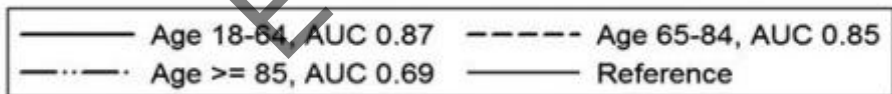
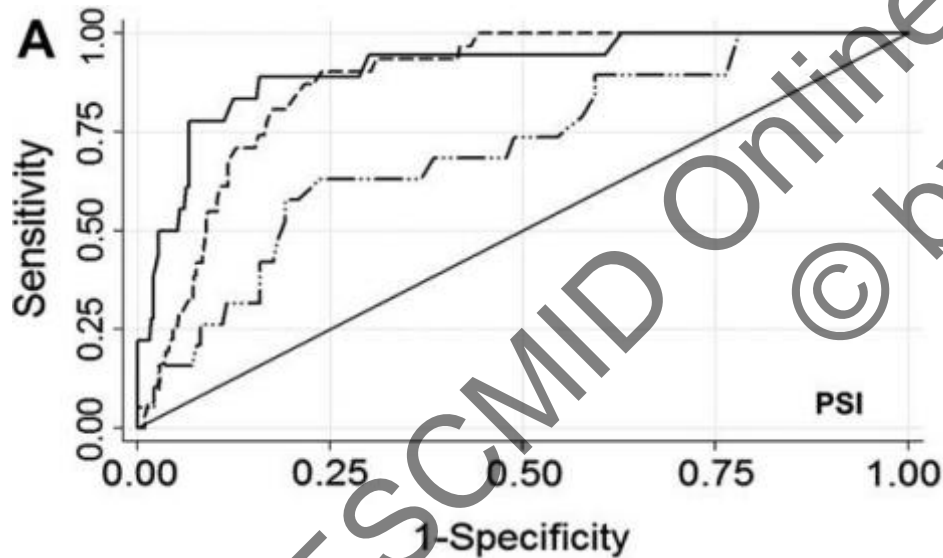
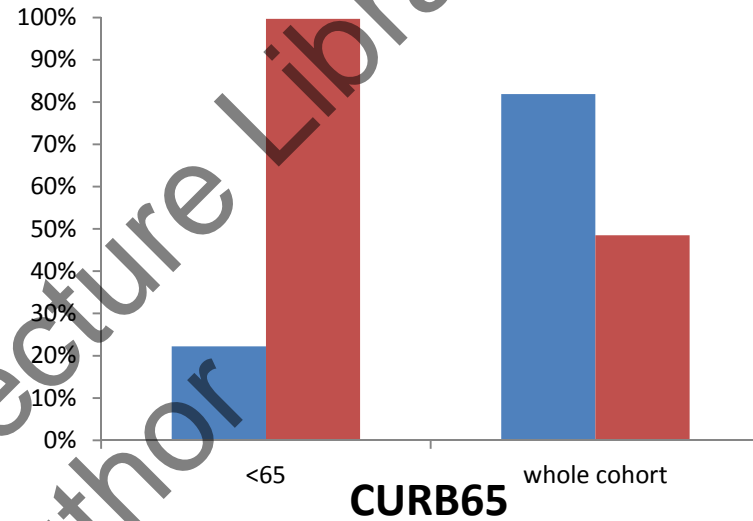
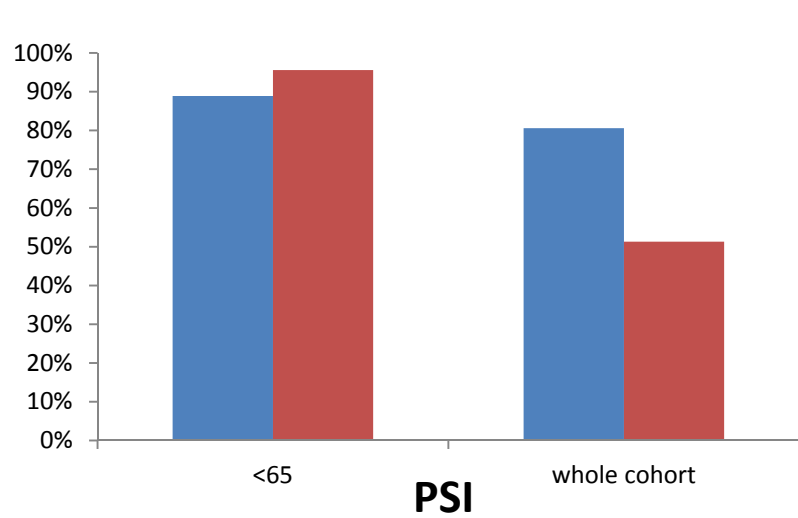


Why are low risk patients still hospitalised?

Contraindication to outpatient care	Frequency in PSI user sites	Frequency in CURB65 user sites
Hypoxaemia	1.5%-8.8%	31.4%- 35%
Failure of outpatient (oral therapy)	11.2%-14%	14%
Unstable co-morbidities	43%-71.5%	16.4-30%
Further investigations	Not reported	7.8%-29.5%
Pneumonia related complications	1.5%-32.5%	8.5%-10.2%
Unmet social needs	6.4%-18%	2.9%-11.9%
Oral intolerance	14%	0.9%-5%
Others	8%-19.3%	8.7%
No reason identified for admission	4.3%	17%-19.3%

Chowdhury et al. *Eur Respir J.* 2011;38(3):643-8
 Aliberti et al. *Respir Med.* 2011 ;105(11):1732-8;
 Arnold et al. *Chest.* 2003;124(1):121-4.

Weaknesses of severity scores



Strengths and weaknesses of Severity assessment tools

Pneumonia severity index

Strengths

- Robust
- Well validated
- Identifies low risk patients
- The only score proven to improve patient care

Weaknesses

- Heavily weighted by age and co-morbidities
- Underestimates mortality in young patients
- Does not predict need for mechanical ventilation or other major complications
- Complex and difficult to use

CURB65

Strengths

- Robust
- Well validated
- Identifies low risk patients
- Simple and easy to use

Weaknesses

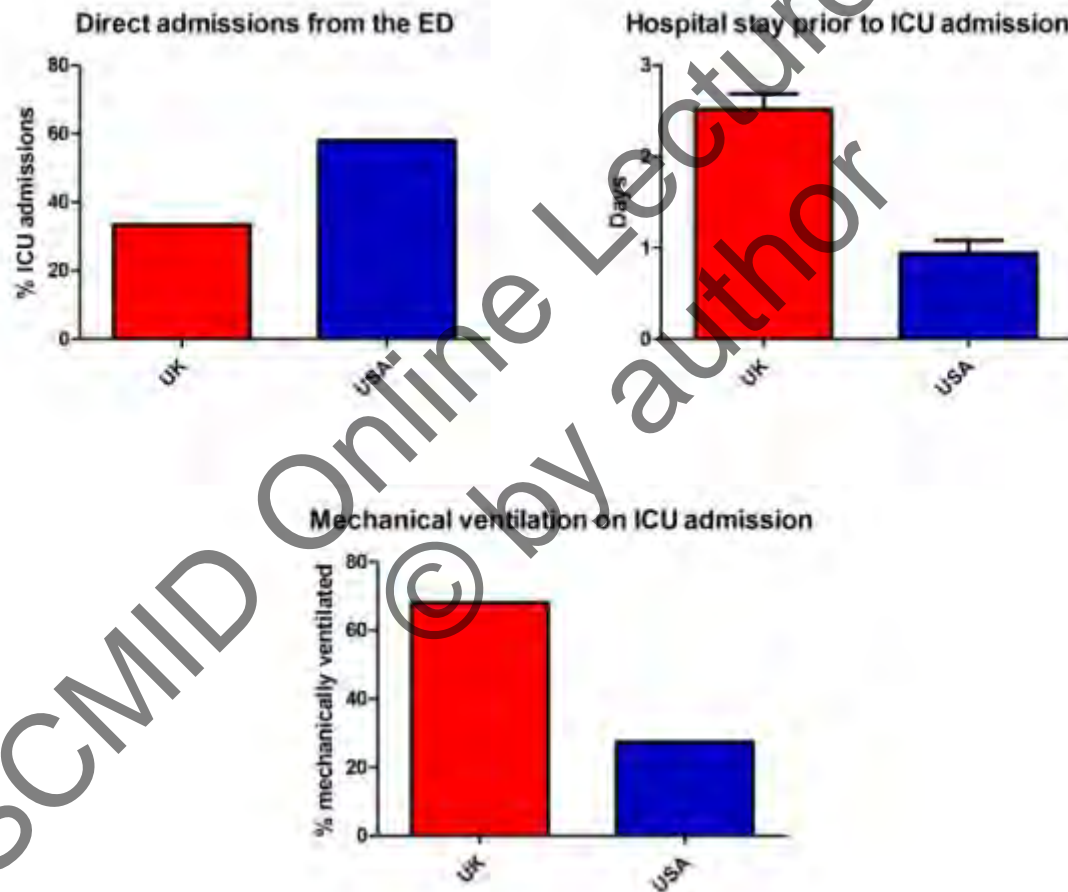
- Weighted by age
- Underestimates mortality in young patients
- Does not predict need for mechanical ventilation or other major complications
- Does not include oxygenation
- Lack of impact data

Can we use severity assessment tools to guide ICU admission?



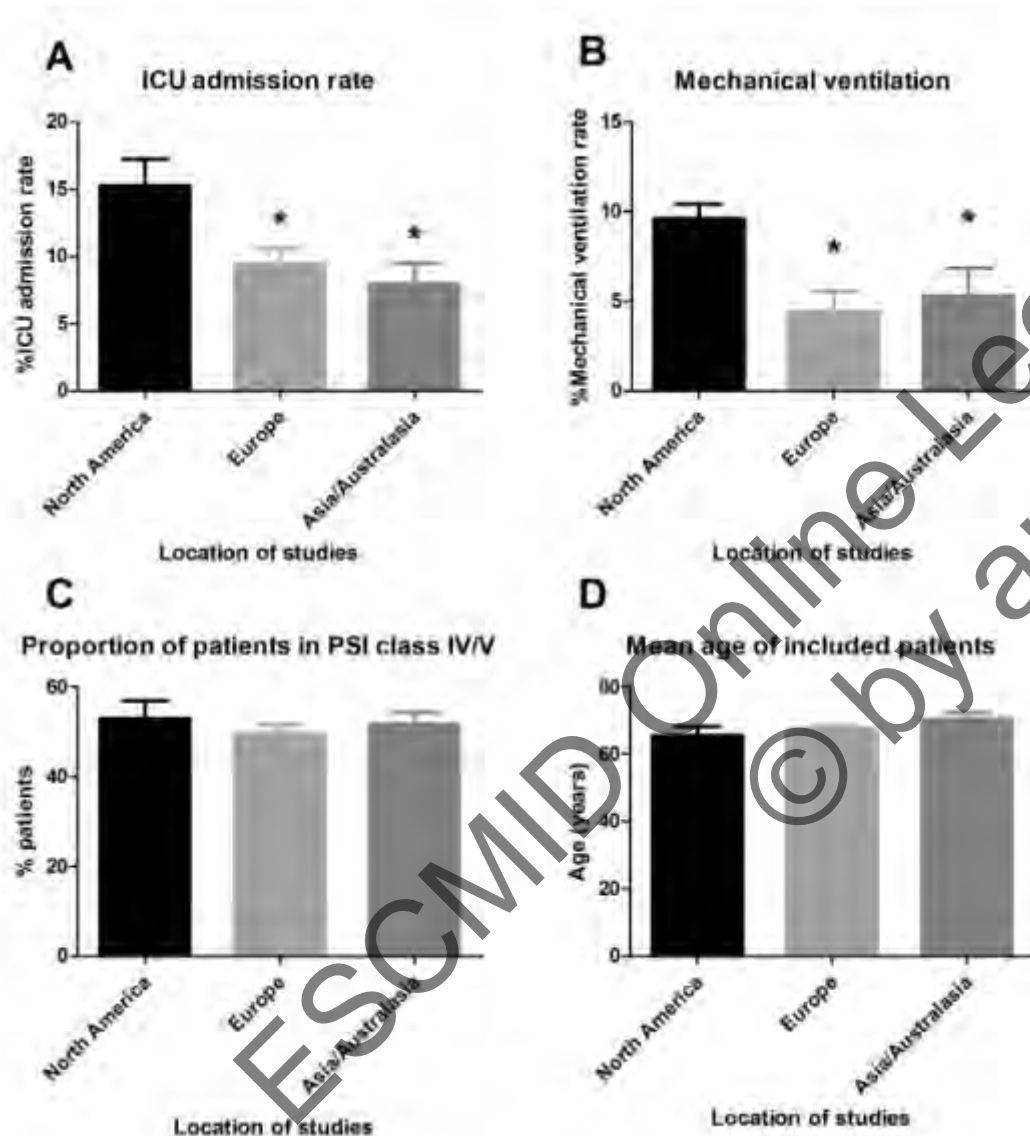
Intensive care unit admission

The United States has 7x as many ICU beds as the UK per capita



Wunsch H. *Am J Respir Crit Care Med* 2011;188;12:1666-1678.

ICU admission and outcome

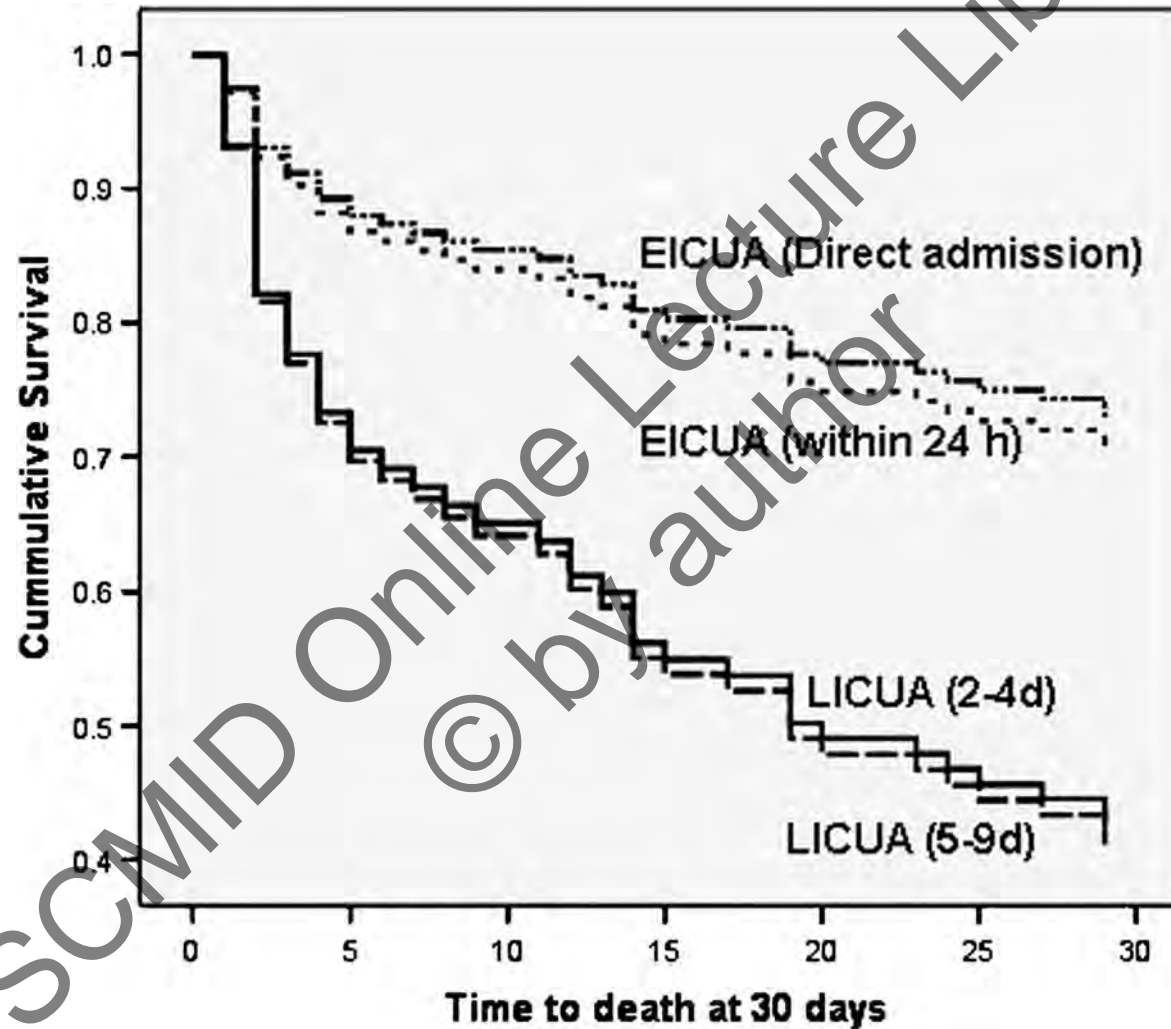


CAP patients admitted to hospitals in the United States are more likely to be admitted to an ICU and more likely to be mechanically ventilated.

Differences in outcome have not been established.

Chalmers JD *et al.*
Intensive Care Med. 2011; 37(9):1409-20.

Delayed ICU admission



EICUA= early ICU admission

LICUA= late ICU admission

IDSA/ATS criteria

Major Criteria
Major pneumonia
Mechanical ventilation
Septic shock requiring vasopressors

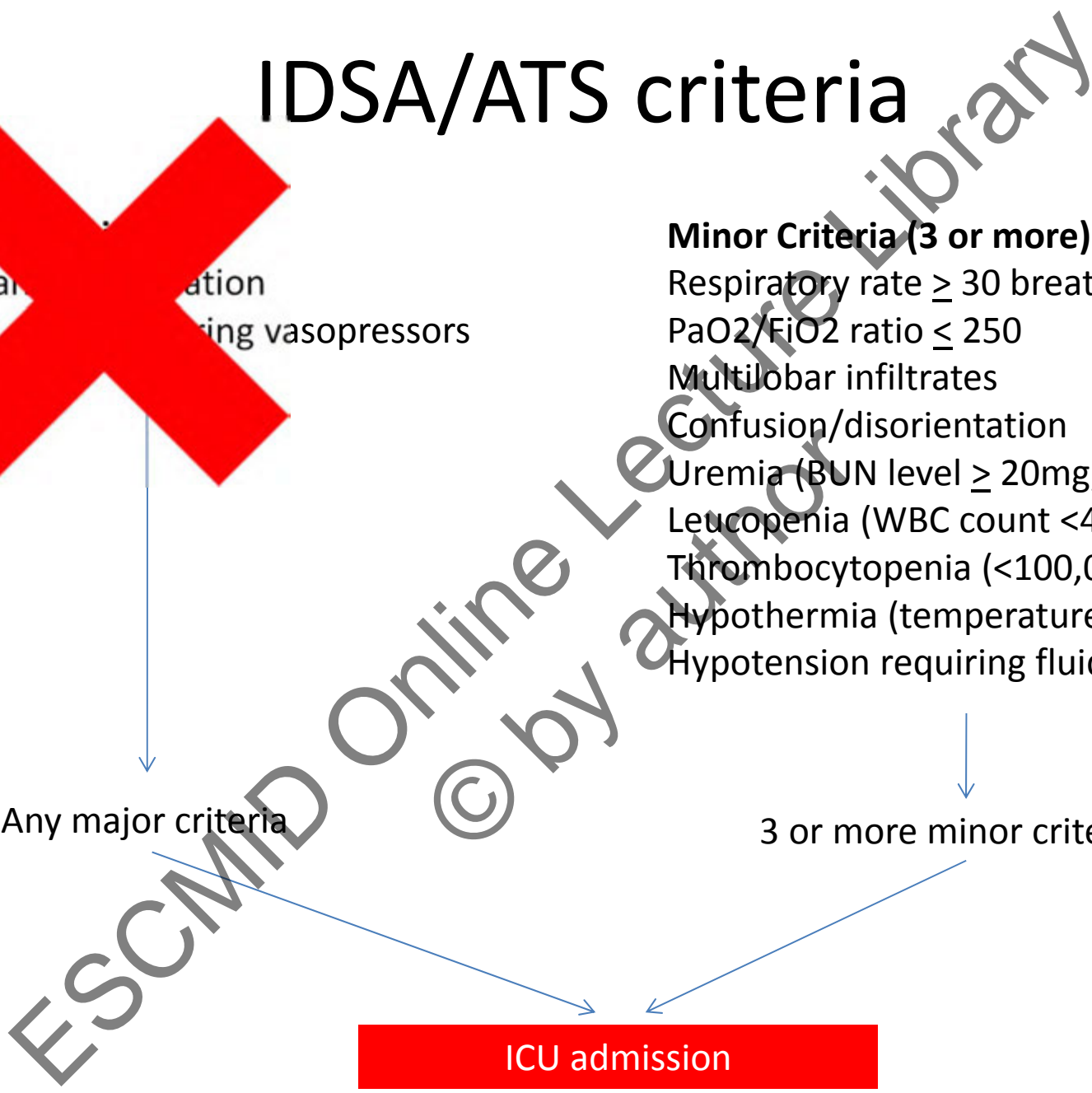
Minor Criteria (3 or more)

- Respiratory rate ≥ 30 breaths/min
- PaO₂/FiO₂ ratio ≤ 250
- Multilobar infiltrates
- Confusion/disorientation
- Uremia (BUN level ≥ 20 mg/dL)
- Leucopenia (WBC count < 4000 cells/mm³)
- Thrombocytopenia ($< 100,000$ cells/mm³)
- Hypothermia (temperature $< 36^{\circ}\text{C}$)
- Hypotension requiring fluid resuscitation

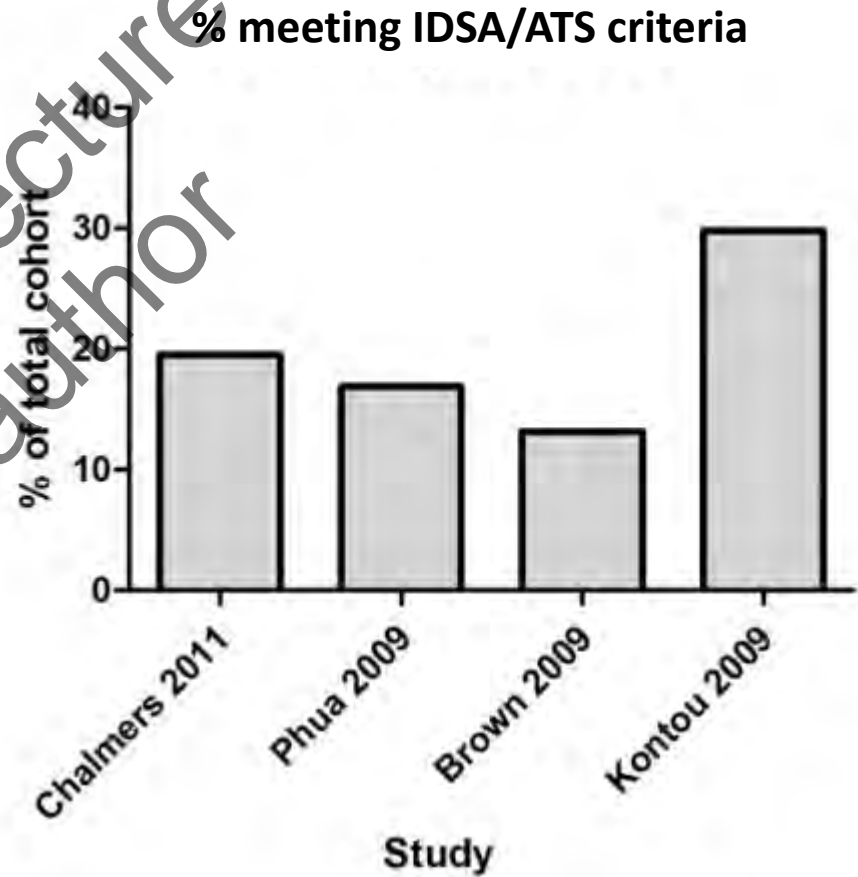
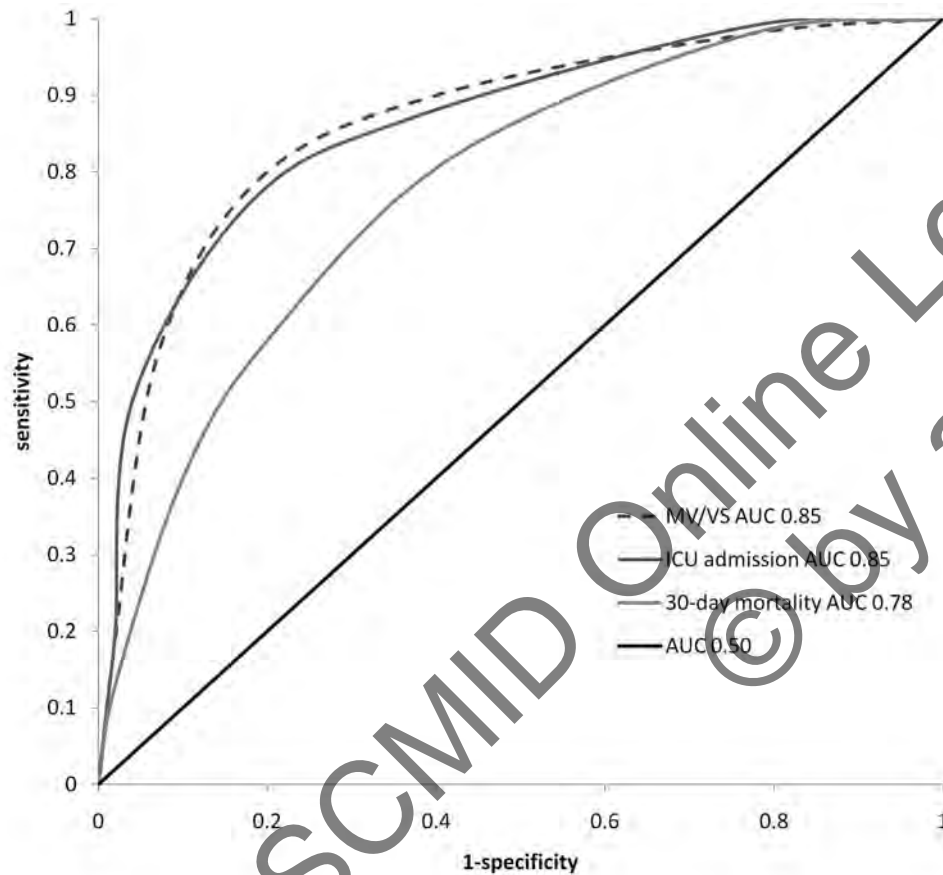
Any major criteria

3 or more minor criteria

ICU admission



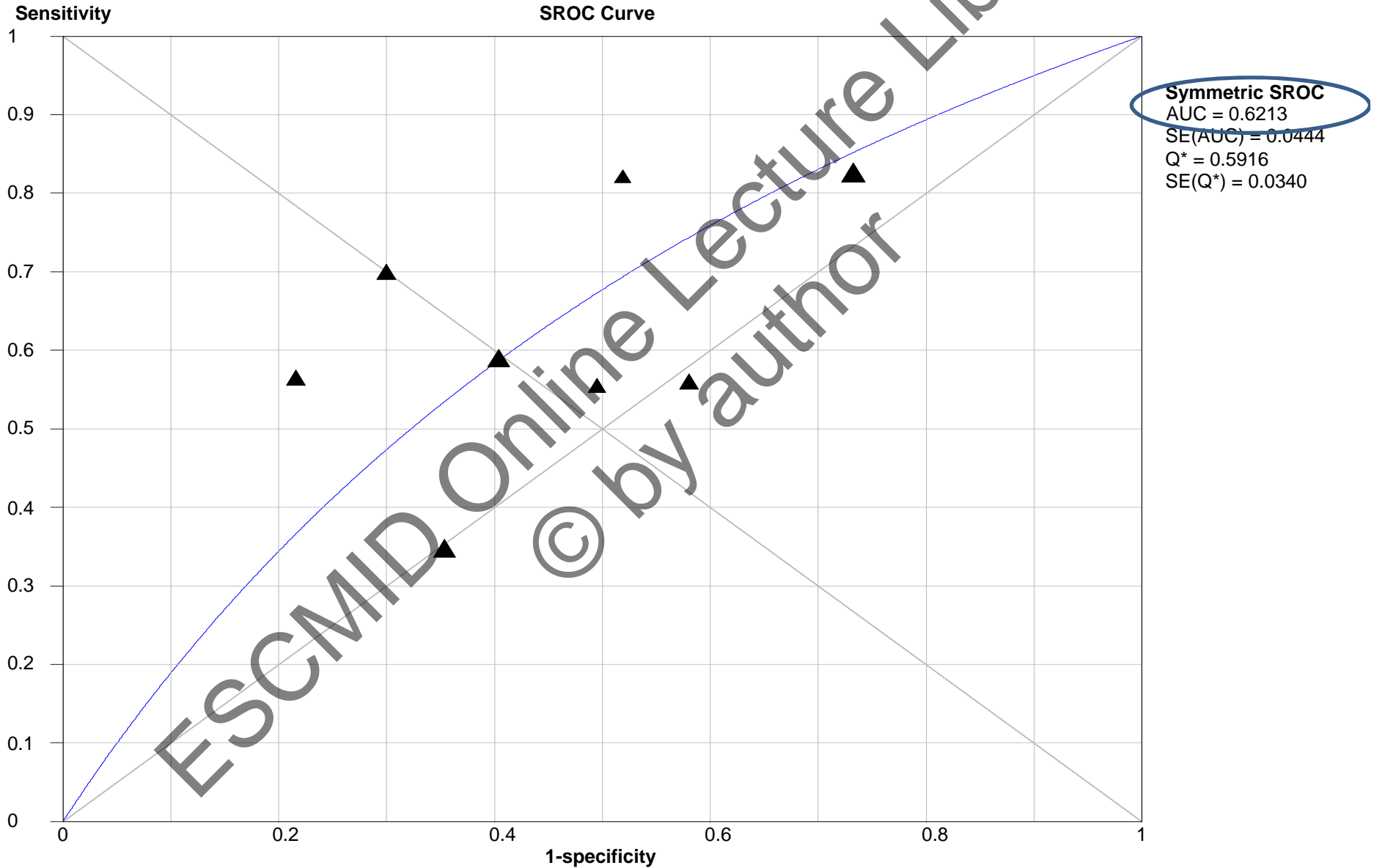
IDSA/ATS criteria



Biomarkers

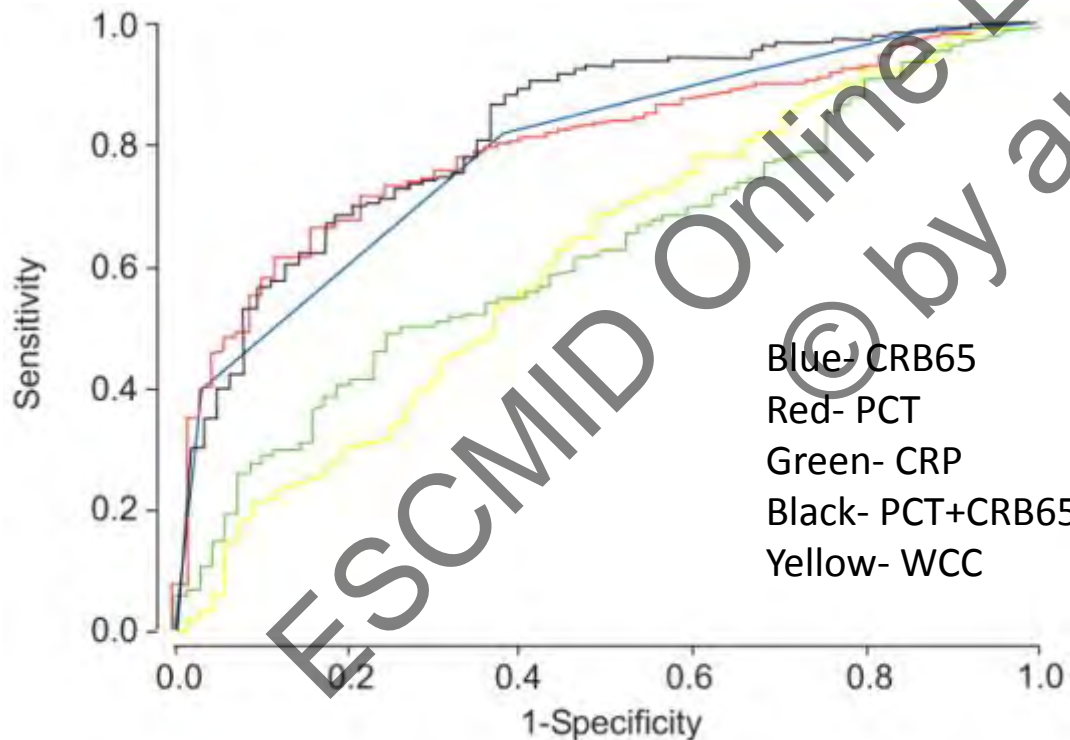


C-reactive protein- no value in severity assessment?



Procalcitonin

<u>First author</u>	<u>Journal-date</u>	<u>AUC (PCT)</u>	<u>AUC(CURB65)</u>	<u>AUC- PCT+CURB65</u>
Schuetz	ERJ 2010	0.60	0.64	0.70
Menendez	Thorax 2009	0.66	0.82	0.85
Huang	Ann Em Med 2008	0.64	0.75	N/A
Kruger	ERJ 2008	0.80	0.79	0.83



Other markers
 Pro-adrenomedullin
 Pro-ANP
 Pro-vasopressin
 Copeptin
 Pro-endothelin 1
 BNP

Summary

- Severity assessment tools have an established role in identifying low risk patients suitable for outpatient care
- There is currently no established role for scores in guiding ICU admission

Summary

- Biomarkers may improve severity prediction but further studies are needed
- All tool have strengths and weaknesses and should be used alongside clinical judgement