



GiViTI - Gruppo italiano per la Valutazione
degli Interventi in Terapia Intensiva

Multicontinental evaluation of the SMS-ICU score

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Background

- Multiple scores are currently used to predict mortality in ICU patients, but none are globally applicable
- A key limitation of many existing scores is lack of data availability for variables and outcomes
- A simplified score that uses broadly available data, *e.g.* SMS-ICU, may help to address this
- The SMS-ICU score has been customised to predict in-hospital mortality (Zampieri *et al.*, 2020).

The case for an international severity of illness scoring system

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INTRODUCTION

Severity of illness scores in the critical care context have evolved to serve multiple functions. These scores enable risk-adjusted outcomes to be benchmarked for the assessment of intensive care unit (ICU) performance, inform resource allocation, and enable the characterization of disease severity. Numerous illness severity scores have been developed to optimize calibration at the national level, but few studies have examined the international application of such scores.⁽¹⁾

The COVID-19 pandemic demonstrated the value of benchmarking outcomes across heterogeneous populations and across various health care systems. Severity of illness scores were widely used to describe trial populations, assess treatment effects and evaluate the quality of care during the pandemic. Similar use cases apply to other priorities for international critical care research and quality improvement, such as improving outcomes following traumatic injuries and expanding access to complex medical, surgical and obstetric care.^(2,3) Therefore, this article argues that the development of an international illness severity score is an urgent priority for critical care research.

CURRENT LIMITATIONS TO THE INTERNATIONAL USE OF ILLNESS SEVERITY SCORES

The international use of current illness severity scores poses several challenges. Firstly, such scores are often constructed in a way that limits their global relevance. For example, many scores incorporate diseases and comorbidities that are predominant in critically ill patients from high- and middle-income countries. Age categories also reflect life expectancies and outcomes in higher-income contexts. Score performance may be further impacted by geographical differences in the age profile of patients admitted to ICUs.⁽⁴⁾

Secondly, many illness severity scores incorporate variables, such as laboratory investigation results, that are not universally available in all settings. Therefore, there is a high prevalence of missing data when the scores are used in low-income countries.⁽⁵⁻⁷⁾ This may occur because certain investigations are not readily available or because of differences in decision-making and prioritization by clinicians in different settings. Such variations in clinical practice are not captured by illness severity scores that incorporate these variables. Efforts to address this limitation have been hindered by the inadequate reporting of missing values in studies that examine illness severity scores in lower- and middle-income countries.⁽⁷⁾

Study design

- Federated external validation study
- 1st January – 31st December 2023
- Mortality predicted using customised SMS-ICU model (Zampieri *et al.*, 2020)
- Compared to actual in-hospital mortality (primary analysis) and actual ICU mortality (to broaden representation)



Aim & objectives

Aim: to evaluate the suitability of the customised SMS-ICU score for use across critical care registries on multiple continents



Objective 1: to determine the discrimination of SMS-ICU in registries across multiple continents. An AUROC > 0.7 is defined as acceptable discrimination

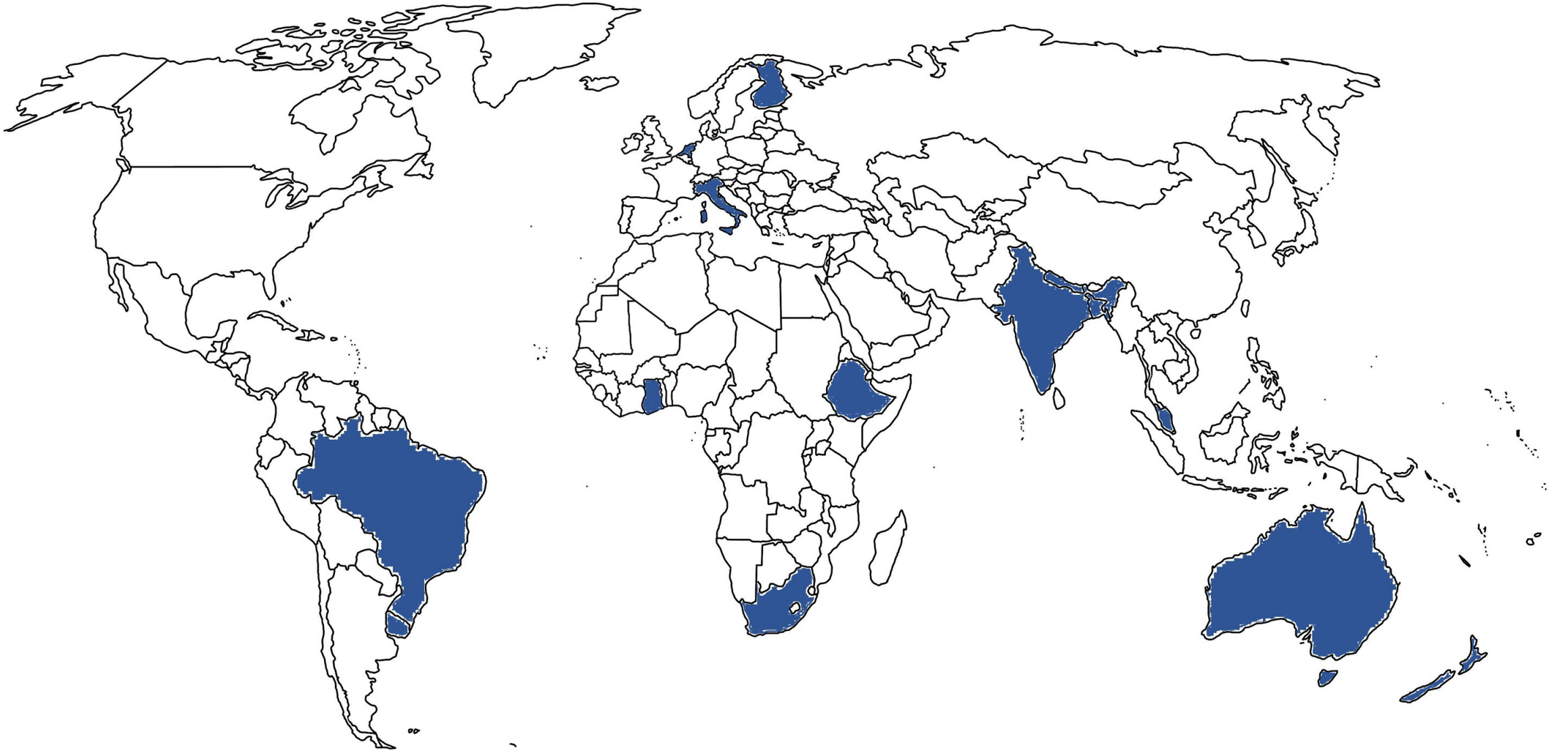


Objective 2: to describe the calibration of SMS-ICU in each participating registry. This is quantified using O/E ratios (SMRs) and calibration curves



Objective 3: to quantify overall fit in each registry. This is achieved using the Brier score (a score close to 0 suggests good fit, 0.25 represents an uninformative model).

Participating registries



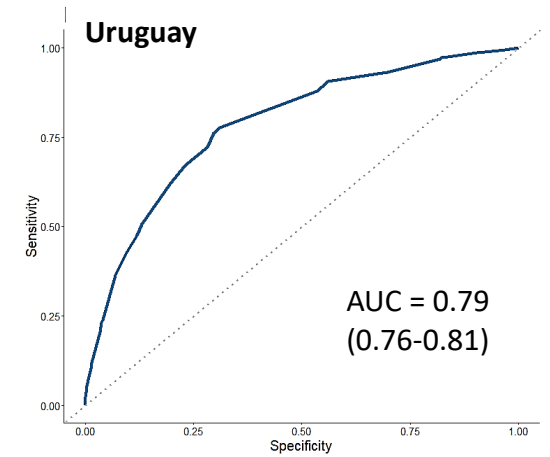
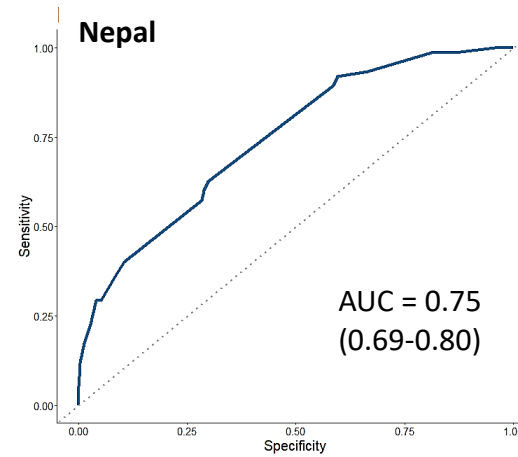
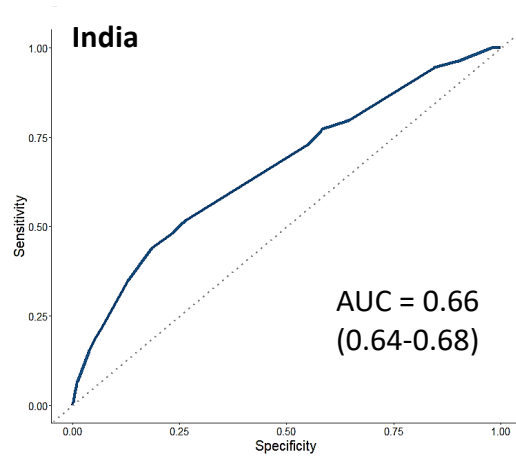
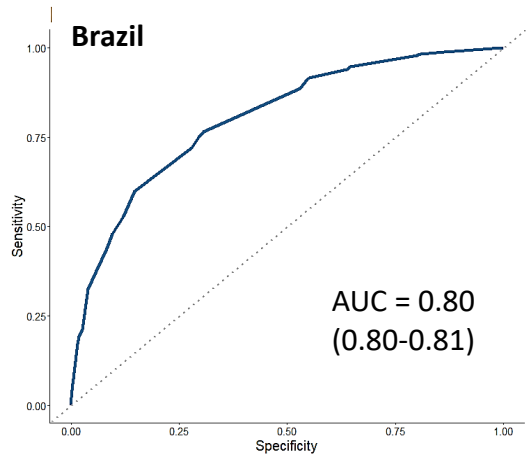
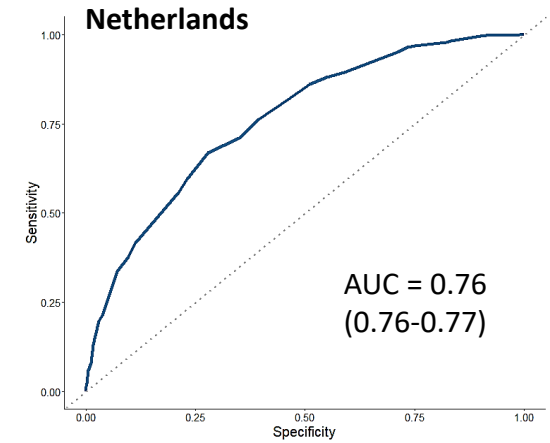
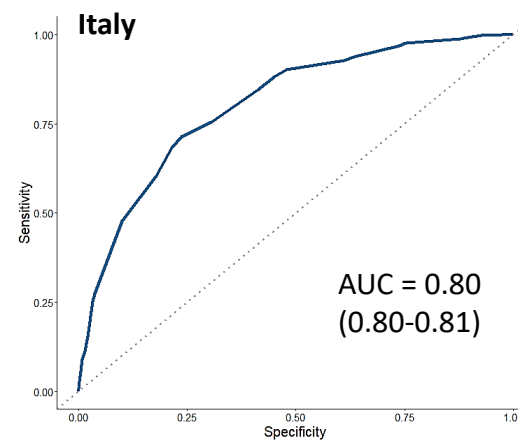
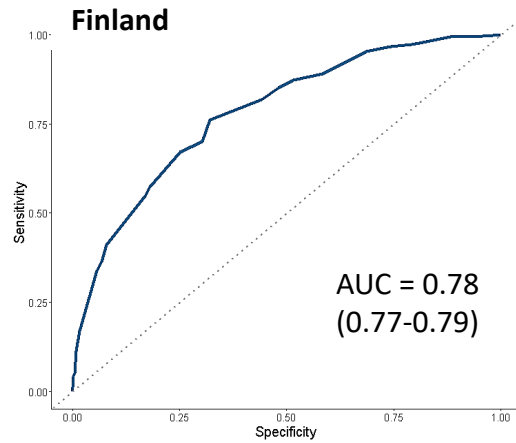
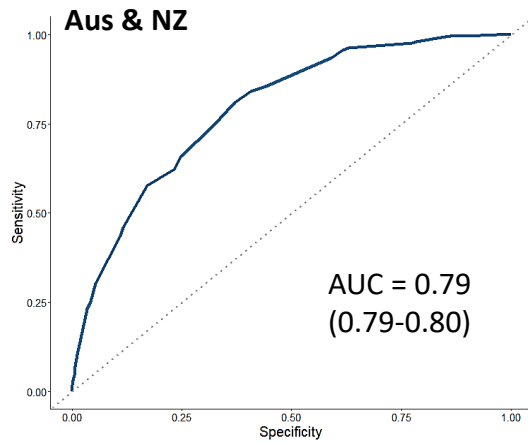
Study population: in-hospital mortality

		Aus & NZ	Brazil	Finland	India	Italy	Nepal	Netherlands	Uruguay
Number of ICUs included		194	207	25	11	130	1	68	6
Total ICU admissions during study period		197713	180268	16460	7610	46983	822	70080	2240
Number of admissions included		183444	176866	13573	6615	39350	621	64163	2068
Exclusions due to missing outcome		747	0	1	383	508	103	0	0
Total number of in-hospital deaths (%)		14864 (8.1)	22382 (12.7)	1636 (12.1)	1022 (15.5)	7794 (19.8)	75 (12.1)	8384 (13.1)	439 (21.2)
Prevalence of missing data for study variables	Blood pressure (%)	0 (0)	2549 (1.44)	210 (1.6)	10 (0.15)	36 (0.09)	0 (0)	482 (0.75)	84 (4.1)
	Metastasis or haematological malignancy (%)	0 (0)	81 (0.05)	692 (5.9)	0 (0)	0 (0)	0 (0)	0 (0)	3 (0.1)
	Vasopressor or inotrope use (%)	11747 (6.4)	204 (0.12)	0 (0)	10 (0.15)	2 (0.01)	0 (0)	0 (0)	2 (0.1)
	Respiratory support (%)	0 (0)	204 (0.12)	1544 (11.4)	10 (0.15)	2 (0.01)	0 (0)	0 (0)	2 (0.1)
	Renal replacement therapy (%)	13037 (7.1)	204 (0.12)	0 (0)	10 (0.15)	1 (0)	0 (0)	36195 (56.4)	2 (0.1)
	Admission type (%)	0 (0)	0 (0)	29 (0.2)	0 (0)	1 (0)	0 (0)	201 (0.31)	0 (0)

Study population: ICU mortality

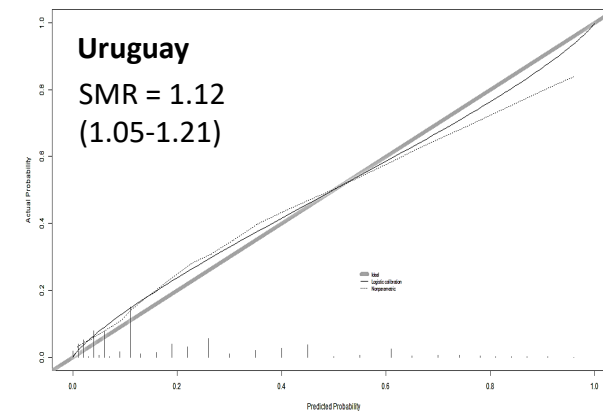
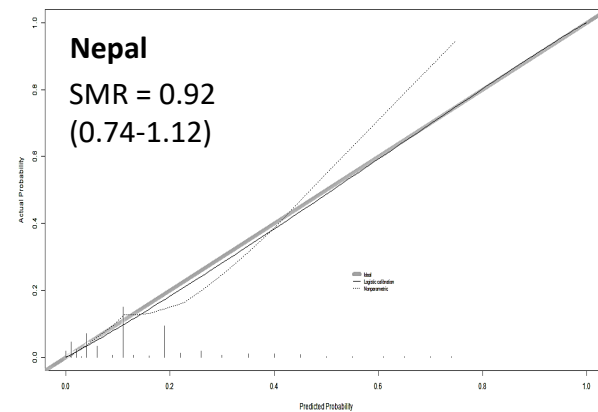
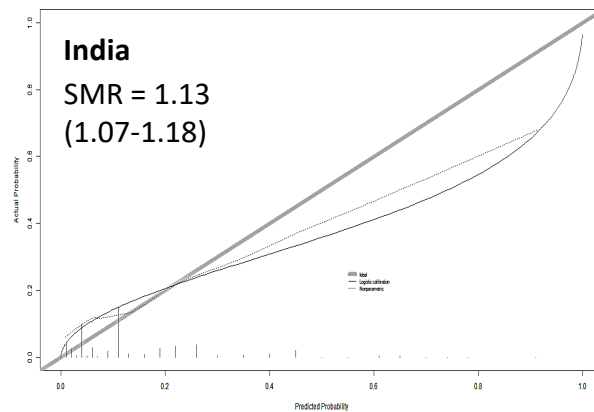
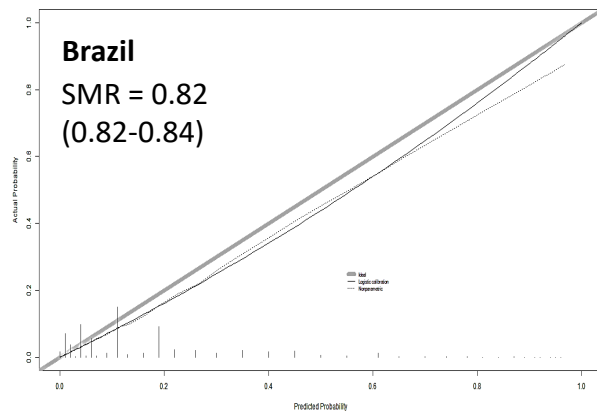
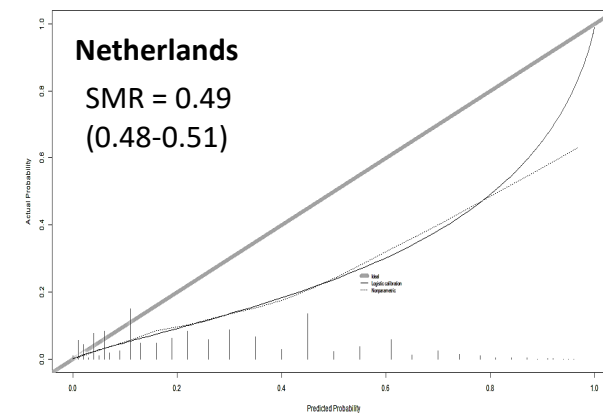
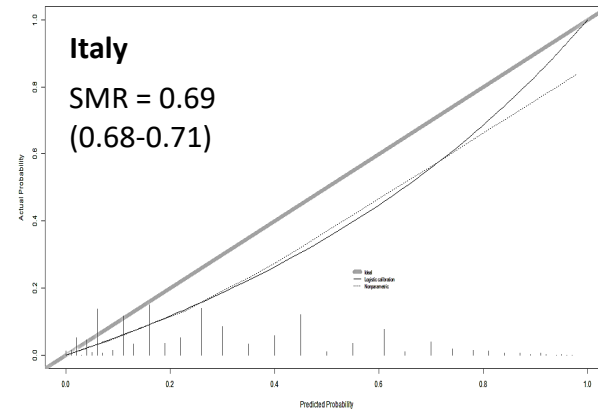
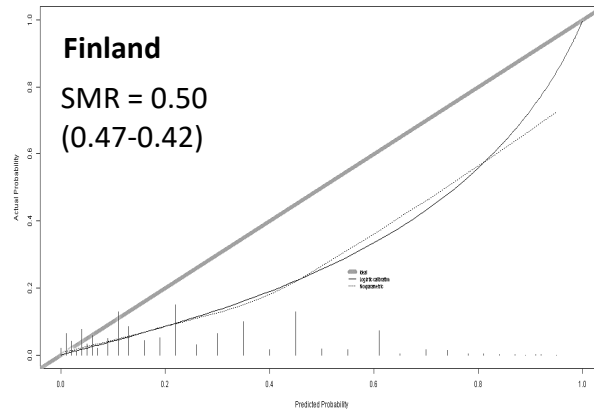
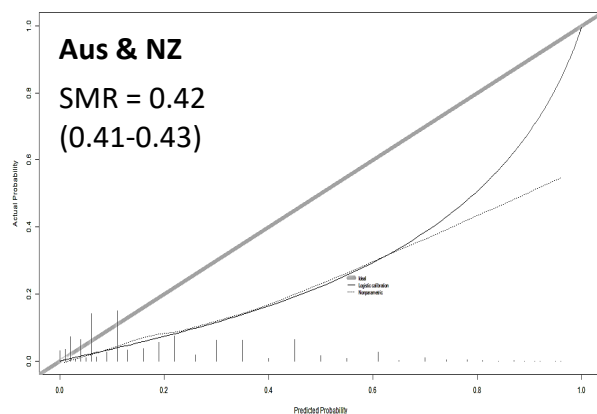
		Aus & NZ	Bangla-desh	Brazil	Ethiopia	Finland	Ghana	India	Italy	Malaysia	Nepal	Nether-lands	South Africa	Uruguay
Number of ICUs included		194	1	207	2	25	1	22	130	4	12	68	4	6
Total ICU admissions during study period		197713	1334	180268	564	16460	209	15002	46983	2363	7187	70080	1285	2240
Number of admissions included		183944	1221	176866	480	13573	163	13690	39559	2106	6326	64163	1190	2068
Exclusions due to missing outcome		247	0	0	0	26	0	117	299	0	0	0	0	0
Total number of ICU deaths (%)		9810 (5.3)	694 (56.8)	12602 (7.13)	160 (33.3)	1008 (7.4)	50 (30.7)	1263 (9.23)	5991 (15.1)	297 (14.1)	815 (12.9)	8384 (13.1)	143 (12.0)	355 (17.2)
Prevalence of missing data for study variables	Blood pressure (%)	0 (0)	1 (0.08)	2549 (1.44)	5 (1.04)	187 (1.4)	3 (1.84)	66 (0.48)	42 (0.11)	0 (0)	11 (0.17)	482 (0.75)	18 (1.51)	84 (4.1)
	Metastasis or haematological malignancy (%)	0 (0)	0 (0)	81 (0.05)	0 (0)	669 (4.9)	0 (0)	0 (0)	3 (0.01)	0 (0)	0 (0)	0 (0)	0 (0)	3 (0.1)
	Vasopressor or inotrope use (%)	11795 (6.4)	1 (0.08)	204 (0.12)	5 (1.04)	0 (0)	3 (1.84)	66 (0.48)	4 (0.01)	0 (0)	11 (0.17)	0 (0)	18 (1.51)	2 (0.1)
	Respiratory support (%)	0 (0)	1 (0.08)	204 (0.12)	5 (1.04)	1528 (11.3)	3 (1.84)	66 (0.48)	4 (0.01)	0 (0)	11 (0.17)	0 (0)	18 (1.51)	2 (0.1)
	RRT (%)	13084 (7.1)	1 (0.08)	204 (0.12)	5 (1.04)	0 (0)	3 (1.84)	66 (0.48)	3 (0.01)	0 (0)	11 (0.17)	36195 (56.4)	18 (1.51)	2 (0.1)
	Admission type (%)	0 (0)	0 (0)	0 (0)	0 (0)	29 (0.2)	0 (0)	0 (0)	4 (0.01)	0 (0)	0 (0)	201 (0.31)	0 (0)	0 (0)

Results: in-hospital mortality

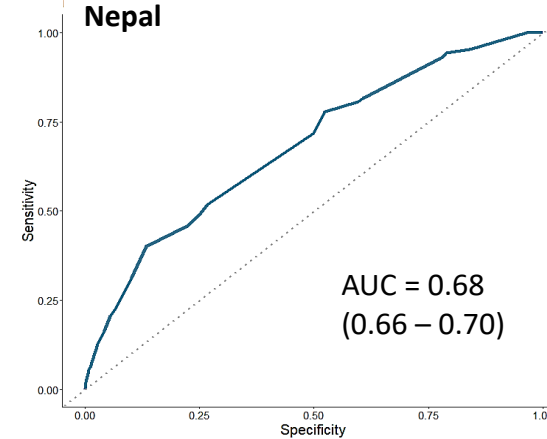
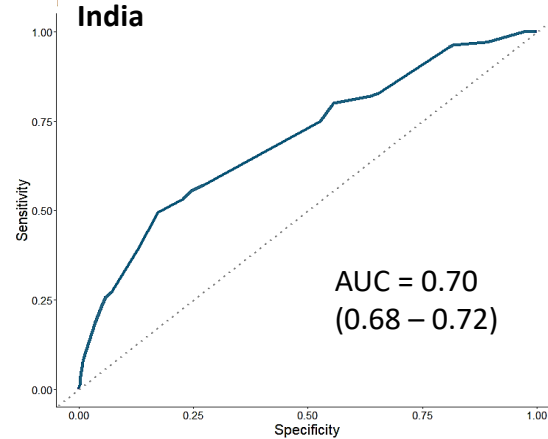
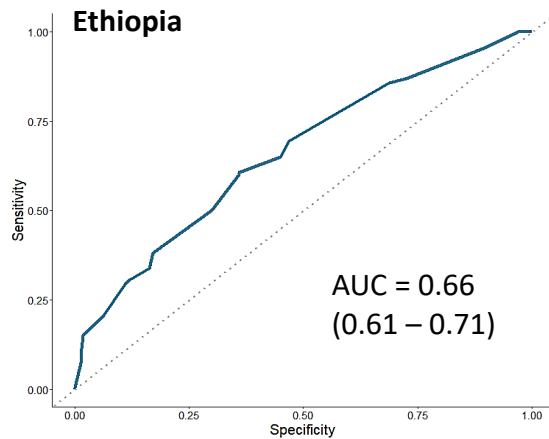
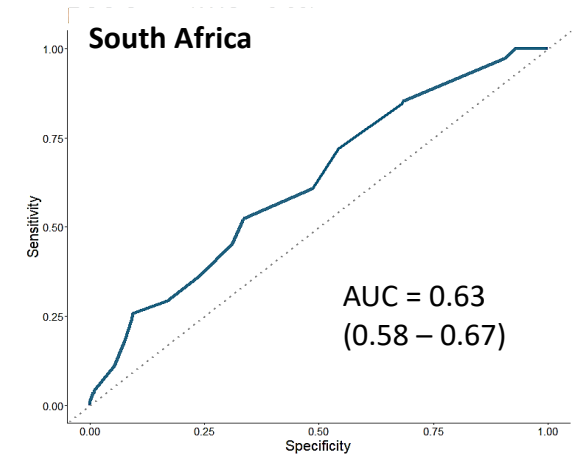
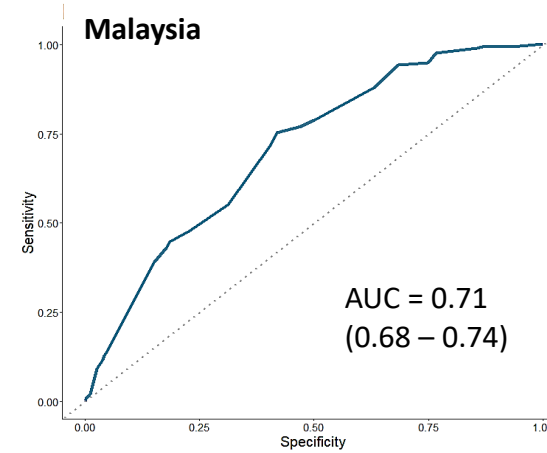
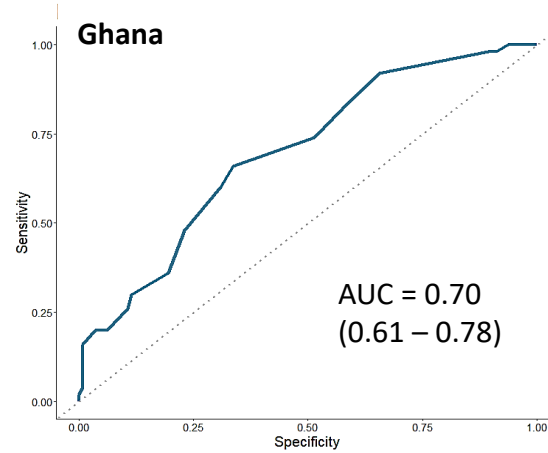
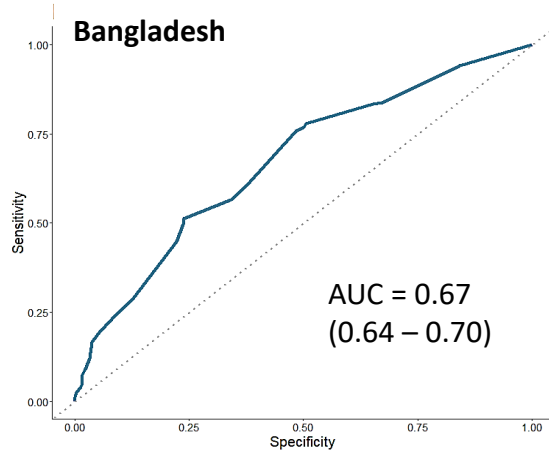


Total Pooled AUC = 0.77 (0.73-0.80)

Results: in-hospital mortality

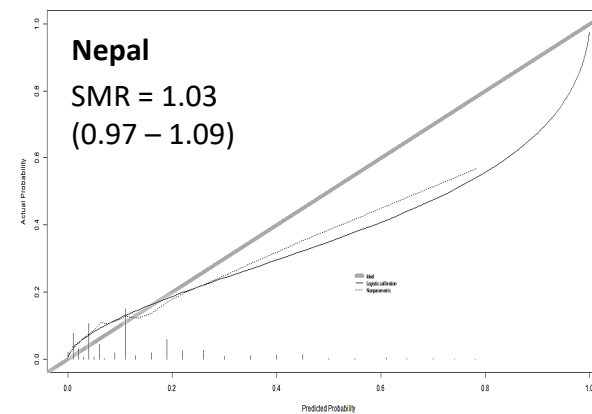
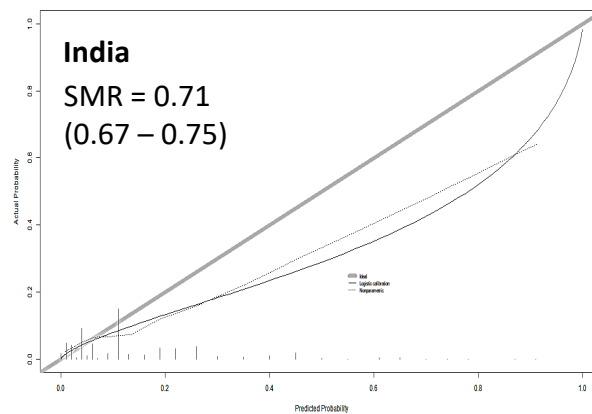
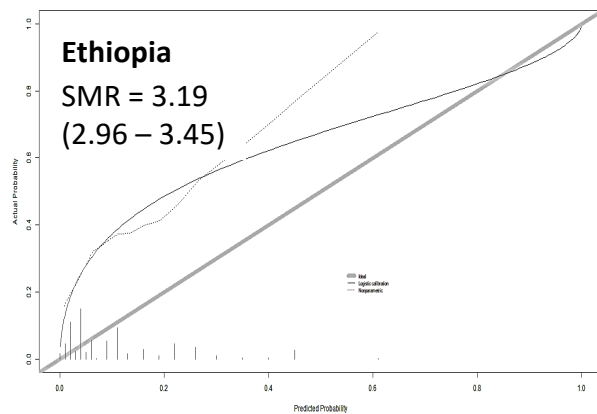
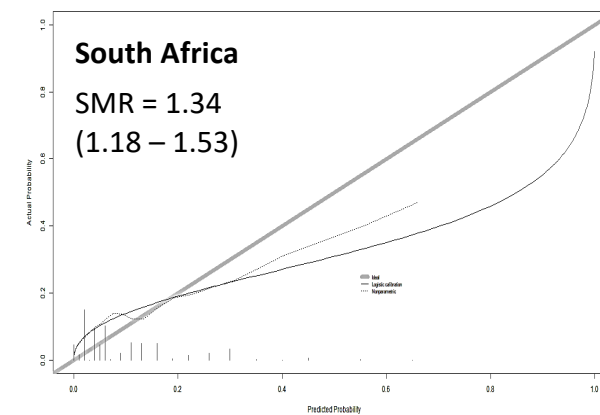
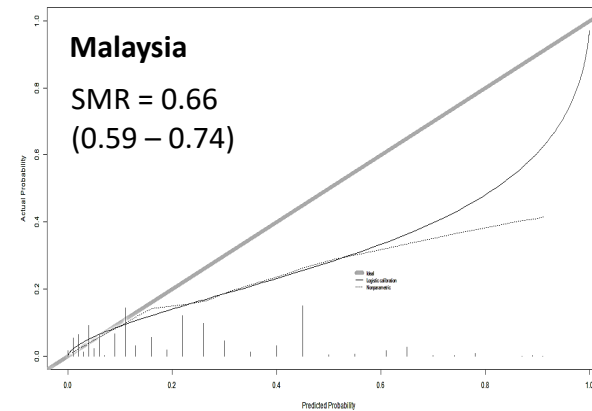
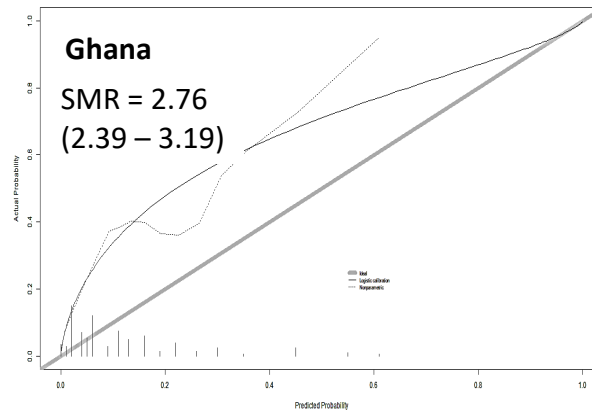
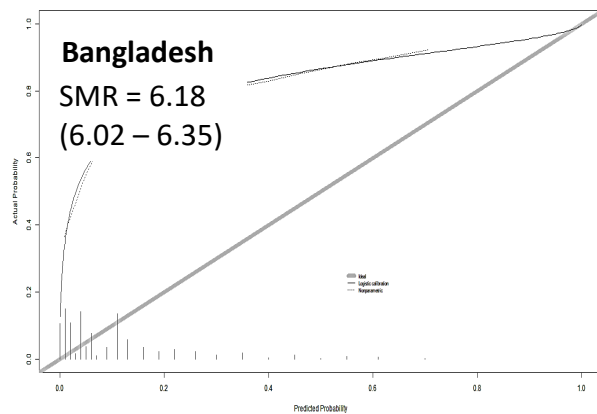


Results: ICU mortality



Total Pooled AUC = 0.74 (0.70 – 0.78)

Results: ICU mortality



Interpretation

- Low prevalence of missing data in most settings
- Acceptable discrimination and overall fit for primary (in-hospital mortality) analysis
- However, the ICU mortality analysis showed variable discrimination, especially in African/Asian registries
 - differences in case-mix?
 - differences in healthcare processes/organisation?
 - heterogeneity within healthcare systems?
- Calibration varied significantly between contexts

Overall, the global applicability of SMS-ICU is limited by variable calibration. This could potentially be addressed in future by customisation based on contextual factors.

Next steps

Timeline:

- October 2025: first draft of manuscript circulated for comments/feedback
- November 2025: submission for peer review
- January 2026: target publication date

In future:

- Customisation to re-calibrate based on contextual factors?
 - would require broader collection of hospital outcome data

