Evaluation of COVID-19 Severity Prediction Scores in Aotearoa New Zealand 2022

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Introduction

COVID-19 remains a common cause of hospital admission

Identifying those patients likely to die from their illness is critical for triage and admission decisions

Risk prediction scores can be used to assess disease severity but have the potential to increase inequities. Equity centred evaluation is required in the current Aotearoa context where the population is highly vaccinated, the Omicron SARS-CoV-2 variant predominates, and Māori and Pacific people have experienced greater rates of hospitalization and death

Aims

1. Evaluate and re-calibrate COVID-19 severity prediction scores in the New Zealand context

2. Evaluate COVID-19 severity prediction scores for Māori and Pacific peoples to understand the potential impact of these scores on equity

Methods

Retrospective cohort study at 11 hospitals across Aotearoa New Zealand, 1 Jan – 30 Apr 2022

Inclusion of adult (age ≥16 years) patients whose admission was attributable to COVID-19 based on standardised definition:

Evaluation of candidate risk predictions scores (Table 1)

Table 1: Relevant mortality risk prediction tools for use in patients with COVID-19

Prediction tool	Original outcome	Predictors included in models
4C Mortality Severity Score	In hospital mortality	Age, gender, number of comorbidities, respiratory rate, oxygen saturation on room air, Glasgow coma scale, blood urea, C-reactive protein
PRIEST COVID-19 Clinical	30 day mortality or major organ support	Age, sex, respiratory rate, oxygen saturation, heart rate, systolic blood pressure, temperature, alertness, inspired oxygen, performance status
CURB-65	30 day mortality	Confusion, blood urea, respiratory rate, blood pressure, age
VACO	30 day mortality	Age, gender, Charlson comorbidity index, myocardial infarction or peripheral vascular disease
Charlson Co-morbidity Index	Death, or a composite of death, severe acute respiratory syndrome or intensive care admission	Age, myocardial infarction, congestive heart failure, peripheral vascular disease, cerebrovascular accident or transient ischaemic attack, dementia, chronic obstructive pulmonary disease, connective tissue disease, peptic ulcer disease, liver disease, diabetes mellitus, hemiplegia, chronic kidney disease, solid tumour, leukaemia, lymphoma, acquired immune-deficiency syndrome

Outcome: death in hospital or within 28 days of admission

Study centred on Te Tiriti of Waitangi, with co-leadership structure and formation of Equity Expert Reference Group

- Sampling of every Māori and Pacific patient and every second non-Māori , non-Pacific patient to provide equal explanatory power of analyses for each ethnic group
- Linking with national databases to enhance accuracy of ethnicity classification, and consideration of 'total' rather than 'prioritised' ethnicity
- Consideration of causal pathways – not ethnicity as a risk factor

Risk prediction score evaluation:

- Calibration - observed/expected ratio, overall miscalibration and slope
- Discrimination - C-statistic
- Clinical utility - sensitivity, specificity, positive predictive value and negative predictive value

Results

2,375 (53.3%) of 4,459 admissions were attributable to COVID-19. The description of 2,319 patients who experienced 2,375 admissions shown in Table 2.

The most accurate risk prediction scores (Figure 1): 4C mortality (c-statistic 0.87, 95% CI 0.85-0.90), CURB-65 (0.86, 95% CI 0.84-0.89) and modified PRIEST (0.93, 95% CI 0.80). Confidence intervals were widest for Māori (Figure 2).

Patients with a 4C score <8, a mPRIEST score <6, and a CURB-65 <1 had <1% probability of death (Figures 3) and included 49.7%, 42.9%, and 38.4% of the study population respectively

Table 2: Characteristics of patients admitted due to COVID-19, Aotearoa New Zealand, 2022

Characteristic	Māori (N=582)	Pacific (N=914)	Non-Māori non-Pacific (N=862)	Overall (N=2319)
	n (%)	n (%)	n (%)	n (%)
Age (years), median (Q1, Q3)	51.5 (34.0, 65.0)	57.0 (37.0, 72.0)	63.0 (40.0, 78.0)	57.0 (37.0, 74.0)
Female	358 (61.5%)	523 (57.2%)	516 (59.9%)	1371 (59.1%)
Male	224 (38.5%)	391 (42.8%)	346 (40.1%)	948 (40.9%)
Symptom duration (days), median (Q1, Q3)	3.0 (1.0, 6.0)	3.0 (1.0, 6.0)	3.0 (1.0, 6.0)	3.0 (1.0, 6.0)
Number of COVID-19 vaccinations				
≤1	155 (26.6%)	213 (23.3%)	131 (15.2%)	491 (21.2%)
≥2	427 (73.4%)	701 (76.7%)	731 (84.8%)	1,828 (84.8%)
Heart Rate, median (Q1, Q3)	88.0 (74.0, 102.0)	85.0 (73.0, 99.0)	85.0 (75.0, 100.0)	85.0 (74.0, 100.0)
Respiratory rate, median (Q1, Q3)	20.0 (18.0, 24.0)	20.0 (18.0, 24.0)	20.0 (18.0, 22.0)	20.0 (18.0, 24.0)
Systolic blood pressure, median (Q1, Q3)	126.0 (112.0, 143.0)	130.0 (116.0, 149.0)	130.0 (116.0, 147.0)	129.0 (115.0, 147.0)
Diastolic blood pressure, median (Q1, Q3)	78.0 (68.0, 88.0)	77.0 (68.0, 88.0)	78.0 (69.0, 89.0)	78.0 (68.0, 88.0)
Hypoxia	51 (8.8%)	74 (8.1%)	48 (5.6%)	172 (7.4%)
Creatinine, umol/L median (Q1, Q3)	79.0 (62.0, 117.5)	92.0 (66.0, 142.0)	77.0 (62.0, 101.0)	81.0 (63.0, 117.0)
C-reactive protein, mg/L median (Q1, Q3)	13.0 (4.9, 37.0)	20.0 (6.0, 63.8)	17.0 (6.0, 49.0)	16.0 (6.0, 52.0)
Died during admission or within 28 days	24 (4.1%)	64 (7.0%)	59 (6.8%)	146 (6.3%)
Age standardised mortality, % (95% CI)	4.0% (2.5-5.9%)	5.4% (4.1-7.1%)	3.5% (2.5-5.0%)	4.5% (3.7-5.4%)

Figure 1. COVID-19 risk prediction scores receiver-operator curves, New Zealand, 2022

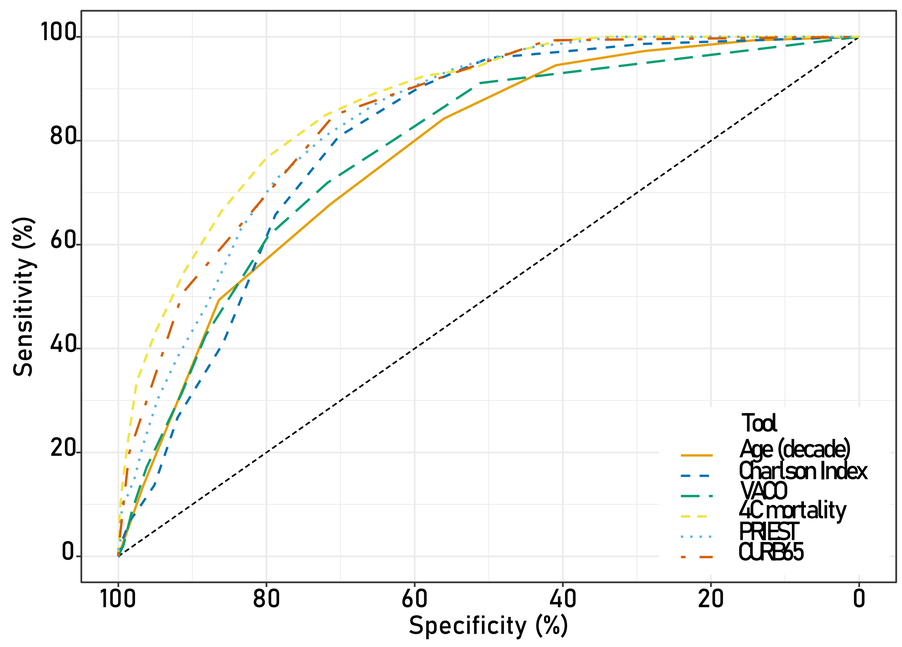


Figure 2 COVID-19 risk prediction scores calibration statistics by ethnicity, New Zealand, 2022

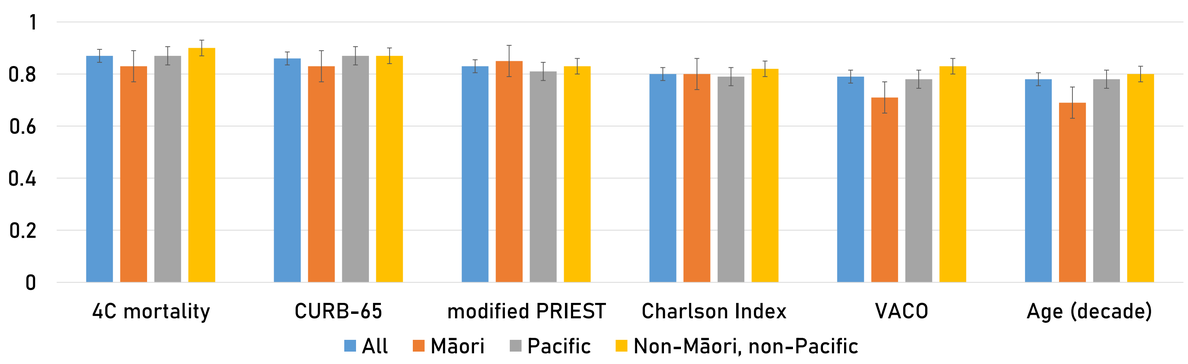
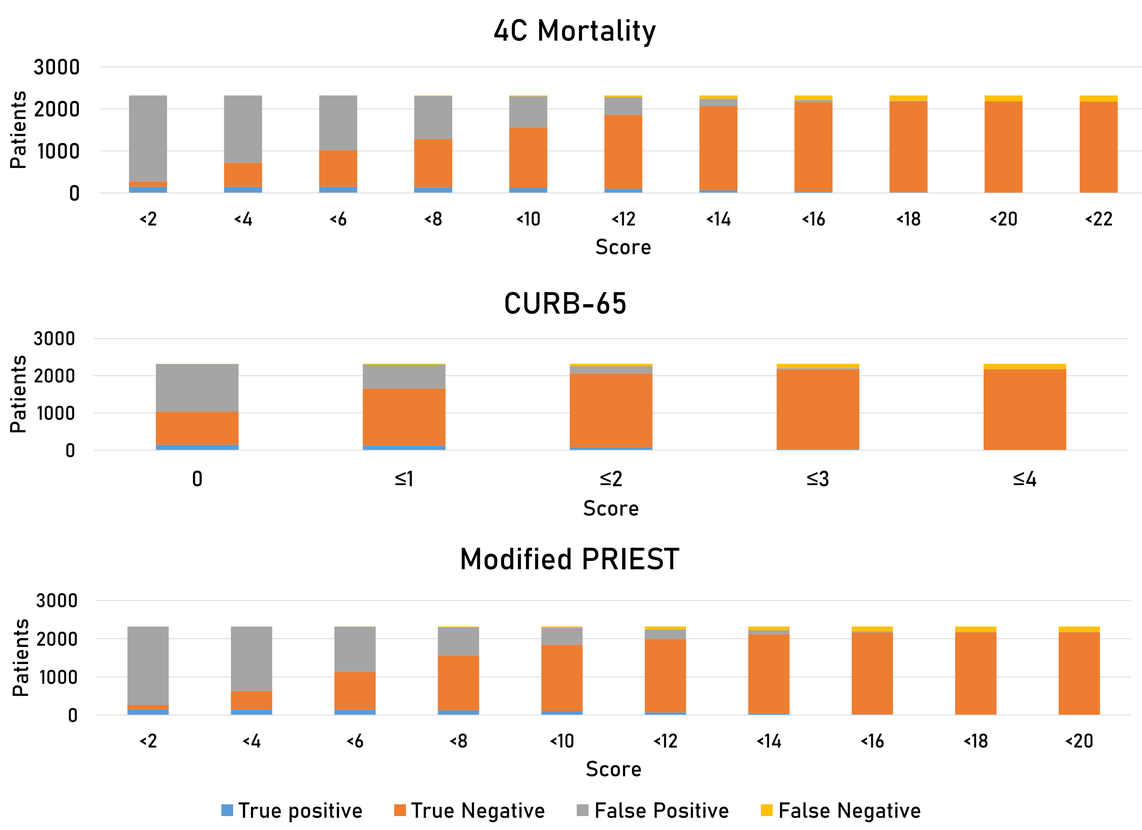


Figure 3. Accuracy of selected COVID-19 risk prediction scores, Aotearoa New Zealand, 2022



Conclusions

CURB-65, PRIEST and 4C mortality could all be used as 'rule out' tests to aid with discharge decisions for patients with COVID-19

Implementation will require more certainty about accuracy for Māori, consultation with clinicians about choice of score, appropriate threshold cut-off, and how best to integrate into usual practice.

Funded by: Ministry of Health Manatū Hauora

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