

Appendix 1: Supplemental material

Table S1. Characteristics and enrolment periods for participating sites

Hospital	Province	Start Date	End Date	Hospital Type		Derivation cohort	Validation cohort
				Rural/Urban	Teaching	n	n
Vancouver General Hospital	BC	Mar 1, 2020	Jun 30, 2020	Urban	Teaching	91	
Lions Gate Hospital	BC	Mar 1, 2020	Sep 19, 2020	Urban	NT		142
Saint Paul's Hospital	BC	Mar 1, 2020	Mar 20, 2020	Urban	Teaching		59
Mount St Joseph's Hospital	BC	Mar 1, 2020	Oct 31, 2020	Urban	NT		90
Surrey Memorial Hospital	BC	Mar 19, 2020	Sep 20, 2020	Urban	Teaching	895	
Royal Columbian Hospital	BC	Mar 1, 2020	Nov 15, 2020	Urban	Teaching	221	
Abbotsford Regional Hospital	BC	Apr 20, 2020	Jul 15, 2020	Urban	NT	329	
Eagle Ridge Hospital	BC	Mar 1, 2020	Nov 30, 2020	Urban	NT	162	
Royal Inland Hospital	BC	Mar 1, 2020	Nov 30, 2020	Urban	NT	35	
Kelowna General Hospital	BC	Mar 1, 2020	Nov 2, 2020	Urban	Teaching	105	
University of Alberta Hospital	AB	Apr 8, 2020	Oct 5, 2020	Urban	Teaching	263	
Foothills Medical Centre	AB	Mar 1, 2020	Oct 14, 2020	Urban	Teaching	511	
Rockyview General Hospital	AB	Mar 1, 2020	Oct 24, 2020	Urban	Teaching		446
Peter Lougheed Centre	AB	Mar 1, 2020	Oct 17, 2020	Urban	Teaching	829	
South Health Campus	AB	Mar 1, 2020	Oct 17, 2020	Urban	Teaching		329
Royal Alexandra Hospital	AB	Mar 1, 2020	May 7, 2020	Urban	Teaching		180
Northeast Community Health Centre	AB	Mar 1, 2020	Nov 06, 2020	Urban	Teaching	115	
St Paul's Hospital	SK	Mar 17, 2020	Dec 5, 2020	Urban	Teaching		149
Royal University Hospital	SK	Mar 17, 2020	Sep 20, 2020	Urban	Teaching	33	
Saskatoon City Hospital	SK	Mar 17, 2020	Nov 17, 2020	Urban	Teaching	42	
Sunnybrook Hospital	ON	May 14, 2020	Jul 31, 2020	Urban	Teaching		86
The Ottawa Hospital - Civic	ON	Mar 1, 2020	Nov 30, 2020	Urban	Teaching	214	
The Ottawa Hospital - General	ON	Mar 1, 2020	Oct 31, 2020	Urban	Teaching		293
Kingston General Hospital	ON	Mar 1, 2020	Dec 31, 2020	Urban	Teaching	32	
Hamilton General Hospital	ON	Mar 1, 2020	Aug 31, 2020	Urban	Teaching	46	
Jurviski Hospital	ON	Mar 1, 2020	Aug 31, 2020	Urban	Teaching	42	
Health Science North	ON	May 14, 2020	Jul 25, 2020	Urban	NT	10	
University Hospital - LHSC	ON	Mar 1, 2020	Nov 30, 2020	Urban	Teaching	312	

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Toronto Westem Hospital	ON	Sep 1, 2020	Sep 19, 2020	Urban	Teaching	76	
Hôtel-Dieu de Lévis	QC	Mar 1, 2020	Nov 17, 2020	Urban	NT	267	
Jewish General Hospital	QC	Mar 1, 2020	May 3, 2020	Urban	Teaching	815	
CHUL	QC	Mar 1, 2020	Nov 15, 2020	Urban	Teaching		57
Royal Victoria Hospital	QC	Mar 1, 2020	Oct 31, 2020	Urban	Teaching	789	
Hôpital de l'Enfant-Jésus	QC	Mar 1, 2020	May 4, 2020	Urban	Teaching	51	
Hôpital du Saint-Sacrement	QC	Mar 1, 2020	Nov 15, 2020	Urban	Teaching	33	
Hôpital Saint-François d'Assise	QC	Mar 1, 2020	Nov 15, 2020	Urban	Teaching	56	
Hôtel-Dieu de Québec	QC	Mar 1, 2020	Nov 15, 2020	Urban	Teaching	21	
IUCPQ	QC	Mar 1, 2020	Nov 15, 2020	Urban	Teaching		312
Hôpital du Sacré-Coeur	QC	Mar 17, 2020	Jun 11, 2020	Urban	Teaching	664	
Montreal General Hospital	QC	Mar 1, 2020	Nov 30, 2020	Urban	Teaching	296	
Saint John Regional Hospital	NB	Mar 1, 2020	Nov 30, 2020	Urban	Teaching		9
Halifax Infirmary	NS	Mar 1, 2020	Nov 24, 2020	Urban	Teaching	37	
Dartmouth General Hospital	NS	Mar 1, 2020	Nov 24, 2020	Com	NT	16	
Hants Community Hospital	NS	Mar 1, 2020	Nov 24, 2020	Rural	NT		<5
Cobequid Community Health Centre	NS	Mar 1, 2020	Nov 24, 2020	Com	NT	11	
Secondary Assessment Centers	NS	Mar 26, 2020	May 15, 2020	Urban	Teaching		31

BC=British Columbia, AB=Alberta, SK=Saskatchewan, ON=Ontario, QC= Québec, NB=New Brunswick, NS= Nova Scotia, LHSC=London Health Sciences Centre, CHUL=Centre Hospitalier de l'Université Laval, IUCPQ=Institut universitaire de cardiologie et de pneumologie de Québec, Com=community

Table S2. Candidate variables for entry into regression model

Variable	Definition	N (%) Missing
Demographics		
Age	Age in years	0 (0)
Sex	Male, Female, Other	0 (0)
Arrival from		42 (0.6)
	Home + Inter-hospital transfer + other (not clearly documented)	
	Single room + no fixed address + shelter	
	Institutional living: long-term care/rehab + correctional	
Emergency department variables		
ED arrival mode		0 (0)
Ambulance:	arrived by ambulance	
Self/police	self-transported or transported to ED by police	
Arrival heart rate	beats/minute	131 (1.8)
Arrival respiratory rate	breaths/minute	324 (4.4)
Arrival oxygen saturation	%	131 (1.8)
Arrival systolic blood pressure	mmHg	352 (4.7)
Fever	Temperature ≥ 37.5 OR self-reported fever	0 (0)
Respiratory distress	Increased work of breathing documented by treating clinician and Patient-reported symptom of shortness of breath as documented by treating clinician	0 (0)
Bloodwork in ED	Yes/No	
Supplemental oxygen delivered in the ED	Yes/No	0 (0)
COVID symptoms		
Chest pain (includes discomfort or tightness)	Patient-reported symptom as documented by treating clinician	0 (0)
Chills	Patient-reported symptom as documented by treating clinician	0 (0)
Cough	Patient-reported symptom as documented by treating clinician	0 (0)
Dysgeusia/anosmia	Patient-reported symptom as documented by treating clinician	0 (0)
Fatigue/malaise	Patient-reported symptom as documented by treating clinician	0 (0)
Headache	Patient-reported symptom as documented by treating clinician	0 (0)
	Patient-reported symptom as documented by treating clinician	0 (0)
Hemoptysis (bloody sputum)		
Muscle aches (myalgia)	Patient-reported symptom as documented by treating clinician	0 (0)
No reported symptoms	Patient-reported symptom as documented by treating clinician	0 (0)
Current tobacco user	Documented current tobacco use	0 (0)
Current illicit user	Documented methamphetamine, opioid or other illicit drug use	0 (0)
Pregnant	Documented current pregnancy	0 (0)
Arrival confusion	Patient-reported symptom of altered consciousness/confusion or Glasgow Coma Score of < 14	0 (0)
Covid Symptom-gastric	Patient-reported symptom of diarrhea and nausea/vomiting	0 (0)
Mode of oxygen delivery combined with oxygen received in the ED	Documented mode of oxygen delivery, combined with maximum oxygen received if given nasal prongs. Most invasive method of oxygen delivery selected if more than one documented.	0 (0)
	Intubation	
	BiPap + CPAP + HFNO	
	Facemask + simple rebreather + non-rebreather + nasal prongs with $> 6L/min$	
	Nasal prongs $< 5L/min$	
	No oxygen	
Common Comorbid Conditions, n (%)		
Active malignant neoplasm (cancer)	The diagnosis, conditions, problem or circumstances for the patient's ED visit that is in addition to the main diagnosis.	0 (0)
Coronary artery disease	The diagnosis, conditions, problem or circumstances for the patient's ED visit that is in addition to the main diagnosis.	0 (0)
Congestive heart failure	The diagnosis, conditions, problem or circumstances for the patient's ED visit that is in addition to the main diagnosis.	0 (0)
Hypertension	The diagnosis, conditions, problem or circumstances for the patient's ED visit that is in addition to the main diagnosis.	0 (0)

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Asthma	The diagnosis, conditions, problem or circumstances for the patient's ED visit that is in addition to the main diagnosis.	0 (0)
Chronic kidney disease	The diagnosis, conditions, problem or circumstances for the patient's ED visit that is in addition to the main diagnosis.	0 (0)
Dialysis	The diagnosis, conditions, problem or circumstances for the patient's ED visit that is in addition to the main diagnosis	0 (0)
Diabetes	The diagnosis, conditions, problem or circumstances for the patient's ED visit that is in addition to the main diagnosis	0 (0)
Moderate/severe liver disease	The diagnosis, conditions, problem or circumstances for the patient's ED visit that is in addition to the main diagnosis	0 (0)
Organ transplant	The diagnosis, conditions, problem or circumstances for the patient's ED visit that is in addition to the main diagnosis	0 (0)
Dementia	The diagnosis, conditions, problem or circumstances for the patient's ED visit that is in addition to the main diagnosis	0 (0)
Rheumatologic disorder	The diagnosis, conditions, problem or circumstances for the patient's ED visit that is in addition to the main diagnosis	0 (0)
Obesity (clinical impression)	The diagnosis, conditions, problem or circumstances for the patient's ED visit that is in addition to the main diagnosis	0 (0)
Atrial fibrillation	The diagnosis, conditions, problem or circumstances for the patient's ED visit that is in addition to the main diagnosis	0 (0)

Table S3. Performance of the CCEDRRN COVID Mortality Score to rule out and rule in in-hospital mortality at different cut-off values in the validation cohort

Score	n (%)	Sensitivity (% , 95% CI)	Specificity (% , 95% CI)	Negative LR	Positive LR	PPV (%)	NPV (%)	Mortality (%)
Rule out:								
≤-1	50 (2.3)	100 (97.5-100)	2.5 (1.8-3.2)	0.0	1.0	6.9	100	0.0
≤0	208 (9.5)	100 (97.5-100)	10.2 (8.9-11.6)	0.0	1.1	7.4	100	0.0
≤1	363 (16.6)	100 (97.5-100)	17.8 (16.2-19.5)	0.0	1.2	8.1	100	0.0
≤2	458 (21.0)	100 (97.5-100)	22.5 (20.7-24.3)	0.0	1.3	8.5	100	0.0
≤3	576 (26.4)	100 (97.5-100)	28.3 (26.3-30.3)	0.0	1.4	9.1	100	0.0
≤4	689 (31.5)	100 (97.5-100)	33.8 (31.8-35.9)	0.0	1.5	9.8	100	0.0
≤5	866 (39.6)	100 (97.5-100)	42.5 (40.3-44.7)	0.0	1.7	11.1	100	0.0
≤6	1050 (48.1)	100 (97.5-100)	51.5 (49.3-53.7)	0.0	2.1	13.0	100	0.0
≤7	1260 (57.7)	98.6 (95.2-99.8)	61.7 (59.6-63.8)	0.0	2.6	15.7	100	0.2
≤8	1474 (67.5)	93.9 (88.7-97.2)	71.9 (69.9-73.8)	0.1	3.3	19.2	99.8	0.6
≤9	1669 (76.4)	85.7 (79.0-90.9)	80.9 (79.1-82.6)	0.2	4.5	24.4	99.4	1.3
≤10	1848 (84.6)	75.5 (67.7-82.2)	88.9 (87.5-90.2)	0.3	6.8	32.9	98.7	1.9
Rule in:								
≥10	516 (23.6)	85.7 (79.9-90.9)	80.9 (79.1-82.6)	0.2	4.5	24.4	98.7	24.4
≥11	337 (15.4)	75.5 (67.7-82.2)	88.9 (87.5-90.2)	0.3	6.8	32.9	98.1	32.9
≥12	212 (9.7)	60.5 (52.2-68.5)	94.0 (92.8-95)	0.4	10.0	42.0	97.1	42.0
≥13	100 (4.6)	34.0 (26.4-42.3)	97.5 (96.8-98.2)	0.7	13.9	50.0	95.3	50.0
≥14	37 (1.7)	18.4 (12.5-25.6)	99.5 (99.1-99.8)	0.8	37.4	73.0	94.4	73.0
≥15	17 (0.8)	8.8 (4.8-14.6)	99.8 (99.5-99.9)	0.9	45.1	76.5	93.8	76.5
≥16	4 (0.2)	2.7 (0.7-6.8)	100 (99.8-100)	1.0	-	100.0	93.4	100.0
≥17	1 (0.0)	0.7 (0.3-7)	100 (99.8-100)	1.0	-	100.0	93.3	100.0

LR=Likelihood ratio, FN=false negative, FP=false positive, NPV=negative predictive value, PPV=positive predictive value, TN=true negative, TP=true positive.

Table S4. Receiver operator curves and area under the curve (AUC) for the CCEDRRN COVID Mortality Score, the SEIMC score, the 4C Mortality Score, and the VACO Index

Model	Data set	Patients with required parameters (n)	AUC (95% CI)
CCEDRRN COVID Mortality Score (CCMS)	Derivation and Validation	9605	0.92 (0.91-0.93)
CCEDRRN COVID Mortality Score (CCMS)	Validation	2185	0.92 (0.90-0.93)
SEIMC score (Berenguer et al.)(11)	Validation	1620	0.88 (0.86-0.91)
4C Mortality Score (Knight et al.)(9)	Validation	610	0.88 (0.84-0.92)
VACO Index (King et al.)(37)	Validation	2185	0.87 (0.84-0.89)

SEIMC score: the estimated glomerular filtration rate was calculated without race.

4C Mortality Score: human immunodeficiency virus, AIDS, and connective tissue disease, and urea not included.

VACO Index: race, body mass index, acquired immunodeficiency syndrome (AIDS), diabetes with complications, peptic ulcer disease, peripheral vascular disease, and plegia not included.

Table S5. Predicted risk for each value of the CCEDRRN COVID Mortality Score (CCMS) based on the model with only the CCMS as a predictor (i.e., $\text{expected risk} = \exp(-9.049 + 0.652 \cdot \text{CCMS}) / (1 + \exp(-9.049 + 0.652 \cdot \text{CCMS}))$)

Score	Predicted Risk
-1	0.0001
0	0.0001
1	0.0002
2	0.0004
3	0.0008
4	0.0016
5	0.0031
6	0.0058
7	0.0112
8	0.0212
9	0.0399
10	0.0739
11	0.1327
12	0.2271
13	0.3605
14	0.5197
15	0.6750
16	0.7995
17	0.8844

Figure S1. Distribution and performance of the CCEDRRN COVID Mortality Score in the derivation cohort: A) distribution of the score, B) observed in-hospital mortality across the range of the score, C) predicted versus observed probability of in-hospital mortality, and D) receiver operating characteristic curve with area under the curve (AUC) and associated 95% confidence interval.

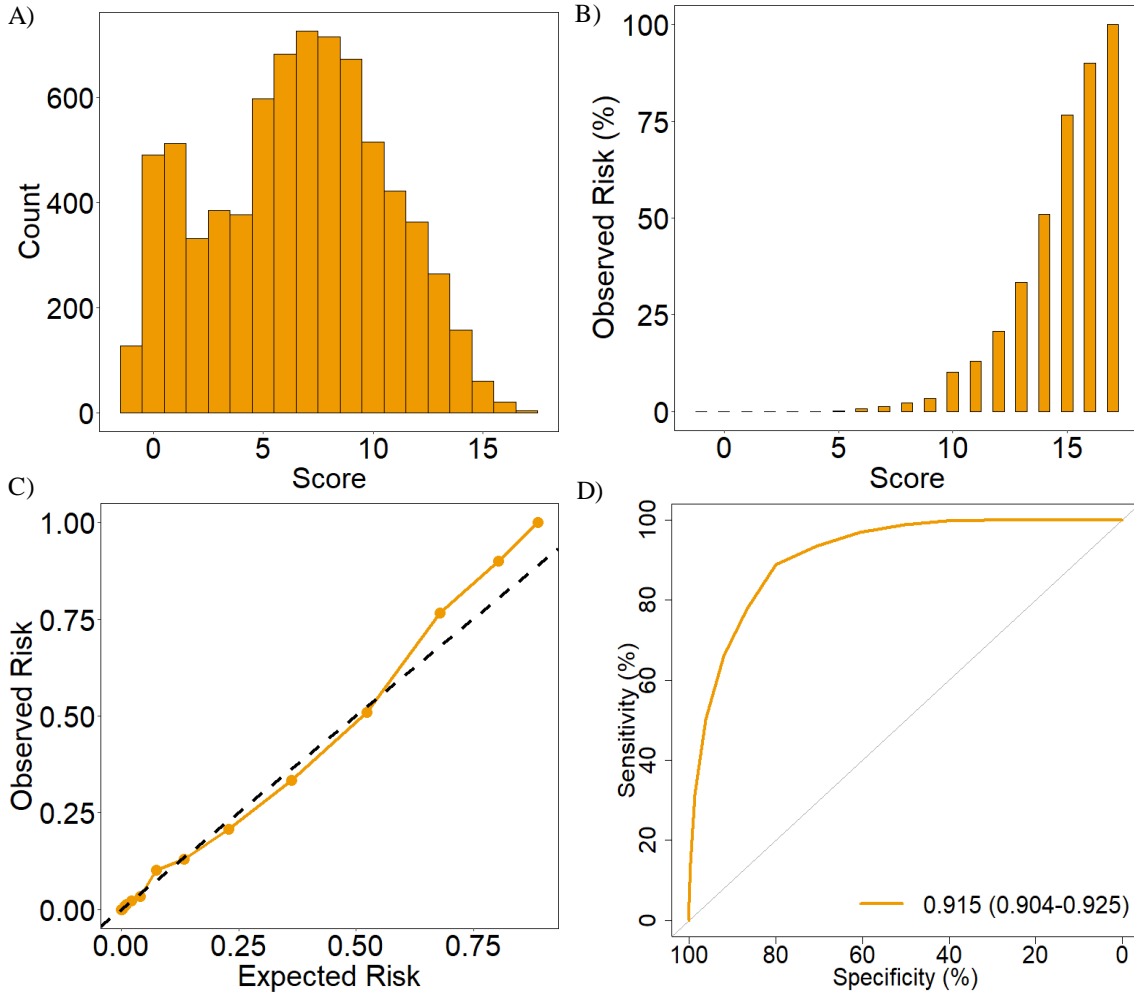


Figure S2. Receiver operator curves and area under the curve (AUC) for the CCEDRRN COVID Mortality Score in the derivation and validation cohorts, the SEIMC score (Berenguer et al.),(11) the 4C Mortality Score (Knight et al.),(9) and the VACO Index (King et al.) in the validation cohort.(37)

