SuperLearner versus Clinicians to Prioritise Trauma Patients (working title)

Test version 0.0.0.9000

Results

During the study period, we approached a total of 1500 patients for enrollment. 54 patients did not provide informed consent. Out of the 1446 patients who provided informed consent, 99 had missing data on priority level assigned by clinicians, leaving 1401 patients. An additional 539 were excluded because of missing outcome data. Thus, the final study sample included 862 patients.

Table 1 shows sample characteristics. The median age among included patients was 30 (IQR 24-42) years. A majority, 680 (79%) patients, were males. The most common mechanism of injury was transport accidents, accounting for 358 (42%) patients. A total of 518 (60%) patients were transported to participating centres in some sort of private vehicle, such as a car, taxi, or rickshaw. A majority of patients had normal vital signs on arrival to participating centres. Out of all patients, 61 (7%) died within 30 days of arrival. The number of patients in the training and test samples were 562 and 300 respectively.

The AUROCC of the continuous SuperLearner prediction in the training sample was 0.9994 (Figure 1A). Figure 2A shows the agreement between the continuous predictions and observed outcomes in the training sample. The cutpoints identified by the grid search were 0.27, 0.46, and 0.99. We used these cutpoints to bin the continuous SuperLearner prediction into the four priority levels green, yellow, orange, and red. The AUROCC of the binned SuperLearner predictions in the training sample was 0.9997. Table 2 shows the number of patients and all cause 30-day mortality in each group.

We then applied the SuperLearner to the test sample. The AUROCC of the continous SuperLearner prediction was 0.9811 Figure 1B. Figure 2B shows the agreement between the continuous predictions and observed outcomes in the test sample. We used the same cutpoints as in the training sample to bin the continuous predictions into the four priority levels. The AUROCC of the binned SuperLearner predictions in the test sample was 0.9429. Table 3 shows the number of patients and all cause 30-day mortality in each group.

In the test sample we compared the performance of the binned SuperLearner prediction with that of clinicians. The AUROCC of priority levels assigned by clinicians was 0.9723. Table 4 shows the priority levels assigned by clinicians and the all cause 30-day mortality in each group. The difference in AUROCC between the binned SuperLearner prediction and clinicians was 0.0294 (95% CI -0.0313 - 0.0672). The net reclassfciation in events and non-events were 0.0033 (95% CI 0.0034 - 0.0139) and -0.0133 (95% CI -0.1321 - -0.1003) respectively. The overall reclassification is show in Table 5. Figure 3 shows the all cause 30-day mortality across priority levels assigned by the SuperLearner and clinicians.

Figure 1: Receiver operating characteristics curves in training (A) and test (B) samples
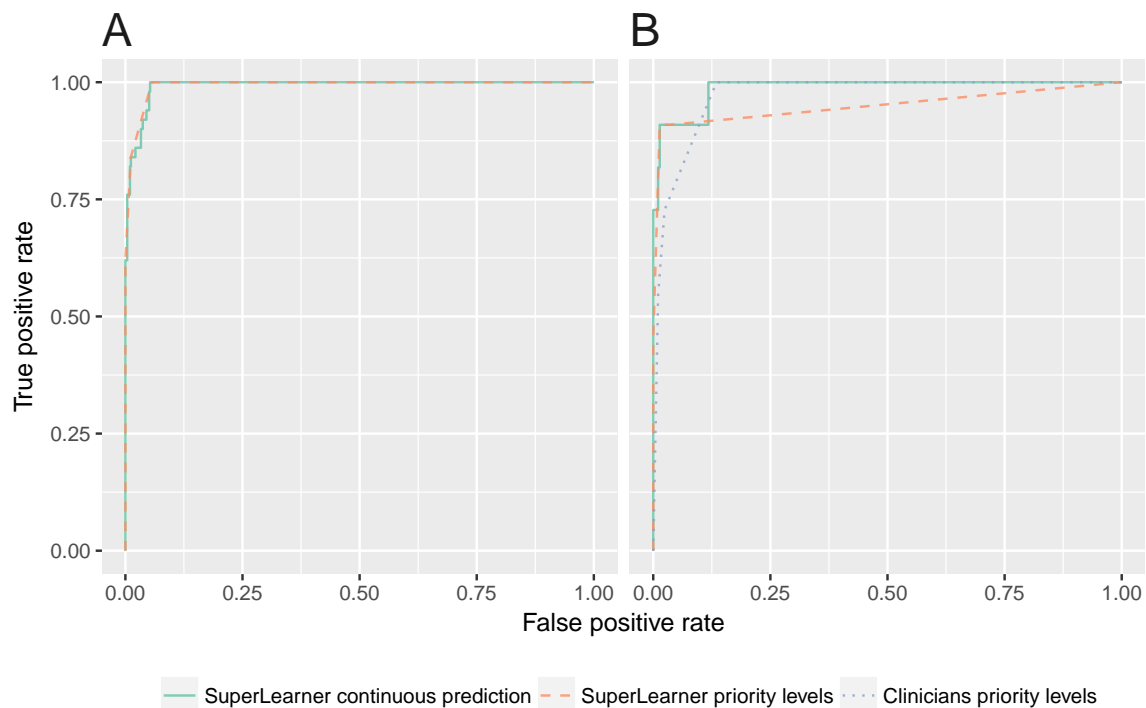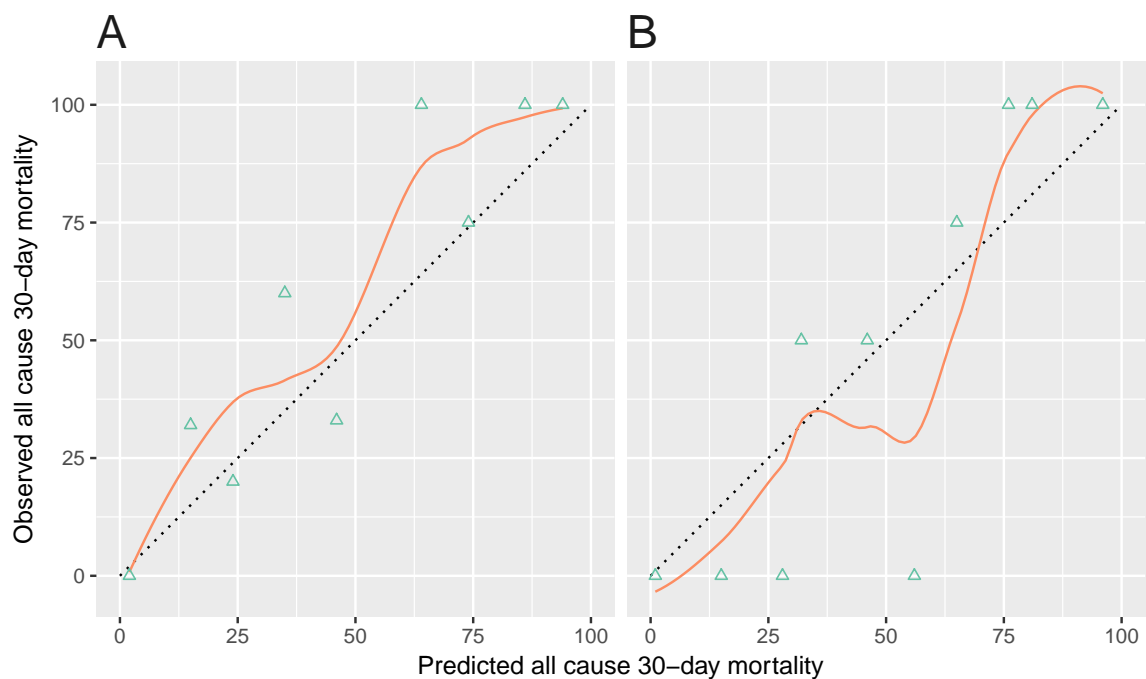

Figure 2: Agreement between the continuous SuperLearner prediction and observed all cause 30-day mortality in the training (A) and test (B) samples.

The straight dotted line indicates perfect agreement. The solid orange line is a smoothed association between mean mortality and mean predicted mortality across deciles of predicted mortality. The triangles are mortality point estimates across the same deciles.

Figure 3: All cause 30-day mortality across priority levels in the test sample
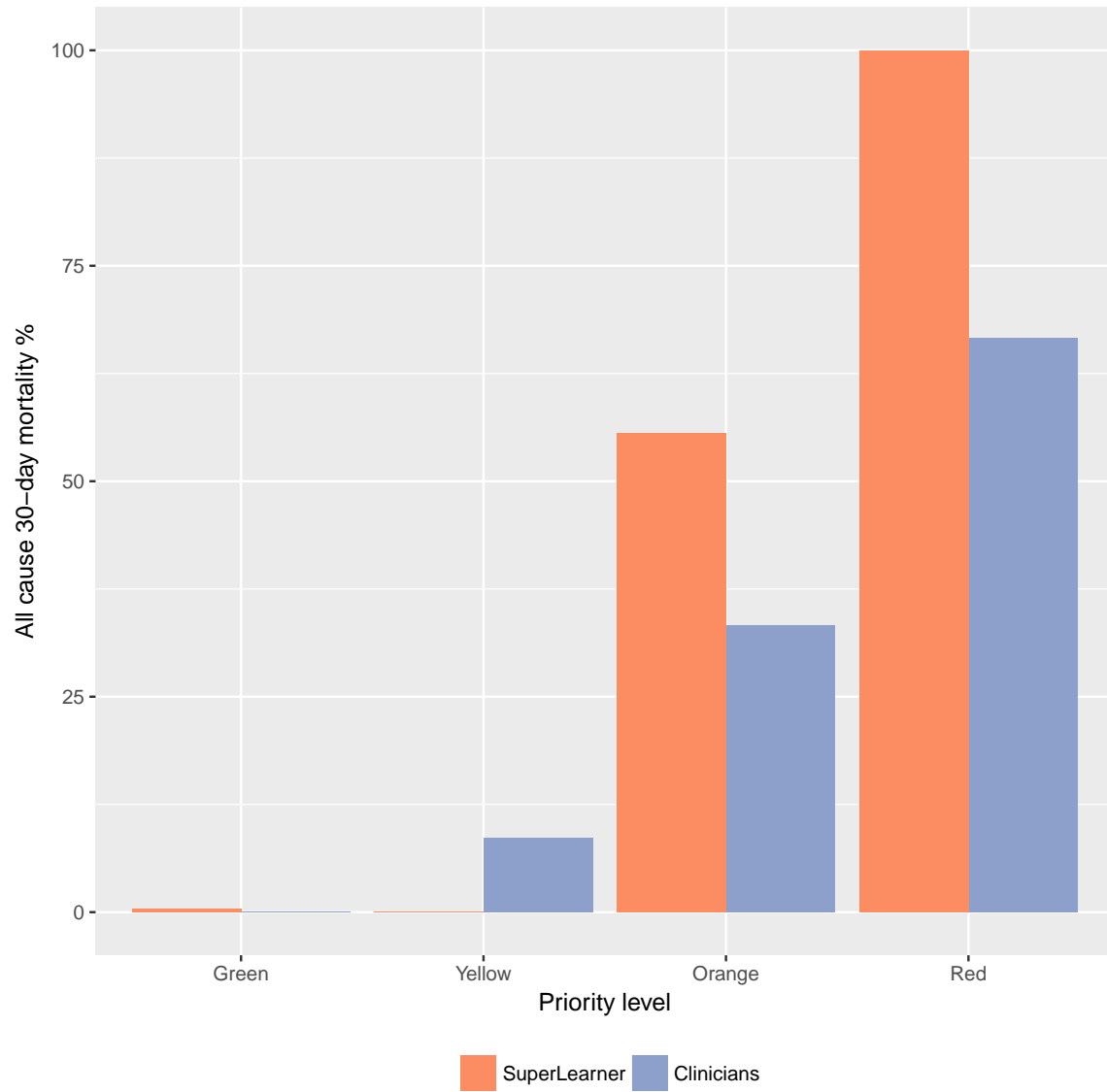
Table 1: Sample characteristics

Characteristic	Level	Training	Test	Overall
n (%)		562 (65.2)	300 (34.8)	862 (100.0)
Age in years (median [IQR])		30.0 [24.0, 45.0]	30.0 [23.0, 40.0]	30.0 [24.0, 42.0]
Sex (%)	Female	117 (20.8)	65 (21.7)	182 (21.1)
	Male	445 (79.2)	235 (78.3)	680 (78.9)
Mechanism of injury (%)	Assault	77 (13.7)	49 (16.3)	126 (14.6)
	Burn	2 (0.4)	1 (0.3)	3 (0.3)
	Event of undetermined intent	1 (0.2)	0 (0.0)	1 (0.1)
	Fall	150 (26.7)	81 (27.0)	231 (26.8)
	Intentional self harm	2 (0.4)	1 (0.3)	3 (0.3)
	Other external cause of accidental injury	67 (11.9)	73 (24.3)	140 (16.2)
	Transport accident	263 (46.8)	95 (31.7)	358 (41.5)
Type of injury (%)	Blunt	550 (97.9)	300 (100.0)	850 (98.6)
	Penetrating	10 (1.8)	0 (0.0)	10 (1.2)
	Blunt and penetrating	2 (0.4)	0 (0.0)	2 (0.2)
Mode of transport (%)	Ambulance	238 (42.3)	41 (13.7)	279 (32.4)
	Police	24 (4.3)	8 (2.7)	32 (3.7)
	Private vehicle	286 (50.9)	232 (77.3)	518 (60.1)
	Arrived walking	14 (2.5)	19 (6.3)	33 (3.8)
Transferred (%)	No	315 (56.0)	253 (84.3)	568 (65.9)
	Yes	247 (44.0)	47 (15.7)	294 (34.1)
SBP (median [IQR])		120.0 [111.0, 130.0]	122.0 [114.0, 134.0]	121.0 [112.0, 132.0]
DBP (median [IQR])		80.0 [70.0, 86.8]	82.0 [73.0, 90.0]	80.0 [72.0, 88.0]
SpO^2 (median [IQR])		98.0 [97.0, 98.0]	98.0 [98.0, 98.0]	98.0 [97.0, 98.0]
HR (median [IQR])		88.0 [78.0, 96.8]	87.0 [78.0, 100.0]	88.0 [78.0, 98.0]
RR (median [IQR])		20.0 [18.0, 22.0]	24.0 [20.0, 26.0]	22.0 [18.0, 24.0]
EGCS (%)	1	33 (5.9)	11 (3.7)	44 (5.1)
	2	8 (1.4)	1 (0.3)	9 (1.0)
	3	17 (3.0)	1 (0.3)	18 (2.1)
	4	503 (89.5)	286 (95.3)	789 (91.5)
	Non testable	1 (0.2)	1 (0.3)	2 (0.2)
VGCS (%)	1	35 (6.2)	10 (3.3)	45 (5.2)
	2	11 (2.0)	4 (1.3)	15 (1.7)
	3	7 (1.2)	0 (0.0)	7 (0.8)
	4	22 (3.9)	0 (0.0)	22 (2.6)
	5	487 (86.7)	285 (95.0)	772 (89.6)
	Non testable	0 (0.0)	1 (0.3)	1 (0.1)
MGCS (%)	1	15 (2.7)	4 (1.3)	19 (2.2)
	2	7 (1.2)	2 (0.7)	9 (1.0)
	3	9 (1.6)	4 (1.3)	13 (1.5)
	4	6 (1.1)	1 (0.3)	7 (0.8)
	5	23 (4.1)	3 (1.0)	26 (3.0)
	6	500 (89.0)	286 (95.3)	786 (91.2)
	Non testable	2 (0.4)	0 (0.0)	2 (0.2)
AVPU (%)	Unresponsive	17 (3.0)	4 (1.3)	21 (2.4)
	Pain responsive	28 (5.0)	9 (3.0)	37 (4.3)
	Voice responsive	18 (3.2)	1 (0.3)	19 (2.2)
	Alert	499 (88.8)	286 (95.3)	785 (91.1)
Delay (median [IQR])		170.0 [50.0, 893.5]	66.0 [35.0, 288.0]	120.0 [43.2, 693.8]
All cause 30-day mortality (%)	No	512 (91.1)	289 (96.3)	801 (92.9)
	Yes	50 (8.9)	11 (3.7)	61 (7.1)

Abbreviations and explanations: AVPU, Alert, voice, pain, unresponsive scale; DBP, Diastolic blood pressure in mmHg; Delay, Time between injury and arrival to participating centre in minutes; EGCS, Eye component of the Glasgow Coma Scale; HR, Heart rate; MGCS, Motor component of the Glasgow Coma Scale; RR, Respiratory rate in breaths per minute; SBP, Systolic blood pressure in mmHg; SpO^2, Peripheral capillary oxygen saturation; Transferred, Transferred from another health facility; VGCS, Verbal component of the Glasgow Coma Scale

Table 2: Priority levels assigned by the binned SuperLearner prediction in the training sample (n = 562)

All cause 30-day mortality	Green (%)	Yellow (%)	Orange (%)	Red (%)	Overall (%)
No	509 (100)	3 (25)	0 (0)	0 (NaN)	512 (91)
Yes	0 (0)	9 (75)	41 (100)	0 (NaN)	50 (9)

Table 3: Priority levels assigned by the binned SuperLearner prediction in the test sample (n = 300)

All cause 30-day mortality	Green (%)	Yellow (%)	Orange (%)	Red (%)	Overall (%)
No	283 (100)	3 (75)	3 (25)	0 (NaN)	289 (96)
Yes	1 (0)	1 (25)	9 (75)	0 (NaN)	11 (4)

Table 4: Priority levels assigned by clinicians in the test sample (n = 300)

All cause 30-day mortality	Green (%)	Yellow (%)	Orange (%)	Red (%)	Overall (%)
No	250 (100)	32 (91)	4 (67)	3 (33)	289 (96)
Yes	0 (0)	3 (9)	2 (33)	6 (67)	11 (4)

Table 5: Priority levels assigned by SuperLearner and clinicians in complete test sample (n = 300)

Clinicians	SuperLearner Green	Yellow	Orange	Red	Rec. %	Rec. up %	Rec. down %
Green	249	0	1	0	0	0	
Yellow	32	1	2	0	97	6	91
Orange	1	3	2	0	67	0	67
Red	2	0	7	0	100		100

Reclassification (Rec.) figures refer to % of patients reclassified by the SuperLearner compared to clinicians. Rec. up and Rec. down indicates % of patients reclassified to a higher or lower priority level respectively.