

TABLE 1. Characteristics of Patients

Characteristic	Values
Age, years (median [IQR])	69 [62-78] (n= 646)
Male sex, k/n (%)	366/657 (56)
Height in meter (median [IQR])	1.65 [1.58-1.72] (n= 663)
Weight in kilogram (median [IQR])	67 [60-72] (n= 663)
BMI (median [IQR])	25 [23-26] (n= 663)
Measured PaO ₂ /FiO ₂ ratio (median [IQR])	174 [125-226] (n= 663)
PaO₂/FiO₂ ratio, values by threshold	
PaO ₂ /FiO ₂ > 300 k/n (%)	53/663 (21)
PaO ₂ /FiO ₂ ≤ 300 k/n (%)	187/663 (28)
PaO ₂ /FiO ₂ ≤ 200 k/n (%)	162/663 (24)
PaO ₂ /FiO ₂ ≤ 150 k/n (%)	171/663 (26)
PaO ₂ /FiO ₂ ≤ 100 k/n (%)	90/663 (14)
Number of ABG performed	
1 measurement k/n (%)	522/659 (79)
2 measurements k/n (%)	75/659 (12)
3 measurements k/n (%)	62/659 (9)
SOFA score (median [IQR])	5 [4-7] (n= 660)

TABLE 2. Results of Oximetry and Arterial Blood Gas

Variables	Values
Patient Located in ICU, k/n (%)	612/612 (100)
ABG Done during the Day, k/n (%)	484/661 (73)
Pulse Oximeter Location	
Earlobe, k/n (%)	6/663 (0.9)
Finger, k/n (%)	652/663 (98.3)
Toe, k/n (%)	3/663 (0.5)
Forehead, k/n (%)	2/663 (0.3)
Pulse Oximeter Type	
Disposable Sensor, k/n (%)	512/654 (78)
Reusable Sensor, k/n (%)	140/654 (21)
Forehead (transreflectance) Sensor, k/n (%)	2/654 (1)
SpO ₂ (median [IQR])	98 [96-99] (n=654)
SpO ₂ (where SpO ₂ ≤ 96%) (median [IQR])	95 [93-96] (n= 177)
Adequate Pulse Oximeter Waveform, k/n (%)	647/649 (99)
Skin Pigmentation	
Light, k/n (%)	31/660 (5)
Light/Medium, k/n (%)	439/660 (66)
Medium, k/n (%)	163/660 (25)
Medium/Dark, k/n (%)	24/660 (3)
Dark, k/n (%)	3/660 (1)

pH (median [IQR])	7.41 [7.37-7.47] (n= 662)
PCO ₂ (median [IQR])	39 [34 - 46] (n= 663)
PaO ₂ (median [IQR])	75 [65 - 87] (n= 663)
SaO ₂ (median [IQR])	95 [93 - 97] (n= 663)
Methemoglobin (median [IQR])	1.20 [1.10 – 1.40] (n= 133)
Carboxyhemoglobin (median [IQR])	-0.20 [-0.40 - 0.10] (n= 128)
Temperature at time of ABG, °C (mean (± SD))	37 ± 0.7 (n= 662)
On vasopressor at time of ABG, k/n (%)	106/658 (16)
Na (median [IQR])	139 [137-143] (n= 661)
Cl (median [IQR])	108 [104 - 112] (n= 663)
HCO ₃ (median [IQR])	25 [23 - 29] (n= 662)
K (median [IQR])	3.9 [3.6 - 4.3] (n= 662)
BUN (median [IQR])	23 [17 - 29] (n= 663)
Creatinine (median [IQR])	1.50 [0.79 - 1.75] (n= 655)
PEEP, cmH ₂ O (median [IQR])	5.00 [4.00 - 8.00] (n= 663)
FiO ₂ , % (median [IQR])	45 [40 - 60] (n= 663)
Tidal volume, mL (mean (SD))	361 ± 69 (n=663)
Tidal volume (adjusted per body weight), mL/Kg (mean (SD))	6 ± 1 (n = 663)
Minute ventilation, L/min (median [IQR])	5 [4 - 7] (n= 663)

TABLE 3: Comparison of Error on Each Imputation Technique

Imputation technique	Mean absolute error	Standard deviation of error	P value (comparison with non-linear imputation)	Percentage of ABG with error < 25 mmHg	Proportion of ABG with error < 50 mmHg
All ABGs (n=663)					
Non-linear	67.7	71.9	N/A	22.2	47.4
Linear	41.9	67.5	P<0.001	45.4	71.8
Log-linear	42.2	59.4	P<0.001	29.6	69.1
ABGs with SpO₂ ≤ 96% (n=177)					
Non-linear	27.5	27.4	N/A	54.2	83.1
Linear	42.5	47.4	P<0.001	44.6	62.7
Log-linear	50.1	26.9	P=0.218	11.9	45.2
ABGs where other ARDS criteria met (n=132)					
Non-Linear	63.4	58.8	N/A	22.6	46
Linear	35.4	43	P<0.001	43.8	71.5
Log-linear	40.9	33.2	P<0.001	24.8	61.3
ABGs with SpO₂ ≤ 96% where other ARDS criteria met (n=44)					
Non-linear	26.4	21.5	N/A	48.9	86.7
Linear	39.3	37.2	P<0.001	42.2	66.7
Log-linear	51.2	23.6	P=0.075	11.1	40

TABLE 4. Area Under the Receiver Operating Characteristic Curve for Moderate to Severe Acute Respiratory Distress Syndrome, All Acute Respiratory Distress Syndrome, and Acute Respiratory Failure

Severe ARDS (PF ratio \leq 150)						
Imputation method	All ABGs (n= 663)		Other ARDS criteria met (n= 132)		Other ARDS criteria are NOT met (n= 531)	
	AUC	95% CI	AUC	95% CI	AUC	95% CI
Non-linear	0.94	0.93-0.96	0.92	0.87-0.96	0.95	0.93-0.97
Linear/log-linear	0.95	0.93-0.97	0.94	0.90-0.98	0.95	0.93-0.97
All ARDS (PF ratio \leq 300)						
Non-linear	0.90	0.85-0.95	0.93	0.79-1	0.90	0.85-0.94
Linear/log-linear	0.88	0.82-0.94	1	1	0.87	0.81-0.93
Severe ARDS (PF ratio \leq 150) where SpO₂ \leq 96%						
	All ABGs (n= 177)		Other ARDS criteria met (n= 44)		Other ARDS criteria are NOT met (n= 133)	
	AUC	95% CI	AUC	95% CI	AUC	95% CI
Non-linear	0.97	0.95-0.99	0.98	0.95-1	0.96	0.94-0.99
Linear/log-linear	0.97	0.95-0.99	0.98	0.96-1	0.97	0.94-0.99
ARDS (PF ratio \leq 300) where SpO₂ \leq 96%						
Non-linear	0.98	0.96-1	1	NA	0.98	0.95-1
Linear/log-linear	0.98	0.96-0.99	1	NA	0.97	0.95-0.99

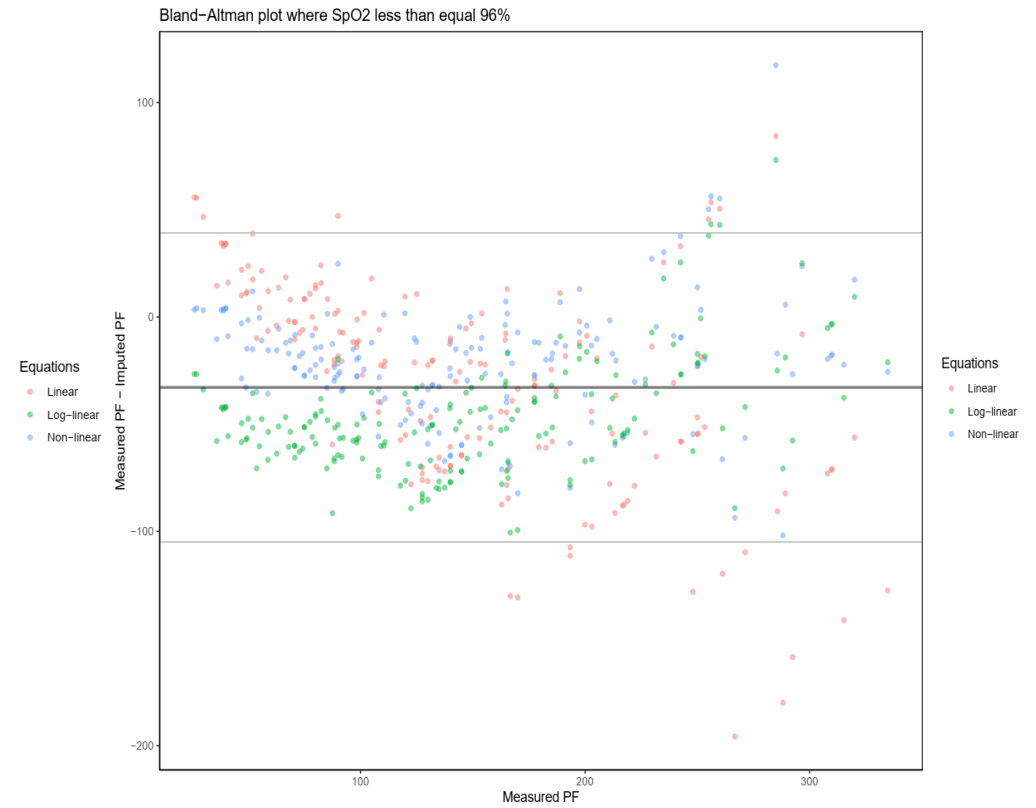
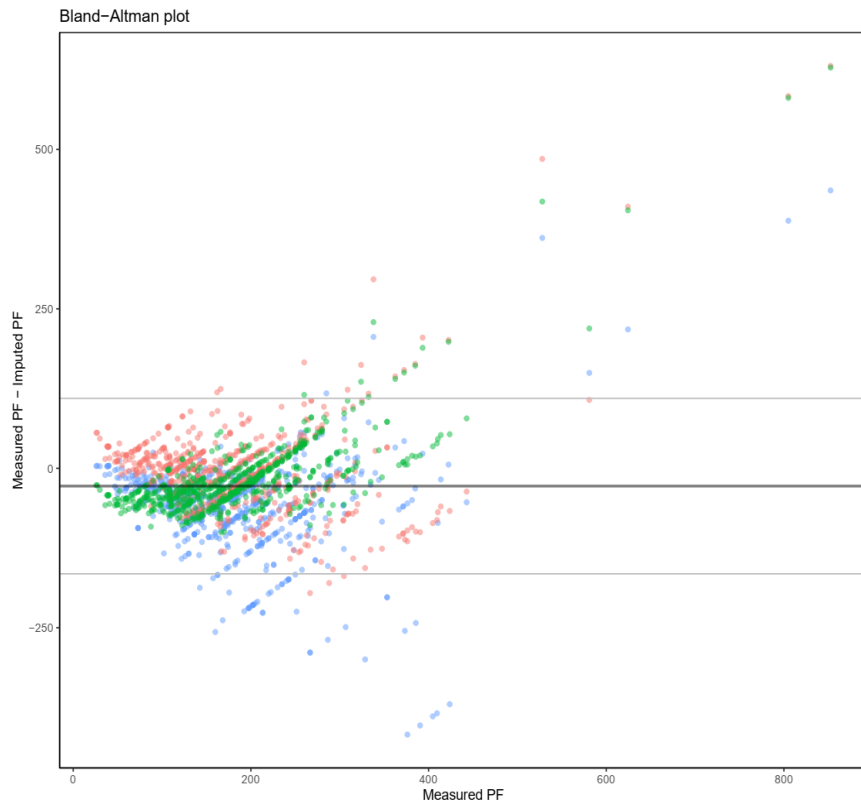


Figure 1. Bland-Altman plot of the difference between measured and imputed Pao₂/Fio₂ (PF) ratios. *Blue* represents nonlinear, *red* represents linear, and *green* represents log-linear imputation results. ABG = arterial blood gas.

Supplement 1

Skin pigmentations from light to dark on a five- point scale: one means the lightest and five means the darkest.

Skin Colors



light



light/medium



medium



medium/dark



dark

Supplement 2

ROC contrast p-value

	Severe ARDS (PF ratio ≤ 150)	ARDS (PF ratio ≤ 300)
Non-linear vs. Linear	0.424	0.239
Non-linear vs. Log-linear	0.424	0.239
Linear vs. Log-linear	1	1

Supplement 3

AUC for logistic regression predicting PF ratio ≤ 300

Models	AUC
PF non-linear	0.9002
PF non-linear + SpO2	0.9063
PF non-linear + SpO2 + Age	0.9062
PF non-linear + SpO2 + Age + Sex	0.9099
PF non-linear + SpO2 + Age + Sex + Creatinine	0.9129

AUC for logistic regression predicting PF ratio ≤ 150

Models	AUC
PF non-linear	0.9426
PF non-linear + FiO2	0.9614
PF non-linear + FiO2 + PcO2	0.9670
PF non-linear + FiO2 + PcO2 + min vent	0.9680
PF non-linear + FiO2 + PcO2 + min vent + SpO2	0.9676
PF non-linear + FiO2 + PcO2 + min vent + SpO2 + Sodium	0.9677