Supplementary Information
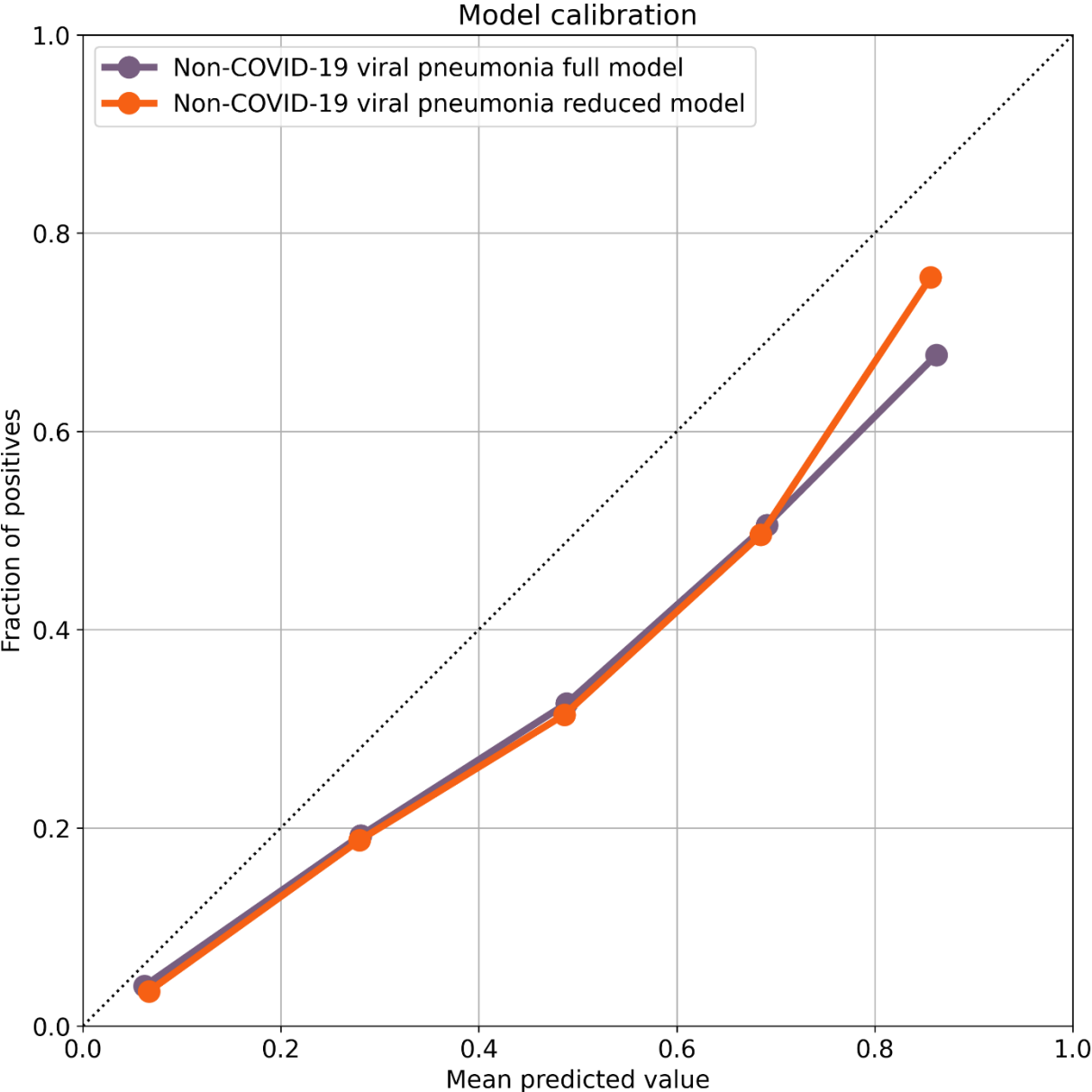
Model training parameter

Parameter group	Parameter	Range/Value	Full model value	Reduced model value
XGBoost	max_depth	2-4	3	3
	gamma	0 – 5	1.472283	0.453242
	min_child_weight	0 - 10	2.501065	2.467975
	max_delta_step	0	0	0
	subsample	0.8 – 1.0	0.971699	0.9072
	colsample_bytree	0.3 – 1.0	0.97187	0.488832
	eta	0.01 – 0.1	0.020001	0.029677
	num_boost_round	10 – 1000	979	390
	alpha	0	0	0
	lambda	1	1	1
Bayesian optimization	Initial random exploration steps	10		
	Optimization steps	100		

Supplementary Table 1: Parameters for XGBoost hyper-parameter tuning. *Shown are the hyper-parameter search ranges used to optimize the predictive performance of the prediction models using a Bayesian optimization approach and the resulting final model values.*

Supplementary Figure 1: Model calibration. *Shown is the observed risk of death within the next 5 days (y axis) vs the mean predicted value of the non-COVID-19 viral pneumonia model trained on all features (purple) and the non-COVID-19 viral pneumonia reduced model trained on the top 20 features (orange). Dashed line indicates perfect calibration.*

Full model feature list

FEATURE	PERCENTILE	UNIT	MEAN ABSOLUTE SHAP VALUE
VASOACTIVE INOTROPIC SCORE	0.5		0.21
THROMBOCYTES	0.1	/nl	0.21
AGE	0.5	a	0.19
HEART RATE	0.1	1/min	0.17
NEUTROPHILS (%)	0.1	%	0.15
PULMONARY INFILTRATES	0.1		0.13
URINE OUTPUT	0.5	ml/d	0.10
RESPIRATORY RATE	0.9	1/min	0.10
PH	0.5		0.10
P/F RATIO	0.1	mmHg	0.09
VENTILATION MODE	0.1		0.09
MEAN ARTERIAL PRESSURE	0.1	mmHg	0.08
PTT	0.1	s	0.08
VENTILATION PEAK PRESSURE	0.5	mbar	0.07
RED BLOOD CELL DISTRIBUTION WIDTH	0.9	%	0.07
VASOACTIVE INOTROPIC SCORE	0.9		0.07
ALANINE AMINOTRANSFERASE	0.1	U/l	0.07
SODIUM	0.9	mmol/l	0.07
RED BLOOD CELL DISTRIBUTION WIDTH	0.1	%	0.07
MONOCYTES (%)	0.9	%	0.07
VENTILATION PEAK PRESSURE	0.1	mbar	0.07
PH	0.1		0.06
OXYGEN SATURATION	0.1	%	0.06
HEART RATE	0.5	1/min	0.06
OXYGEN PARTIAL PRESSURE (ARTERIAL)	0.5	mmHg	0.05
THROMBOCYTES	0.5	/nl	0.05
INR-QUICK	0.9		0.05
LACTATE DEHYDROGENASE	0.5	U/l	0.05
HEIGHT	0.5	cm	0.05
VOLUME INTAKE	0.5	ml/h	0.05
METABOLIC DISORDERS	0.5		0.05
CARCINOMA	0.5		0.05
EOSINOPHILS ABSOLUTE	0.1	/nl	0.05
ANTIMYKOTICS APPLICATION	0.5	1/h	0.05
NOREPINEPHRINE	0.1	µg/kg/min	0.05
ANTITHROMBIN III	0.9	%	0.05
TIDAL VOLUME	0.1	ml	0.04
LACTATE	0.1	mg/dl	0.04
LACTATE DEHYDROGENASE	0.1	U/l	0.04
POTASSIUM	0.9	mmol/l	0.04
CUMULATIVE VOLUME INTAKE	0.5	ml/h	0.04
CREATININE	0.9	mg/dl	0.04

P-RISK SCORE	0.5		0.04
OXYGEN PARTIAL PRESSURE (ARTERIAL)	0.9	mmHg	0.04
P/F RATIO	0.5	mmHg	0.04
THROMBOCYTES	0.9	/nl	0.04
HEMOGLOBIN	0.9	g/dl	0.04
CALCIUM	0.1	mmol/l	0.04
CKMB	0.1	U/l	0.04
P-RISK SCORE	0.1		0.04
VENTILATION PEEP	0.9	mbar	0.03
HEART RATE	0.9	1/min	0.03
RED BLOOD CELL DISTRIBUTION WIDTH	0.5	%	0.03
HYPERTENSION	0.5		0.03
VOLUME BALANCE	0.5	ml/h	0.03
INR-QUICK	0.5		0.03
TRIGLYCERIDE	0.9	mg/dl	0.03
NEUTROPHILS ABSOLUTE	0.1	/nl	0.03
CK	0.5	U/l	0.03
ALBUMIN	0.9	g/l	0.03
LEVOSIMENDAN	0.1	µg/kg/min	0.03
P/F RATIO	0.9	mmHg	0.03
ANTIBIOTICS APPLICATION	0.5	1/h	0.03
D-DIMER	0.9	mg/l	0.03
UREA	0.9	mg/dl	0.03
VENTILATION PEEP	0.9	mbar	0.03
C-REACTIVE PROTEIN	0.9	mg/l	0.03
RESPIRATORY MINUTE VOLUME	0.1	l/min	0.03
D-DIMER	0.5	mg/l	0.02
CD8 CELLS (%)	0.1	%	0.02
MYOGLOBIN	0.1	µg/l	0.02
D-DIMER	0.1	mg/l	0.02
NOREPINEPHRINE	0.9	µg/kg/min	0.02
LACTATE	0.5	mg/dl	0.02
PROCALCITONIN	0.9	µg/l	0.02
CUMULATIVE VOLUME INTAKE	0.5	ml/d	0.02
BILIRUBIN	0.9	mg/dl	0.02
C-REACTIVE PROTEIN	0.1	mg/l	0.02
LUNG COMPLIANCE	0.9	ml/mbar	0.02
BMI	0.5	kg/m²	0.02
CREATININE	0.1	mg/dl	0.02
GLUCOSE	0.9	mg/dl	0.02
GLUCOSE	0.5	mg/dl	0.02
BICARBONATE	0.5	mmol/l	0.02
DIASTOLIC BLOOD PRESSURE	0.5	mmHg	0.02
MONOCYTES ABSOLUTE	0.5	/nl	0.02
ASPARTATE TRANSAMINASE	0.1	U/l	0.02
MONOCYTES (%)	0.1	%	0.02

OXYGEN PARTIAL PRESSURE (ARTERIAL)	0.1	mmHg	0.02
LEUKOCYTES	0.1	/nl	0.02
BILIRUBIN	0.5	mg/dl	0.02
P-RISK SCORE	0.9		0.02
MEAN ARTERIAL PRESSURE	0.5	mmHg	0.02
PTT	0.9	s	0.02
CKMB	0.9	U/l	0.02
VENTILATION PEEP	0.5	mbar	0.02
LACTATE	0.9	mg/dl	0.02
TRIGLYCERIDE	0.1	mg/dl	0.02
VENTILATION PEAK PRESSURE	0.1	mbar	0.01
TIDAL VOLUME	0.5	ml	0.01
NEUTROPHILS (%)	0.5	%	0.01
UREA	0.1	mg/dl	0.01
LACTATE DEHYDROGENASE	0.9	U/l	0.01
ASPARTATE TRANSAMINASE	0.9	U/l	0.01
MONOCYTES (%)	0.5	%	0.01
MYOGLOBIN	0.5	µg/l	0.01
LUNG COMPLIANCE	0.5	ml/mbar	0.01
CK	0.1	U/l	0.01
VENTILATION PEEP	0.5	mbar	0.01
EOSINOPHILS ABSOLUTE	0.9	/nl	0.01
ANTITHROMBIN III	0.1	%	0.01
CALCIUM	0.5	mmol/l	0.01
BODY TEMPERATURE	0.9	°C	0.01
RESPIRATORY MINUTE VOLUME	0.9	l/min	0.01
EOSINOPHILS (%)	0.9	%	0.01
CK	0.9	U/l	0.01
STROKE	0.5		0.01
VASOACTIVE INOTROPIC SCORE	0.1		0.01
GLUCOSE	0.1	mg/dl	0.01
SYSTOLIC BLOOD PRESSURE	0.9	mmHg	0.01
TRIGLYCERIDE	0.5	mg/dl	0.01
TIDAL VOLUME	0.9	ml	0.01
INR-QUICK	0.1		0.01
RESPIRATORY RATE	0.5	1/min	0.01
EOSINOPHILS (%)	0.1	%	0.01
ANTITHROMBIN III	0.5	%	0.01
PROCALCITONIN	0.5	µg/l	0.01
SODIUM	0.1	mmol/l	0.01
ALBUMIN	0.1	g/l	0.01
BASE EXCESS	0.1	mmol/l	0.01
EOSINOPHILS ABSOLUTE	0.5	/nl	0.01
VENTILATION PEEP	0.1	mbar	0.01
OXYGEN SATURATION	0.5	%	0.01
SODIUM	0.5	mmol/l	0.01

RESPIRATORY RATE	0.1	1/min	0.01
VENTILATION PEAK PRESSURE	0.9	mbar	0.01
NEUTROPHILS (%)	0.9	%	0.01
MONOCYTES ABSOLUTE	0.1	/nl	0.01
MONOCYTES ABSOLUTE	0.9	/nl	0.01
LYMPHOCYTES (%)	0.9	%	0.01
VENTILATION PEAK PRESSURE	0.5	mbar	0.01
PROCALCITONIN	0.1	µg/l	0.01
ALBUMIN	0.5	g/l	0.01
CD4 CELLS ABSOLUTE	0.5	/nl	0.01
EPINEPHRINE	0.5	µg/kg/min	0.01
PULMONARY INFILTRATES (PROGRESSIVE)	0.9		0.01
END TIDAL CO2	0.5	mmHg	0.01
FIO2	0.1	%	0.01
BILIRUBIN	0.1	mg/dl	0.01
ASPARTATE TRANSAMINASE	0.5	U/l	0.01
CARBON DIOXIDE PARTIAL PRESSURE	0.1	mmHg	0.01
END TIDAL CO2	0.1	mmHg	0.01
NEUTROPHILS ABSOLUTE	0.9	/nl	0.01
SYSTOLIC BLOOD PRESSURE	0.5	mmHg	0.01
TROPONIN	0.1	ng/l	0.01
SYSTOLIC BLOOD PRESSURE	0.1	mmHg	0.01
PH	0.9		0.01
DIURESIS	0.1	ml/h	0.01
LEUKOCYTES	0.5	/nl	0.01
WEIGHT	0.5	kg	0.01
VENTILATION PEAK PRESSURE	0.9	mbar	0.01
HEMOGLOBIN	0.5	g/dl	0.01
BILIRUBIN DIREKT	0.1	mg/dl	0.01
PULMONARY INFILTRATES (BILATERAL)	0.9		0.01
MYOGLOBIN	0.9	µg/l	0.01
PULMONARY INFILTRATES	0.5		0.00
DIASTOLIC BLOOD PRESSURE	0.1	mmHg	0.00
BPS	0.5		0.00
BPS	0.9		0.00
CARBON DIOXIDE PARTIAL PRESSURE	0.9	mmHg	0.00
PULMONARY INFILTRATES (BILATERAL)	0.5		0.00
TROPONIN	0.5	ng/l	0.00
CD4 CELLS (%)	0.9	%	0.00
BILIRUBIN DIREKT	0.9	mg/dl	0.00
C-REACTIVE PROTEIN	0.5	mg/l	0.00
BASE EXCESS	0.9	mmol/l	0.00
EPINEPHRINE	0.1	µg/kg/min	0.00

PTT	0.5	s	0.00
URINE OUTPUT	0.5	ml/h	0.00
HEMOGLOBIN	0.1	g/dl	0.00
LEUKOCYTES	0.9	/nl	0.00
DELIRIUM	0.1		0.00
VENTILATION PEEP	0.1	mbar	0.00
CHRONIC KIDNEY DISEASES	0.5		0.00
FERRITIN	0.9	µg/l	0.00
NOREPINEPHRINE	0.5	µg/kg/min	0.00
DIASTOLIC BLOOD PRESSURE	0.9	mmHg	0.00
DELIRIUM	0.5		0.00
BICARBONATE	0.9	mmol/l	0.00
BODY TEMPERATURE	0.1	°C	0.00
LUNG COMPLIANCE	0.1	ml/mbar	0.00
UREA	0.5	mg/dl	0.00
ALANINE AMINOTRANSFERASE	0.5	U/l	0.00
LYMPHOCYTES (%)	0.1	%	0.00
LEVOSIMENDAN	0.5	µg/kg/min	0.00
EOSINOPHILS (%)	0.5	%	0.00
BILIRUBIN DIREKT	0.5	mg/dl	0.00
POTASSIUM	0.1	mmol/l	0.00
DIURESIS	0.9	ml/h	0.00
CKMB	0.5	U/l	0.00
DELIRIUM	0.9		0.00
BASE EXCESS	0.5	mmol/l	0.00
DIURESIS	0.5	ml/h	0.00
OXYGEN SATURATION	0.9	%	0.00
POTASSIUM	0.5	mmol/l	0.00
ALANINE AMINOTRANSFERASE	0.9	U/l	0.00
CALCIUM	0.9	mmol/l	0.00
PULMONARY HYPERTENSION	0.5		0.00
CARBON DIOXIDE PARTIAL PRESSURE	0.5	mmHg	0.00
CUMULATIVE VOLUME BALANCE	0.5	ml/d	0.00
LYMPHOCYTES (%)	0.5	%	0.00
BODY TEMPERATURE	0.5	°C	0.00
FIO2	0.5	%	0.00
END TIDAL CO2	0.9	mmHg	0.00
VENTILATION MODE	0.5		0.00
NEUTROPHILS ABSOLUTE	0.5	/nl	0.00
CARDIOVASCULAR DISEASES	0.5		0.00
CORTICOIDS APPLICATION	0.5	1/h	0.00
CREATININE	0.5	mg/dl	0.00
BICARBONATE	0.1	mmol/l	0.00
LYMPHOCYTES ABSOLUTE	0.9	/nl	0.00
EPINEPHRINE	0.9	µg/kg/min	0.00
VASOPRESSIN	0.9	E/kg/h	0.00

Feature		Unit	Importance
DOBUTAMINE	0.9	µg/kg/min	0.00
ENOXIMONE	0.9	µg/kg/min	0.00
LEVOSIMENDAN	0.9	µg/kg/min	0.00
CD4 CELLS ABSOLUTE	0.1	/nl	0.00
CD8 CELLS (%)	0.9	%	0.00
ENOXIMONE	0.1	µg/kg/min	0.00
DOBUTAMINE	0.1	µg/kg/min	0.00
VASOPRESSIN	0.1	E/kg/h	0.00
CD8 CELLS ABSOLUTE	0.9	/nl	0.00
CD4 CELLS ABSOLUTE	0.9	/nl	0.00
PULMONARY INFILTRATES (BILATERAL)	0.1		0.00
PULMONARY INFILTRATES (PROGRESSIVE)	0.1		0.00
TROPONIN	0.9	ng/l	0.00
BPS	0.1		0.00
FERRITIN	0.5	µg/l	0.00
VENTILATION MODE	0.9		0.00
CD4 CELLS (%)	0.1	%	0.00
FIO2	0.9	%	0.00
MEAN ARTERIAL PRESSURE	0.9	mmHg	0.00
CD8 CELLS (%)	0.5	%	0.00
CD8 CELLS ABSOLUTE	0.5	/nl	0.00
CD4 CELLS (%)	0.5	%	0.00
ENOXIMONE	0.5	µg/kg/min	0.00
DOBUTAMINE	0.5	µg/kg/min	0.00
VASOPRESSIN	0.5	E/kg/h	0.00
SEX	0.5		0.00
RESPIRATORY MINUTE VOLUME	0.5	l/min	0.00
PULMONARY INFILTRATES (PROGRESSIVE)	0.5		0.00
PULMONARY FIBROSIS	0.5		0.00
OBESITY	0.5		0.00
MALNUTRITION	0.5		0.00
LUNG DISEASES	0.5		0.00
LYMPHOCYTES ABSOLUTE	0.5	/nl	0.00
CORONARY HEART DISEASE	0.5		0.00
COPD	0.5		0.00
PULMONARY INFILTRATES	0.9		0.00
ASTHMA	0.5		0.00
FERRITIN	0.1	µg/l	0.00
LYMPHOCYTES ABSOLUTE	0.1	/nl	0.00
CD8 CELLS ABSOLUTE	0.1	/nl	0.00
DIABETES	0.5		0.00

Supplementary Table 2: Full model feature list and importances in training data set. *Shown are the features of the full model together with their importances as quantified by mean absolute SHAP values on the training dataset. For P Risk score, see* **Supplementary Table 3**.

P-Risk score

Condition	Score
Completely independently mobile or mostly independently mobile with no pressure ulcer present	0
Completely independently mobile or mostly independently mobile with pressure ulcer present or partially (~50%) independently mobile	1
Only marginally independently mobile or not independently mobile	2
Only marginally independently mobile or not independently mobile with continuous norepinephrine application	3

Supplementary Table 3: P-Risk Score. *The P-Risk Score is a score to measure the risk to develop pressure ulcer primarily based on an assessment of the patient's mobility. Shown are the conditions associated with the respective values of the P-Risk-Score.*