

SUPPLEMENTARY MATERIAL

Patient Management Assisted By A Neural Network Reduces Mortality In An Intermediate Care Unit

Sarah Heili Frades^{1#}, Pablo Minguez^{2#}, Ignacio Mahillo Fernández³, Luis Jiménez Hiscock⁴, Arnoldo Santos⁵, Daniel Heili Frades⁶, María del Pilar Carballosa de Miguel¹, Itziar Fernández Ormaechea¹, Laura Álvarez Suárez¹, Alba Naya Prieto¹, Nicolás González Mangado¹, Germán Peces-Barba Romero¹.

¹ Intermediate Respiratory Care Unit, IIS-Fundación Jiménez Díaz Quirón Salud, Madrid, CIBER de enfermedades respiratorias (CIBERES), REVA Network. ² Genetics and Genomics Department, IIS-Fundación Jiménez Díaz, Madrid, Center for Biomedical Network Research on Rare Diseases (CIBERER), ISCIII, Madrid, Spain ³ Department of Biostatistics and Epidemiology, IIS-Fundación Jiménez Díaz UAM, Madrid, Spain. ⁴ Thoracic Surgery Dept. Sanchinarro University Hospital, HM Hospitals Group, Madrid, Spain. ⁵ ITC Ingeniería y técnicas clínicas. CIBER de enfermedades respiratorias (CIBERES). ⁶ Civil Engineering, Soletanche-Bachy, Paris, France.

Supplementary Table 1. Cut-off values for every variable according to the Youden J index.

Variable	Cut-off	Sensibility	Specificity
AGE	63.8	0.909	0.185
SBP	104	0.182	0.891
DBP	65.5	0.485	0.658
T	36.1	0.212	0.865
RR	24.5	0.212	0.962
LEUCOS	3.23	0.182	0.989
Hb	10.5	0.515	0.725
PL	267	0.788	0.375
CREA	1.48	0.303	0.853
NA	140	0.697	0.412
K	3.68	0.970	0.155
PH	7.33	0.606	0.593
PCO2	103	0.091	0.961
P02	68.0	0.667	0.494
BE	6.35	0.788	0.359
SBC	26.4	0.545	0.651

Supplementary Table 2. Univariate logistic regression analysis.

Variable	OR	(IC 95%)	P
AGE >63.8	2.265	(0.802, 9.485)	0.134
SBP >104	0.581	(0.253, 1.570)	0.261
DBP >65.5	0.553	(0.277, 1.112)	0.096
T >36	0.580	(0.263, 1.461)	0.230
RR >24.5	6.764	(2.636, 15.30)	0.000

LEUCOS >3.23	0.052	(0.020, 0.150)	0.000
Hb >10.4	0.356	(0.177, 0.714)	0.004
PL >266	0.450	(0.179, 0.986)	0.046
CREA >1.48	2.514	(1.133, 5.196)	0.025
NA >140	0.908	(0.411, 1.867)	0.799
K >3.68	5.856	(1.253, 104.4)	0.019
PH >7.33	0.510	(0.246, 1.021)	0.057
PCO2 >103	2.443	(0.577, 7.056)	0.195
P02 >68	0.547	(0.254, 1.111)	0.096
BE >6.35	0.481	(0.191, 1.055)	0.069
SBC >26.4	0.464	(0.229, 0.925)	0.029

Supplementary Table 3. Global profile of the second cohort analysed. NIV means Non Invasive Ventilation; HFO means High Flow Oxygen treatment.

Features	Threshold
Months of study	11
Number of patients	230
Mortality rate (%)	1.30
Failure rate (%) (n=3)	1.73
Age (mean)	69± 15
Gender ratio (male %/female %)	52/48
NIV treatment (%)	65
HFO treatment (%)	12
Weaning procedures (%)	23
Vasoactive drugs (%)	26

Supplementary Table 4. Description of the variables and their values from patients in the second cohort. Percentage of NAs (Not Available value) indicates the missing values of every variable.

Variable	Mean	SD	%NA
SBP	130.2	22.7	0
DBP	68.1	13.3	0
T	36.7	0.5	0
RR	23.8	5.1	0
LEUCOS	11.5	7.1	0
Hb	11.9	2.6	0
PL	265	126.8	0

INR	1.5	1.3	20.69
CREA	0.91	0.71	0.43
NA	137.3	9.78	0
K	4.1	0.75	0.43
PH	7.3	0.49	0
PCO2	52.8	19.87	0
PO2	84.1	31.1	0
BE	4.8	6.05	0.86

Material Resources

BEDS 8 beds: 5 semicritical beds, 2 Cardiorespiratory monitoring, 1 Insulation bed with negative pressure and Sleep Monitoring (Connected to UMS Multidisciplinary Sleep Unit)
 RESPIRATORS 11 respirators
 2 SERVO S (Maquet) 1 SERVO 300 (Maquet)
 5V60 (Phillips Respironics) 1 VISION (Phillips Respironics)
 2 TRIOLGY (transparent respirator for VNI Phillips Respironics) 10 bipap/cpap for hospitalization (provided by supplier company)
 8 Monitors with wireless control unit Shared monitoring with UMS in isolation room

Human Resources

Medical Staff Physicians assigned to the unit: 2 (hours 9 am to 6 pm)
 Doctors for weekend passes: 3 (Hours 9h-15h)
 Guards There are no specialty guards
 In the absence of the staff, the unit is in charge of the UCI and general hospitalization doctors.
 Supervisor of Nursing: 1
 Nursing: 1 nurses / shift ratio 1:5 In high season the IRCU is extended to 8 beds 2 nurses / shift ratio 1:4 according to regulations
 Auxiliaries 1 keeper 1 shared with the hospitalization facility

Other Supplies

Central seizures of O2, air abd Heliox 70/30%
 Bronchoscope in the unit
 Gasometer in the unit Non-volumetric capnograph (t)
 Portable ultrasound recorder 2 dialysis / ultrafiltration sockets (according to nephrology)
 Arterial catheterization (all) Complete hemodynamic monitoring Central venous catheter
 Aspiration systems and O2 intakes and air double stream sockets (16 per bed) Televisions
 Ear Phone in each bed Masks (nasal, facial, helmet, full face mask, olives ... all sizes)
 High flow (optiflow 3 complete equipments) Active humidification (Fischer & Pichel for VMI) in each bed
 Percutaneous tracheotomy kit and cricotomy Complete stopping trolley (RCP)
 Manual defibrillator and DESA in the Wifi unit, tablets and virtual reality glasses in each bed.
 4 computer stations (doctor-nurse-assistant-resident)
 Office: Associate and deputy chief.
 Own electrical box and emergency in case of failure in electrical systems 2 cranes to mobilize the sick
 1 armchair with bed cover Mirrors with each bed

Supplementary Figure 1. Description of the material and human resources of the unit.

Current Admission Criteria

1. Acute hypoxemic or hypercapnic respiratory failure requiring ventilatory support
2. Exacerbation of chronic respiratory failure requiring NIV with /without hemodynamic support
3. Need for sedation to adapt to NIV
4. Serious uncontrolled OSAS, in respiratory acidosis or with abnormally high levels of CO₂ or failure in respirator Interaction.
5. Pulmonary thromboembolism with severe respiratory deterioration
6. Severe ARF in high-flow oxygen therapy or NIV or Helmet
7. Laryngospasm in post extubation of resuscitation (heliox, vmni)
8. Weaning of complex patients of multidisciplinary origin (from ICU)
9. Decanulation protected by tracheal ring in weaning of tracheotomized multidisciplinary patients (from ICU)
10. Postoperative of risky thoracic surgery or postoperative acute respiratory failure
11. Postoperative of any origin if it requires support of NIV, if it is not subsidiary of admission to the ICU.
12. Need for ventilatory support in respiratory failure of neuromuscular origin, Complete and partial weaning. Algorithms
13. Cannulation with support of NIV in the operating room of the non-intubable neuromuscular patient (infrequent 7 cases this year)
14. Risk bronchoscopy (coordinated with ICU)
15. Pneumonia of the immunosuppressed (coordinated with ICU)
16. Control of pulmonary hypertension, right catheterization and vasodilator test, hemodynamic optimization

Supplementary Figure 2. Description of the Admission criteria to the HU-FJD's IRCU.

General Characteristics of Patients Classified by Diagnosis (DRG)

Description	Average Weight (GRD)	Disease Level	Mortality Level
COPD	1,22	3,38	3,48
Traqueostomy with MV96+ hours with extensive or ECMO procedure	14,36	3,85	3,70
Other pneumonia	1,38	3,47	3,21
Heart failure	1,35	3,38	3,56
Pulmonary interstitial and alveolar disease	1,39	3,23	3,00
Pulmonary edema and respiratory failure	1,13	3,00	3,45
Respiratory Diseases with assisted ventilation of more than 96 hours	4,90	3,64	3,45
Septicemia and disseminated infections	2,50	3,80	3,90
Tracheostomy with MV96+ hours without extensive procedure	8,93	3,50	3,40
Others	3,3	3,4	3,3

Supplementary Figure 3. Grouping by GRD of the patients, levels of disease and mortality. Each episode is grouped into an APR with four possible levels of severity (1: moderate, 2: minor, 3: major and 4: extreme). Each of these levels has an increasing weight value (expression of resource consumption) that increases from level 1 to level 4. These weights are calculated annually in the United States. The levels of severity and probability of dying are automatically assigned by the 3M grouper (Grouper) according to the coding of the episodes. The greater the number of secondary diagnoses of complications of these patients, the grouper will signify the episode at a higher level of severity and probability of dying.