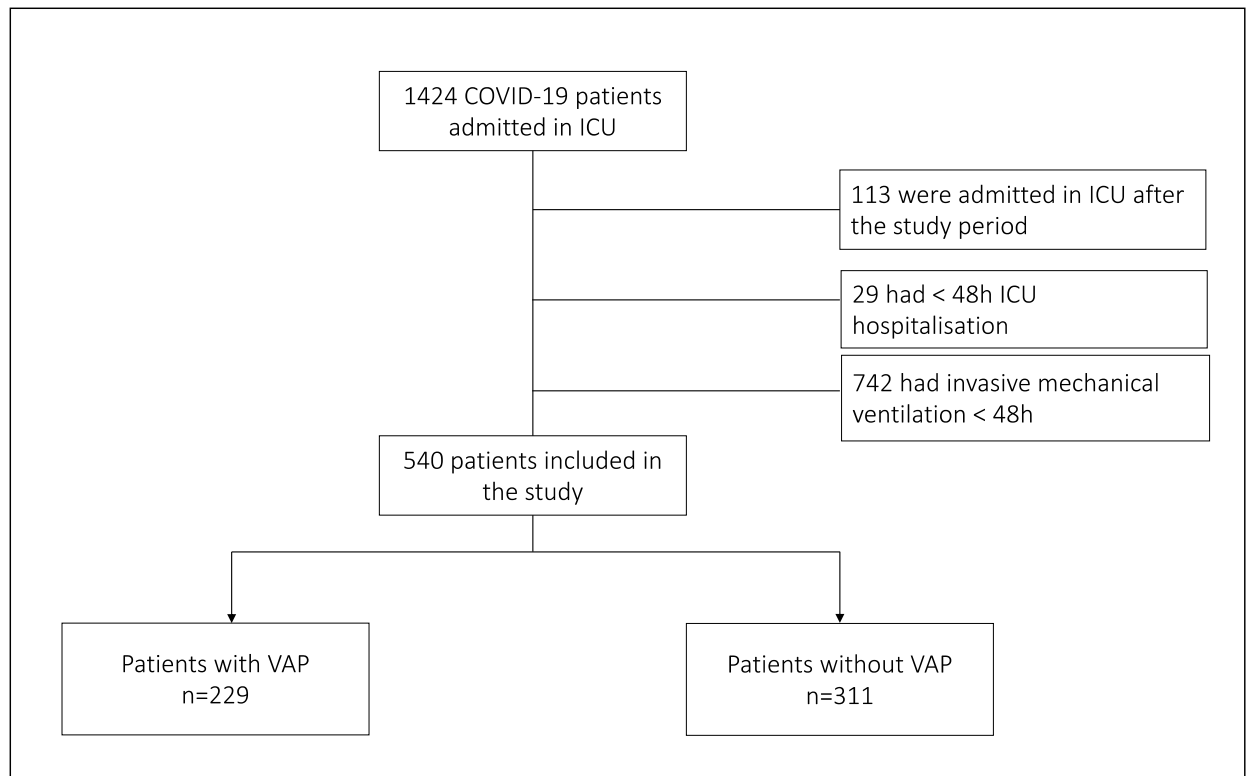


Supplement Figure S1. Flow diagram



Supplement Table S1. Characteristics of pulmonary infections according to the timing and evolution under treatment (expressed by number of episodes of infections: 354 episodes of VAP occurred in 201 patients).

| | VAP | Early VAP* | Late VAP* | p-value | 1st VAP | Superinfection [†] | p-value | 1st VAP | Relapse [‡] | p-value |
|-------------------------------------|------------|------------|------------|---------|------------|-----------------------------|---------|------------|----------------------|---------|
| | n=383 | n=95 | n=288 | | n=236 | n=73 | | n=230 | n=105 | |
| Number of episodes | | | | | | | | | | |
| Gram positive bacteria | 124 (32.4) | 37 (38.9) | 87 (30.2) | 0.11 | 81 (34.3) | 24 (32.9) | 0.82 | 78 (33.9) | 31 (29.5) | 0.43 |
| <i>Streptococcus pneumoniae</i> | 7 (1.8) | 3 (3.2) | 4 (1.4) | 0.26 | 7 (3) | 0 (0) | 0.14 | 6 (2.6) | 1 (1) | 0.33 |
| Other <i>Streptococci</i> | 12 (3.2) | 3 (3.2) | 9 (3.1) | 0.99 | 10 (4.2) | 2 (2.7) | 0.56 | 10 (4.3) | 0 (0) | 0.03 |
| <i>Staphylococcus aureus</i> | 84 (22) | 25 (26.3) | 59 (20.5) | 0.23 | 50 (21.2) | 20 (27.4) | 0.27 | 49 (21.3) | 24 (22.9) | 0.75 |
| <i>Moraxella catarrhalis</i> | 1 (0.2) | 0 (0) | 1 (0.3) | 0.57 | 1 (0.4) | 0 (0) | 0.58 | 1 (0.4) | 0 (0) | 0.50 |
| Gram negative bacteria | 316 (82.6) | 72 (75.8) | 244 (84.7) | 0.05 | 185 (78.4) | 60 (82.2) | 0.48 | 180 (78.3) | 92 (87.6) | 0.04 |
| <i>Haemophilus influenza</i> | 16 (4.2) | 10 (10.5) | 6 (2.1) | < 0.01 | 16 (6.8) | 0 (0) | 0.02 | 16 (7) | 0 (0) | < 0.01 |
| Enterobacteriales | 191 (49.8) | 37 (38.9) | 154 (53.5) | 0.01 | 121 (51.3) | 33 (45.2) | 0.37 | 118 (51.3) | 50 (47.6) | 0.53 |
| Group 1 or 2 enterobacteriales | 103 (26.8) | 21 (22.1) | 82 (28.5) | 0.22 | 68 (28.8) | 21 (28.8) | 0.99 | 67 (29.1) | 21 (20) | 0.08 |
| <i>Proteus sp</i> | 15 (4) | 0 (0) | 15 (5.2) | 0.02 | 8 (3.4) | 6 (8.2) | 0.08 | 8 (3.5) | 2 (1.9) | 0.43 |
| <i>Escherichia coli</i> | 49 (12.8) | 8 (8.4) | 41 (14.2) | 0.14 | 30 (12.7) | 12 (16.4) | 0.42 | 29 (12.6) | 11 (10.5) | 0.58 |
| <i>Klebsiella pneumoniae</i> | 42 (11) | 12 (12.6) | 30 (10.4) | 0.55 | 30 (12.7) | 6 (8.2) | 0.30 | 30 (13) | 9 (8.6) | 0.24 |
| <i>Citrobacter koserii</i> | 6 (1.6) | 2 (2.1) | 4 (1.4) | 0.63 | 5 (2.1) | 1 (1.4) | 0.69 | 5 (2.2) | 1 (1) | 0.43 |
| Group 3 enterobacteriales | 88 (23) | 11 (11.6) | 55 (19.1) | 0.09 | 38 (16.1) | 10 (13.7) | 0.62 | 36 (15.7) | 25 (23.8) | 0.07 |
| <i>Enterobacter sp</i> | 66 (17.2) | 18 (18.9) | 70 (24.3) | 0.28 | 52 (22) | 15 (20.5) | 0.79 | 50 (21.7) | 32 (30.5) | 0.08 |
| <i>Serratia marcescens</i> | 16 (4.2) | 5 (5.3) | 11 (3.8) | 0.54 | 11 (4.7) | 4 (5.5) | 0.78 | 11 (4.8) | 4 (3.8) | 0.69 |
| <i>Citrobacter freundii</i> | 3 (0.8) | 1 (1.1) | 2 (0.7) | 0.73 | 1 (0.4) | 0 (0) | 0.58 | 1 (0.4) | 2 (1.9) | 0.19 |
| <i>Morganella morganii</i> | 5 (1.4) | 1 (1.1) | 4 (1.4) | 0.80 | 4 (1.7) | 1 (1.4) | 0.85 | 4 (1.7) | 1 (1) | 0.58 |
| Non-fermenting GNB | 133 (34.8) | 28 (29.5) | 105 (36.5) | 0.21 | 57 (24.2) | 33 (45.2) | < 0.01 | 55 (23.9) | 54 (51.4) | < 0.01 |
| <i>Pseudomonas aeruginosa</i> | 95 (24.8) | 18 (18.9) | 77 (26.7) | 0.13 | 42 (17.8) | 25 (34.2) | < 0.01 | 41 (17.8) | 37 (35.2) | < 0.01 |
| <i>Stenotrophomonas maltophilia</i> | 17 (4.4) | 5 (5.3) | 12 (4.2) | 0.65 | 9 (3.8) | 1 (1.4) | 0.30 | 9 (3.9) | 7 (6.7) | 0.27 |

| | | | | | | | | | | |
|--|------------|-----------|------------|--------|------------|-----------|--------|------------|------------|--------|
| <i>Acinetobacter baumannii</i> | 24 (6.2) | 5 (5.3) | 19 (6.6) | 0.64 | 6 (2.5) | 11 (15.1) | < 0.01 | 5 (2.2) | 12 (11.4) | < 0.01 |
| MDR or XDR | 114 (29.8) | 18 (18.9) | 96 (33.3) | < 0.01 | 64 (27.1) | 23 (31.5) | 0.47 | 62 (27) | 38 (36.2) | 0.09 |
| ESBL-producing bacteria | 52 (13.6) | 12 (12.6) | 40 (13.9) | 0.76 | 33 (14) | 9 (12.3) | 0.72 | 32 (13.9) | 14 (13.3) | 0.89 |
| Carbapenemase-producing bacteria | 7 (1.8) | 0 (0) | 7 (2.4) | 0.13 | 5 (2.1) | 0 (0) | 0.21 | 5 (2.2) | 2 (1.9) | 0.87 |
| AmpC-hyperproduction | 7 (1.8) | 3 (3.2) | 4 (1.4) | 0.26 | 7 (3) | 0 (0) | 0.14 | 7 (3) | 0 (0) | 0.07 |
| Resistant <i>Pseudomonas aeruginosa</i> § | 36 (9.4) | 4 (4.2) | 32 (11.1) | 0.05 | 12 (5.1) | 8 (11) | 0.07 | 12 (5.2) | 21 (20) | < 0.01 |
| Carbapenem Resistant <i>Acinetobacter baumannii</i> | 11 (2.8) | 2 (2.1) | 9 (3.1) | 0.61 | 2 (0.8) | 7 (9.6) | < 0.01 | 2 (0.9) | 4 (3.8) | 0.06 |
| MRSA | 13 (3.4) | 0 (0) | 13 (4.5) | 0.04 | 5 (2.1) | 7 (9.6) | < 0.01 | 5 (2.2) | 7 (6.7) | 0.04 |
| Susceptible species (<i>Streptococcus sp</i> , <i>Moraxella</i> , <i>Haemophilus</i>) | 34 (8.8) | 14 (14.7) | 20 (6.9) | 0.02 | 32 (13.6) | 2 (2.7) | < 0.01 | 31 (13.5) | 1 (1) | < 0.01 |
| More than one strain | 95 (24.8) | 17 (17.9) | 78 (27.1) | 0.07 | 45 (19.1) | 31 (42.5) | < 0.01 | 43 (18.7) | 35 (33.3) | < 0.01 |
| Time to adequate Antimicrobial therapy | 1 [1 - 2] | 1 [1 - 2] | 1 [1 - 3] | 0.70 | 1 [1 - 2] | 2 [1 - 3] | 0.27 | 1 [1 - 2] | 1 [-3 - 2] | 0.04 |
| Adequacy | 164 (42.8) | 44 (46.3) | 120 (41.7) | . | 105 (44.7) | 34 (48.6) | . | 104 (45.4) | 37 (35.9) | . |
| Bi antimicrobial therapy | 159 (41.6) | 44 (46.3) | 115 (39.9) | 0.27 | 92 (39) | 30 (41.1) | 0.75 | 88 (38.3) | 49 (46.7) | 0.15 |
| Aminoside | 72 (18.8) | 18 (18.9) | 54 (18.8) | 0.97 | 46 (19.5) | 17 (23.3) | 0.48 | 45 (19.6) | 14 (13.3) | 0.16 |
| Fluoroquinolone | 53 (13.8) | 14 (14.7) | 39 (13.5) | 0.77 | 25 (10.6) | 8 (11) | 0.93 | 24 (10.4) | 24 (22.9) | < 0.01 |

*Early-onset VAP was defined as VAP occurring within the first 7 days after invasive ventilation, and late-onset VAP as VAP occurring on or after the 7th day after invasive ventilation.

§ Resistance to ticarcillin, ceftazidime or carbapenem

† different pathogen than previously isolated

‡ same pathogens as previously isolated

VAP: Ventilator-Associated Pneumonia; GNB: Gram Negative Bacteria; MDR: Multi-drug resistant; XDR: Extended-drug resistant; ESBL: Extended-spectrum β -lactamase; MRSA: Methicillin-resistant *Staphylococcus aureus*.

Supplement Table S2. Risks factors associated with day-60 mortality (univariate analysis).

| | Alive n=287 | Dead n=253 | <i>p</i> -value | Hazard Ratio | HR 95% CI | <i>p</i> -value |
|--|-----------------|---------------|-----------------|--------------|---------------|-----------------|
| Period (before May 2020) | 165 (57.5) | 119 (47) | 0.02 | 0.89 | [0.67 - 1.18] | 0.41 |
| Age | | | | | | |
| < 50 | 58 (20.2) | 16 (6.3) | - | - | - | - |
| 50 - 60 | 64 (22.3) | 109 (43.1) | - | 3.86 | [2.26 - 6.61] | < 0.01 |
| 60 - 70 | 77 (26.8) | 85 (33.6) | - | 2.98 | [1.74 - 5.12] | < 0.01 |
| >70 | 88 (30.7) | 43 (17) | < 0.01 | 1.48 | [0.83 - 2.66] | 0.18 |
| Male gender | 211 (73.5) | 190 (75.1) | 0.68 | 0.98 | [0.73 - 1.32] | 0.91 |
| Body-mass index ≥ 30 kg/m ² | 120 (41.8) | 103 (40.7) | 0.80 | 0.94 | [0.72 - 1.21] | 0.62 |
| Comorbidities | 165 (57.5) | 192 (75.9) | < 0.01 | 1.70 | [1.26 - 2.29] | < 0.01 |
| Immunosuppression | 16 (5.6) | 42 (16.6) | < 0.01 | 1.61 | [1.13 - 2.28] | 0.01 |
| ICU admission characteristics | | | | | | |
| Time between symptoms and ICU admission > 10 days | 110 (38.3) | 74 (29.2) | 0.03 | 0.74 | [0.56 - 0.98] | 0.04 |
| Time between ICU admission and intubation > 5 days | 16 (5.6) | 51 (20.2) | < 0.01 | 2.08 | [1.47 - 2.96] | < 0.01 |
| MDR colonization | 13 (4.5) | 19 (7.5) | 0.14 | 1.15 | [0.7 - 1.9] | 0.58 |
| Corticosteroid | 126 (43.9) | 151 (59.7) | < 0.01 | 1.42 | [1.08 - 1.87] | 0.01 |
| Immunomodulator | 41 (14.3) | 43 (17) | 0.39 | 1.04 | [0.73 - 1.47] | 0.84 |
| Antibiotic therapy | 216 (75.3) | 171 (67.6) | 0.05 | 0.70 | [0.53 - 0.92] | 0.01 |
| Broad spectrum antibiotics | 26 (9.1) | 44 (17.4) | < 0.01 | 1.44 | [1.03 - 2.01] | 0.03 |
| Carbapenems | 9 (3.1) | 7 (2.8) | 0.80 | 0.92 | [0.38 - 2.25] | 0.86 |
| During the first 2 days of intubation | | | | | | |
| PEEP > 12 cmH ₂ O | 77 (26.8) | 89 (35.2) | 0.04 | 1.17 | [0.89 - 1.53] | 0.25 |
| Prone position | 98 (34.1) | 77 (30.4) | 0.36 | 0.90 | [0.67 - 1.2] | 0.48 |
| Neuromuscular blockade | 227 (79.1) | 209 (82.6) | 0.30 | 1.09 | [0.77 - 1.55] | 0.61 |
| ECMO | 21 (7.3) | 26 (10.3) | 0.22 | 0.98 | [0.64 - 1.51] | 0.94 |
| Renal replacement therapy | 16 (5.6) | 40 (15.8) | < 0.01 | 1.60 | [1.11 - 2.32] | 0.01 |
| Vasopressor | 161 (56.1) | 145 (57.3) | 0.78 | 1.08 | [0.78 - 1.5] | 0.64 |
| Enteral nutrition | 187 (65.2) | 145 (57.3) | 0.06 | 0.65 | [0.48 - 0.88] | 0.01 |
| Parenteral nutrition | 36 (12.5) | 70 (27.7) | < 0.01 | 1.88 | [1.33 - 2.65] | < 0.01 |
| Lymphocytes/neutrophils ratio>0.1 | 0.1 [0.1 - 0.1] | 0.1 [0 - 0.1] | < 0.01 | 0.57 | [0.41 - 0.79] | <.01 |
| Before period at risk of VAP | | | | | | |
| Antibiotic therapy | 254 (88.5) | 216 (85.4) | 0.28 | 0.76 | [0.53 - 1.09] | 0.14 |
| Broad spectrum antibiotic therapy | 87 (30.3) | 87 (34.4) | 0.31 | 1.02 | [0.78 - 1.34] | 0.86 |
| Carbapenems | 29 (10.1) | 19 (7.5) | 0.29 | 0.63 | [0.38 - 1.05] | 0.08 |

| | | | | | | |
|-----------------------------|------------|------------|------|------|---------------|------|
| Type of VAP | | | | | | |
| VAP | 120 (41.8) | 109 (43.1) | 0.77 | 1.25 | [0.94 - 1.65] | 0.12 |
| Early VAP | 45 (15.7) | 48 (19) | 0.31 | 1.03 | [0.74 - 1.43] | 0.88 |
| Late VAP | 99 (34.5) | 80 (31.6) | 0.48 | 1.36 | [0.99 - 1.85] | 0.06 |
| Superinfection [†] | 36 (12.5) | 22 (8.7) | 0.15 | 1.24 | [0.73 - 2.1] | 0.42 |
| Relapse [‡] | 38 (13.2) | 24 (9.5) | 0.17 | 1.20 | [0.74 - 1.94] | 0.45 |

[†] different pathogen than previously isolated

[‡] same pathogens as previously isolated

ICU: Intensive care unit; MDR: Multi-drug Resistant; PEEP: Positive-End-Expiratory pressure; ECMO: Extracorporeal Membrane Oxygenation; VAP: Ventilator-Associated Pneumonia; ATB: Antibiotic

Supplement Table S3. Risk factors associated with superinfection (univariate analysis).

| | No Superinfection n=172 | Superinfection n=57 | Hazard Ratio | HR95% IC | p-value |
|---|----------------------------|------------------------|--------------|---------------|---------|
| Period (before May 2020) | 104 (60.5) | 18 (31.6) | 0.41 | [0.23 - 0.72] | <0.01 |
| Age > 70 | 55 (32) | 13 (22.8) | 0.71 | [0.36 - 1.38] | 0.31 |
| Male gender | 135 (78.5) | 43 (75.4) | 0.86 | [0.48 - 1.53] | 0.61 |
| Body-mass index ≥ 30 kg/m ² | 72 (41.9) | 34 (59.6) | 1.69 | [1 - 2.86] | 0.05 |
| Immunosuppression | 10 (5.8) | 4 (7) | 1.09 | [0.4 - 2.95] | 0.87 |
| Time between ICU admission and intubation > 5 days | 15 (8.7) | 8 (14) | 1.14 | [0.5 - 2.62] | 0.76 |
| Characteristics before the day of VAP | | | | | |
| Tocilizumab | 8 (4.7) | 4 (7) | 1.72 | [0.61 - 4.82] | 0.30 |
| Carbapenems | 13 (7.6) | 5 (8.8) | 1.16 | [0.45 - 2.99] | 0.76 |
| MDR colonization | 18 (10.5) | 7 (12.3) | 1.19 | [0.53 - 2.67] | 0.67 |
| Steroids | 99 (57.6) | 32 (56.1) | 1.00 | [0.6 - 1.68] | 0.99 |
| ECMO | 20 (11.6) | 17 (29.8) | 2.30 | [1.23 - 4.32] | 0.01 |
| PEEP > 12 cmH ₂ O | 43 (25) | 18 (31.6) | 1.25 | [0.7 - 2.25] | 0.45 |
| Prone position | 50 (29.1) | 17 (29.8) | 1.00 | [0.56 - 1.79] | 1.00 |
| Renal replacement therapy | 38 (22.1) | 11 (19.3) | 0.80 | [0.4 - 1.62] | 0.54 |
| Vasopressor | 68 (39.5) | 25 (43.9) | 1.64 | [0.86 - 3.15] | 0.14 |
| Enteral nutrition | 133 (77.3) | 45 (78.9) | 0.92 | [0.44 - 1.92] | 0.83 |
| Parenteral nutrition | 53 (30.8) | 18 (31.6) | 1.39 | [0.74 - 2.61] | 0.31 |
| Proto pump inhibitor | 127 (73.8) | 41 (71.9) | 0.91 | [0.49 - 1.71] | 0.78 |
| Lymphocytes/neutrophils ratio > 1 | 124 (72.1) | 44 (77.2) | 1.10 | [0.57 - 2.11] | 0.78 |
| Highly susceptible germs | 20 (11.6) | 12 (21.1) | 2.15 | [1.18 - 3.93] | 0.01 |
| <i>Staphylococcus aureus</i> species | 31 (18) | 18 (31.6) | 1.59 | [0.91 - 2.78] | 0.10 |
| Group 1-2 <i>enterobacterales</i> | 53 (30.8) | 11 (19.3) | 0.56 | [0.28 - 1.12] | 0.10 |
| Group 3 <i>enterobacterales</i> | 42 (24.4) | 10 (17.5) | 0.79 | [0.39 - 1.58] | 0.50 |
| Non fermentant species | 48 (27.9) | 7 (12.3) | 0.39 | [0.18 - 0.84] | 0.02 |
| MDR or XDR | 54 (31.4) | 7 (12.3) | 0.36 | [0.16 - 0.8] | 0.01 |
| Bi antimicrobial therapy | 73 (42.4) | 15 (26.3) | 0.51 | [0.28 - 0.92] | 0.03 |
| Broad spectrum antimicrobial therapy | 110 (64) | 28 (49.1) | 0.59 | [0.35 - 1] | 0.05 |
| Adequation | 81 (47.1) | 29 (50.9) | 1.21 | [0.72 - 2.04] | 0.47 |

ICU: Intensive care unit; VAP: Ventilator-Associated Pneumonia; ECMO: Extracorporeal Membrane Oxygenation; PEEP: Positive-End-Expiratory pressure; Non-fermenting species: *Pseudomonas aeruginosa*, *Acinetobacter baumannii*, *Stenotrophomonas maltophilia*; MDR: Multi-drug Resistant; XDR: Extended-drug resistant.

Supplement Table S4. Risk factors associated with relapse (univariate analysis).

| | No Relapse n=168 | Relapse n=61 | Hazard Ratio | HR 95% IC | p-value |
|---|---------------------|-----------------|--------------|---------------|---------|
| Period (before May 2020) | 98 (58.3) | 24 (39.3) | 0.61 | [0.36 - 1.03] | 0.07 |
| Age >70 | 46 (27.4) | 16 (26.2) | 0.70 | [0.31 - 1.57] | 0.39 |
| Male gender | 126 (75) | 52 (85.2) | 1.87 | [0.94 - 3.75] | 0.08 |
| Body-mass index ≥ 30 kg/m ² | 77 (45.8) | 29 (47.5) | 1.00 | [0.6 - 1.64] | 0.99 |
| Immunosuppression | 12 (7.1) | 2 (3.3) | 0.39 | [0.11 - 1.35] | 0.14 |
| Time between ICU admission and intubation > 5 days | 15 (8.9) | 8 (13.1) | 1.13 | [0.52 - 2.46] | 0.75 |
| Characteristics before the day of VAP | | | | | |
| Tocilizumab | 9 (5.4) | 3 (4.9) | 1.27 | [0.37 - 4.3] | 0.70 |
| Carbapenems | 10 (6) | 8 (13.1) | 1.77 | [0.85 - 3.68] | 0.12 |
| MDR colonization | 16 (9.5) | 9 (14.8) | 1.27 | [0.63 - 2.56] | 0.50 |
| Steroids | 94 (56) | 37 (60.7) | 1.19 | [0.72 - 1.99] | 0.49 |
| ECMO | 19 (11.3) | 18 (29.5) | 1.69 | [0.98 - 2.9] | 0.06 |
| PEEP > 12 cmH ₂ O | 44 (26.2) | 17 (27.9) | 0.99 | [0.54 - 1.83] | 0.99 |
| Prone position | 45 (26.8) | 22 (36.1) | 1.27 | [0.73 - 2.21] | 0.39 |
| Renal replacement therapy | 38 (22.6) | 11 (18) | 0.65 | [0.34 - 1.26] | 0.20 |
| Vasopressor | 66 (39.3) | 27 (44.3) | 2.00 | [1.14 - 3.51] | 0.02 |
| Enteral nutrition | 125 (74.4) | 53 (86.9) | 1.15 | [0.48 - 2.76] | 0.76 |
| Parenteral nutrition | 58 (34.5) | 13 (21.3) | 1.24 | [0.58 - 2.66] | 0.58 |
| Proto pump inhibitor | 121 (72) | 47 (77) | 1.21 | [0.64 - 2.28] | 0.56 |
| Lymphocytes/neutrophils ratio > 1 | 122 (72.6) | 46 (75.4) | 1.27 | [0.71 - 2.27] | 0.42 |
| Highly susceptible germs | 25 (14.9) | 0 (0) | | | |
| <i>Staphylococcus aureus</i> species | 36 (21.4) | 8 (13.1) | 0.57 | [0.28 - 1.16] | 0.12 |
| Group 1-2 <i>enterobacteriaceae</i> | 45 (26.8) | 16 (26.2) | 1.02 | [0.57 - 1.84] | 0.94 |
| Group 3 <i>enterobacteriaceae</i> | 37 (22) | 18 (29.5) | 1.47 | [0.84 - 2.56] | 0.17 |
| Non fermentant species | 38 (22.6) | 23 (37.7) | 1.54 | [0.94 - 2.53] | 0.08 |
| MDR or XDR | 45 (26.8) | 16 (26.2) | 1.06 | [0.59 - 1.92] | 0.83 |
| Bi antimicrobial therapy | 64 (38.1) | 24 (39.3) | 1.04 | [0.62 - 1.74] | 0.88 |
| Broad spectrum antimicrobial therapy | 97 (57.7) | 41 (67.2) | 1.48 | [0.87 - 2.54] | 0.15 |
| Adequation | 80 (47.6) | 30 (49.2) | 1.13 | [0.69 - 1.86] | 0.62 |

ICU: Intensive care unit; VAP: Ventilator-Associated Pneumonia; ECMO: Extracorporeal Membrane Oxygenation; PEEP: Positive-End-Expiratory pressure; Non-fermenting species: *Pseudomonas aeruginosa*, *Acinetobacter baumannii*, *Stenotrophomonas maltophilia*; MDR: Multi-drug Resistant; XDR: Extended-drug resistant.

Supplement Table S5. Risk factors associated with treatment failure (univariate analysis).

| | No Failure n=72 | Failure n=157 | Hazard Ratio | HR 95% IC | p-value |
|--|--------------------|------------------|--------------|---------------|---------|
| Period of admission (before May 2020) | 47 (65.3) | 75 (47.8) | 0.97 | [0.69 - 1.36] | 0.85 |
| Age > 70 y | 13 (18.1) | 55 (35) | 1.90 | [1.33 - 2.72] | <0.01 |
| Male gender | 55 (76.4) | 123 (78.3) | 0.90 | [0.6 - 1.33] | 0.58 |
| Body-mass index ≥ 30 kg/m ² | 31 (43.1) | 75 (47.8) | 1.10 | [0.8 - 1.51] | 0.55 |
| Immunosuppression | 3 (4.2) | 11 (7) | 0.77 | [0.41 - 1.44] | 0.42 |
| Time between ICU admission and intubation > 5 days | 1 (1.4) | 22 (14) | 1.30 | [0.8 - 2.09] | 0.28 |
| Characteristics before the day of VAP | | | | | |
| Tocilizumab | 4 (5.6) | 8 (5.1) | 1.30 | [0.62 - 2.73] | 0.48 |
| Carbapenems | 7 (9.7) | 11 (7) | 0.63 | [0.34 - 1.18] | 0.15 |
| MDR colonization | 8 (11.1) | 17 (10.8) | 1.09 | [0.66 - 1.83] | 0.73 |
| Steroids | 38 (52.8) | 93 (59.2) | 1.46 | [1.05 - 2.03] | 0.02 |
| ECMO | 2 (2.8) | 35 (22.3) | 0.99 | [0.66 - 1.5] | 0.98 |
| PEEP > 12 cmH ₂ O | 9 (12.5) | 52 (33.1) | 1.36 | [0.94 - 1.96] | 0.11 |
| Prone position | 16 (22.2) | 51 (32.5) | 1.22 | [0.86 - 1.74] | 0.26 |
| Renal replacement therapy | 6 (8.3) | 43 (27.4) | 1.42 | [0.99 - 2.03] | 0.06 |
| Vasopressor | 21 (29.2) | 72 (45.9) | 1.24 | [0.85 - 1.82] | 0.27 |
| Enteral nutrition | 60 (83.3) | 118 (75.2) | 0.82 | [0.52 - 1.3] | 0.40 |
| Parenteral nutrition | 19 (26.4) | 52 (33.1) | 1.53 | [0.98 - 2.39] | 0.06 |
| Proto pump inhibitor | 51 (70.8) | 117 (74.5) | 1.27 | [0.85 - 1.88] | 0.24 |
| Lymphocytes/neutrophils ratio > 1 | 51 (70.8) | 117 (74.5) | 0.93 | [0.63 - 1.37] | 0.70 |
| Highly susceptible germs | 10 (13.9) | 22 (14) | 1.07 | [0.68 - 1.7] | 0.77 |
| <i>Staphylococcus aureus</i> species | 16 (22.2) | 33 (21) | 0.98 | [0.66 - 1.46] | 0.93 |
| Group 1 or 2 <i>enterobacteriaceae</i> | 24 (33.3) | 40 (25.5) | 0.99 | [0.68 - 1.45] | 0.95 |
| Group 3 <i>enterobacteriaceae</i> | 21 (29.2) | 31 (19.7) | 0.85 | [0.57 - 1.27] | 0.44 |
| Non fermentant species | 17 (23.6) | 38 (24.2) | 1.21 | [0.83 - 1.77] | 0.32 |
| MDR or XDR | 19 (26.4) | 42 (26.8) | 1.08 | [0.75 - 1.56] | 0.67 |
| Bi antimicrobial therapy | 23 (31.9) | 65 (41.4) | 1.07 | [0.78 - 1.49] | 0.67 |
| Broad spectrum antimicrobial therapy | 50 (69.4) | 88 (56.1) | 0.77 | [0.55 - 1.08] | 0.13 |
| Adequation | 32 (44.4) | 78 (49.7) | 1.09 | [0.79 - 1.51] | 0.60 |

ICU: Intensive care unit; VAP: Ventilator-Associated Pneumonia; ECMO: Extracorporeal Membrane Oxygenation; PEEP: Positive-End-Expiratory pressure; Non-fermenting species: *Pseudomonas aeruginosa*, *Acinetobacter baumannii*, *Stenotrophomonas maltophilia*; MDR: Multi-drug Resistant; XDR: Extended-drug resistant.

Supplement Table S6. Main recent studies describing VAP in COVID-19 patients.

| Study | Sample size | VAP incidence [†] | VAP complications | Mortality [‡] |
|----------------------|-------------|----------------------------|---|-------------------------------|
| Rouzé et al | 568 | 36 / NA | 23% MDR | 29.2% |
| Garcia-Vidal et al | 144 | 25 / NA | - | 9.8% |
| Pickens et al | 179 | 44.4 / 45.2 | - | 19% |
| Gragueb-Chatti et al | 151 | 60 / 26 | 37% recurrence, 68% with same pathogen | 17% d-28, 26% d-60 |
| Luyt et al | 50 | 86 / NA | 66% ≥ 1 recurrence, 38% polymicrobial | 34% |
| Maes et al | 81 | 48 / 28 | - | 38% |
| Blonz et al | 188 | 48.9 / 33.7 | 20% multiple VAP, 3.6% empyema 1.4% abscesses | 30.4% (VAP), 29% (overall) |
| Razazi et al | 90 | 64 / NA | 25% recurrence (23% MDR) | 40% |
| Llitjos et al | 176 | 52 / NA | 21% recurrence | 31% |
| Moretti et al | 39 | 54 / NA | - | 44% |
| Rouyer et al | 79 | 53 / NA | 28% recurrences, 17% clinical success (d-7) | 52% |
| Giacobbe et al | 586 | 29 / NA | - | 46% |
| Contou et al | 73 | 64 / NA | Among 73 death in ICU 23% recurrence (21% MDR) | 48% |
| Grasselli et al | 774 | 50 / 11.7 | - | 26% |
| D'Humières et al | 77 | 84.4 / NA | 57.4% failure at (d-7) | 51% (overall) |
| Beaucoté et al | 161 | 73 / NA | 14% abscess, polymicrobial | 56%, (65% if lung abscess) |

NA: not available; ECMO: Extra-Corporeal Membrane Oxygenation; MDR: Multi-drug Resistant.

[†] VAP crude incidence (%) and incidence density (expressed per 1000 mechanical ventilation days), whenever available.

[‡] Crude ICU-mortality (%), d-28 or d-60 or attributable mortality whenever available.