Follow-Up Data and Machine Learning [Improve Mortality Predictions for Patients with Mechanical Circulatory Support](https://www.ahajournals.org/doi/pdf/10.1161/CIRCGEN.119.002877)

**Ryan S. Cantor, Byron C. Jaeger, Ramaraju Rudraraju**

**MAIN RESULTS**

Table 1: Patient characteristics selected for inclusion in the final mortality risk prediction model.

|  | | | **Hazard ratio (95% CI)** | |
| --- | --- | --- | --- | --- |
| **label** | **Number (%) missing values** | **Mean (SD) or Number (%)** | **Unadjusted** | **Adjusted** |
| *Pre-implant variables* | | | | |
| Patient age, years | 0 (0.00%) | 57.0 (12.9) | 1.35 (1.30, 1.41) | 1.20 (1.15, 1.25) |
| *Week 1 variables* | | | | |
| BUN, md/dL | 121 (0.96%) | 30.2 (20.8) | 1.40 (1.35, 1.45) | 1.06 (1.01, 1.10) |
| Platelet count | 94 (0.74%) | 219 (99.9) | 0.70 (0.67, 0.72) | 0.93 (0.89, 0.98) |
| *Month 1 variables* | | | | |
| Total bilirubin, mg/dL | 2,669 (21%) | 1.19 (2.69) | 1.32 (1.30, 1.35) | 1.17 (1.14, 1.19) |
| BUN, mg/dL | 320 (2.5%) | 22.9 (16.9) | 1.53 (1.48, 1.58) | 1.18 (1.13, 1.23) |
| Platelet count | 338 (2.7%) | 296 (108) | 0.66 (0.63, 0.68) | 0.87 (0.83, 0.91) |
| Intubated | 180 (1.4%) | 1119 (8.97%) | 3.76 (3.43, 4.13) | 1.42 (1.25, 1.60) |
| Followup status: outpatient | 103 (0.81%) | 7230 (57.6%) | 0.44 (0.41, 0.48) | 0.77 (0.71, 0.84) |
| White blood cell count | 335 (2.6%) | 9.24 (4.16) | 1.21 (1.19, 1.23) | 1.10 (1.08, 1.13) |
| SGOT | 2,704 (21%) | 41.0 (149) | 1.09 (1.08, 1.10) | 1.02 (0.99, 1.04) |
| LDH | 2,721 (21%) | 399 (305) | 1.11 (1.09, 1.14) | 1.06 (1.03, 1.09) |
| NYHA: unable to carry on minimal physical activity | 3,674 (29%) | 1492 (16.6%) | 2.28 (2.08, 2.49) | 1.33 (1.20, 1.46) |
| Albumin, g/dL | 3,011 (24%) | 3.21 (0.63) | 0.74 (0.71, 0.76) | 0.94 (0.91, 0.98) |
| Right heart failure, INO NOREPI | 10,524 (83%) | 415 (19.4%) | 5.05 (4.41, 5.79) | 1.56 (1.33, 1.83) |
| Respiratory adverse event count | 0 (0.00%) | 0.14 (0.41) | 2.02 (1.91, 2.13) | 1.16 (1.08, 1.25) |

Table 2: Incidence rates and ratios for patients classified as high or low risk at pre-implant and one month following implant of mechanical circulatory support device.

|  | **1-year Mortality risk classification** | | | |
| --- | --- | --- | --- | --- |
|  | **Low risk at both visits** | **High risk at pre-implant only** | **High risk at month 1 only** | **High risk at both visits** |
| *Overall* | | | | |
| Number (%) of patients | 9,108 (72%) | 1,234 (9.7%) | 1,322 (10%) | 994 (7.9%) |
| Number of events | 1,600 | 399 | 615 | 543 |
| Months of follow up | 179,913 | 27,234 | 18,956 | 15,179 |
| Incidence rate (95% CI) | 8.9 (8.5, 9.3) | 15 (13, 16) | 32 (30, 35) | 36 (33, 39) |
| Incidence ratio (95% CI) | 1 (ref) | 1.7 (1.5, 1.8) | 3.6 (3.3, 4.0) | 4.0 (3.6, 4.4) |
| *Stage 1: Critical cardiogenic shock* | | | | |
| Number (%) of patients | 1,130 (61%) | 188 (10%) | 284 (15%) | 249 (13%) |
| Number of events | 182 | 46 | 127 | 126 |
| Months of follow up | 20,518 | 3,018 | 3,449 | 3,112 |
| Incidence rate (95% CI) | 8.9 (7.6, 10) | 15 (11, 20) | 37 (31, 44) | 40 (34, 48) |
| Incidence ratio (95% CI) | 1 (ref) | 1.7 (1.2, 2.3) | 4.0 (3.2, 5.0) | 4.4 (3.5, 5.6) |
| *Stage 2: Progressive decline* | | | | |
| Number (%) of patients | 3,081 (71%) | 433 (9.9%) | 482 (11%) | 364 (8.3%) |
| Number of events | 521 | 152 | 222 | 202 |
| Months of follow up | 58,745 | 9,738 | 6,827 | 5,777 |
| Incidence rate (95% CI) | 8.9 (8.1, 9.7) | 16 (13, 18) | 33 (28, 37) | 35 (30, 40) |
| Incidence ratio (95% CI) | 1 (ref) | 1.8 (1.5, 2.1) | 3.6 (3.1, 4.3) | 3.9 (3.3, 4.6) |
| *Stage 3: Stable but inotrope dependent* | | | | |
| Number (%) of patients | 3,414 (76%) | 421 (9.4%) | 392 (8.7%) | 260 (5.8%) |
| Number of events | 615 | 131 | 185 | 132 |
| Months of follow up | 67,870 | 9,566 | 5,871 | 4,287 |
| Incidence rate (95% CI) | 9.1 (8.4, 9.8) | 14 (11, 16) | 32 (27, 36) | 31 (26, 36) |
| Incidence ratio (95% CI) | 1 (ref) | 1.5 (1.2, 1.8) | 3.5 (3.0, 4.1) | 3.4 (2.8, 4.1) |
| *Stage 4 or higher* | | | | |
| Number (%) of patients | 1,480 (76%) | 192 (9.8%) | 163 (8.3%) | 121 (6.2%) |
| Number of events | 280 | 70 | 80 | 83 |
| Months of follow up | 32,741 | 4,912 | 2,807 | 2,003 |
| Incidence rate (95% CI) | 8.6 (7.6, 9.6) | 14 (11, 18) | 29 (23, 35) | 41 (33, 51) |
| Incidence ratio (95% CI) | 1 (ref) | 1.7 (1.3, 2.2) | 3.3 (2.6, 4.2) | 4.8 (3.8, 6.2) |

Figure 1: Benchmark comparison of modeling algorithms.



**SUPPLEMENT**

Figure S1: Benchmark comparison modeling algorithms.

