# *Supplementary Material*

## Performance of the PIM3 and PIM2 in 41,541 patients admitted to 22 Brazilian Pediatric Intensive Care Units

Daniel Hilário Santos Genu, MD, MSc[1]; Fernanda Lima-Setta, MD, PhD[1]; José Colleti Jr, MD, PhD[2]; Daniela Carla de Souza, MD, PhD[3]; Sérgio D'Abreu Gama, MD[4]; Letícia Massaud Ribeiro, MD, MSc [5]; Ivan Pollastrini Pistelli, MD, PhD[6], José Oliva Proença Filho, MD[7]; Thaís de Mello Cesar Bernardi, MD[8]; Taísa Roberta Ramos Nantes de Castilho, MD[9]; Manuela Guimarães Clemente, MD[10]; Cibele Cristina Manzoni Ribeiro Borsetto, MD[11]; Luiz Aurelio de Oliveira, MD[12]; Thallys Ramalho Suzart Alves, MD[13]; Diogo Botelho Pedroso, MD[14]; Fabíola Peixoto Ferreira La Torre, MD[15]; Lunna Perdigão Borges[16]; Guilherme Santos[16]; Juliana Freitas de Mello e Silva, PhD[1]; Maria Clara de Magalhães-Barbosa, MD, PhD[1]; Antonio José Ledo Alves da Cunha, MD, PhD[1,5]; Marcio Soares, MD, PhD[1,16]; Arnaldo Prata-Barbosa, MD, PhD[1,5], on behalf of the Brazilian Research Network in Pediatric Intensive Care (BRnet-PIC).

## 1    Supplementary Material - Ethics

The study protocol was approved by the following Institutional Review Boards:

1) Research Ethics Committee of the "D'Or Institute for Research and Education (IDOR)", under the **nº 3.384.961**, which was responsible for the following hospitals, all from the D'Or Network of hospitals in Brazil:
    a. in Rio de Janeiro, Brazil: Hospital Caxias D'Or, Hospital Copa D'Or, Hospital Oeste D'Or, Hospital Quinta D'Or, Hospital Real D'Or, Hospital Rios D'Or, Hospital Jutta Batista, Hospital Estadual da Criança, and Hospital Adão Pereira Nunes;
    b. in São Paulo, SP: Hospital Ribeirão Pires, Hospital São Luiz São Caetano, Hospital São Luiz Anália Franco, and Hospital Sinobrasileiro;
    c. in Brasília, DF: Hospital Santa Luzia and Hospital Santa Helena;
    d. in Olinda, PE: Hospital Esperança.
2) Research Ethics Committee of the "Hospital e Maternidade São Luiz)", under the **nº 3,558,506**, which was responsible for the following hospitals in São Paulo, Brazil: Hospital Brasil, Hospital São Luiz Jabaquara, and Hospital São Luiz Morumbi.
3) Research Ethics Committee of the Hospital Assunção, São Bernardo do Campo, SP, Brazil, under the **nº 3,805,463**.
4) Research Ethics Committee of the Hospital Sirio Libanês, São Paulo, SP, Brazil, under the **nº 3,573,580**.
5) Research Ethics Committee of the Instituto de Puericultura e Pediatria Martagão Gesteira, of the Federal University of Rio de Janeiro, Brazil, under the **nº 3,707,277**.

## 2    Supplementary Tables

**TABLE S1 |** Characteristics of the total study and patients who died.

| Patients' characteristics | Total sample No. (%) | Absolute No. | %, total sample | %, by category | %, among deaths |
|---|---|---|---|---|---|
| No. of patients | 41,541 (100.0) | 763 | 1,84 | | |
| Gender | | | | | |
|   Female | 18,490 (44.5) | 346 | 0.83 | 1.87 | 45.35 |
|   Male | 22,765 (54.8) | 413 | 0.99 | 1.81 | 54.13 |
|   Missing | 286 (0.7) | 4 | 0.01 | 1.40 | 0.52 |
| Age (yrs), median (IQR) | 2 (0-5) | 1 (0-5) | | | |
|   Infant 1 (<12 mo.) | 13,811 (33.2) | 325 | 0.78 | 2.35 | 42.60 |
|   Infant 2 (12-23 mo.) | 10,483 (25.2) | 176 | 0.42 | 1.68 | 23.07 |
|   Preschool (2-5 yr.) | 7,382 (17.8) | 79 | 0.19 | 1.07 | 10.35 |
|   Grade schooler (6-12 yr.) | 8,117 (19.5) | 143 | 0.34 | 1.76 | 18.74 |
|   Adolescent (13-16 yr.) | 1,748 (4.2) | 40 | 0.10 | 2.29 | 5.24 |
| Type of admission | | | | | |
|   Medical | 36,803 (88.6) | 657 | 1.58 | 1.79 | 86.11 |
|   Surgical | 4,738 (11.4) | 106 | 0.26 | 2.24 | 13.89 |
| Surgical group, type of admission | | | | | |
|   Scheduled surgery | 2,840 (59.9) | 64 | 0.15 | 2.25 | 8.39 |
|   Emergency surgery | 1,898 (40.1) | 42 | 0.10 | 2.21 | 5.50 |
| Source of PICU admission | | | | | |
|   Emergency department | 29,526 (71.1) | 337 | 0.81 | 1.14 | 44.17 |
|   Ward/floor | 3,681 (8.9) | 134 | 0.32 | 3.64 | 17.56 |
|   Operating room | 3,667 (8.8) | 84 | 0.20 | 2.29 | 11.01 |
|   Transfer from other hospital | 3,002 (7.2) | 148 | 0.36 | 4.93 | 19.40 |
|   Other | 1,665 (4.0) | 60 | 0.14 | 3.60 | 7,86 |
| Support on first hour of admission | | | | | |
|   Non-invasive ventilation, n (%) | 4,378 (10.5) | 91 | 0.22 | 2.08 | 11.93 |
|   Invasive mechanical ventilation, n (%) | 2,419 (5.8) | 528 | 1.27 | 21.83 | 69.20 |
|   Non-invasive/Invasive ventilation, n (%) | 6,797 (16.3) | 619 | 1.49 | 9.11 | 81.13 |
|   Vasopressors, n (%) | 1,130 (2.7) | 335 | 0.81 | 25.57 | 43.91 |
| PICU length of stay (d), median (IQR) | 3 (2-5) | 7 (2-22) | | | |
| Readmissions, n (%) | 1,917 (4.6) | 99 | 0.24 | 5.16 | 12.98 |
| Elective admissions, n (%) | 3,814 (9.2) | 88 | 0.21 | 2.31 | 11.53 |

**TABLE S2 |** Observed and expected number of deaths and survivors across ten groups of risk.

| | PIM 3 | | | | | | PIM 2 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **Deaths** | | **Survivors** | | | | **Deaths** | | **Survivors** | |
| | No. of patients | PIM3 (%) | Obs. | Exp. | Obs. | Exp. | No. of patients | PIM2 (%) | Obs. | Exp. | Obs. | Exp. |
| 1 | 3708 | 0.00-0.15 | 5 | 5,1 | 3703 | 3702,89 | 4206 | 0.00-0.18 | 6 | 6.9 | 4.330 | 4329.1 |
| 2 | 4601 | 0.15-0.17 | 4 | 7,2 | 4597 | 4593,81 | 4123 | 0.18-0.24 | 11 | 9.2 | 4.259 | 4260.8 |
| 3 | 4154 | 0.17-0.23 | 7 | 8,2 | 4147 | 4145,85 | 4166 | 0.24-0.36 | 15 | 13.5 | 4.211 | 4212.5 |
| 4 | 4156 | 0.23-0.39 | 16 | 12,8 | 4140 | 4143,17 | 4658 | 0.36-0.75 | 30 | 27.3 | 4.351 | 4353.7 |
| 5 | 4202 | 0.39-1.21 | 47 | 28,2 | 4155 | 4173,78 | 3989 | 0.75-0.86 | 21 | 33.9 | 4.103 | 4172,4 |
| 6 | 4143 | 1.21-1.26 | 19 | 50,9 | 4124 | 4092,09 | 3925 | 0.86-0.99 | 35 | 38.3 | 4.024 | 4026,5 |
| 7 | 4188 | 1.26-1.42 | 23 | 55,9 | 4165 | 4132,11 | 4012 | 0.99-1.19 | 41 | 47.9 | 4.292 | 4197,0 |
| 8 | 4081 | 1.42-1.78 | 28 | 64,3 | 4053 | 4016,73 | 4154 | 1.19-1.59 | 65 | 57.4 | 4.031 | 4170,4 |
| 9 | 4159 | 1.78-3.28 | 74 | 97,8 | 4085 | 4061,16 | 4163 | 1.59-3.33 | 95 | 97.4 | 4.132 | 4118,5 |
| 10 | 4149 | 3.28-100.0 | 540 | 426,8 | 3609 | 3722,19 | 4145 | 3.33-100.0 | 467 | 541.6 | 3.758 | 3562,8 |

**TABLE S3 |** Statistical data from the GiViTI calibration test.

| Calibration belt | statistic | p-value | $\beta_0$ | $\beta_1$ | $\beta_2$ | $\beta_3$ |
|---|---|---|---|---|---|---|
| PIM2 (total period, 0-100%) | 55.742 | 7.078e-11 | -0.12986053 | 0.77822534 | -0.05761306 | 0 |
| PIM3 (total period, 0-100%) | 74.314 | < 2.2e-16 | 0.461063853 | 0.934334733 | -0.091653228 | -0.009438559 |
| PIM2 (total period, 0-5%) | 48.975 | 9.48e-0.8 | 19.9075507 | 13.8708989 | 2.6723262 | 0.1818811 |
| PIM3 (total period, 0-5%) | 80.543 | < 2.2e-16 | 41.6931481 | 28.8661606 | 5.9649037 | 0.4114314 |
| PIM2 Period 1 | 15.413 | 0.01584 | 0.03746302 | 0.73960160 | -0.06350381 | 0 |
| PIM3 Period 1 | 4.2317 | 0.1205 | 0.1320599 | 0.9917300 | 0 | 0 |
| PIM2 Period 2 | 16.012 | 0.01212 | -0.14361229 | 0.74131244 | -0.05240984 | 0 |
| PIM3 Period 2 | 50.442 | 4.655e-08 | 0.84031820 | 1.03797804 | -0.08700228 | -0.01185569 |
| PIM2 Period 3 | 56.811 | 4.199e-11 | -0.21517607 | 0.84446101 | -0.05802483 | 0 |
| PIM3 Period 3 | 55.877 | 6.625e-11 | 0.17337021 | 0.81340745 | -0.08691097 | 0 |

Period 1: 2013-10-01 to 2015-09-30; Period 2: 2015-10-01 to 2017-09-30; Period 3: 2017-10-01 to 2019-09-30

## 3    Supplementary Figures
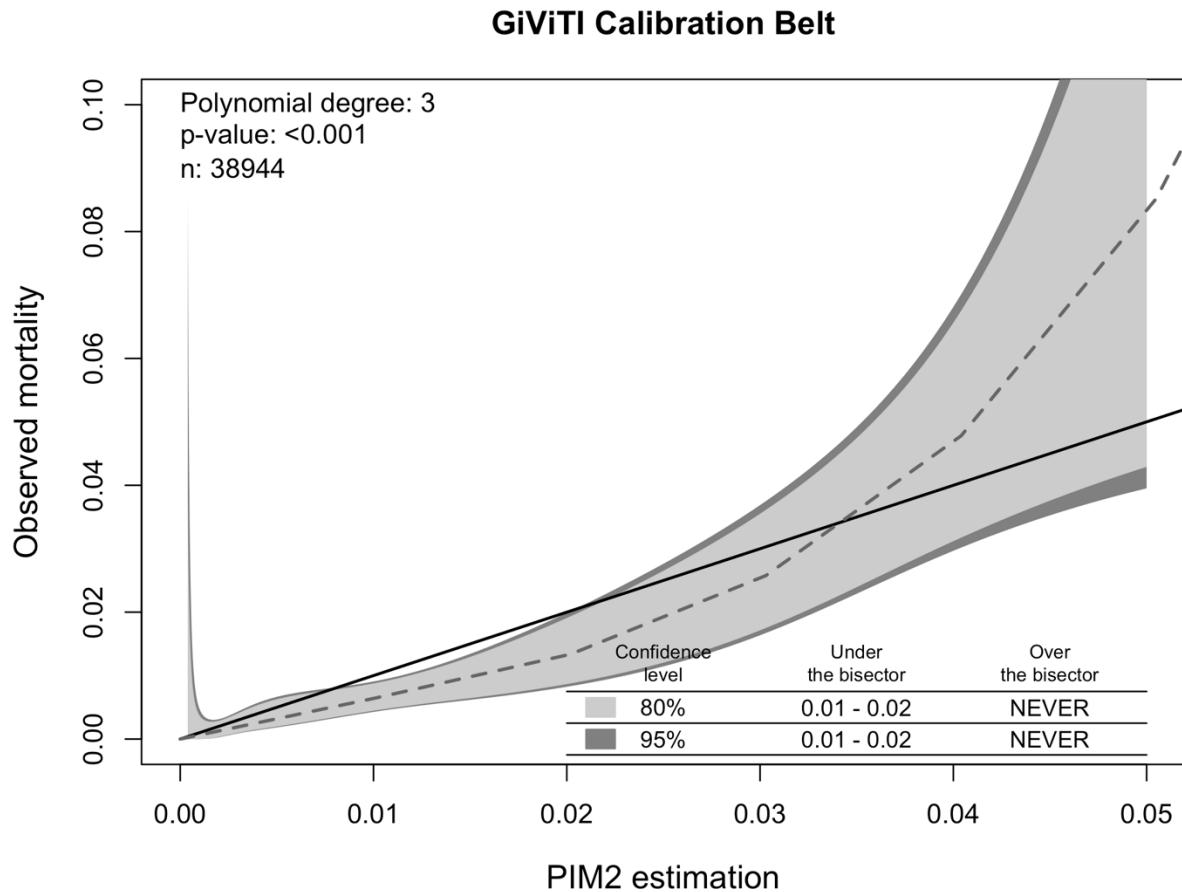
**GiViTI Calibration Belt**



**Figure S1.** The PIM2 calibration belt for the risk range between 0 and 5% (about 94% of the population). The dashed curve represents the mean line compared to the bisector, which indicates a perfect match between the PIM2 results and the outcomes it tries to predict. The p-value expresses a Wald-like statistic that tests the null hypothesis that there is no difference between this line and the bisector, which was rejected. The belt (95% confidence interval) had adequate calibration in most of this risk range, never underestimating mortality, but a poor calibration between a small range between 1 and 2% risk of mortality, overestimating mortality in this group of patients.

**GiViTI Calibration Belt**

Polynomial degree: 3
p-value: <0.001
n: 39385

Observed mortality (y-axis)
PIM3 estimation (x-axis)

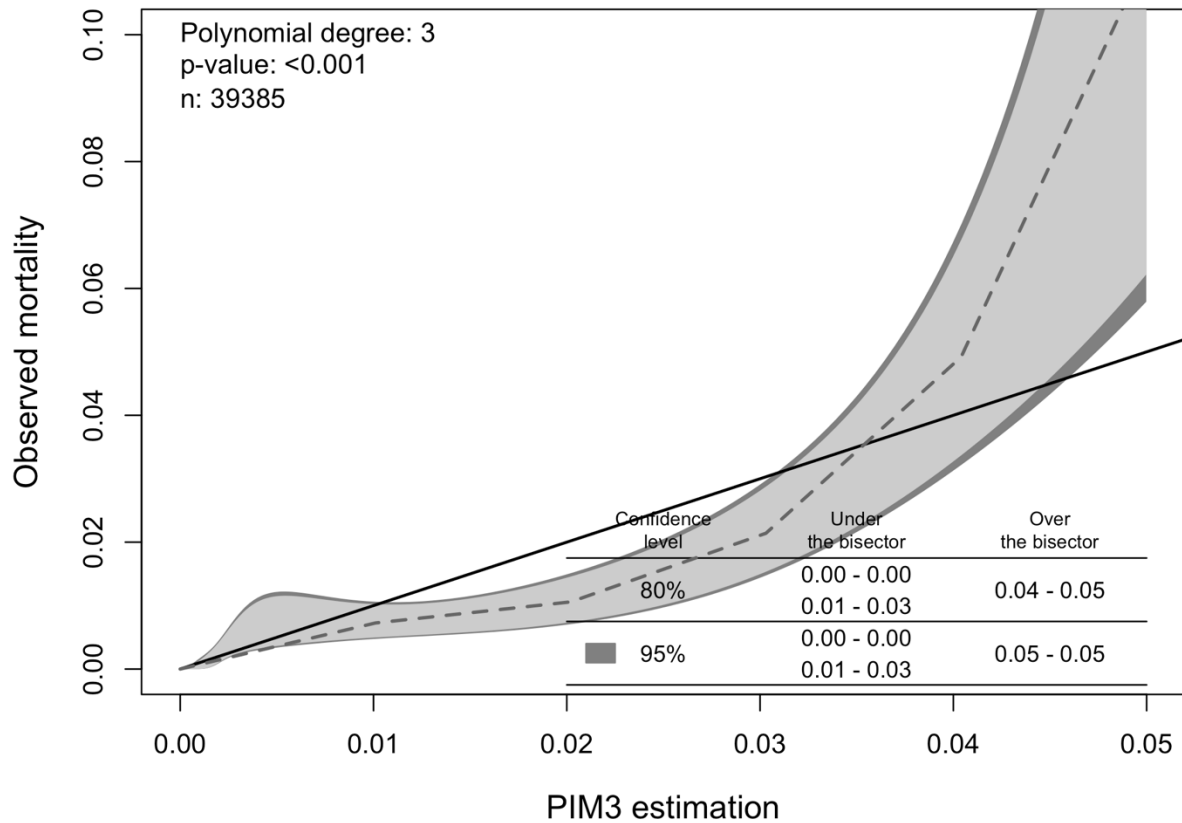| Confidence level | Under the bisector | Over the bisector |
|---|---|---|
| 80% | 0.00 - 0.00 0.01 - 0.03 | 0.04 - 0.05 |
| 95% | 0.00 - 0.00 0.01 - 0.03 | 0.05 - 0.05 |

**Figure S2.** The PIM3 calibration belt for the risk range between 0 and 5% (about 95% of the population). The dashed curve represents the mean line compared to the bisector, which indicates a perfect match between the PIM3 results and the outcomes it tries to predict. The p-value expresses a Wald-like statistic that tests the null hypothesis that there is no difference between this line and the bisector, which was rejected. The belt (95% confidence interval) had a poor calibration between 1 and 3% risk of mortality (overestimating mortality in this group of patients) and above 4.5% (underestimating mortality). Calibration was only adequate in the range of 0-1% and 3-4.5% mortality risk.