

PICU Performance and Outcome Scores around the Globe

PIM2 Score Validation in Argentina

Pablo G. Minces MD

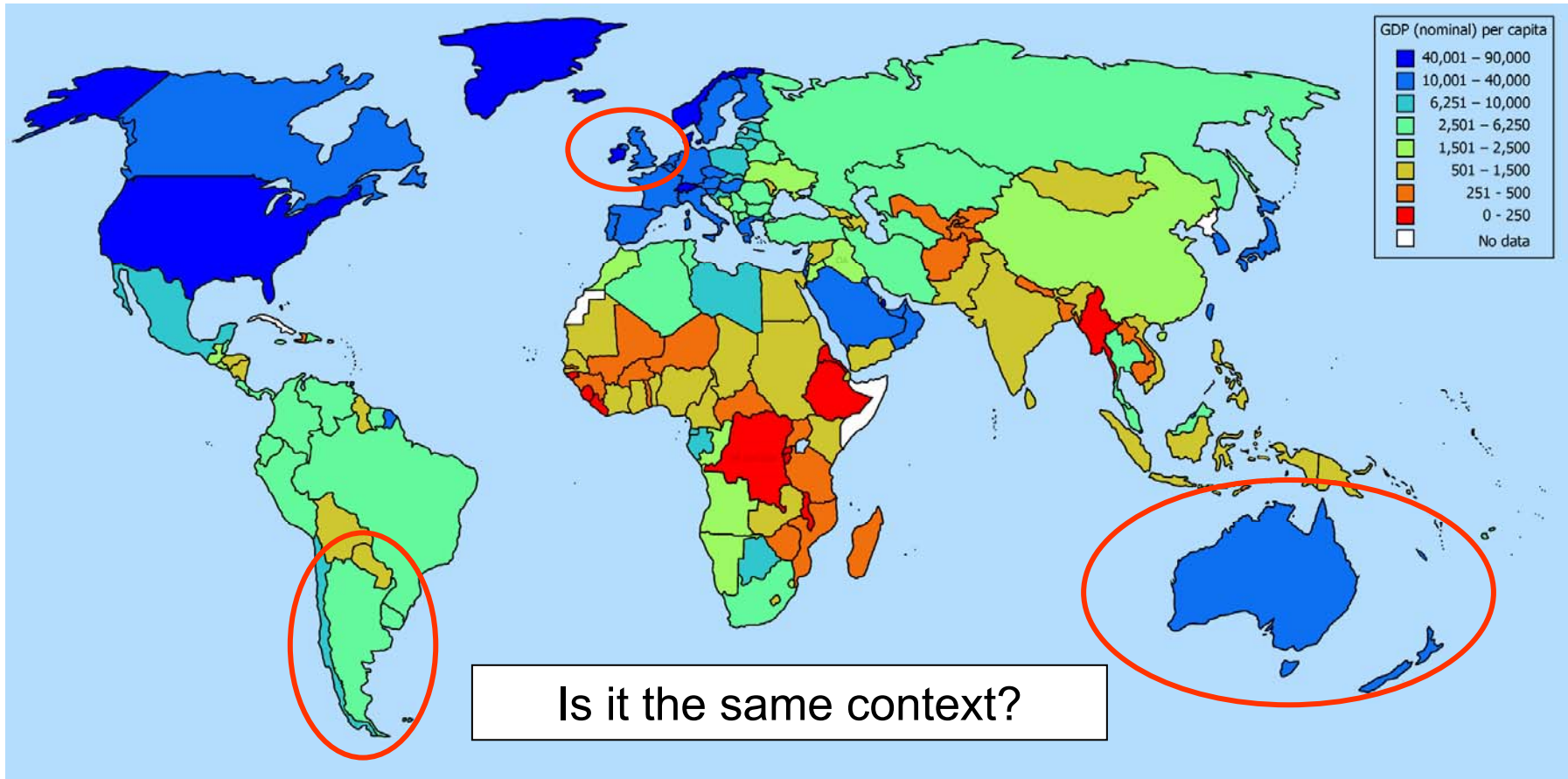
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Gross Domestic Product per capita (IMF, 2005)

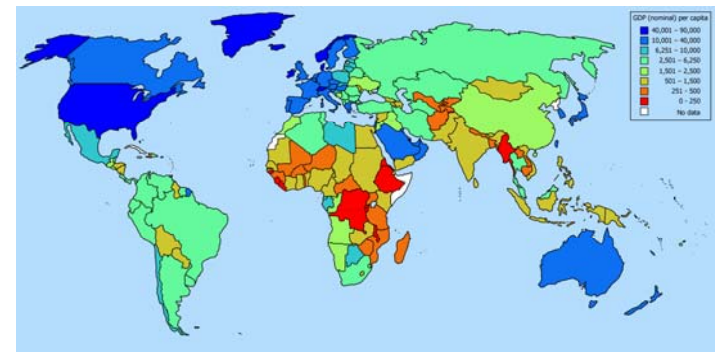


	Argentina	United Kingdom	Australia	New Zealand
				
Gross Domestic Product per capita (US\$)	4,799	37,023	34,740	26,464
% of central government expenditure (1994-2004*) allocated to health	5	15	14	17
% share of household income 1994-2004*, lowest 40%	10	18	18	18
% share of household income 1994-2004*, highest 20%	57	44	41	44
Infant mortality rate (under 1), 2005	15	5	6	5
Under-5 mortality rate, 2005	18	6	8	6
Life expectancy at birth, 2005, (yrs)	75	79	81	79
Population (thousands), under 18 years old, 2005	12277	13117	4797	1048
Total population (thousands), 2005	38747	59668	20155	4028
% of population under 18	31,7	22	23	26
Cost PICU/day (\$ USA)	200-500	2400-3600	1700	1700

•Duncan AW. The burden of paediatric intensive care: an Australian and New Zealand perspective Paediatric Respiratory Reviews 2005;6:166–173.
 •Piva JP, Schnitzler EJ, Celiny Garcia P, Garcia Branco R. The burden of paediatric intensive care: a South American perspective. Paediatric Respiratory Reviews 2005;6:160–165.
 •Macrae DJ. The burden of paediatric intensive care: a perspective from the UK and Ireland. Paediatr Respir Rev. 2005;6:154-9.

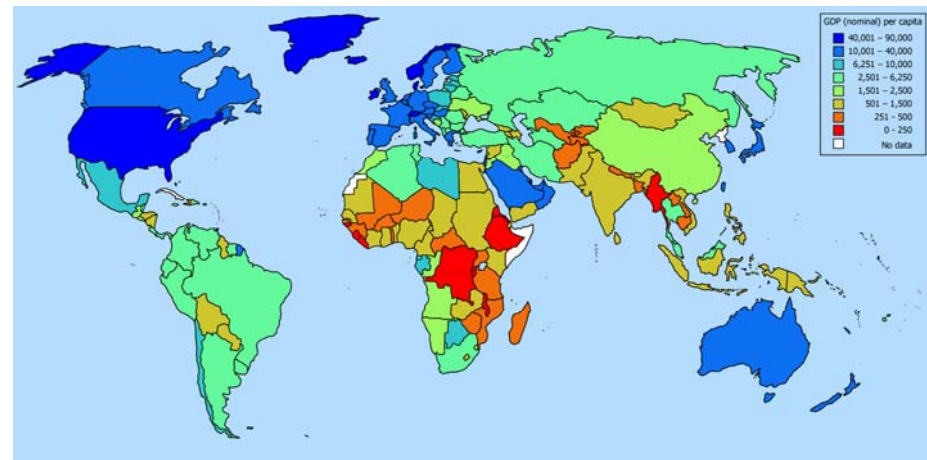
Is it the same context?

- GDP per capita 1/3.
- Government support (health) 1/3.
- > gap between povers and riches.
- Mortality < 1 & 5 years old: x 3.
- Younger population.
- PICU budget 1/6.



The question

- Taking into account these differences in resources, is it possible for us to reach the same outcomes?



Validation of Pediatric Index of Mortality 2 (PIM2) in a single pediatric intensive care unit of Argentina*

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Objective: Pediatric Index of Mortality 2 (PIM2) is an up-to-date mortality prediction model in the public domain that has not yet been widely validated. We aimed to evaluate this score in the population of patients admitted to our pediatric intensive care unit.

Design: Prospective cohort study.

Setting: Multidisciplinary pediatric intensive care unit in a general university hospital in Buenos Aires, Argentina.

Patients: All consecutive patients admitted between January 1, 2004, and December 31, 2005.

Interventions: None.

Measurements and Main Results: There were 1,574 patients included in the study. We observed 41 (2.6%) deaths, and PIM2 estimated 48.1 (3.06) deaths. Discrimination assessed by the area under the receiver operating characteristic curve was 0.9 (95%

confidence interval, 0.89–0.92). Calibration across five conventional mortality risk intervals assessed by the Hosmer–Lemeshow goodness-of-fit test showed $\chi^2(5) = 12.2$ ($p = .0348$). The standardized mortality ratio for the whole population was 0.85 (95% confidence interval, 0.6–1.1).

Conclusions: PIM2 showed an adequate discrimination between death and survival and a poor calibration assessed by the Hosmer–Lemeshow goodness-of-fit test. The standardized mortality ratio and clinical analysis of the Hosmer–Lemeshow table make us consider that PIM2 reasonably predicted the outcome of our patients. (*Pediatr Crit Care Med* 2007; 8:54–57)

KEY WORDS: mortality; intensive care; outcome assessment; clinical score; Pediatric Index of Mortality; Pediatric Index of Mortality 2



- **Objective:** We aimed to evaluate the Pediatric Index of Mortality 2 (PIM2) in the population of patients admitted to our Pediatric Intensive Care Unit (PICU).
- **Design:** Prospective Cohort Study.
- **Setting:** Multidisciplinary Pediatric Intensive Care Unit from a general university hospital from Buenos Aires, Argentina.
- **Patients:** All consecutive patients admitted between January 1st 2004 and December 31st 2005.



MATERIALS AND METHODS

- ***Criteria of inclusion:*** all consecutive patients admitted to our PICU.
- ***Criteria of exclusion:***
 - CPR on arrival without achieving spontaneous circulation for at least 2 hours.
 - Brain death at admission to PICU.
 - Age > 18 years old or < 30 days old.
- ***Reproducibility*** of data collection was assessed by repeating PIM2 calculation on randomly selected patients.



MATERIALS AND METHODS

- **Discrimination** between death and survival was assessed by the area under receiver operating characteristic (ROC) curve (adequate if $AUC > 0.80$).
- **Calibration** was evaluated by calculating the Expected (E) & Observed (O) deaths and survivors in 5 frequently used risk intervals using the Hosmer-Lemeshow goodness-of-fit chi-square statistic: $\sum (O - E)^2 / E$ (a p value > 0.05 indicates good fit).
- **Overall performance** was assessed by Standardized Mortality Ratio (SMR): O/E . (CI 95%).



Table 1. Patient characteristics

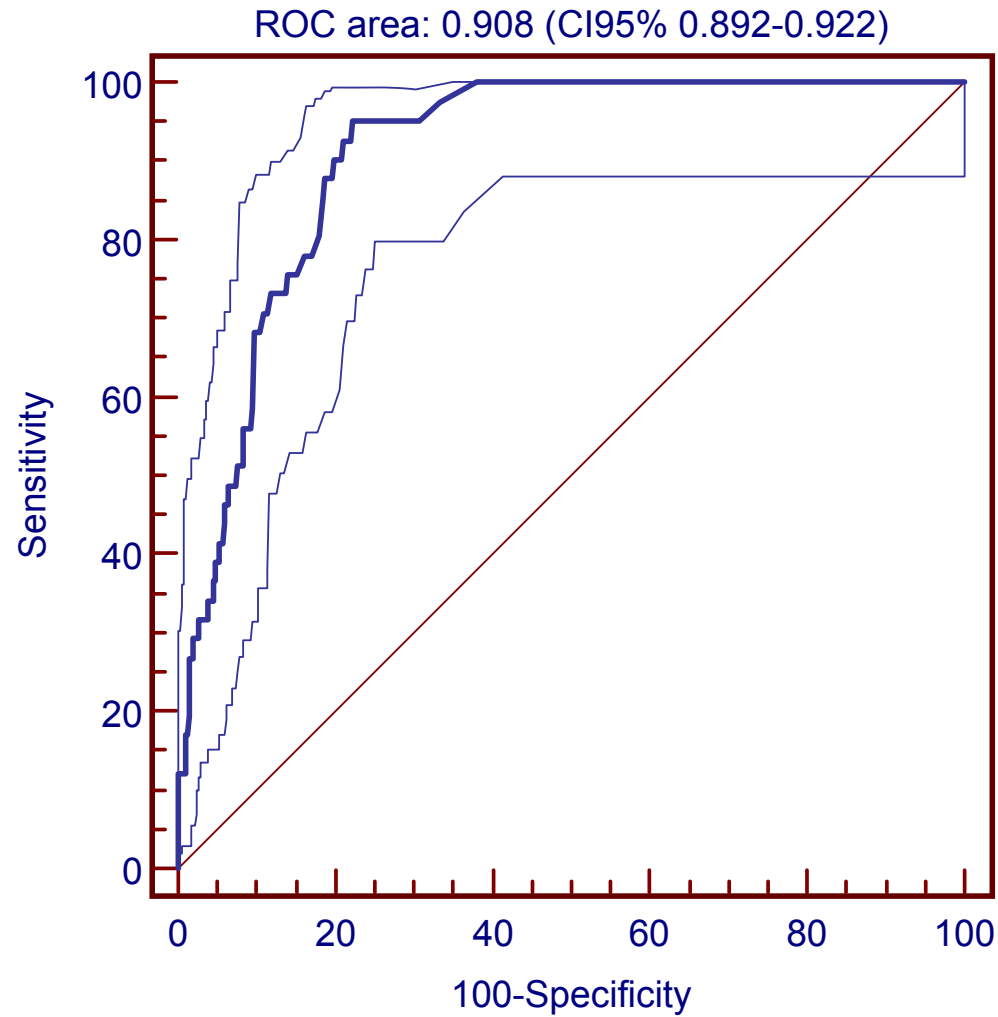
N°	1574
Mortality (%)	41 (2.6)
Male/Female (%)	805/769 (51/49)
Age (months): Median (p 25 – 75)	45 (10 – 118)
Length of Stay (days): Median (p 25 – 75)	2 (1 – 5)
Mechanical Ventilation (%)	369 (23.5)
TISS 28: Median (SD)	23,6 (43,9)
Medical Patients (%)	979 (62.2)
Surgical Patients (%)	595 (37.8)

N°, number of patients; (%) percentage; p (25 -75), percentile 25 – 75;



Discrimination

ROC curve for the whole population



ROC, receiver operating characteristic; CI 95%, 95% confidence interval

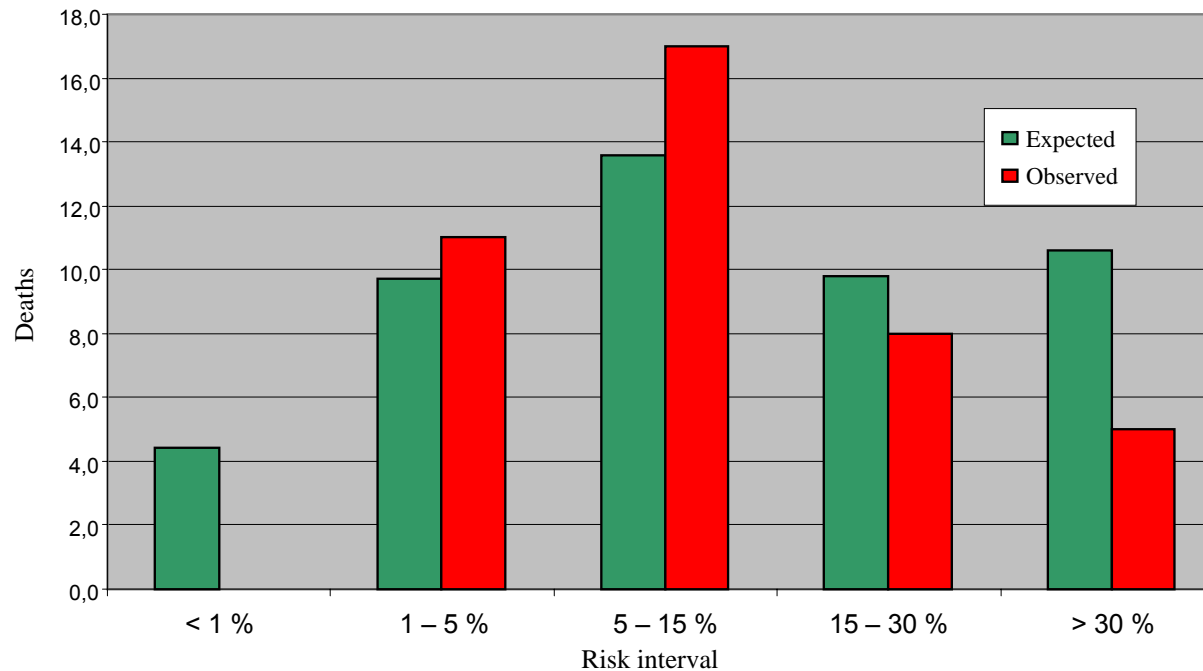
Calibration

Table 3. Calibration across risk intervals of death: Observed and expected number of deaths and survivors across five risk intervals of death

Risk Interval, %	Mean Probability of Death	No.	Deaths		Survivors		χ^2 Hosmer-Lemeshow Goodness of Fit
			Observed	Expected	Observed	Expected	
<1	0.5	870	0	4.4	870	865.6	4.4
1-5	2.1	464	11	9.7	453	454.3	0.2
5-15	7.9	172	17	13.6	155	158.4	0.9
15-30	20.4	48	8	9.8	40	38.2	0.4
>30	52.9	20	5	10.6	15	9.4	6.3
Total	3.06	1574	41	48.1	1,533	1,525.9	12.2 ^a

^a $p = .0348$.

Observed and expected number of deaths across 5 risk intervals of death



SMR for the whole population and sugroup of patients

Subgroup	No.	Observed Deaths (N ^o)	Expected Deaths (N ^o)	SMR (95% CI)
Whole population	1574	41	48,1	0.85 (0.6 – 1.1)
Higher risk	704	41	43,7	0.94 (0.68 – 1.2)
Pediatrics	979	30	35.2	0.85 (0.56 – 1.13)
Post-operative	595	11	13.1	0.84 (0.33 – 1.34)
< 1 year old	468	11	13.1	0.84 (0.36 – 1.31)
> 1 year old	1106	30	35.4	0.84 (0.55 – 1.13)
Ventilated patients	369	41	36.1	1.13 (0.85 – 1.41)

SMR, standardised mortality ratio; N^o, number of patients; (95% CI), 95% confidence interval



Results

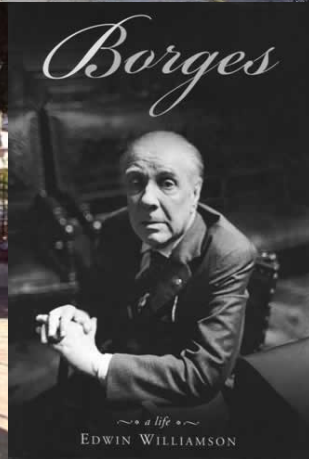
- Discrimination
 - Adequate: AUC ROC = 0.908 (95%CI 0.892 to 0.922)
- Calibration (Hosmer and Lemeshow goodness-of-fit test)
 - Poor: $p = 0.0348$
- Overall Performance
 - SMR : 0.86 (95% CI 0.6 to 1.1)



Limitations

- Wide 95% CI of the SMR
- Difficulties with Hosmer and Lemeshow test
 - Inadequate number of patients
 - Inadequate number of events (deaths)
- A single PICU





Are these results generalizable to our country?

Epidemiology and quality of care in a multicenter consecutive sample of patients from Argentina

Ratto ME, Saligari L, Albano L, Peltzer C, Ko I, Farías J, Minces P, Díaz S, Laín Fagalde G, Boada N, Sasbón J, Siaba Serrate A, Eulmesebian P, Schnitzler E.

- *Objective:* To report the results on epidemiology and quality assessment obtained through the use of a self-report software by each participating Pediatric Intensive Care Unit (PICU).
- *Design:* Prospective, multicenter, descriptive study.
- *Results:* 2592 patients from 8 PICUs
 - Mortality observed: 10.92% (283 patients)
 - Mortality expected (PIM2): 7.37% Mean (192 patients)
 - SMR: 1.47
 - TISS 28 22.05 (SD 8.58).
 - Mechanical ventilation 41.55% (1077 patients)



In summary

- In our PICU
 - PIM2 showed an adequate discrimination between death and survival and a poor calibration assessed by Hosmer and Lemeshow goodness-of-fit test.
 - The SMR and *clinical* analysis of the Hosmer and Lemeshow table make us consider that PIM2 reasonably predicted the outcome of our patients.
- In Argentina
 - The Observed Mortality was significantly higher than the Expected Mortality.



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Thank you for your attention