RELIABILITY OF PEDIATRIC RISK OF MORTALITY III (PRISM III) AND PEDIATRIC INDEX OF MORTALITY 3 (PIM3) SCORES IN THE PEDIATRIC INTENSIVE CARE UNIT OF EL-HUSSEIN UNIVERSITY HOSPITAL

By

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ABSTRACT

Introduction: *Mortality rate in Pediatric Intensive Care Units (PICU) depends on the severity of illness and can be assessed by scoring systems. Pediatric Risk of Mortality III (PRISM III) and Pediatric Index of Mortality 3 (PIM3) are scores used to assess mortality risk among infants and children admitted in the PICU.*

Setting: *tertiary care unit PICU at El-Hussein University Hospital, Faculty of Medicine, Al-Azhar University, Cairo, Egypt. Design: Thesis, prospective descriptive study.*

Objectives: *To compare the accuracy of the PRISM III and the PIM 3 scores among children admitted to PICU.*

Patients and Methods: *All children admitted to the PICU during the period from December 2015 till December 2016, total 100 patients were studied. We excluded patients who stayed less than 12 hour in the PICU and patients who died within 12 hours after discharge.*

Measurements and Main Results: *Of 100 patients, death ratio was 17 %, the discriminatory performance AUR was 0.987 for PRISM III (CI 95%, 0.968-1.000) and 0.973 (CI 95%, 0.877-0.998) for PIM 3. For calibration PRISM III (Chi-square= 27.25, p = 0.0001) and PIM 3 (Chi-square =20.54, p > 0.0001). Sensitivity for PRISM III (95.12%) and for PIM 3 (82.35%). Specificity for PRISM III (95.18%) and for PIM 3 (97.56%). There were significant correlations between the risk of mortality and both PRISM III and PIM3.*

Conclusion: *Both scores showed excellent overall discrimination. PRISM III showed more discrimination and both scores showed poor calibration under Egyptian circumstances.*

INTRODUCTION

The intensive care unit has got a very important role in the management of critically ill children. These patients who require continuous monitoring, hemodynamic support, respiratory support and advanced airway management are admitted in the pediatric intensive care units to achieve better outcome **(Siddiqui Nu et al., 2015)**.

Mortality rate in the ICUs depends on the severity of illness and the patient population analyzed, 6.4–10.3% of critically ill patients were reported to die. Scoring systems for use in intensive care unit (ICU) patients have been introduced and developed over the last 30 years. They allow an assessment of the severity of disease and provide an estimate of in-hospital mortality. This estimate is achieved by collating routinely measured data specific to a patient **(Filho et al., 2012)**.

PRISM III score is a frequently used, physiologically based severity of illness measure using 17 commonly measured physiologic variables and their ranges. The PRISM III score is a quantification of physiologic status using predetermined physiologic variables and their ranges that use categorical variables to facilitate accurate estimation of mortality risk. PRISM III is commonly used to control for severity of illness in studies and to assess quality of care through standardized mortality ratios (SMRs) **(Pollack et al., 2015)**.

PIM score is one of the severity scoring systems being used for predicting outcome of patients admitted to intensive care units (ICUs). The first version of PIM was developed using data collected from 5,695 admissions from seven PICUs in Australia and one from the United Kingdom. The second generation model, PIM2, was developed using data collected from 20,787 pediatric patients treated in intensive care units between 1997 and 1999 in Australia, New Zealand, and the United Kingdom. Recent applications of PIM2 to other study populations have shown mixed results. PIM3 is an updated model built using a larger dataset with more ICUs and greater representation across four countries **(Imamura et al., 2012)**.

So, it is essential to compare between the specificity and sensitivity of both scores as predictive of mortality risk.

This study is carried out to compare the accuracy of the PRISM III and the PIM3 scores

within 24 hours after admission in the PICU in relation to prediction of patients' outcome. We use death rate as an outcome measure to estimate the validity of all these scores.

PATIENTS AND MATERIALS

Data were collected prospectively as a descriptive study on 100 patients over a period of one year from December 2015 till December 2016 for children admitted to the PICU at El-Hussein University Hospital, Faculty of Medicine, Al-Azhar University, Cairo, Egypt.

The PICU at El-Hussein University Hospital that is a 9-bedded ICU. each bed is well equipped with its mechanical ventilator, infusion pumps and ECG/pulse oximeter monitor. It consists of 4 rooms:

- A resuscitation room for emergency conditions contains all equipments and drugs needed for resuscitation, defibrillator, crash trolley, ABG analyzer, portable X-ray machine, portable ultrasound machine and portable echocardiography machine.
- An isolation room for immune compromised patients and when patient isolation is indicated.
- Two ordinary rooms for usual admissions.

We admit different patients from different areas and specialties (medical and surgical specialties) from the age of one month till 18 years of age, (General PICU).

Data were collected over a maximum of 24 hours immediately after PICU admission as a part of routine management.

Inclusion Criteria:

- Patients admitted to the PICU with medical or surgical problem with one or more system failure.
- Patients staying alive at least 12 hours after admission. Readmissions to the PICU during the same hospitalization will be analyzed as separate patients because each admission presented a separate opportunity for an outcome.

Exclusion criteria:

- Patients older than 18 years.
- Patients who stayed or died in less than 12 hour in the PICU.

PRISM III has 17 physiologic variables subdivided into 26 ranges classified as following: (Pollack, et al., 1996).

1. Cardiovascular and neurologic vital signs: 5 measures.
2. Acid-base and blood gas parameters: 5 measures.

3. Chemistry tests: 4 measures.
4. Hematology tests: 3 measures (with PT and PTT counted as one).
   - Minimum total PRISM III score = 0 and Maximum total PRISM III score =74
   - Predictive equations for prognosis are available for the 12 hour and 24 hour scores.
   - Logit = 0.207 × PRISM III score - (0.005 × (age in months) – 0.433 × 1 (if postoperative) – 4.782
   - Predicted Death Rate = $\frac{e^{Logit}}{1+e^{Logit}}$ %

Table (1): Age Group distribution in PRISM III score

Age Group	Age Range
Neonate	0 to < 1 month
Infant	1 to 12 months
Child	> 12 to 144 months (12 years)
Adolescent	> 144 months (> 12 years)

Table (2): Cardiovascular and Neurologic Vital Signs of PRISM III score

Cardiovascular and Neurologic Vital Signs	Findings	Points
Systolic blood pressure	Neonate > 55 mm Hg	0
	Neonate 40 - 55 mm Hg	3
	Neonate < 40 mm Hg	7
	Infant > 65 mm Hg	0
	Infant 45 - 65 mm Hg	3
	Infant < 45 mm Hg	7
	Child > 75 mm Hg	0
	Child 55 - 75 mm Hg	3
	Child < 55 mm Hg	7
	Adolescent > 85 mm Hg	0
	Adolescent 65 - 85 mm Hg	3
	Adolescent < 65 mm Hg	7
Heart rate	Neonate < 215 beats/minute	0
	Neonate 215 - 225 beats/minute	3
	Neonate > 225 beats/minute	4
	Infant < 215 beats/minute	0
	Infant 215 - 225 beats/minute	3
	Infant > 225 beats/minute	4

	Child < 185 beats/minute	0
	Child 185 - 205 beats/minute	3
	Child > 205 beats/minute	4
	Adolescent < 145 beats/minute	0
	Adolescent 145-155 beats/minute	3
	Adolescent > 155 beats/minute	4
Temperature	< 33°C	3
	33 - 40°C	0
	> 40°C	3
Mental status	Glasgow coma score ≥ 8	0
	Glasgow coma score < 8	5
Pupillary response	Both reactive	0
	1 reactive (1 fixed and > 3 mm)	7
	Both fixed and both > 3 mm	11

Where the heart rate should not be monitored during crying or iatrogenic agitation, pupillary size should not be assessed after iatrogenic dilatation, body temperature may be rectal, oral, and axillary or blood and mental status should not be scored within 2 hours of sedation, paralysis or anesthesia. If sedation, paralysis or anesthesia is continuous, score based status prior to sedation, paralysis or anesthesia.

Table (3): Acid-Base and Blood Gases of PRISM III score

Acid-Base and Blood Gas parameters	Findings	Points
Acidosis	pH > 7.28 and total CO_2 ≥ 17 mEq/L	0
	(pH 7.0 -7.28) or (total CO_2 5-16.9 mEq/L)	2
	pH < 7.0 or total CO_2 < 5 mEq/L	6
pH	< 7.48	0
	7.48 - 7.55	2
	> 7.55	3
PCO_2	< 50 mm Hg	0
	50 - 75 mm Hg	1
	> 75 mm Hg	3
Total CO_2	≤ 34 mEq/L	0
	> 34 mEq/L	4
PaO_2	≥ 50 mmHg	0
	42 - 49.9 mm Hg	3
	< 42 mm Hg	6

Where PaO2 requires arterial blood and PCO2 can be measured from arterial, venous or capillary specimens.

Table (4): Chemistry Tests of PRISM III score

Chemistry Tests	Findings	Points
Glucose	≤ 200 mg/dL	0
	> 200 mg/dL	2
Potassium	≤ 6.9 mEq/L	0
	> 6.9 mEq/L	3
Creatinine	Neonate ≤ 0.85 mg/dL	0
	Neonate > 0.85 mg/dL	2
	Infant ≤ 0.90 mg/dL	0
	Infant > 0.90 mg/dL	2
	Child ≤ 0.90 mg/dL	0
	Child > 0.90 mg/dL	2
	Adolescent ≤ 1.30mg/dL	0
	Adolescent > 1.30 mg/dL	2
BUN	Neonate ≤ 11.9 mg/dL	0
	Neonate > 11.9 mg/dL	3
	Not neonate ≤ 14.9 mg/dL	0
	Not neonate > 14.9 mg/dL	3

Where whole blood measurements for glucose over serum are increased 10% and for potassium 0.4 mEq/L.

Table (5): Hematologic Tests of PRISM III score

Hematologic Tests	Findings	Points
White blood cell count	≥ 3,000 per µL	0
	< 3,000 per µL	4
Platelet count	> 200,000 per µL	0
	100,000 - 200,000 per µL	2
	50,000-99,999 per µL	4
	< 50,000 per µL	5
PT and PTT	Neonate PT ≤ 22 seconds and PTT ≤ 85 seconds	0
	Neonate PT > 22 seconds or PTT > 85 seconds	3
	Not neonate PT ≤ 22 seconds and PTT ≤ 57 seconds	0
	Not neonate PT > 22 seconds or PTT > 57 seconds	3

Where the upper limit of the normal reference ranges for PT and PTT are not given.

PRISM III score calculation is done throw android software called pediatric score from (Developer **Email: joselu.grksoft@gmail.com)**.

PIM3 score is calculated from the information collected at the time when the child is admitted to PICU, these information are collected as variables, calculation of PIM3 value (PIM3val) is done by process of summation and subtraction of each variable multiplied by specific constant number according to the following formula: **(Straney et al.,2013)**.

PIM3val = (3.8233×Pupils value) – (0.5378×Elective value) + (0.9763×Mech Vent value) + (0.0671×(absolute Base Excess)) – (0.0431×SBP) + (0.1716× (SBP×SBP/1000)) + (0.4214×(100×FiO2/PaO2)) – (1.2246×Recov_CardBypPr value) – (0.8762×Recov_CardNonBypPr value) – (1.5164×Recov_NonCardPr value) + (1.6225× VHRdiag value) + (1.0725×HRdiag value) – (2.1766×LRdiag value) – 1.7928

PIM3 Risk of Death = e^(PIM3val)/〖1+e〗^(PIM3val)%.

Use the first value of each variable measured within the period from the time of first contact to 1 hour after arrival in your ICU. The first contact may be in your ICU, your emergency department, a ward in your own hospital or in another hospital (e.g. on a retrieval).

Only one of VHRdiag (very high risk diagnosis), HRdiag (high risk diagnosis), and LRdiag (low risk diagnosis) can be included in the calculation of PIM3val, with the most severe risk overriding the lesser risks **(Straney et al., 2013)**.

1. Systolic blood pressure, mm Hg. Record SBP as 0 if the patient is in cardiac arrest, record as 30 if the patient is shocked and the blood pressure is so low that it cannot be measured

2. Pupils value includes pupillary reactions to bright light (>3 mm and both fixed =1, other or unknown = 0). Pupillary reactions to bright light are used as an index of brain function. Do not record an abnormal finding if this is due to drugs, toxins, or local eye injury.

3. ([FiO2 × 100]/PaO2). PaO2 is the arterial oxygen tension, mm Hg, as measured in an arterial blood gas sample only. FiO2 is the fraction of inspired oxygen being delivered via endotracheal tube (ETT), non-invasive ventilation (NIV), or headbox. Both the FiO2

and PaO2 must relate to the same time. If FiO2 or PaO2 unknown, its default value 0.23 (derived from the normal value of PaO2 in air ((0.21×100)/90).

4. Base excess in arterial or capillary blood, mmol/L (unknown = 0).

5. Mechanical ventilation at any time during the first hour in ICU (no = 0, yes = 1). Mechanical ventilation includes invasive ventilation, mask, nasal continuous positive airway pressure, bilevel positive airway pressure or negative pressure ventilation.

6. Elective admission to ICU (no = 0, yes = 1). It includes admission (planned or foreseeable) after elective surgery or admission for an elective procedure (e.g. insertion of a central catheter), elective monitoring or review of home ventilation. An ICU admission or an operation is considered elective if it could be postponed for more than 6 hours without adverse effect.

7. Recovery from surgery or a procedure (includes a radiology procedure or cardiac catheter) is the main reason for ICU admission. Do not include patients admitted from the operating theater where recovery from surgery is not the main reason for ICU admission (e.g. a patient with a head injury who is admitted from theater after insertion of an intracranial pressure monitor; in this patient the main reason for ICU admission is the head injury. Classify according to the following:

- No, recovery from surgery or a procedure: (record 0).
- Yes, recovery from a bypass cardiac procedure: (record 1 in Recov_CardBypPr variable)
- Yes, recovery from a non-bypass cardiac procedure: (record 1 in Recov_CardNonBypPr variable).
- Yes, recovery from a noncardiac procedure: (record 1 in Recov_NonCardPr variable).

8. Low-risk diagnosis: Record (0) = No and record (1) = Yes for the following:

- Asthma is the main reason for ICU admission.
- Bronchiolitis is the main reason for ICU admission including children who present either with respiratory distress or central apnea where the clinical diagnosis is bronchiolitis.

- Croup is the main reason for ICU admission.
- Obstructive sleep apnea is the main reason for ICU admission including patients admitted following adenoidectomy and/or tonsillectomy in whom obstructive sleep apnea is the main reason for ICU admission (and code as recovery from surgery).
- Diabetic ketoacidosis is the main reason for ICU admission.
- Seizures is the main reason for ICU admission including patients who require admission primarily due to status epilepticus, epilepsy, febrile convulsion, or other epileptic syndrome where admission is required either to control seizures or to recover from the effects of seizures or treatment.

9. High-risk diagnosis: Record (0) = No and record (1) = Yes for the following:

- Spontaneous cerebral hemorrhage, the hemorrhage must be spontaneous (for example, from an aneurysm or AVM). Do not include traumatic cerebral hemorrhage or intracranial hemorrhage that is not intracerebral (e.g. subdural hemorrhage).
- Cardiomyopathy or myocarditis requires the documented diagnosis of myocarditis or cardiomyopathy.
- Septic shock as defined by the International Pediatric Sepsis Consensus Conference, 2002, requires the presence of the systemic inflammatory response syndrome (SIRS) and suspected or proven infection and cardiovascular organ dysfunction.
- Hypoplastic left heart syndrome includes only cases where a Norwood procedure or equivalent is required in the neonatal period to sustain life.
- Neurodegenerative disorder requires a history of progressive loss of milestones (even if no specific condition has been diagnosed), or a diagnosis where this will inevitably occur.
- Necrotizing enterocolitis is the main reason for ICU admission.

10. Very high-risk diagnosis: Record (0) = No and record (1) = Yes for the following:

- Cardiac arrest preceding ICU admission includes both in-hospital and out-of-hospital arrest, requires either documented absent pulse or the requirement for external cardiac compression. Do not include past history of cardiac arrest.
- Severe combined immune deficiency.
- Leukemia or lymphoma, after first induction, includes only cases where admission is related to leukemia or lymphoma or the therapy for these conditions.
- Bone marrow transplant recipient.
- Liver failure is the main reason for ICU admission, acute or chronic. Do not include patients admitted following an elective liver transplant.

PIM3 score calculation is done with an excel file from The Australian and New Zealand Pediatric Intensive Care (ANZPIC) Registry (http://www.anzics.com.au/Downloads/PIM3%20Calculator.xlsx).

Data was entered into Microsoft Excel 2010 (Microsoft Corp., Redmond, CA were analyzed using the Statistical Package for Social Sciences (SPSS) version 21.0 for Windows (IBM Corp., USA). P value <0.05 was considered statistically significant.

The quantitative data were tested for normality using Kolmogorov–Smirnov test, and was described with median and Inter-Quartile Range (IQR). The qualitative data was described by frequency and percent. Spearman's correlation was conducted to correlate results of PIM 3 score and PRISM III score.

Comparison of qualitative data was done using Chi-square test. Comparison of quantitative data was done using Mann–Whitney U test and Kruskal–Wallis one-way analysis of variance.

To know how well PIM 3 score and PRISM III score can predict mortality, the positive predictive value (PPV), negative predictive value (NPV), sensitivity and specificity were used. Efficiency is an overall estimate of a test's ability to classify patients correctly. It is estimated by adding the numbers of the two correct classifications (true positive and true negative) and dividing by the total number of patients assessed.

ROC (receiver operator characteristics) curve(s) were constructed to assess area under the curve (AUROC). Patients were classified into two groups (below

and above the cutoff values). Best cutoff values for the independent variables were determined by maximizing the Youden index (Se+Sp-1).

RESULTS

Our results were tabulated and analyzed in the following tables and figures:

Table (6): Characteristics of the Studied Patients

Variables		Number (n)
Age (months)	Median (8 months)	
	IQR	4-36
Age groups stratification (years)	≤ 2	18
	2–12	44
	>12	38
Gender	Males	58
	Females	42
Causes of admission	Chest disorders	32
	Heart disorders	8
	CNS disorders	4
	Endocrine and Metabolic disorders	6
	GIT disorders	13
	MODS	24
	Surgical problems	13
Length of hospital stay (LOS) (days)	Median	7
	IQR	4 - 11
(LOS) stratification	≤ 2 days	10
	2-7 days	43
	>7 days	47
Outcome	Survivors	83
	Non survivors	17

Table (7): Area under the Curve for both PRISM III and PIM3 Scores

Test Result Variable(s)	Cut-Off value	Area	P value	Asymptotic 95% Confidence Interval	
				Lower Bound	Upper Bound
Expected death by PRISM III score	5.85	0.987	<0.001	0.986	1.000
Expected death by PIM 3 score	9.10	0.937	<0.001	0.887	0.998

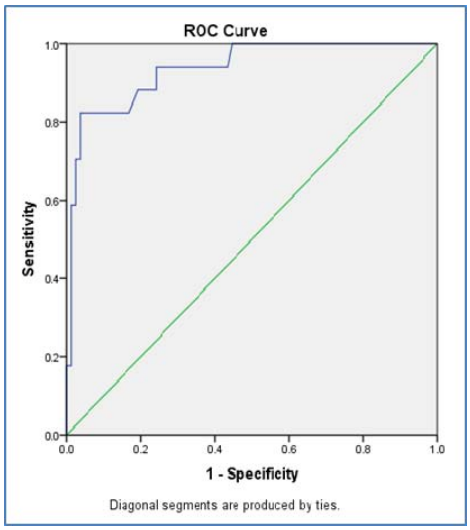

Fig. (1) ROC curve for PIM 3 score

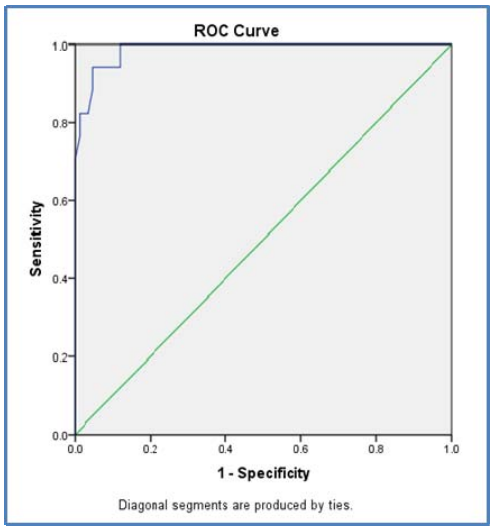

Fig. (2) ROC curve for PRISM III score

The discriminatory performance of the models, measured by area under the ROC curve. The area under the ROC curve was 0.987 (CI 95%, 0.968-1.000) for PRISM III score and 0.973 (CI 95%, 0.877-0.998) for PIM3 score. Findings were shown to have a good discriminatory performance between survivors and non-survivors.

Table (8) Hosmer-Lemeshow Goodness-of-Fit for PRISM III score*

PRISM III Score Expected mortality %	Total (n)	Expected mortality	Observed mortality	Expected survival	Observed survival	SMR
< 3	72	0.89	0	71.11	72	Not applicable
3 – 5	6	0.23	1	5.77	5	4.35
5 – 10	8	0.55	3	7.45	5	5.45
10 - 25	4	0.58	3	3.42	1	5.17
> 25	10	5.8	10	4.2	0	1.7
total	**100**	**8.05**	**17**	**91.95**	**83**	**2.11**

Chi -square = 27.25 p =<.0001

As regard PRISM III score we stratified the expected mortality into 5 intervals according to severity (<3, 3–5, 5–10, 10–25 and >25) and calculated the number of survivors and non-survivors compared to the expected mortality in each score group.

As regard Goodness-of-Fit for PRISM III score X2 was 27.25 and P value was <0.0001. The standardized mortality ratio (SMR) that equals observed to expect mortality was 2.11.

Table (9) Hosmer-Lemeshow Goodness-of-Fit for PIM 3 Score*

PIM 3 Score Expected mortality %	Total (n)	Expected mortality	Observed mortality	Expected survival	Observed survival	SMR
< 3	58	0.9	1	57.1	57	1.11
3 - 5	21	0.76	2	20.24	18	2.63
5 – 15	9	0.86	4	8.14	5	4.65
>15	12	4.42	10	7.58	2	2.26
total	**100**	**6.94**	**17**	**93.06**	**83**	**2.44**

Chi-square = 20.54 p = 0.0001

As regard PIM 3 score we stratified the expected mortality into 4 intervals according to severity (<3, 3–5, 5–15 and >15) and calculated the number of survivors and non-survivors compared to the expected the mortality in each score group.

As regard Goodness-of-Fit for PIM 3 score X2 was 20.54 and P value was 0.0001. The standardized mortality ratio (SMR) that equals observed to expected mortality was 2.44. ***(Hosmer et al., 2013)**.

Table (10) PRISM III and PIM 3 Score Expected Mortality Median among Survivors and Non-survivors

	Outcome	Expected mortality IQR score	Expected mortality Median score
PRISM III	**Non-survivors**	10.0-52.0	37.9
	Survivors	0.8-2.2	1.2
PIM3	**Non-survivors**	10.0-38.2	22.6
	Survivors	1.5-3.1	2.1

As regard PRISM III score the median were 1.2 among survivors and 37.9 among non-survivors. As regard PIM 3 score the median were 2.1 among

survivor and 22.9 among non-survivor.

Table (11) Diagnostic Tests for PRISM III and PIM 3 Scores

	Cut-off value	sensitivity	specificity	PPV	NPP	Accuracy
PRISM III score	<0.001	94.12%	95.18%	80.00%	98.75%	95.00%
PIM 3 score	<0.001	82.35%	97.56%	87.50%	96.39%	95.00%

Sensitivity for PRISM III (94.12%) and for PIM 3 (82.35%), specificity for PRISM III (95.18%) and for PIM 3 (97.56%), positive predicted values for PRISM III (80.00%) and for PIM 3 (87.50%), negative predicted values for PRISM III (98.75%) and for PIM 3 (96.39%) and the accuracy of both PRISM III and PIM3 scores was (95.00%).

DISCUSSION

In our study the median age of the studied patients was 8 months and 58 subjects (58.00% of the sample) were males. The most frequently affected system was the respiratory system (32.0%). on the other hand the least affected system was the CNS (4.0%). The second reasons for ICU admission (24%) were severe sepsis, septic shock and multi organ dysfunction syndrome (MODS). The median length of hospital stay was 7 days.

Several studies conducted in the 1980s and 1990s reported mortality rates around 50% in children with septic shock. Other investigations reported mortality rates of 20–30% **(Pollack, 1985)**.

Our study showed a mortality of 17% that is higher as compared to many studies from developed countries. **Choi et al.2005**, found a low mortality of 2.6%. They gave explanation for this as sepsis was significantly under-represented in their study population (2.3%) compared with other reports (30%-41%) **(Bilan et al., 2009)**.

Validation and performance of the scoring system was tested by assessing calibration and discrimination. Calibration is the ability to provide a risk estimate corresponding to the observed mortality. In another words calibration refers to the level of agreement between individual probabilities and actual outcomes. It was assessed by the Hosmer-Lemeshow, Goodness-of-Fit testes and calibration curves.

Discrimination refers to the ability of the test to calculate a higher mortality probability among non-survivors than survivors across the whole group, with acceptable discrimination represented by an area under the ROC curve of 0.70–0.79, and good discrimination by an area ≥0.80 and excellent by an AUC ⩾0.9 **(Tibby et al., 2002)**.

In our study the discriminatory performance of the models, measured by the area under the ROC curve, was 0.987 for PRISM III (CI 95%, 0.968-1.000) and 0.973 (CI 95%, 0.877-0.998) for PIM3. Findings were shown to have an excellent discriminatory performance between survivors and non-survivors.

In the study done by **Pollack et al., 2015**, about PIM 3 the area under the ROC curve for the development and validation sets was 0.88 ± 0.013 and 0.90 ± 0.018.

In Brazilian study conducted by **Martha et al., 2005**, showed that the discriminatory performance of the models, measured by area under the ROC curve, resulted in an area of 0.870 (0.810-0.930) for the PRISM III and 0.845 (0.769-0.920) for the PIM 3.

An Indian study conducted by **Varma et al., 2017**, showed that the overall performance of the PRISM III score was good with AUC of 0.86 (good discrimination) and reasonable agreement between observed and expected mortality.

In previous validation studies, the area under the ROC curve (c-index) for PIM 3 and PRIM III were acceptable, but the values varied between 0.74 and 0.92 The c-indices in those studies were lower than the value reported in our study, which means that study index had better discriminatory power. The variation may be explained by regional differences in study populations **(Straney et al., 2013)**.

As regard PRISM III score at the cut-off point of 5.85, there was some similarity in both predicted and observed morality. In our study it predicted 8 patients to die and the observed mortality was 17. As regard PIM 3 score at the cut-off point of 9.10, there was also some similarity in both predicted and observed morality. In our study it predicted 7 patients to die and the observed mortality was 17.

With increases in PRISM III and PIM 3 scores, there were increases in the percentage of mortality, as PRISM III median scores were 37.9 among non-

survivors and 1.2 among Survivors and PIM 3 median scores were 22.6 among non-survivors and 20.1 among Survivors.

Calibration evaluates how well the model classifies patients into low, medium and high risk categories. In another words, calibration refers to the level of agreement between individual probabilities and actual outcomes. It is the ability to provide a risk estimate corresponding to the observed mortality which is evaluated by examining the Hosmer–Lemeshow Goodness-of-Fit. The acceptable calibration is evidenced by a p value <0.001. The results are also presented as observed to expected mortality ratios within the standard risk categories.

To simplify this we categorized score mortality ratios into intervals provided that most of these intervals contain at least one expired patient.

The overall expected death rate was the sum of the probability of death for each admission, and the ratio of observed to expected death rates was known as the standardized mortality ratio (SMR). Values less than one imply good performance, and values greater than one imply poor performance **(Rapoport et al., 1994)**.

Jean-Pierre et al., 2015, sowed that the Hosmer-Lemeshow Goodness-of-Fit test showed a good calibration only for PRISM III (PRISM III: $\chi 2$= 3.820, p = 0.282) and concluded that PRISM III had good discrimination and calibration in studying pediatric population that required intensive critical care **(Jean-Pierre et al., 2015)**.

In korea, Ok **Jeong Lee et al.,2017**, showed that the calibration of PIM 3 was good, with a $\chi 2$ of 9.4 in the Goodness-of-Fit test (P=0.313) as the observed mortality rate was 8.47%, and the predicted mortality rate was 6.57% for patients aged < 18 years.

In our study we found that $\chi 2$ was 27.25 and p =<0.0001 for PRISM III and $\chi 2$ was 20.54 and p = 0.0001 for PIM 3. SMR for PRISM III was 2.11 and that for PIM 3 was 2.44 that mean poor calibration of both scores.

Poor calibration has been attributed to various factors like poor resources of medical system. This is more important in developing countries where resources are more limited. Other factors include different case mix, disease pattern and failure of the scoring system equation to model

the actual situation accurately **(Leteurtre et al., 2004)**.

However, Diamond 1992, demonstrated that perfect calibration and perfect discrimination cannot coexist; a perfectly calibrated model is not perfectly discriminatory because it has an AUC of only 0.83 rather than 1 **(Diamond et al., 1992)**.

Bhupal et al., 2014, concluded that PIM II and PRISM III under predicted mortality and also had poor calibration with good discrimination. Overall both scores exhibited good capacity to discriminate between survivors and non survivors and can be used as a tool with a comparable performance for prognostic evaluation **(Bhupal et al., 2014)**.

Sensitivity (also called the true positive rate) measure the percentage of non-survivors who are expected to die by the scoring system for PRISM III was 94.12% and for PIM 3 was 82.35%.

Specificity (also called the true negative rate) measures the percentage of survivors who expected to survive by the scoring system for PRISM III was 95.18% and for PIM 3 was 97.56%.

CONCLUSION

- Both scores had excellent discrimination, especially PRISM III, and had good sensitivity and specificity but both had poor calibration. PRISM III was better than PIM 3 because it was easy to collect and did not depend on the diagnosis.
- Although we had poor calibration, when the results were taken as whole, both scores exhibited good capacity to discriminate between survivors and non-survivors and can be used as a tool with a comparable performance for prognostic evaluation of pediatric patients admitted in a PICU setting.
- Further studies are required to validate the PRISM III and PIM 3 scores to our environment.

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اعتمادية كل من مقياس مخاطر الوفيات 3 ومقياس مؤشر الوفيات 3 في وحدة الرعايه المركزه بمستشفي الحسين الجامعي

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في العقود الاخيره تم تطوير وحدات الرعايه المركزه في الكثير من مجالات الطب بما في ذلك طب الاطفال ومما لاشك فيه ان تقليل الوفيات هو أهم الأهداف الرئيسيه في وحدات الرعاية المركزه للأطفال ويتم تحقيق ذلك بالمراقبه التامه للاطفال ذوي الحالات الحرجه. تعتبرانظمه مجموع النقاط المحرزه تم تطويره منذ 30 عاما حيث يسمح بتقييم شدة المرض وتقدير الوفيات داخل المستشفي.

نظام مقياس مخاطر الوفيات في الأطفال 3:

تم تطويره عن طريق عينه من 11165 حاله دخول مرضي في 32 وحده رعايه مركزه للاطفال ويتم التقييم من خلال 17 متغيرات فسيولوجيه مقسمه الي 26مدي وينقسم الي:

- جهاز القلب والأوعيه الدمويه والجهاز العصبي والعلامات الحيويه: 5 قياسات.
- نظام توازن الحمض والقاعده وغازات الدم: 5 قياسات.
- تحاليل كيميائيه: 4 قياسات.

• تحاليل الدم: 3 قياسات.

نظام مقياس مؤشر الوفيات في الأطفال 3:

اول نسخه تمت عن طريق5695 حاله دخول في 7 وحدات رعايه مركزة للأطفال وتم تطوير النسخه الثانيه بين عام 1997 , 1999 والنسخه الثالثه عام 2012.

يتم حساب مؤشر الوفيات في الأطفال 3 من المعلومات التي يتم تجميعها وقت دخول الطفل وحدة الرعايه المركزه مع الأخذ في الاعتبار ان القيم التي يتم تسجيلها تكون في خلال ساعه من وصول الطفل الي وحده الرعايه المركزه وهذه القيم تشمل قياس ضغط الدم الانقباضي وحاله بؤبؤ العين ونسبه الاكسجين المستنشق الي ضغط الاوكسجين الشرياني ووجود حمضيه او قلويه بالدم واستخدام جهاز التنفس الصناعي واختياريه الحجر في وحده الرعايه والحجز بعد العمليات او اي اجراءات وتقسيم تشخيص الحاله الي ذات خطوره بسيطه او متوسطه او عاليه.

الهدف من الدراسه:

تحديد دقه كل من مقياس مخاطر الوفيات 3 ومقياس مؤشر الوفيات3 في التنبأ بالوفاه في مرضي وحده العنايه المركزه للأطفال بمستشفي الحسين الجامعي.

الوسائل والمرضي:

سيتم ذلك في وحده الرعايه المركزه للأطفال بمستشفي الحسين الجامعي والتي تتسع 9أسره كل سرير يشتمل علي نظام متابعه الوظائف الحيويه وجهاز تنفس صناعي وسرنجه الدفعوتتكون الرعايه من 4 غرف غرفة لانعاش الحالات الحرجه وتحتوي بالاضافه لما سبق علي جهاز الصدمات الكهربائيه وجهاز اشعه اكس متحرك وجهاز موجات فوق صوتيه وغرفة لعزل اي طفل اذا لزم الامر وغرفتان للحالات المعتادة وتستقبل الرعاية الاطفال من عمر شهر الي 18 سنه في جميع التخصصات الطبية والجراحية ماعدا مرضي السرطان.

سيتم قبول كل اطفال الرعايه المركزه في الدراسه ماعدا الاطفال التي لم تستكمل بياناتهم ومن قلت فتره اقامته عن 12 ساعه واذا تم اعاده دخول الطفل في الرعايه اكثر من مره تحتسب كل مره من جديد.

سيتم مقارنه كلا من نظام مقياس مخاطر الوفيات في الأطفال 3 ونظام مقياس مؤشر الوفيات في الأطفال 3 من حيث التمييز بين الوفيات والاحياء وسيتم معايره النمازج للتاكد من ان نسبه احتملات النماذج مساويه لواقع الوفيات.

النتيجه:

تمت الدراسه علي 100 حاله وكان متوسط العمر للحالات 8 شهور عدد الوفيات 17 حاله يعتبر الجهاز التنفسي

اكثر تاثر في حالات الدخول حيث يمثل 32 % من الحالات تاتي بعد ذلك حالات التاثر المتعدد لانظمه الجسم والذي يمثل السبب الاول للوفيات.

يعتبركل من انظمه محجموع النقاط المحرزه محل الدراسه استنادا الي نقاط القطع مؤشرا جيدا للتفرقه بين الاحياء والاموات في مرضي الدراسه حيث توقع نظام مقياس مخاطر الوفيات في الأطفال 3 عدد 20 حالات وفاه من اصل 17 وفاه حقيقيه وتوقع ونظام مقياس مؤشر الوفيات في الأطفال 3 عدد 17 حالات وفاه من اصل 17 وفاه حقيقيه وبالنسبه للمعايره وهي نسبه الوفاه المتوقعه في المجموعه ككل ونسبه الوفاه الحقيقيه فهعي ضعيفه بعض الشيء حيث كان التنبأ لكل منهما بنصف عدد الحالات.

الاستنتاج:

يعتبر كلا من نظام مقياس مخاطر الوفيات في الأطفال 3 ونظام مقياس مؤشر الوفيات في الأطفال 3 مقياسا جيدا للتنبا بحالات الوفاه في وحدات الرعايه المركزه للاطفال ,وتبين ان كلا منهما جيد الحساسيه والنوعيه ولكن معايره كل منهما ضعيفه بعض الشيء حيث لم تتوافق احتمالات الوفاه مع واقع الوفاه ولكن بالرغم من ضعف المعايره لكل من نموذجي نظام مقياس مخاطر الوفيات في الأطفال 3 ونظام مقياس مؤشر الوفيات في الأطفال 3 عندما تؤخد النتيجه ككل يمكن لكلا المنموذجين التنبأ بالوفيات في مرضي وحده العنايه المركزه للأطفال ويتم الاعتماد عليهم لتقييم الحالات.

نظـــام مقيـــاس مخـــاطر الوفيـــات فـــي الأطفـــال 3 اســـهل مـــن نظـــام مقيـــاس مؤشـــر الوفيـــات فـــي الأطفـــال 3 مـــن حيـــث انـــه ســـهل التجميـــع ولا يعتمـــد علـــي التشـــخيص ونوصـــي بدراســـات اخـــري علـــي المعيـــارين للتاكـــد مـــن ســـريان مفعولهمـــا فـــي المحـــيط الخـــاص بنا.