Admission Criteria in a pediat ric Intensive Therapy Unit: Presentation of an Evaluation Instrument

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ABSTRACT

Background: Eligibility for intensive care admission/discharge is based on clinical reversibility, the probability of benefit with intensive treatment and the prospect of patient recovery. In this sense, the models in place to evaluate the indication of intensive care include four categories: diagnosis, objective parameters, priorities and predictive laboratory scores of severity.

Objective: To describe an evaluation instrument for indication of admission in a paediatric intensive care unit (PICU).

Methods: Observational, descriptive, cross-sectional study conducted at a public PICU in, Brazil. The probabilistic sample indicated the need to evaluate 236 children, but instead, all 608 children admitted to the PICU in the years 2011 and 2012 were evaluated. The completion of data for the domains contained in the instrument was performed by a medical professional who is a specialist in paediatric intensive care medicine (PICM). The structure of the questionnaire consisted of five domains and 14 assertions, each with respective alternatives. The presence of only one domain (physiological disturbance) in the assessment by PICM specialists represents indication for ICU admission, which justified the absence of a need to assign values to the different domains and therefore, to establish a scoring system for these domains. The five implemented domains were: 1) Central nervous system, 2) Respiratory system; 3) Cardiovascular system; 4) Digestive system and 5) Genitourinary system. Domains were built according to the American Heart Association Guidelines for the critically ill child and related guidelines.

Results: The proposed instrument was applied to the records of 609 children and correctly identified 557 (91.4%) patients. The same patient may have had more than one affected domain. CNS (558), cardiovascular system (269), respiratory system (261), digestive system (28) and renal system (25) involvement were detected. The remaining 8.6% corresponded to patients with chronic diseases and those in palliative care, who would not benefit from PICU care.

Conclusion: The proposed instrument correctly identified more than 90% of hospitalized patients who had indications for admission to a paediatric intensive care unit.

Keywords: *Admission in PICU; Severity; Prognosis; Mortality; Child.*

INTRODUCTION

The severely ill child faces a clinical situation of severe dysfunction of one or more organ systems, which, if not treated effectively and early, significantly increases the risk of sequelae and death. The first treatment performed in the emergency sector aims at early stabilization in the first hour of assistance, followed by adequate monitoring until the transfer to the Paediatric Intensive Care Unit (PICU), where the patients will continue to undergo specialized clinical investigation, invasive monitoring and appropriate treatment.

Since the 1980s, with the increase of investments in technology, research, production of new equipment and drugs used in life support, the requirement for the use of clinical protocols has increased, which undoubtedly contributed to the

reduction of mortality from 15%–20% to 3%–10% between the 1980s and the 1990s[1,2].

As in other countries, Brazil has made progress in tackling public health issues in the last 20 years. However, there are still structural, organizational and health education problems that limit the equity of health services delivered to the population at the primary, secondary and tertiary levels. This is why Brazilian health policy aims at the integral care of children and adolescents, with emphasis on primary care. However, the inadequacies of public health services, due to low funding in the sector, especially in primary health care, and the population's deficiency in health promotion and prevention programs, together with a change in the epidemiological profile of causes of death in childhood in recent years, have contributed to the overload of the tertiary health sector, including paediatric intensive care[3,4].

In medical practice, indications for paediatric intensive care are based on subjective medical evaluation, as there is no clinical instrument that is practical in the evaluation, safely indicating the patient who should or should not occupy the intensive care unit. Some authors have prepared scoring systems for predicting the prognosis of severely ill children to guide the physician in the indication of paediatric intensive care, according to the admission diagnosis; presence of comorbidities and clinical, laboratory or therapeutic parameters.

However, these severity scores, although useful, are difficult to interpret and are not always accepted by the medical team, who consider them difficult to apply due to the large number of variables to be analysed and the need for many laboratory tests for the application in complex mathematical formulas, which are not practical at the bedside[5-8].

In many cases, PICU beds are occupied by children with irreversible chronic diseases or carriers of various comorbidities who will not benefit from the specialized assistance offered at the PICU. The lack of objectivity in bed utilization implies increased risk, sequelae and mortality for patients with a greater chance of survival, who, in the short term of hospitalization, could release the bed to be reused in a rational and optimized way[8].

Eligibility for admission and discharge from intensive care should be based on the reversibility of the clinical picture, the probability of benefits with intensive treatment and the expectation of patient recovery, according to the principle of screening and for the benefit of intensive care patients.

However, uncertainty about the capacity of resources and the prognosis of patients limits the capacity of decision-makers to use this principle of priorities in not indicating patients who would not benefit from the ICU and thereby denying or delaying care to patients who could benefit more. This implies broadening the discussion about strategies to reduce uncertainty and improve decision making by using fast and practical instruments at the bedside in order to better share and process information that benefits more patients, in the face of limited PICU beds[7,8].

Thus, the objective is to describe an assessment instrument for indication of admission to the paediatric intensive care unit (PICU).

METHODS

This is an observational, descriptive, cross-sectional study performed at a PICU in the city of Vitória, State of Espírito Santo, Brazil. The probabilistic sample indicated the need to evaluate 236 children, but all 608 children hospitalized in the ICU in 2011 and 2012 were evaluated.

An evaluation tool was developed containing five domains and 14 assertions (Box 1). The presence of only one domain in the assessment of PICM specialists represents the indication for ICU admission, which justified the lack of need to assign values to the different domains and therefore, not to establish a scoring system for these domains.

The five established domains were

1) Central nervous system,

2) Respiratory system,

3) Cardiovascular system,

4) Digestive system and

5) Genitourinary system.

Domains were constructed according to the American Heart Association Guidelines for the critically ill child and similar protocols[7-9]. It aimed to register data on the functional clinical examination of the five domains for indication of PICU admission.

The data for filling in the domains were collected by a medical professional specialized in paediatric intensive care medicine (PICM), based on primary data (medical records) from

patients hospitalized during the study period registering acute and chronic diseases, related conditions and physiological disturbances upon admission to the ICU. Data were compiled and transcribed for a data storage worksheet and inserted into a statistical analysis program. The study was approved by the REC of the institution (CAAE No. 12328313.5.0000.5065). **Box 1**

RESULTS

The proposed instrument was applied to the medical records of 609 children admitted to a paediatric ICU in the city of Vitória - Espírito Santo State, from January 2011 to December 2012. Many of the patients had more than two organ systems affected, the respiratory system being the most affected, as shown in Table 1.

Age (Months)	Organ or System Affected					
	Total	Respiratory	Cardiovascular	Nervous	Renal	Digestive
01–12	**357**	197	88	62	7	3
13–24	**128**	66	23	35	1	3
25–36	**65**	35	13	16	0	1
37–48	**56**	25	13	14	0	4
49–60	**40**	18	12	10	0	0
61–120	**186**	81	44	51	5	5
>120	**309**	141	76	73	12	7
Total	**1141**	**563**	**269**	**261**	**25**	**23**

The proposed evaluation instrument correctly identified 557 (91.4%) patients presenting clinical pictures compatible with the need for paediatric intensive care. The others represented patients with chronic diseases and patients in palliative care who would not benefit from intensive care.

DISCUSSION

The evaluation instrument tested in this study was shown to be useful for the indication of paediatric intensive care, as it was based on the clinical alteration identified exclusively in the physical examination, which is a mandatory procedure performed in all patients seeking medical care. The simplicity of the instrument allows its use by physicians without specific training in paediatric intensive care.

In the present study, it was observed that the majority of patients admitted to the PICU presented more than two diagnoses, likely influenced by factors related to failures of the public health system on the three levels of care, favouring the late diagnosis of the disease and associated complications, in conjunction with the lack of paediatric intensive care beds in public hospitals and access to a paediatric patient profile, characterized by comorbidities and damages established when admitted to the unit.

Intensive care is one of the medical areas most concerned with determining the patient's prognosis[6,10-12], as intensive care physicians frequently encounter death and severely ill or injured patients, and the well-being of the patient is the family's main concern.

The evaluation criteria to identify the diagnoses were based on objective clinical, laboratory and imaging parameters indicative of ICU treatment to assess the risk of severity and mortality, but all had positive and negative aspects. A priority-oriented criterion is based on the broad clinical picture, considering the evolution of the disease and the prognosis of the patient, in addition to the availability of treatment resources. It requires medical expertise in the field of paediatric intensive care.

The combination of diagnostic models and objective parameters increases the capacity for the evaluation of intensive care, especially for emergency physicians who provide assistance to patients in the emergency room or patients who evolve with significant changes in the clinical picture in other sectors of the hospital (clinical or surgical), whereas the priorities model is ideal for intensive care physicians because it requires the physician's experience with clinical pictures of severity, prognosis and availability of resources for each case. Scoring systems in predicting prognosis and mortality are important and reliable, but not always useful for rapid decision making to indicate admission to the paediatric ICU, because they require the analysis of a large number of variables and the evaluator's experience for their interpretation.

Currently, most medical procedures are based on well-defined protocols available in the literature. Among them, the application of scoring systems to objectively predict clinical severity aimed at reducing the physician's subjectivity of the past, weakly supported by the physician's clinical eye, which defines who would or would not receive a certain treatment[13-15].

Predictive indexes of severity in paediatrics help the paediatrician to discriminate between patients who are likely to require invasive medical intervention and those with low risk of death, as they assess the severity of the disease and predict the patient's prognosis according to the active therapy established, number of necessary therapeutic interventions and evaluation of physiological and/or laboratory parameters[16].

In Brazil, there is an indication that the number of intensive care beds is insufficient to meet the population's demand. Thus, the use of an evaluation instrument for indication of paediatric intensive care is an ally of the paediatrician and the hospital institution in the qualification of care for critically ill children. The paediatric ICU where the study was developed provides six beds for a hospital that has 100 infirmary beds and an emergency unit located in a 24-h open-door emergency room.

Prognostic indices emerged to answer questions regarding the efficiency and quality of services in comparison with other units. Studies concerning these indices have shown that the inverse relationship between technology and mortality is not true, and that prognostic indices are actually capable of showing the difference in quality of care between these units. Furthermore, it provides parameters for indication of hospitalization and discharge, specifying the number and qualification of the professionals that are needed for the service, improving the cost effectiveness of care provided to hospitalized patients and rationalizing the treatment of patients without an established prognosis[10-12,16].

The Brazilian government also encourages the qualification of existing intensive care beds, and among the criteria for receipt of funds is the adoption of care protocols, clinical guidelines and administrative procedures. The adoption of care protocols qualifies health care, aiming at integral care. In this manner, the indication of paediatric intensive care should be based on protocols with clinical criteria for access to these units[17].

However, in daily medical practice, these scores are difficult to apply because they involve complex mathematical calculations and laboratory tests, which make them impractical and intricate for bedside evaluation. In addition, they present dynamic characteristics, that is, they change continuously over time, requiring a doctor's time for their execution, in addition to the one assisting the patient.

The development of the main paediatric predictive scores took place in developed countries (from North America, Europe and Oceania). Studies involving distinct populations, such as those in Latin America, in addition to developed countries, could add variables that would contribute to the same prognostic score in different populations[18].

There are a number of factors in the PICU that influence patient outcome, including the clinical severity of the current condition, the coexistence of an underlying disease, the experience of the assistant team, the availability of technological resources, the adoption of treatment protocols and whether it is a specialized unit, such as a cardiology unit, or whether it treats an extensive number of diseases. The comparison of indicators of mortality of the PICUs is important; however, it is necessary to take into account the aforementioned factors, besides the severity score of patients admitted to each unit[19-21].

General and specific prognostic scores for certain clinical situations, such as trauma, meningococcal disease, oncological diseases and neonates, are described in the medical literature. Scores that evaluate the number and severity of organ dysfunctions are useful in comparative studies, in the evaluation of new therapeutics and in the monitoring of those instituted[6,22].

The clinical instrument proposed in the study, besides evaluating the child's need for intensive care through objective criteria, may contribute to the accomplishment of comparative studies from other PICUs in the country, regarding the quality of health care for severely ill children.

The choice for a particular type of predictive score depends on the purpose of its use, taking into account some criteria for its selection. The prognostic score, for its validation, needs to have a good capacity of discrimination and calibration in the different levels of severity. The ability to discriminate characterizes individuals with high and low risk of death, while the power of calibration compares observed and expected mortality at different severity intervals[18,19]. The evaluated instrument has a good capacity for discrimination, since the criteria that were used reinforce the clinical pictures of greatest severity within each organic system contemplated.

It was in the 1980s that the first generic prognostic system - Acute Physiology and Chronic Health Evaluation (APACHE) -

appeared; however, it was so complex that in 1985 it was reformulated and the APACHE II score was published with a smaller number of variables and data collected in the first 24 h of ICU admission[13-15]. In 1991 it was again improved after study with a larger sample of patients[23].

The origin of the prognostic score was based on subjective data collection methods, and over time, the number of variables included has been progressively reduced, making their use more practical in hospital routines. In that sense, chronologically, new scores were created and refined, in order to improve the positive aspects and reduce their limitations. Today, both adult and paediatric intensive care units are looking for those that are more adjusted to their patient profile, with the aim of improving the quality of health care, optimizing the use of available resources and reducing costs[13-15, 24].

In the 1990s, the third generation of severity scores used in PICUs[25] emerged. These scores use a combination of demographic variables; chronic diagnoses; reason for admission and physiological, laboratory and therapeutic variables both prior to admission to the PICU and during the first 24 h after PICU admission (use of mechanical pulmonary ventilation and vasoactive amines). The statistical analysis uses a combination of logistic regression methods and clinical judgment, which determine the final variables.

Some authors, for example, Pollack and Leteurtre, have chosen to focus on the dysfunctions of some organ systems, based on clinical or therapeutic criteria, with the most recent scores analysing six systems: respiratory, cardiovascular, renal, haematological, neurological and hepatic. This type of score should preferably have objective and easily obtained variables in the most diverse PICUs and be independent of the patient's characteristics. Ideally, scores should be applied in emergency situations in order to identify those patients at high risk[25].

The instrument in this study focused on the five organ systems most affected in the paediatric age group, according to prior scores described in the medical literature, and included severity criteria validated by Milne and Whitty[26] in a study to calculate the need for intensive care beds. In this study, the respiratory, cardiovascular and nervous systems were the most affected. Similar results were reported by Linhareset al[27].

Additionally, in the proposed instrument, the indication of paediatric intensive care was

considered for the child or adolescent who fulfilled at least one criterion contained therein, having as an advantage, beyond the objectivity of the selected criteria, lack of a need forspecific mathematical calculations, characteristics that facilitate its use at the bedside, this being one of the objectives of the study.

When the patient has access to hospital care, it is observed by a thorough anamnesis that a contributing factor to an unfavourable clinical evolution is the non-identification of signs and symptoms of severity by those who perform the first assessment in the basic health network, combined with the late search for medical care when the resoluteness comes to depend on hospital assistance. This means that the adoption of health promotion and prevention measures is still far below the desirable level in the country. The understanding of healthcare problems at the tertiary level contributes to the development of strategies in public policies on child health and strategies to address problems of morbidity, mortality and the quality of life of the paediatric population.

The results of this study indicate that the search for a practical and easy-to-apply tool at the bedside in the indication of intensive care is important for the prognosis of the critically ill or injured child who is initially treated at the paediatric emergency unit and whose clinical evolution is worsened by the late indication of paediatric intensive care.

As for the first aid and intensive care paediatrician, as a subsidy to strengthen their medical conduct, the avoidance of medical error by not indicating or belatedly indicating admission in the PICU is advised. This type of error impairs the patient's prognosis in the short term and increases the number of (often avoidable) deaths in the long term in addition to increasing public expenses for care in the clinical cases that evolve with serious complications. It should be noted that, during data collection according to the protocol, it was observed that some surgical patients, others with metabolic disorders that were haematological in their initial phase and those who were admitted to the ICU did not fulfil the indication criteria of intensive care admission according to the studied instrument, because haemodynamic repercussion was not present. This is considered as a negative point in the study and is subject to improvement in future studies.

It is likely that investment in specific lines of research in this area of healthcare and the

elaboration and use of clinical protocols compatible with the current legislation may favour the rational use of beds, thus promoting better use and greater equity in the distribution of beds for the population assisted by the Unified Health System[28].

The motivation to assemble a clinical instrument to evaluate the indication of paediatric intensive care through the use of main criteria according to the organ systems usually affected in the paediatric age group was based on the fact that, to date, there is no knowledge of a practical clinical instrument that is easy to apply at the bedside, especially in developing countries such as Brazil, where the number of intensive care beds does not meet the population demand.

Future studies that include endocrine/metabolic and haematological systems, as well as information on social determinants, can improve the arrangement and content of the data in the proposed instrument and broaden its use in the design of public health policy in paediatrics.

CONCLUSION

The clinical instrument proposed in the study to evaluate the indication of paediatric intensive care contains 14 items and adequately identified 91.4% of the sample studied. In addition, the instrument displayed adequate clarity and objectivity for the items described.

Due to the applicability of the instrument to a high percentage of the studied sample, it is possible that, in the context of paediatric emergency services, the instrument can be used as a tool to identify critically ill children and thus qualify health care in tertiary services.

DECLARATIONS

Ethics Approval and Consent to Participate

The present study respected the ethical precepts that involves research with human beings, being submitted to the committee of ethics with human beings and only being realized after its approval. The study was approved by the Research Ethics Committee of the Santa Casa de Misericórdia School of Science in Vitória (EMESCAM), No. 374,229, by written consent. A written informed consent form was sent to those responsible for adolescents, as well as the agreement of the participants to the research.

Availability of Data and Material

The datasets used and/or analysed during the current study available from the corresponding author on reasonable request.

AUTHORS' CONTRIBUTIONS

Batista NOW: Designed research; conducted research; analyzed data or performed statistical analysis; wrote paper; had primary responsibility for final content. **Silva JP**: Designed research; conducted research; analyzed data or performed statistical analysis; wrote paper; had primary responsibility for final content. **Trugilho SM:** Analyzed data or performed statistical analysis; wrote paper; had primary responsibility for final content. **Coelho MCR**: Designed research; analyzed data or performed statistical analysis; wrote paper; had primary responsibility for final content. **SANTOS CVA:** Designed research; analyzed data or performed statistical analysis; wrote paper; had primary responsibility for final content. **BEIRIZ YR:** Designed research; analyzed data or performed statistical analysis; wrote paper; had primary responsibility for final content. **Silva VR:** Designed research; analyzed data or performed statistical analysis; wrote paper; had primary responsibility for final content.

List of Abbreviations

PICU - paediatric intensive care unit;

PICM - paediatric intensive care medicine;

ICU - intensive care unit.

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Box1. *Clinical instrument for PICU indication. Vitória, Brazil. 2017*

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1. Personal data

Name:_____

City of origin: _____

Age (months): _____Gender (M/F): _____

Date of birth: ___/___/____ Date of admission: ___/___/____

Date of discharge/death: ___/___/____

Admission diagnoses: _____

Systems involved: _____

2. Evaluation of organic systems (domains)

2.1 Central nervous system

(1) Hyporeactivity of central origin

(2) Glasgow coma scale <8 (acute evolution)

(3) Seizure not responsive to usual treatment

(4) Intracranial hypertension (ICP monitoring)

2.2 Respiratory system

(1) Respiratory insufficiency

(2) O_2>60% (hood, mask, catheter, CPAP)

(3) Mechanical pulmonary ventilation (except in chronic patients)

2.3 Cardiovascular System

(1) Congestive Heart Failure

(2) Shock of any aetiology (use of amines and invasive arterial and/or venous monitoring)

(3) Cardiac arrhythmia of any aetiology

(4) Severe arterial hypertension of any aetiology

2.4 Digestive System

(1) Uncontrolled digestive tract bleeding

(2) Acute hepatic insufficiency

2.5 Genitourinary System

(1) Acute renal failure