

Translation and adaptation of a pediatric early warning score

Tradução e adaptação de um escore pediátrico de alerta precoce
Traducción y adaptación de un instrumento pediátrico de alerta precoz

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ABSTRACT

The Brighton Paediatric Early Warning Score (BPEWS) is an instrument developed to identify warning signs for clinical deterioration in hospitalized children. **Objective:** to translate and adapt the BPEWS for the Portuguese language, with the purpose of verifying its applicability in the Brazilian context studied. **Method:** methodological study guided by international and nationally accepted recommendations for translation and adaptation of health measurement instruments. Stages of conceptual, item, semantic, operational and pre-test equivalence are described for obtaining the BPEWS Portuguese version to be used in Brazil. **Results:** the BPEWS version translated and adapted for Brazilian Portuguese (BPEWS-Br) identified, in the pilot study, that 26.6% of children were presenting warning signs for clinical deterioration. **Conclusion:** the BPEWS-Br seems to be applicable for the context studied, and its use might help nurses in the recognition and documentation of warning signs for clinical deterioration in hospitalized Brazilian children.

Descriptors: Translating; Alert; Hospitalized Child; Patient Acuity; Pediatric Nursing.

RESUMO

O Brighton Paediatric Early Warning Score (BPEWS) é um instrumento construído para identificar sinais de alerta para deterioração clínica em crianças hospitalizadas. **Objetivo:** traduzir e adaptar o BPEWS para o português a fim de verificar sua aplicabilidade no contexto brasileiro estudado. **Método:** estudo metodológico guiado por recomendações internacional e nacionalmente aceitas para tradução e adaptação de instrumentos de medida em saúde. Descreve-se as etapas de equivalências conceitual, de itens, semântica, operacional e pré-testagem para obtenção da versão em português do BPEWS para uso no Brasil. **Resultados:** o BPEWS na sua versão traduzida e adaptada para o português brasileiro (BPEWS-Br) identificou no estudo-piloto que 26,6% das crianças estavam apresentando sinais de alerta para deterioração clínica. **Conclusão:** o BPEWS-Br parece ser aplicável ao contexto estudado, e seu uso poderá ajudar o enfermeiro no reconhecimento e documentação de sinais de alerta para deterioração clínica em crianças brasileiras hospitalizadas.

Descritores: Tradução; Alerta; Criança Hospitalizada; Gravidade do Paciente; Enfermagem Pediátrica.

RESUMEN

El Brighton Paediatric Early Warning Score (BPEWS) es un instrumento construido para identificar señales de alerta de deterioro clínico en niños hospitalizados. **Objetivo:** traducir y adaptar el BPEWS al portugués, a fin de verificar su aplicabilidad en el ámbito brasileño estudiado. **Método:** estudio metodológico orientado por recomendaciones nacional e internacionalmente aceptadas de traducción y adaptación de instrumentos de medición en salud. Se describen las etapas de equivalencias: conceptual, de ítems, semántica, operativa y pre-testeo para obtención de versión en portugués del BPEWS para utilización en Brasil. **Resultados:** el BPEWS en su versión traducida y adaptada al portugués brasileño (BPEWS-Br) identificó en su estudio piloto que el 26,6% de los niños estaba presentando señales de

alerta de deterioro clínico. **Conclusión:** el BPEWS-Br parece ser aplicable en el contexto estudiado, y su uso ayudará al enfermero en el reconocimiento y documentación de señales de alerta de deterioro clínico en niños brasileños hospitalizados.

Descriptores: Traducción; Alertas; Niño Hospitalizado; Gravedad del Paciente; Enfermería Pediátrica.

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INTRODUCTION

Clinical deterioration can be described as the manifestation of signs and symptoms that translate physiological instability. In children, warning signs for clinical deterioration might be already present or emerge suddenly. The identification of these signs and early care might prevent the evolution of the current clinical condition worsening, shock, respiratory failure, or cardiorespiratory arrest. Public expending with its treatment can be reduced, as well as the possibility of complications and sequelae⁽¹⁻³⁾. However, sometimes, clinical conditions of patients deteriorate before health teams are able to recognize and respond to the warning signs⁽⁴⁾.

In this scenario, Pediatric Early Warning Score (PEWS) instruments have been developed and validated⁽⁵⁻⁹⁾ for the last 10 years, for early identification of warning signs in hospitalized children's bedside. Their objective is to signal the team regarding the need for providing urgent care to patients at risk for serious events, by means of regular monitoring of clinical signs and pre-established criteria⁽¹⁰⁾.

Published in 2005, the Brighton Paediatric Early Warning Score (BPEWS) or Monaghan PEWS is among the PEWS instruments. It was developed by a nurse of the University of Brighton and it basically uses three evaluation components: neurological, cardiovascular, and respiratory, with score from 0 to 13. From three points up, the higher the score, the higher the risk of clinical deterioration⁽⁵⁾.

At the time of its conception, there was a strong indicator that a warning score for clinical deterioration had a place in the pediatric scenario; however, there was a shortage of publications, as it seemed to be a relatively new concept. In this perspective, a multidisciplinary group was created to discuss severity markers in children, thus deciding to develop a score based on available systems for adults. In this process, children's specificities, need for implementation of an instrument of easy application, and quick evaluation that would not cause extra work for the nursing team were taken into consideration⁽⁵⁾.

The BPEWS was chosen for translation and adaptation to our context because it was pointed as a valid and reliable indicator of warning signs for clinical deterioration in children, which uses clinical evaluation without the need for measurement devices of vital parameters^(5,11-14). Moreover, in the searched health databases (PubMed, CINAHL, Capes Portal, Virtual Health Library), there were no studies that translated and adapted scores to the Portuguese language, with the purpose of use in Brazil. In addition, the BPEWS was not adapted to other languages, but English.

In this respect, the objective of this study was to translate and adapt the BPEWS for the Portuguese language, with the purpose of verifying its applicability in the Brazilian context

studied.

METHOD

This was a methodological study guided by international and nationally accepted recommendations for the process of translation and adaptation of health measurement instruments⁽¹⁵⁻¹⁹⁾. In the literature, there is no consensus regarding the best method for translation and adaptation of instruments; however, studies in this topic affirm that some procedures must be followed. Scholars suggest a combination between the translation of words and phrases from a language into another, and a systematic process that includes the context of the target population who will use the adapted version^(16-18,20-21).

For the translation and cross-cultural adaptation process, it is recommended that operational stages be followed to achieve equivalence between the original version and the translated /adapted version. This equivalence is didactically subdivided in conceptual, item, semantic, operational, measurement, and functional equivalences⁽¹⁶⁻¹⁸⁾.

In this study, stages of conceptual, item, semantic, operational, and pre-test equivalences are described for obtaining the BPEWS version in Portuguese and applying it in a Brazilian context. This process was authorized by the author of the score.

The stages described above were developed at a large-sized pediatric hospital with 280 beds, located in a city in the state of Bahia, Brazil. Thirty children aged 0 to 10 years who were hospitalized in emergency stabilization and clinical-surgical hospitalization units were included in the pre-test or pilot test. Children with a heart disease diagnosis described in their medical record were excluded, since in the literature there is an adapted score for children with heart diseases.

This research is part of a thesis project developed at the School of Nursing of the Federal University of the Bahia and approved by its research ethics committee.

Conceptual and item equivalences

In this stage, a review on publications of the original instrument and discussion with specialists and the target population are recommended^(16,18). The procedures for the BPEWS development were searched in the literature, as well as in studies that applied it in the clinical practice and evaluated its psychometric properties (validity and reliability). The authors also studied the event that the BPEWS was intended to measure (warning signs for clinical deterioration in children). It was followed by discussion with a group made up of two doctors and four specialist nurses in pediatrics, about the relevance and pertinence of the components of the score for evaluation of the phenomenon in question, in addition to its applicability and use in the clinical practice of the context experienced by professionals.

An integrative review was developed⁽²²⁾ whose search was carried out in the databases of PubMed, CINAHL, and the Virtual Health Library of Brazil. Eleven studies that used the BPEWS in their design were found, and the psychometric properties already tested and the instrument's application in the hospital scenario of other contexts were verified.

Semantic equivalence

Semantic equivalence involves transferring the meaning of words in the original instrument to a new version, aiming at achieving a similar effect in respondents of both cultures^(16,18). This stage started in the initial translation of the original version and goes up to the pre-test of the new version, with a slight variation according to the literature adopted.

In this study, the translation and adaptation of the BPEWS for the Portuguese language followed stages of translation, back-translation, panel of specialists, evaluation by the author of the score and a pilot test (Figure 1).

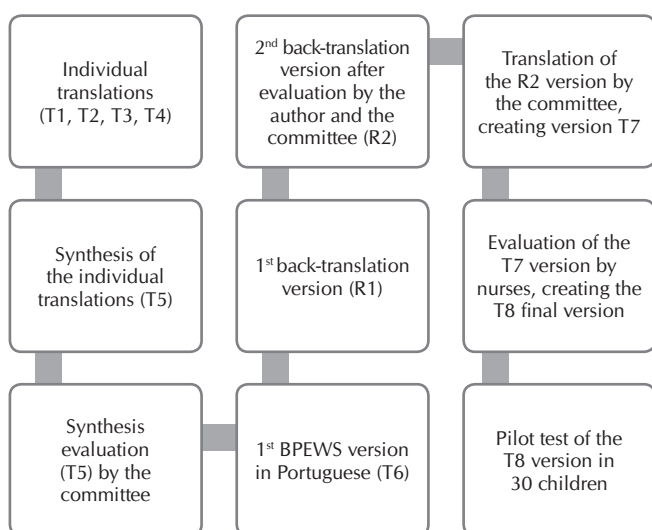


Figure 1 – Flowchart of the Brighton Paediatric Early Warning Score translation and adaptation

Because it is a score composed of clinical components, the initial stage of the translation was done individually by a committee made up of four health professionals, obtaining the translated versions (T1, T2, T3, and T4). The committee members were two nurses and two pediatricians, with proficiency in English language and knowledge of the topic, considering the need for understanding the concerned phenomenon.

After the individual translation, synthesis of the four translations was carried out (T5). This was reassessed by the panel of specialists and, after discussion about consensus and dissensions of the initial translations, the first version of the Portuguese score was achieved (T6). This was submitted to back-translation (R1) into the English language by a Brazilian doctor with American citizenship and fluency in both languages.

The back-translation version (R1) was evaluated on-line by the author of the score. Aspects discussed between the author and the committee were related to specificities of the Portuguese language and use of mean values as references for heart and respiratory frequencies. The second back-translation version (R2) was obtained after discussion of these aspects.

The second back-translation version (R2) was submitted again to translation (T7) into Portuguese language by the panel of specialists and it was evaluated by two pediatric nurses who worked in the clinical practice of a large-sized pediatric hospital. The nurses exposed their questions, understood the BPEWS evaluation components and, after training on its use, each one of them applied it to five children. After this application, they suggested two alterations for a better understanding of the instrument, creating the adapted version of the score (T8) for pilot test application.

Operational equivalence

This equivalence refers to the evaluation regarding the vehicle's relevance and adequacy, and format of the instrument, its instructions, its context, and methods of application and categorization⁽¹⁸⁾. In this study, the following topics were discussed between the committee and nurses: layout, instructions, viable time for use, and units indicated for application, in order to achieve acceptance among the team and better results.

Pilot test

The BPEWS in its final version (T8) was applied in a pilot study with 30 children, aiming at undertaking necessary adjustments. No component of the T8 version was modified.

RESULTS

Conceptual and item equivalences

From analysis and discussion about singularities of clinical deterioration in children and the BPEWS components to measure this event, the committee judged that, for the context studied, the instrument could be relevant and pertinent to the nursing practice in the care provided to children.

For contemplating neurological, cardiovascular, and respiratory manifestations considered universal and that might appear in face of deterioration, the BPEWS components could help in the early recognition of this phenomenon. Therefore, for its use, some adaptations should be made for improving its understanding and applicability in the context studied.

In the integrative review conducted, five of the 11 studies that used the BPEWS in their design described it as a valid and reliable instrument for the identification of warning signs for clinical deterioration in children hospitalized in the contexts researched.

Semantic equivalence

Box 1 presents the synthesis of modifications made in the BPEWS, from the original version in English language up to the final version in Portuguese language. Modifications judged necessary for the translation and adaptation of the score are described based on its components.

Box 1 – Description of the synthesis of the Brighton Paediatric Early Warning Score modifications in the translation and adaptation process

Neurological component					
Versions	Description	Score			
		0	1	2	3
Original	Behaviour	Playing/ appropriate	Sleeping	Irritable	Lethargic/confused or reduced response to pain
T6	<i>Estado neurológico</i>	<i>Ativo</i>	<i>Sonolento</i>	<i>Irritado</i>	<i>Letárgico/ obnubilado ou resposta reduzida à dor</i>
R2	Neurological state	Active	Sleepy	Irritable	Lethargic/ obtunded or reduced response to pain
T8	<i>Estado neurológico</i>	<i>Ativo</i>	<i>Sonolento/hipoativo</i>	<i>Irritado</i>	<i>Letárgico/ obnubilado ou resposta reduzida à dor</i>
Cardiovascular component					
Versions	Description	Score			
		0	1	2	3
Original	Cardiovascular	Pink or capillary refill 1–2 seconds	Pale or capillary refill 3 seconds	Grey or capillary refill 4 seconds. Tachycardia of 20 above normal rate	Grey and mottled or capillary refill 5 seconds or above. Tachycardia of 30 above normal rate or bradycardia
T6	<i>Cardiovascular</i>	<i>Corada ou TEC* 1–2 segundos</i>	<i>Pálido ou TEC 3 segundos</i>	<i>Moteado ou TEC 4 segundos ou FC** ≥ 20 bpm*** acima do limite superior para a idade</i>	<i>Acinzentado/ cianótico ou TEC ≥ 5 seg ou FC ≥ 30 bpm acima do limite superior para a idade ou bradicardia para a idade</i>
R2	Cardiovascular	Normal color or capillary refill 1–2 seconds	Pale or capillary refill 3 seconds	Patchy skin or capillary refill 4 seconds or HR ≥ 20 bpm above the upper limit for the age	Grey/cyanotic or capillary refill ≥ 5 seconds or HR ≥ 30 bpm above the upper limit for the age or bradycardia for the age
T8	<i>Cardiovascular</i>	<i>Corado ou TEC 1–2 seg</i>	<i>Pálido ou TEC de 3 seg ou FC acima do limite superior para a idade</i>	<i>Moteado ou TEC 4 seg ou FC ≥ 20 bpm acima do limite superior para a idade</i>	<i>Acinzentado/ cianótico ou TEC ≥ 5 seg ou FC ≥ 30 bpm acima do limite superior para a idade ou bradicardia para a idade</i>
Respiratory component					
Versions	Description	Score			
		0	1	2	3
Original	Respiratory	Within normal parameters, no recession or tracheal tug	> 10 above normal parameters, using accessory muscles, 30+ % FiO2 or 4+ litres/min	> 20 above normal parameters, reccessing tracheal tug, 40+ % FiO2 or 6+ litres/min	5 below normal parameters with sternal recession, tracheal tug or grunting, 50% FiO2 or 8+ litres/min
T6	<i>Respiratório</i>	<i>FR**** normal para a idade, sem retração.</i>	<i>FR acima do limite superior para a idade, uso de musculatura acessória ou FiO2***** ≥ 30% ou 4 litros/min de O₂*****</i>	<i>FR ≥ 20 rpm***** acima do limite superior para a idade; retrações subcostais, intercostais e de fúrcula ou FiO2 ≥ 40% ou 6 litros/ min de O₂</i>	<i>FR ≤ 5 rpm abaixo do limite inferior para a idade; retrações subcostais, intercostais, de fúrcula, de esterno e gemência ou FiO2 ≥ 50% ou 8 litros/ min de O₂</i>
R2	Respiratory	RR normal for the age, no retractions.	RR above the upper limit for the age, use of accessory muscles or FiO2 ≥ 30% or 4 liters/min of O2.	RR ≥ 20 bpm above upper limit for the age; subcostal retractions, intercostal retractions and suprasternal retractions or FiO2 ≥ 40% or 6 liters/ min of O2	RR ≥ 5 bpm below the lower limit for the age; subcostal retractions, intercostal retractions, suprasternal retractions, sternal retractions and grunting or FiO2 ≥ 50% or 8 liters/min of O2
T8	<i>Respiratório</i>	<i>FR normal para a idade, sem retração</i>	<i>FR acima do limite superior para a idade, uso de musculatura acessória ou FiO2 ≥ 30% ou 4 litros/min de O₂</i>	<i>FR ≥ 20 rpm acima do limite superior para a idade; retrações subcostais, intercostais e de fúrcula ou FiO2 ≥ 40% ou 6 litros/min de O₂</i>	<i>FR ≤ 5 rpm abaixo do limite inferior para a idade; retrações subcostais, intercostais, de fúrcula, de esterno e gemência ou FiO2 ≥ 50% ou 8 litros/ min de O₂</i>

To be continued

Box 1 (concluded)

Extra points of the score	
Versions	Description
Original	Score 2 extra for ¼ hourly nebulisers or persistent vomiting following surgery
T6	<i>Adicionar 02 pontos extras se recebeu nebulização até há 15 minutos ou vômitos persistentes após cirurgia</i>
R2	Add 2 extrapoints if received nebulization therapy in the past 15 minutes or if persistent vomiting post surgery.
T8	<i>Adicionar 02 pontos extras se recebeu nebulização até há 15 minutos ou vômitos persistentes após cirurgia</i>

Notes: *TEC (CRT): Tempo de Enchimento Capilar (Capillary refill time), **FC (HR): Frequência Cardíaca (Heart rate), ***bpm: Batimentos/minuto (beats per minute) ****FR (RR): Frequência Respiratória (Respiratory rate), *****FiO2: Fração Inspirada de Oxigênio (Fraction of inspired oxygen), *****O2: Oxigênio (Oxygen), *****rpm (bpm): respirações /minuto (breaths per minute).

Neurological component

The BPEWS neurological component did not undergo significant adaptations. Most terms were understood and translated in a similar way. The term "Behaviour" in the original version was translated and adapted as "*Estado Neurológico*" ("Neurologic status") in the final version. The term "Sleeping" was translated as "*Sonolento*" ("Sleepy"); however, after evaluation of nurses, the addition of the term "*Hipoativo*" ("Hypoactive") was suggested, since this term is often used to refer to children with a slight neurological alteration with verbal response.

Cardiovascular component

In this component, in the evaluation of score 0, the author of the score suggested the use of the term "Normal color" instead of "Pink". In the Portuguese language, these terms were translated as "*Corado*" ("Pink"), which was considered an appropriate skin color for a pediatric patient. In the evaluation of score 1, nurses suggested the addition of "*ou FC acima do limite superior para a idade*" ("or HR above the upper limit for the age"), due to an existing gap between the upper limit of the normal HR and HR \geq 20 bpm (evaluation of score 2).

In the evaluation of scores 2 and 3, the terms "Grey and mottled" were widely discussed by the committee based on what is found in the literature. The cutaneous findings that may indicate inadequate transference of oxygen to fabrics are pallor/colorlessness, mottling and cyanosis. Mottling may be normal or result from serious conditions (hypoxemia, hypovolemia and shock) and central cyanosis usually indicates the need for immediate intervention, such as oxygen therapy and ventilatory support²³. Therefore, using the term "*Moteado*" ("Mottled") with score 2 and the terms "*Acinzentado/cianótico*" ("Grey/cyanotic") with score 3 were considered appropriate.

Respiratory component

In the respiratory component, score 1 was attributed to "> 10 above normal parameters", that is, a RR above 10 bpm of the normal parameters used as reference. The committee understood that this way, there would be a gap between the upper limit of the normal RR up to the value of 10 bpm, replacing with "*FR acima do limite superior para a idade*" ("RR above the upper limit for the age").

Regarding the respiratory effort, the evaluation of retractions and/or grunting is described as "recessing tracheal tug" or "sternal recession, tracheal tug or grunting". In this case, children

receive score 1 if they are using accessory musculature in isolation, increasing this score to 2 or 3 when there are retractions and/or grunting. In the translation and adaptation, the committee judged necessary to describe the musculature used in the respiratory effort according to the difficulty to breathe, in order to make the evaluation objective, based on the guidelines of the American Heart Association (AHA)⁽²³⁾.

The AHA classifies the degree of respiratory difficulty as mild to moderate, and severe, according to the retraction's location. Nevertheless, grunting may follow the response to pain or fever, but it can also be a progression sign of discomfort for respiratory failure, indicating greater severity⁽²³⁾.

Considering the increase in the effort, and the higher the effort, the higher the severity, score 1 was attributed to "*músculos acessórios*" ("accessory muscles") isolated; score 2 to "*retrações subcostais, intercostais e de fúrcula*" ("subcostal retractions, intercostal retractions, and suprasternal retractions"); and score 3 to "*retrações subcostais, intercostais, de fúrcula, de esterno e gemência*" ("subcostal retractions, intercostal retractions, suprasternal retractions, and grunting").

Extra points

In the BPEWS development, the author added 2 extra points: if children received nebulization therapy in the past fifteen minutes before the evaluation; or if children presented persistent vomiting following surgery (more than three episodes). Initially, the committee considered these observations unnecessary; however, they were maintained, considering that recent nebulization may simulate a momentary improvement of the respiratory condition, suggesting the need for re-assessment. In addition, persistent vomiting might aggravate children's condition in the postoperative period.

Operational equivalence

Regarding the score layout, the committee judged necessary the addition of the terms "*Escore Parcial*" ("Partial score") for the record of each component's score and "*Escore Final*" ("Final score") for the record of the sum of the partial scores. Furthermore, nurses requested the inclusion of a gap for the record of values measured and used in patients' evaluation (Age, HR, CRT, RR, and FiO2). According to them, this measure would facilitate the score's filling and would strengthen the records' reliability. After the adjustments, the Portuguese version of the final BPEWS layout was obtained for pilot application.

An important guidance for the BPEWS application is that, during an evaluation, if children present warning signs in two scores, they must receive the highest score.

The sectors considered appropriate for the application of the score were the clinical-surgical and observation hospitalization units of the emergency department, where demand of nursing care is higher, and its application would direct care to children in risk of deterioration.

Reference values adopted for respiratory and heart rates

The BPEWS author suggested the adoption of mean values of respiratory rate (RR) and heart rate (HR), considering that pediatric vital parameters described in the literature are wide and diverse, and there is no consensus on their values. Nonetheless, after search in the literature, it was opted for merging the intervals recommended by the AHA⁽²³⁾ with the Brazilian guidelines for community-acquired pneumonia in pediatrics⁽²⁴⁾, and the World Health Organization consensus for clinical classification of severity of pneumonias in children from two months to five years⁽²⁵⁾. Box 2 presents pediatric parameters adopted in this study for the BPEWS application.

Box 2 – Respiratory and heart rates for pediatric patients

Age	RR/minute	Age	HR/minute during vigil	HR/minute during sleep
< 2 months	30–60			
2 months - < 1 year	30–50	Newborn to 3 months	85–205	80–160
1–3 years	24–40	3 months-2 years	100–190	75–160
4–5 years	22–34	2–10 years	60–140	60–90
6–12 years	18–30	> 10 years	60–100	50–90

Source: adapted from the American Heart Association (2012), the Brazilian Guidelines of Community-Acquired Pneumonia in Pediatrics (2007), and the World Health Organization (2013).

Note: RR = respiratory rate; HR = heart rate.

Regarding values of reference, the committee opted for changing the signals “>” and “<”, used in the original score, to “≥” and “≤”, aiming at making values more accurate, since this alteration would not impact on the interpretation of values, would bring lesser risk of bias and would improve standardization.

Pilot test

After the translation and adaptation stages of the Brigh-ton Paediatric Early Warning Score for Brazilian Portuguese (BPEWS - BR), the score was applied to 30 children in the clinical-surgical and observation hospitalization units of emergency. The mean time for the BPEWS application was 3.9 minutes. Table 1 presents the results of this application.

Table 1 – Distribution of age groups and the BPEWS-BR final score in hospitalized children from 0 to 10 years, Feira de Santana, Bahia, Brazil, June, 2015

Criteria	n (N = 30)	%
Age		
6–10 anos	06	20.0
1–5 anos	18	33.4
< 1 ano	14	46.6
Final score		
0–2	22	73.4
≥ 3	08	26.6

Source: data collected from the pilot test

DISCUSSION

The early recognition of signs and symptoms that show severity in pediatric patients is a decisive factor for survival and good prognosis. Quick assessment is the first impression of health professionals about patients, and it consists on the evaluation of their general appearance, respiratory pattern, and manifestations associated with circulation⁽¹⁻²⁾.

Recognizing warning signs that may indicate clinical deterioration in hospitalized children must be a daily exercise of nurses. With the purpose of helping them in this practice and contributing for the reduction of complications, pediatric early warning scores were developed on the international scene, such as the BPEWS.

Regarding the BPEWS validity for detection of clinical deterioration in hospitalized children, the score presented sensitivity of 90.2%, specificity of 74.4%, positive predictive value (PPV) of 58%, and negative predictive value (NPV) of 99.8% for score 3⁽¹¹⁾. As an early indicator of deterioration leading to the call of the rapid response team or code blue, the BPEWS showed sensitivity of 85.5% for score ≥ 4⁽¹²⁾. For ICU transference, the sensitivity and specificity of a BPEWS modified version were of 62% and 89%, respectively⁽¹⁴⁾. In the prediction of the need for transference to the ICU in 24 hours from admission, the BPEWS presented sensitivity of 68.4% and specificity of 81.6%⁽²⁶⁾.

Regarding interrater reliability, two studies calculated the intraclass correlation coefficient, showing high reliable values of 0.92 and 0.91^(11,27).

Based on the BPEWS evidence of validity and reliability, the committee of experts considered this instrument relevant and pertinent to alert health professionals regarding the event of pediatric practice deterioration, since its evaluation components properly represent the main neurological, respiratory and cardiovascular warning signs described in the literature^(1-2,23,28).

Regarding the BPEWS-Br neurological component, pediatric patients may be active, sleepy/hypoactive, irritable, lethargic/ obtunded or with reduced response to pain. Quick neurological assessment of children must search for identification of altered conscience level. These can be manifested by no recognition of parents, mental confusion, somnolence, irritability, prostration⁽²⁾.

Quick analysis of the main components of the central nervous system (cerebral cortex and brainstem) involves the monitoring of children’s neurological state alterations⁽²⁸⁾. Level of consciousness,

muscle tone, and pupillary response must be checked for the quick assessment of neurological functions. Conventional assessments of neurological functions comprise the AVPU scale (Alert, Verbal response, response to Pain or Unresponsive), the Pediatric Glasgow Coma Scale and the pupillary light reflex⁽²³⁾.

In this context, the AVPU scale quickly evaluates the patient's state of consciousness, and its indicators are correlated to the BPEWS neurological component indicators (Alert = active; Verbal response = sleepy/hypoactive or irritable; response to Pain or Unresponsive = lethargic/obtunded or with reduced response to pain). Using the Pediatric Glasgow Coma Scale and the pupillary light reflex would demand more time and, therefore, it would avoid the objectivity and rapidity criteria recommended for warning scores.

For the cardiovascular component evaluation, the BPEWS uses three indicators: skin color, capillary refill time, and heart rate; the Pediatric Assessment Triangle, used for initial impression of children, only observes the skin color⁽²⁹⁾; whereas the AHA, for primary clinical evaluation of seriously ill children, adopts heart rates and rhythms, flow of peripheral and central pulses, capillary refill time, skin color and temperature, blood pressure measurement, and urine output as indicators of cardiovascular evaluation⁽²³⁾. It is believed that an early warning score should include summary indicators of quick application that may indicate risk of clinical deterioration. After this, more detailed evaluation must be undertaken.

Regarding the use of blood pressure as an evaluation criterion of early warning signs in children, further discussion is necessary. Different from adults, whose hypotension is considered a predictor of deterioration, hypotension in children is characterized as a sign of shock out of control, thus being a late rather than early sign of clinical deterioration^(3,5).

In the BPEWS respiratory component, RR, oxygen support, and use of accessory muscle are evaluated. The recognition of warning respiratory signs in children involves the evaluation of airway permeability and breathing quality. These can be evaluated from respiratory rates and effort, chest expansion, air movement, lungs and airway sounds, and oxygen saturation by means of oximetry⁽²³⁾.

Depending on the context, the use of any type of device to apply a warning score could make its use difficult. In the Brazilian reality, for example, monitoring in wards is an unusual practice, except when it is indicated. Moreover, it is worth mentioning that it is possible to identify warning signs in children only by observing apparent clinical signs. Nonetheless, after this initial recognition, the patient must be fully evaluated, according to recommendations from advanced life support courses in pediatrics.

The World Health Organization suggests that, for the approach of sick children, certain clinical aspects must be initially observed before touching them unnecessarily. The orientation is to keep children in the arms of their mother or guardian, observing the highest number of possible signs: the children's neurological state (if they can speak, cry, emit sounds, if they are alert, sleepy, irritable, if they present vomiting, if they are able to breastfeed), skin color (cyanosis or pallor), and signs of respiratory discomfort (use of accessory muscles, presence of retractions, tachypnea)⁽²⁵⁾.

The BPEWS does not require the use of devices for its application, consisting of a merely clinical evaluation. This score's

profile makes its application quick and easy, especially in services with excessive demand and that do not have resources for individual monitoring in units of lesser complexity, which is a common reality in pediatric public hospitals in Brazil.

According to the BPEWS-Br assessment regarding data of the pilot study, 26.6% of the children had a score ≥ 3 , thus presenting warning signs for clinical deterioration. These cases were signaled and the team on duty reassessed the children, proceeding with proper care. Considering a BPEWS ≥ 3 to unchain the risk warning for clinical deterioration, the ratio found was close to percentages of other studies.

A prospective study conducted with 2,979 hospitalized patients from 0 to 22 years calculated the BPEWS every 4 hours and considered the highest score for analysis. The result showed that 73.2% presented a score ≤ 2 ; 8% had score 3; 8% had score 4; 7% had score 5; and 1.2% presented a score ≥ 7 ⁽¹¹⁾.

Comparing children with BPEWS ≥ 3 and BPEWS ≤ 2 regarding age, diagnosis, and severity indicators, a retrospective study with 761 patients from 0 to 18 years found that 16.2% had BPEWS ≥ 3 and 83.8% had BPEWS ≤ 2 ⁽³⁰⁾.

Considering BPEWS ≥ 4 a critical score or a single partial score with 3 points, another retrospective study conducted with 186 patients from 0 to 21 years, with 170 who had tried a call of the rapid response team, and 16 who presented a code blue, found that 73.1% of the patients had a critical BPEWS shortly before the call of the team or the code blue. The mean time of a critical score, shortly before the event was 30 minutes⁽¹²⁾.

To validate a BPEWS modified version, a retrospective study conducted with 100 patients in a case group (transferred from the medical-surgical ward to the ICU) and 250 in a control group (not transferred to the ICU) from 0 to 14 years, found that the maximum BPEWS score was significantly higher in the case group (case: 2.95 ± 1.5 versus control: 1.4 ± 0.8 , $p > 0.0001$)⁽¹⁴⁾.

After the translation and adaptation process for obtaining the BPEWS-Br, the need for a more consistent validation study from the application of the score in the reality experienced by the nurses and doctors in the Brazilian hospital context is highlighted. The BPEWS-Br might help healthcare teams in detecting children at risk of clinical deterioration, in a rapid and early way, seeking for immediate actions, reduction of complications and hospitalization in the ICU.

Regarding the BPEWS-Br applicability in the context studied, in the integrative review carried out for conceptual and item equivalences, the score was mentioned as practical and of easy application, and it seemed to be viable for use at pediatric hospitals in Brazil, especially of public initiative, most of which do not offer bedside monitoring, have an insufficient number of beds in intensive care units, and reduced professional staff for the high demand of care, often not enabling a more accurate evaluation of patients. In addition, the BPEWS-Br could give more consistency to the evaluation of hospitalized children by nurses, considering that in the reality experienced in many wards, the doctors, after their daily evaluation, are only called in situations that the nurses judge necessary. Therefore, the use of an instrument with easy and quick applicability, without the need for more sophisticated technologies, such as the BPEWS, could help in this context⁽²²⁾.

CONCLUSION

The BPEWS was already described in the international literature as a valid and reliable instrument in some contexts to identify warning signs for clinical deterioration in children in the hospital environment; however, up to the moment this study was developed, there was no version translated and adapted for the Portuguese language and use in Brazil.

Considering evidence presented by previous studies that used the BPEWS as a clinical deterioration indicator, as well as the reality experienced by nurses in Brazilian pediatric hospitals, this score seems to be applicable for the context studied.

The present study translated and adapted the BPEWS for the Portuguese language, verifying its initial validity. Later, the authors conducted a validation study with 271 children, applying the BPEWS-Br for data collection. Nonetheless, this instrument, as well as others with the same purpose, must be tested regarding its validity and reliability in other Brazilian pediatric services, with the aim of helping nurses in the bedside daily evaluation of children in the hospital environment.

The use of the BPEWS-Br might contribute to the work of nurses in the recognition and documentation of warning signs for clinical deterioration in hospitalized children, and along with the healthcare team, act in early risk situations, preventing associated complications.

REFERENCES

- Melo MCB, Vasconcellos MC. Reconhecimento e primeiro atendimento ao paciente gravemente enfermo. IN: Brasil. Ministério da Saúde. Atenção às urgências e emergências em pediatria [Internet]. Belo Horizonte: Escola de Saúde Pública de Minas Gerais; 2005 [cited 2013 Nov 23];p. 13–26. Available from: <https://www.nescon.medicina.ufmg.br/biblioteca/imagem/4642.pdf>
- Melo MCB, Ferreira AR, Vasconcellos MC, Gresta MM, Silva NLC, Ferri PM. Novas recomendações para o atendimento ao paciente pediátrico gravemente enfermo. Rev Med Minas Gerais [Internet]. 2011 [cited 2013 Nov 23];21(4 Supl 1):S12–21. Available from: <http://mmg.org/artigo/detalhes/803>
- Melo MCB, Silva NLC. Reconhecimento do paciente gravemente enfermo. IN: Urgência em Atenção Básica em Saúde [Internet]. Belo Horizonte: Nescon; 2011 [cited 2013 Nov 24];p. 39–42. Available from: <https://www.nescon.medicina.ufmg.br/biblioteca/imagem/3046.pdf>
- National Patient Safety Agency. Recognising and responding appropriately to early signs of deterioration in hospitalised patients [Internet]. London: NPSA; 2007 [cited 2013 Dec 12];21 p. Available from: <http://www.nrls.npsa.nhs.uk/resources/?entryid45=59834>
- Monaghan A. Detecting and managing deterioration in children. Paediatr Nurs [Internet]. 2005 [cited 2013 Dec 12];17(1):32–5. Available from: <http://journals.rcni.com/doi/abs/10.7748/paed2005.02.17.1.32.c964>
- Haines C, Perrott M, Weir P. Promoting care for acutely ill children: development and evaluation of a Paediatric Early Warning Tool. Intensive Crit Care Nurs [Internet]. 2006 [cited 2014 Dec 12];22(2):73–81. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/16271295>
- Duncan H, Hutchison J, Parshuram CS. The Pediatric Early Warning System score: a severity of illness score to predict urgent medical need in hospitalized children. J Crit Care [Internet]. 2006 Sep [cited 2015 Feb 26];21(3):271–8. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/16990097>
- Parshuram CS, Duncan HP, Joffe AR, Farrell CA, Lacroix JR, Middaugh KL, et al. Multicentre validation of the bedside paediatric early warning system score: a severity of illness score to detect evolving critical illness in hospitalised children [Internet]. Critical Care. 2011 [cited 2014 Dec 12];p. R184. Available from: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3387627/pdf/cc10337.pdf>
- Egdell P, Finlay L, Pedley DK. The PAWS score: validation of an early warning scoring system for the initial assessment of children in the emergency department. Emerg Med J [Internet]. 2008 [cited 2015 Mar 24];25(11):745–9. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/18955610>
- Chapman SM, Grocott MPW, Franck LS. Systematic review of paediatric alert criteria for identifying hospitalised children at risk of critical deterioration. Intensive Care Med [Internet]. 2010 [cited 2014 Dec 14];36(4):600–11. Available from: <http://link.springer.com/article/10.1007/s00134-009-1715-x>
- Tucker KM, Brewer TL, Baker RB, Demeritt B, Vossmeier MT. Prospective evaluation of a pediatric inpatient early warning scoring system. J Spec Pediatr Nurs [Internet]. 2009 Apr [cited 2015 Apr 13];14(2):79–85. Available from: <http://onlinelibrary.wiley.com/doi/10.1111/j.1744-6155.2008.00178.x/abstract>
- Akre M, Finkelstein M, Erickson M, Liu M, Vanderbilt L, Billman G. Sensitivity of the pediatric early warning score to identify patient deterioration. Pediatrics [Internet]. 2010 [cited 2015 Mar 22];125(4):e763–9. Available from: <http://pediatrics.aappublications.org/content/125/4/e763>
- Randhawa S, Roberts-Turner R, Woronick K, DuVal J. Implementing and sustaining evidence-based nursing practice to reduce pediatric cardiopulmonary arrest. West J Nurs Res [Internet]. 2011 [cited 2014 Apr 13];33(3):443–56. Available from: <http://wjn.sagepub.com/content/33/3/443>
- Skaletzky SM, Raszynski A, Totapally BR. Validation of a modified pediatric early warning system score: a retrospective case-control study. Clin Pediatr (Phila) [Internet]. 2012 [cited 2015 Mar 24];51(5):431–5. Available from: <http://cpj.sagepub.com/content/51/5/431.long>
- Beaton DE, Bombardier C, Guillemin F, Ferraz MB. Guidelines for the process of cross-cultural adaptation of self-report measures. Spine [Internet]. 2000 [cited 2014 Mar 13];25(24):3186–91. Available from: <http://www.spoerges.kemaer.dk/sites/default/files/files/articles/beaton.pdf>
- Herdman M, Fox-Rushby J, Badia X. A model of equivalence

- in the cultural adaptation of HRQoL instruments: the universalist approach. *Qual life Res* [Internet]. 1998 [cited 2014 Mar 13];7:323–35. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/9610216>
17. Guillemin F, Bombardier C, Beaton D. Cross-cultural adaptation of health-related quality of life measures: literature review and proposed guidelines. *J Clin Epidemiol* [Internet]. 1993 [cited 2014 Mar 13];46(12):1417–32. Available from: <http://www.sciencedirect.com/science/article/pii/089543569390142N>
 18. Reichenheim ME, Moraes CL. Operacionalização de adaptação transcultural de instrumentos de aferição usados em epidemiologia. *Rev Saúde Pública* [Internet]. 2007 [cited 2014 Mar 13];41(4):665–73. Available from: http://www.scielo.br/pdf/rsp/v41n4/en_6294.pdf
 19. World Health Organization. Management of substance abuse: process of translation and adaptation of instruments [Internet]. 2014 [cited 2014 Mar 13]. Available from: http://www.who.int/substance_abuse/research_tools/translation/en/
 20. Cha ES, Kim KH, Erlen JA. Translation of scales in cross-cultural research: issues and techniques. *J Adv Nurs* [Internet]. 2007 [cited 2014 Mar 13];58(4):386–95. Available from: <http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2648.2007.04242.x/epdf>
 21. Behling O, Law KS. *Translating questionnaires and other research instruments: problems and solutions*. 133rd ed. Thousand Oaks-CA: Sage; 2000. 1-70 p.
 22. Miranda J, Camargo C, Sobrinho C, Portela D, Monaghan A. Deterioração clínica em crianças hospitalizadas: revisão integrativa de um escore pediátrico de alerta precoce. *Rev Enferm UFPE* [Internet]. 2016 [cited 2016 May 30];10(3):1128–36. Available from: http://www.revista.ufpe.br/revistaenfermagem/index.php/revista/article/view/8994/pdf_9897
 23. American Heart Association. *Abordagem sistemática à criança gravemente doente ou ferida*. American Heart Association Suporte avançado de vida em pediatria manual do profissional. 2012. p. 7–29.
 24. Sociedade Brasileira de Pneumologia. *Diretrizes brasileiras em pneumonia adquirida na comunidade em pediatria*. *J Bras Pneumol* [Internet]. 2007 [cited 2014 Mar 13];33(S1):S31–50. Available from: <http://www.scielo.br/pdf/jbpneu/v33s1/02.pdf>
 25. World Health Organization. *Pocket Book of Hospital Care for Children: Guidelines for the Management of Common Childhood Illnesses* [Internet]. 2013 [cited 2015 Oct 3];1-414 p. Available from: http://apps.who.int/iris/bitstream/10665/81170/1/9789241548373_eng.pdf
 26. Zhai H, Brady P, Li Q, Lingren T, Ni Y, Wheeler DS, et al. Developing and evaluating a machine learning based algorithm to predict the need of pediatric intensive care unit transfer for newly hospitalized children. *Resuscitation* [Internet]. 2014 Aug [cited 2015 Apr 13];85(8):1065–71. Available from: [http://www.resuscitationjournal.com/article/S0300-9572\(14\)00477-8/abstract](http://www.resuscitationjournal.com/article/S0300-9572(14)00477-8/abstract)
 27. Gold DL, Mihalov LK, Cohen DM. Evaluating the Pediatric Early Warning Score (PEWS) system for admitted patients in the pediatric emergency department. *Acad Emerg Med* [Internet]. 2014 [cited 2015 Mar 12];21(11):1249–56. Available from: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4300231/pdf/nihms-654089.pdf>
 28. Matsuno AK. Reconhecimento das situações de emergência: avaliação pediátrica. *Medicina (Ribeirão Preto)* [Internet]. 2012 [cited 2014 Mar 13];45(2):158–67. Available from: http://revista.fmrp.usp.br/2012/vol45n2/Simp1_Reconhecimento%20das%20Situa%E7%F5es%20de%20Emerg%Eancia_Avalia%E7%E3o%20Pedi%E1trica.pdf
 29. Dieckmann RA, Brownstein D, Gausche-Hill M. The pediatric assessment triangle: a novel approach for the rapid evaluation of children. *Pediatr Emerg Care* [Internet]. 2010 [cited 2014 Mar 13];26(4):312–5. Available from: <http://www.nwhrn.org/media/Dieckmann-et-al-the-PAT.pdf>
 30. Solevåg AL, Eggen EH, Schröder J, Nakstad B. Use of a modified pediatric early warning score in a department of pediatric and adolescent medicine. *PLoS One* [Internet]. 2013 Jan [cited 2014 Mar 24];8(8):e72534. Available from: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3753259/pdf/pone.0072534.pdf>