

## Immediate Response Systems in Children, what are they? How do they Work? A Proposal for the Mexican Pediatric Population

Vania Hernández Ávila<sup>1\*</sup>, Gonzalo Reyes Blanco<sup>2</sup>, Yaneth Martínez Tovilla<sup>3,4</sup>, Miguel Ángel Coral García<sup>5</sup>, Héctor Alfonso López Santos<sup>6,7</sup>, Diego Martínez Juárez<sup>8</sup> and Irving Eduardo García Lorenzo<sup>8</sup>

<sup>1</sup>Paediatrics, Puebla, Mexico

<sup>2</sup>Head of the Emergency Service, Hospital Ángeles Puebla, México

<sup>3</sup>Department of Pediatrics, Benemérita Universidad Autónoma de Puebla, México

<sup>4</sup>Academic Secretariat, University of Health of the State of Puebla, México

<sup>5</sup>Department of Medical Writing, University of Health of the State of Puebla, México

<sup>6</sup>Direction of the Physician and Surgeon degree, University of Health of the State of Puebla, México

<sup>7</sup>Pediatric Service, Child Rehabilitation and Teletón Integration Center, Puebla, México

<sup>8</sup>General Medicine, Puebla, México

\*Corresponding Author: Vania Hernández Ávila, Paediatrics, Puebla, Mexico.

Received: April 28, 2021; Published: May 27, 2021

### Abstract

**Introduction:** In Mexico there is already a concern to implement teams and systems of immediate response for adult patients, very little has been described about these concepts for children.

**Objective:** To propose an early warning scale: modified BPEWS for the Mexican population.

**Methods:** We decided to merge parameters from the Brighton PEWS and the Irish BPEWS and translate them into a format that is easy for healthcare workers to record and view.

**Results:** The BPEWS scale modified by Hernández and Cols (Table 1) is constituted of 4 modules: airway, circulation, neurological status and so on.

**Discussion:** It is estimated that as the score is higher, so is the risk of clinical deterioration.

**Conclusion:** It is proposed to implement the BPEWS Scale modified by Hernández and Cols in a second or third level hospital for pediatric patients. In order to validate the scale and the rapid response system and then demonstrate its usefulness in hospital mortality decrease.

**Keywords:** Severity Scale; Rapid Response of the Activation Team

### Abbreviations

PEWS: Pediatric Early Warning Score/Pediatric Early Warning System; NEWS 2: National Early Warning Score 2; BPEWS: Bedside Pediatric Early Warning Score; PICU: Pediatric Intensive Care Unit; PRRT: Pediatric Rapid Response Teams; SBAR: Situation, Background, Assessment, Recommendation

### Introduction

No child should die, but this premise is just a utopia. Inevitably some children will face death due to the nature of their disease, however, and although we are embarrassed to say so, a sensitive percentage of the deceased within a hospital unit can be considered as “potentially preventable deaths”. This concept is supported by the fact that several retrospective studies have identified alarm data or signs of deterioration at least 12 to 24 hours before death [1].

If the final result could be the same, there is still the possibility of a different one of having acted promptly in the face of the deterioration of these patients, and it is this gap that prompts us to look for tools to identify children at risk of cardiorespiratory arrest early or associated negative consequences.

In Mexico there is already concern to implement teams and systems of immediate response for adult patients, very little has been described about these concepts for children and although they seem innovative concepts, these programs have been developed for more than 20 years in first world countries such as the United Kingdom, Canada, Australia and the United States [2].

In the case of children, little research has been done to detect the rate of preventable deaths within a hospital; however, the few studies carried out yielded alarming data. Such is the case of a confidential investigation carried out in the United Kingdom in 2008, where a group of 89 cases of children who died in a hospital were evaluated. In this research they report having found 21% avoidable factors in 49% of deaths [1].

It is known that this research promoted the pediatric immediate response programs in this country, since it highlighted the lack of recognition of the level of severity and the incipient clinical deterioration as the main aggravating factor, making an urgent need to have an instrument capable of helping in early detection of these cases. Such was the impact of this review that 5 years later PEWS programs had become a reality in most UK hospitals [3].

With the aim of avoiding more potentially preventable deaths, scales and systems have been developed that allow early identification of the patient at risk of deterioration, and it is in this way that the so-called “PEWS” are born, abbreviation for Pediatric Early Warning Score or Pediatric Early Warning System that, although they share the same acronyms, have a different meaning.

PEWS as a scale, is an assembly of objective physiological variables and subjective assessments that allow giving a score to the clinical status of a patient. The scores will usually give a level of alert (low, moderate or severe) in order to encourage the clinical evaluation of the patient and carry out interventions that improve their condition. On the other hand, PEWS as a system refers to the set of human resources, materials and infrastructure that allow the response and monitoring of the patient in a systematic way [4].

### Pews scales

Although adult early warning scales were first described in 1990, it was not until 2005 that the first pediatric rating scale was proposed, the PEWS developed in the UK by Monaghan in 2005 at the Royal Alexandra Children’s Hospital in Brighton [3].

Many efforts have been made to design the best scale, but unlike the situation in adults with the NEWS 2 scale, in children there is no internationally validated scale for its generalized implementation, nor the instrument that allows to assess or validate them adequately [5,6]. The problem lies in the characteristics of pediatric patients, their great adaptive and compensatory capacity, the enormous variability of their vital signs by age. All the articles about PEWS agree that these types of tools should be easy to use, understand and not involve an extra load of work.

There are two types of PEWS scales, those in which a single parameter triggers a response and others in which variables are evaluated together. For the purposes of this work we will focus on the latter.

The Brighton PEWS scale is one of the best known for its age and ease of use. Broadly, it consists of three evaluable variables, neurological behavior, cardiovascular and respiratory status, subsequently adding other observations such as persistent postoperative vomiting and the requirement of nebulizations every 15 minutes for respiratory disorders, finally, three levels of alert, low, moderate or high risk for clinical deterioration [7].

Other authors have recognized that despite its ease of use, patients with low scores who had major complications have been reported [5,8]. This drawback shows that early warning scales are not a panacea, but rather an instrument that helps to identify the patient at risk, but must be accompanied by medical judgment.

In addition to this assertion, it is necessary to take into account the so-called “physician gut feeling” or the doctor’s feeling that “something is not right”. Certainly, although it is a feeling or assessment with a high tendency to subjectivity, it is not without validity, and on many occasions it has been useful to save lives [9,10].

On the other hand, the BPEWS scale developed in Canada at the Hospital for Sick Children in Toronto (2006) added other variables, with a total of 7 parameters that include; heart rate, blood pressure, capillary filling, respiratory rate, respiratory effort, saturation and oxygen therapy, as well as the Brighton PEWS according to the score, a staging of the alert level is obtained, however, it has the same problem, no has been validated [9].

In summary, in other reviews of the literature, at least 38 PEWS scales have been found and evaluated, between original and modified works, and although a great variety is described in the number, type of parameters used and recording strategies, all use as a basis vital signs by age. To date, there is no consensus on which variables or signs should be included in a scale for the evaluation and immediate care of pediatric patients [1]. An observation that does not go unnoticed is that in a hospital center a comparative study was carried out between 18 PEWS scales, finding different results in their performance for the same case [8].

The objective of these scales is not only to avoid mortality, but also the deterioration itself, since the latter caused by hypovolemia, asphyxia, arrhythmias, sepsis, etc., have hypoxia as a consequence, sometimes so severe that, although it triggers or not a cardiorespiratory arrest can leave unfortunate consequence.

In two series of reported cases, only 24% of 544 children and 27% of 880 who had cardiorespiratory arrest survived to hospital discharge; of the survivors, 34% had severe neurological sequelae. Therefore, the objective is to reduce adverse events secondary to clinical deterioration, urgent transfers to the pediatric intensive care unit (PICU), from the hospitalization floor and to carry out scheduled transfers instead of emergency transfers [9].

Another important point observed among the centers with more experience in PEWS is the determination to include parents in the evaluation and in the activation of rapid response systems, since they are the people who know the most about their children’s behavior [11,12].

It is worth mentioning that these types of tools demonstrate their usefulness for children in hospitalization and not on admission to the emergency room, although an initial assessment can be made, its objective is to monitor behavior during hospitalization and not as a basis for deciding whether to admit to hospital or discharge from the emergency room [4,13].

### About immediate response teams in children (IRTC)

The ideal team should be made up of personnel trained in specialized care for children, with the most expert as the team leader; a structure very similar to that proposed by the American Heart Association (AHA) for the care of critically ill patients, in turn must be trained in the use and meaning of the implemented scale, activation protocols and operation of the IRTC. Whether we are talking about public or private hospitals, the “dream team” must have:

- Pediatrician or Pediatric Intensivist as team leader, extensively trained in pediatric advanced life support.
- On-call doctor, or resident doctor specialized in Pediatrics. Activated by CODE IRTC, he will be second in charge, extensively trained in basic life support and ideally pediatric advanced life support.
- Internal medic. Activated by CODE IRTC, trained in basic life support and ideally pediatric advanced life support.
- Nurse or nurse in charge: It is usually who activates the code, should be trained in basic life support and ideally pediatric advanced life support.
- Nursing supervision, who should function only as a communication channel with other hospital services (pharmacy, pediatric intermediate or intensive care unit, operating room and imaging).
- Nurse Assistant. Ideally trained in basic life support and able to perform transfer maneuvers to other units.
- Respiratory therapy staff. Personnel who can master airway skills, provide supplies for ventilation, or use supplemental oxygen.

### Immediate response systems

Rapid response systems are an algorithm of steps to follow once the patient on alert for deterioration has been identified. They usually have an immediate response team, which is made up of a group of people trained in urgent and specialized patient care. These teams are usually made up of a medical leader, nursing staff, doctors-in-training, transportation and respiratory therapy staff, and even administrative staff.

The system must have specific protocols that help hospitalization personnel to communicate effectively with the treating or base physician. The SHER sequence (situation, history, evaluation and response) has proven to be useful, providing the personnel of first contact with the patient with the most correct way to report what is observed. Finally, it is worth mentioning that they must have a platform or record sheet where the interventions carried out, the time it took the team to respond, the time for the interventions proposed by the IRTC to be carried out and whether or not they were effective will be recorded.

The general logistics of the system is made up of:

- Afferent branch: Its objective is to detect clinical deterioration and trigger an adequate response.
- Efferent branch: This is the equipment that can respond quickly to the needs of the patient. In other words, the immediate response team.
- Registration and improvement of processes: This boils down to the evaluation and constant feedback about the efficiency of the system and the performance of the immediate response teams, registration of cases and reliable statistics. Essential for identifying successes and failures throughout the process.

- Administrative Committee. A group or office associated with the culture of safety in the hospital with expert leaders on the subject, who should promote the continuous training of each and every one of the hospital workers from the person who opens the door on arrival, the reception, nurses, interns, attached. Knowing that it exists will help improve your performance [14].

The system can be as small as for use within a hospital, or so large that it involves a group of first, second and third level hospitals.

It is worth mentioning that for all this to work, a change in the general culture of hospital management is necessary in favor of patient safety, as well as improving communication between patient and family health personnel [4,13-15].

In Ireland there is a whole BPEWS system, which is free on the web with implementation guides, documents and free access formats, showing the importance of making these initiatives an international reality [16,17]. This BPEWS has an inclusion program for parents as an essential part of the system, which consists of brochures, surveys and information that is constantly available within the unit to inform that, given the uncertainty of changes in the state and behavior of their children, can approach the nursing or medical staff to request the assessment by the IRTC [1,16].

### Objective of the Study

Therefore, the objective of this work is to propose an early warning scale: modified BPEWS for the Mexican pediatric population.

### Methods

In the search for the best scale to apply it within a private hospital in the city of Puebla (Mexico), we found the Irish BPEWS guidelines and protocol. These materials are freely accessible. These guides establish the steps to follow for the correct implementation of the protocol, thus showing that adopting and adapting this type of system to the needs of hospitals that care for children is a global priority [2,3].

It is well known that all the proposed scales have similar parameters, therefore, the big differences lie in how are they applied and how will the immediate response system work? adapting to the characteristics of each hospital center.

This is why we decided to merge parameters from the Brighton PEWS<sup>7</sup> and the Irish BPEWS<sup>16</sup> and transfer it to a format that is easy for healthcare personnel to record and view.

### Results

The BPEWS scale modified by Hernández and Cols (Table 1) is made up of 4 modules: airway, circulation, neurological status and miscellaneous. In turn, each module has sub parameters. The BPEWS scale modified by Hernández and Cols (Table 1) is made up of 4 modules: airway, circulation, neurological status and miscellaneous. In turn, each module has sub parameters.

A+B	Airway and ventilation	<ul style="list-style-type: none"> <li>• Breathing frequency</li> <li>• Shortness of breath</li> <li>• Oxygen saturation</li> <li>• Oxygen therapy</li> </ul>
C	Circulation	<ul style="list-style-type: none"> <li>• Heart rate</li> <li>• Blood pressure</li> <li>• Capillary filling</li> </ul>
E	Neurological status	<ul style="list-style-type: none"> <li>• Rated by AVDI</li> </ul>
M	Miscellaneous	<ul style="list-style-type: none"> <li>• Hourly nebulisations</li> <li>• Postoperative vomiting</li> <li>• Concern of parents or health personnel</li> </ul>

**Table 1:** BPEWS scale modified by Hernández and Cols.

By applying the scale (Table 1) and the format (Figure 1) we can obtain the following alert levels:

- Mild alert (Green): Score between 0-2 pts. Indicates low risk of clinical deterioration. It requires evaluation by a competent nurse, or an intern, both with the power to decide on changes in the frequency of clinical monitoring.
- Moderate Alert (Yellow): Score between 3 to 5 points. Indicates intermediate risk of clinical deterioration. It requires urgent medical evaluation by the resident, assigned, treating or equivalent doctor, who will have the power to make management decisions that can improve the current state of the patient. In turn, they may decide to increase the frequency of vital signs monitoring and activate or not the immediate response team.
- Serious Alert (Red): Score of 6 or more points. Indicates some risk of clinical deterioration. It requires urgent assessment by the immediate response team and assess rapid transfer to a pediatric intermediate or intensive care unit as the case requires.
- The appropriate response will always be guided by the medical personnel specialized in Pediatrics.

It is recommended that the frequency of taking vital signs according to the score obtained is as follows (Table 2).

0 - 2 points	Take vital signs every 2-4 hours	Nursing assessment
3 - 5 points	Take vital signs every hour	Assessment by an on-call doctor. Probable activation of ERIN
6 points or more	Take vital signs every 30 minutes or continuous monitoring if necessary	Assessment by an on-call doctor. Activation of ERIN

Table 2: Frequency of taking vital signs.

The use of the BPEWS format modified by Hernández and Cols (Figure 1) for a 24-hour surveillance for the number of days the patient remains in hospital.

Figure 1: BPEWS format modified by Hernández and Cols.

### Discussion

One problem to be solved is that for many scales it is necessary to carry out a comparative exercise with the patient's vital signs and the matrix table to give the score, however, the work overload of doctors in training and nursing personnel, sometimes makes it impractical, ignoring the obvious. That is why, in the modification made, alert colors were assigned in the graphic format.

Following the line of other PEWS scales, our tool assigns a numerical value of 1 - 3 points according to the alert level and correlated with the vital signs matrix, assigning a color to each alert level (yellow, orange and red). 5 formats were made by age, 0 - 3 months, 4 - 11 months, 1 - 4 years, 5 - 12 years, older than 12 years [3]. In the case of the BPEWS format modified by Hernández and Cols (Figure 1), the example of the format made for pediatric patients 5 - 12 years of age is observed. It will be necessary to have the matrix of vital signs according to each of the age groups.

In the BPEWS format modified by Hernández and Cols (Figure 1) the parameters to qualify are in vertical order with the sequence A + B, C, D, E, M. We include in this the thermal curve without giving it a score. This, because the cardiopulmonary physiology of the child changes due to fever; data such as tachycardia or tachypnea, without fever, are considered systemic inflammatory response data. A By being present in the format, we can also take it into account as a sensitive piece of information, but without adding extra alert, since many hospitalized children are admitted for feverish conditions. It is worth mentioning that other scales consulted do not take into account hypothermia or fever as elements that add to the score.

Another extra piece of information is uresis, we place in each format (Figure 1) the normal value of uresis per hour by age group, in order to monitor whether or not it is adequate.

It is estimated that as the score is higher, so is the risk of clinical deterioration.

At the end of the record, the format (Figure 1) has a space or table to perform the sum and obtain the total, which will be noted within the degree of alert corresponding to the numerical value. The table (Table 2) describes the appropriate interventions for each case, and recommendations are issued regarding the frequency of clinical monitoring, as well as the urgency of the review by the appropriate health personnel.

The physiology and great adaptive capacity of the pediatric patient, the scarce presence of comorbidities, and the meticulous care that parents, caregivers and health personnel give to children, are situations that contribute to the fact that hospital mortality in pediatric patients is significantly lower than that of adults, however, we must not forget that any number of preventable deaths within a hospital is a sensitive number and that it deserves the search for protocols that allow them to be avoided. Therefore, although international randomized controlled studies have failed to show that mortality improves significantly, we must pay attention to studies carried out in various hospital centers around the world, who maintain that mortality figures seem to decrease with the time of implementation and monitoring of said systems.

We must take into account that not only the scales or the systems seek to eliminate potentially preventable death, but also the number of cardiorespiratory arrests, urgent and unplanned transfers from the hospitalization floor to the PICU, or from one level to another of medical care, trying to the maximum extent to avoid unnecessary deterioration and that can generate a negative impact on the patient's prognosis.

We know that one of the great challenges to overcome is linked to the operation of hospitals in Mexico, where the overload of work and the lack of material and human resources make it difficult to implement and monitor this type of work and systems, but, many of the incidents or failures reported in first world hospitals are linked to the lack of assessment by assigned doctors, since it is the nurse or the

internal doctor who is in charge of monitoring the patient, therefore, instead of viewing this situation as a problem, we can transform it into an area of opportunity, since in most teaching hospitals there will always be a resident doctor close to the patient.

It is imperative to recognize that this type of initiative cannot prosper in an environment of rejection or fear of change, which is why we call for an urgent change in the culture of Medicine in our country, which is characterized by being historical and highly hierarchical, where the internal physician cannot address the highest ranking resident physician, and this in turn to his/her assigned, or where the nursing staff, despite being the one who has the greatest contact with the patient, may perceive that their opinion lacks validity. We must support entrepreneurship, the thirst for improvement and the hunger for knowledge, call for education and positive upbringing of our future specialists, promoting the culture of “speak up”. If something worries you, say it, ask, and do teamwork.

On the other hand, it is essential to motivate the nursing staff, who are in charge of registering vital signs, since the proper registration of the formats may fail due to lack of enthusiasm towards the program, as it means “more work”; however, we must direct him to recognize in this type of system the opportunity to avoid the anguish associated with “I don’t know what happens to the patient” and the obstacles derived from a patient deteriorating and increasing his days of hospital stay, occupation of a bed in intermediate or intensive care units, due to the lack of early recognition of deterioration, and contribute even more to the improvement or cure of the patient, shortening days of hospitalization promoting early discharge.

### Conclusion

Although many children are admitted to hospital to treat non-serious illnesses or are stabilized, they are not exempt from the fact that during their stay they can deteriorate and die.

Immediate response systems have proven to be useful in reducing hospital pediatric morbidity and mortality. These systems must be implemented and applied in public and private hospitals. In the public sector, it will prevent work overload from preventing the identification of those children who are deteriorating towards the inevitable cardiorespiratory arrest, reducing costs, hospitalization days and improving the prognosis of patients. In the private sector, it will also reduce the gap of ignorance due to the rotations of non-expert personnel in Pediatrics, it will create trust among parents who take their children to these centers in search of the best care, it will help to monitor private patients they don’t always have their treating physician with them and will significantly reduce the number of malpractice lawsuits.

In Mexico we must fight for the implementation of these systems, which is why a change in the culture of education and operation of hospitals is essential. The proposed tool is easy to use and, if validated, will eventually succeed in replacing the current formats of vital signs used in hospitals that provide pediatric care, reducing the costs of implementing the program, improving patient surveillance by reducing the problem. related to lack of knowledge and training.

Therefore, we propose to implement the BPEWS Scale modified by Hernández and Cols. in a second or third level hospital for pediatric patients conducting prospective studies in order to validate the scale and the rapid response system and demonstrate its usefulness in reducing hospital mortality. To achieve this, the modified BPEWS format can be included, whose registration is easy and fast, offering the advantage of not having to compare with a matrix table of vital signs or clinical response table, since both are included, and thus solve the problem associated with inexperience due to the lack of knowledge of vital signs by age, a situation that unfortunately is a reality even for pediatric doctors or pediatric nurses in training and it must be recognized that it is practically impossible to know them by heart.

This tool should not be seen as an additional burden of stationery, but as an instrument that allows to empower with arguments based on clinical evidence those who do not dare to speak in favor of the patient’s health, such as students in the health area, and even parents.

### Conflict of Interest

The authors declare that they have no conflicts of interest in relation to this article.

### Bibliography

1. Pearson GA. "Why Children Die: A Pilot Study 2006; England (South West, North East and West Midlands), Wales and Northern Ireland". London: CEMACH (2008).
2. Elguea EPA., *et al.* "Equipos de respuesta Rápida en México, previniendo el paro cardiorrespiratorio intrahospitalario". *Revista de la Asociación Mexicana de Medicina Crítica y Terapia Intensiva* 28.2 (2014): 113-123.
3. Chapman SM and Maconochie IK. "Early warning scores in paediatrics: an overview". *Archives of Disease in Childhood* 104.4 (2019): 395-399.
4. Roland D. "Paediatric Early Warning Systems: myths and muses". *Paediatrics and Child Health* 27.5 (2017): 242-246.
5. Chapman SM., *et al.* "Systematic review of paediatric track and trigger systems for hospitalised children". *Resuscitation* 109 (2016): 87-109.
6. Trubey R., *et al.* "Validity and effectiveness of paediatric early warning systems and track and trigger tools for identifying and reducing clinical deterioration in hospitalised children: a systematic review". *BMJ Open* 9.5 (2019): 1-22.
7. Monaghan A. "Detecting and managing deterioration in children". *Pediatric Nursing Journal* 17.1 (2005): 32-35.
8. Chapman SM., *et al.* "The Score Matters': wide variations in predictive performance of 18 paediatric track and trigger systems". *Archives of Disease in Childhood* 102.6 (2017): 487-495.
9. DeVita M. "Textbook of rapid response systems". Second edition. Switzerland: Springer (2017).
10. Lillitos PJ., *et al.* "Can paediatric early warning scores (PEWS) be used to guide the need for hospital admission and predict significant illness in children presenting to the emergency department? An assessment of PEWS diagnostic accuracy using sensitivity and specificity". *Emergency Medicine Journal* 33.5 (2016): 329-337.
11. Urbane UN., *et al.* "Value of parental concern and clinician's gut feeling in recognition of serious bacterial infections: a prospective observational study". *BMC Pediatrics* 19 (2019): 219.
12. Heat G. "Developing a Tool to Support Communication of Parental Concerns When a Child is in Hospital". *Healthcare* 4.1 (2016): 1-14.
13. Roland D., *et al.* "Scoring systems in paediatric emergency care: Panacea or paper exercise?" *Journal of Paediatrics and Child Health* 52.2 (2016): 181-186.
14. Roland D. "Beyond Mortality: Improving Outcomes for Children Who Deteriorate in Inpatient Settings". *Journal of Hospital Medicine* 14.8 (2019): 512-513.
15. Roland D. "But I told you she was ill! The role of families in preventing avoidable harm in children". *BMJ Quality and Safety* 24.3 (2015): 186-187.

16. Department of Health. Irish National Early Warning System V2 (NCEC National Clinical Guideline No. 1). (2020).
17. Department of Health. The Irish Paediatric Early Warning System (PEWS) (NCEC National Clinical Guideline (2016)).

**Volume 10 Issue 6 June 2021**

**© All rights reserved by Vania Hernández Ávila, et al.**