DOI: 10.1590/1809-2950/20026728032021

ORIGINAL RESEARCH

Barriers and facilitators of early mobilization at the pediatric intensive care unit: a systematic review

Barreiras e facilitadores da mobilização precoce na unidade de terapia intensiva pediátrica: revisão sistemática

Barreras y facilitadores de la movilización temprana en una unidad de cuidados intensivos pediátrica: revisión sistemática

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ABSTRACT | This systematic review aimed to identify barriers and facilitators for the implementation of early mobilization in pediatric intensive care units. A systematic search was carried out based on studies that addressed barriers and/or facilitators for early mobilization in children and adolescents. Studies published until June 2019 in the MEDLINE®, Physiotherapy Evidence Database, Latin American & Caribbean Health Sciences Literature, Cochrane Library, and Scientific Electronic Library Online databases were included. Selection and assessment of methodological quality were performed by two independent reviewers. Data that could be identified as barriers and/or facilitators were extracted for analysis. 358 records were found in the databases, of which 13 articles were included. 18 barriers were cited; the most cited ones were the insufficient number of professionals and team's insecurity. Of the 11 mentioned facilitators, the most frequent were training/education of the multidisciplinary team and the establishment of guidelines/consensus. There are many barriers to be broken for early mobilization to be effective, but some facilitators are already known and can be implemented, making their implementation feasible for the pediatric population.

Keywords | Intensive Care Units; Pediatrics; Early Ambulation.

RESUMO | O objetivo desta revisão sistemática foi identificar as barreiras e facilitadores para a implementação da mobilização precoce em unidades de terapia intensiva pediátrica. Realizou-se uma busca sistemática baseada em estudos que abordassem barreiras e/ou facilitadores para mobilização precoce em crianças e adolescentes. Foram incluídos estudos publicados até junho de 2019 nas bases de dados MEDLINE®, Physiotherapy Evidence Database, Literatura Latino-Americana e do Caribe em Ciências da Saúde, Cochrane Library, Scientific Electronic Library Online. A seleção e a avaliação da qualidade metodológica foram realizadas por dois revisores independentes. Dados que pudessem ser identificados como barreiras e/ou facilitadores foram extraídos para análise. Foram encontrados 358 registros nas bases de dados, dos quais foram incluídos 13 artigos. Foram citadas 18 barreiras, sendo as mais citadas o número insuficiente de profissionais, e insegurança da equipe. Dos 11 facilitadores citados, os mais frequentes foram treinamento/educação da equipe multidisciplinar e a instituição de diretriz/consenso. Existem muitas barreiras a serem quebradas para que a mobilização precoce seja efetiva, porém alguns facilitadores já são conhecidos e podem ser implementados, tornando viável a sua implementação para a população pediátrica.

Descritores | Unidades de Terapia Intensiva; Pediatria; Deambulação Precoce.

RESUMEN | El propósito de esta revisión sistemática fue identificar barreras y facilitadores para aplicar la movilización temprana en las unidades de cuidados intensivos pediátrica. Se realizó una búsqueda sistemática de estudios que abordaron barreras y/o facilitadores para la movilización temprana en niños y adolescentes. Se incluyeron estudios publicados hasta junio de 2019 en las bases de datos MEDLINE®, Physiotherapy Evidence Database, Literatura Latinoamericana y del

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Caribe en Ciencias de la Salud, Cochrane Library y Scientific Electronic Library Online. La selección y evaluación de la calidad metodológica fue realizada por dos revisores independientes. Los datos que se han identificado como barreras y/o facilitadores se extrajeron para su análisis. De los 358 registros encontrados en las bases de datos, se incluyeron 13 artículos. Se mencionaron 18 barreras, y las más citadas fueron el número insuficiente de profesionales y la inseguridad del equipo. De los 11 facilitadores mencionados, los más frecuentes fueron la formación/educación del equipo multidisciplinario y el establecimiento de lineamientos/consensos. Hay muchas barreras que romper para que la movilización temprana sea efectiva, pero algunos facilitadores ya son conocidos y pueden ser aplicados, haciendo su aplicación factible a la población pediátrica.

Palabras clave | Unidades de Cuidados Intensivos; Pediatría; Ambulación Precoz.

INTRODUCTION

Children admitted to the Pediatric Intensive Care Unit (PICU) are subject to risk factors that are associated with disease severity, stage of development, pharmacological interventions (such as the use of corticosteroids, sedatives, neuromuscular blockers), and immobility in bed. These factors can lead to acquired weakness, delirium, longer duration of mechanical ventilation, and, thus, loss of function and of quality of life for the child[1].

It is known that, in adult patients, muscle strength decreases from 3 to 11% with each additional day of immobility in bed[2]. This loss leads to repercussions on quality of life, which remain after 24 months of discharge from the Intensive Care Unit (ICU).[2]

In view of these harms caused by hospitalization, early mobilization (EM) has been used as an important therapeutic strategy in the ICU. This term is understood as appropriate rehabilitation exercises with varying degrees. Despite this, the ideal time to start therapy has not yet been defined. Studies have not shown a consensus on the time to start EM, but some authors describe it as 48 to 72 hours[3-5]. Aquim et al.[3] recommend starting in 48 hours for patients on mechanical ventilation and in 72 hours for patients on spontaneous breathing.

In addition to the decrease in acquired muscle weakness, EM is associated with the prevention and reduction of polyneuropathy and myopathy in critically ill patients, with a reduction in thrombosis, an improvement in quality of life, and a decrease in the time under mechanical ventilation. Thus, EM favors early ventilatory weaning and a reduction in hospital stay and mortality, both in the adult and child population[6-8]. The use of EM for children seems to be safe, effective, and feasible, being one of the daily care goals of the PICU [6,9].

The use of EM in adults is associated with shorter time under mechanical ventilation and, thus, shorter stay in the ICU[10]. Despite all the known benefits of EM, there are still several barriers to its implementation in the PICU[11].

Although some studies mention some barriers, such as structural difficulties, cultural obstacles, and limitations related to the health team and the patient[11], previous studies do not specifically synthesize what are the barriers and how often they hinder adherence to EM. Also, the investigation and synthesis of potential facilitators for the use of EM is of fundamental importance and may contribute to the implementation of these facilitators, therefore supporting the use of EM at PICUs. Thus, this review aimed to systematically assess the literature on the barriers and facilitators for EM to be effectively implemented in the PICU practice.

METHODOLOGY

The Prisma recommendation was used to conduct this systematic review, prospectively registered on the platform *International Prospective Register of Systematic Reviews* – Prospero (CRD42020140379).

Article search and selection strategy

The search was performed in the following databases: MEDLINE® via PubMed®, *Physiotherapy Evidence Database* (PEDro), Latin American & Caribbean Health Sciences Literature (LILACS), Cochrane *Library, and Scientific Electronic Library Online* (SciELO). A manual search was also carried out in the references of studies published on the subject.

The search strategy comprised the keywords "*critical illness*,""*intensive care units*,""*pediatric* ,""*rehabilitation*," "*child*," "*adolescent*," "*barriers*," "early mobilisation," and their combinations. No date limit was used in the searches and all studies published in Portuguese, English, and Spanish, from the beginning of the databases to April 2019, were included. The search, selection, and evaluation of articles was carried out between April and June 2019.

Inclusion and exclusion criteria

A mixed-method systematic review was performed including any experimental or non-experimental studies, both observational studies and randomized and non-randomized clinical trials (quantitative approach), as long as they evaluated the use of EM in children and adolescents aged between 29 days and 18 years old and who presented the report of patients, professionals, caregivers, or family members (qualitative approach) of barriers and/or facilitators to the use of EM at the PICU. Articles that did not mention barriers and/or facilitators, review and guideline studies, and studies covering the adult and neonatal population were excluded.

Data extraction

The titles and abstracts of the articles identified in the search strategy were analyzed by two independent reviewers, according to the inclusion and exclusion criteria. In the next phase, the same reviewers performed a complete reading of the selected articles to independently verify the eligibility criteria. Articles with insufficient information in the abstract were also selected for full reading. Disagreements between reviewers were solved by consensus between them.

To determine what are the barriers and facilitators of the use of EM and estimate how often they appear in the studies, two authors extracted the information and transferred them to a standardized form containing the following information: (1) Author's name and year of study; (2) Type/Design of the study; (3) Main diagnosis; (4) Details regarding the intervention; (5) Information about the variables of interest, namely: (1) Barriers to the use of EM and (2) Facilitators to the use of EM. Barriers and facilitators were considered to be any factor mentioned by the author that impeded/hindered and contributed to the accomplishment of EM at the PICU, respectively.

Assessment of methodological quality

The critical analysis of the methodology of the studies was carried out by two authors (EPS and ACPNP), independently, and both were not co-authors in any of the included articles. Observational studies were evaluated using the Newcastle-Ottawa Scale (NOS) by two independent, previously trained, and qualified reviewers[12]. The Newcastle-Ottawa Scale is recommended by the Brazilian Ministry of Health in "Methodological Guidelines" for evaluating observational studies in Systematic Reviews[13]. A study is evaluated from three main perspectives: selection of study groups (4 stars/points); comparability of groups (2 stars/points); and determination of the exposure or outcome of interest for case-control or cohort studies (3 stars/points), respectively.

Randomized clinical trials (RCT) were evaluated using the Cochrane Risk-of-Bias assessment tool, by two independent reviewers. It is recommended by Cochrane[14]. The tool includes seven domains to be assessed: random sequence generation; allocation concealment; blinding of participants and professionals; blinding of outcome evaluators; incomplete outcome data; selective outcome report; and other sources of bias. For each domain of the RCT risk-of-bias assessment tool, a high, uncertain, or moderate risk of bias is classified.

Statistical analysis

Data were descriptively summarized in tables and graphs using counts, proportions, means, and standard deviation, or medians and interquartile range, when appropriate. The program used for the analyses was the statistical package for social sciences version 20.0.

RESULTS

A total of 356 articles were found in the database and other 2 in studies' references, totaling 358 articles, of which 32 were removed because they were duplicates. After analyzing the title and abstract, 27 articles remained for full reading. At the end, 13 reports from 11 articles were included (see Flowchart – Figure 1). The Kappa coefficient of agreement between the evaluators in the selection of studies was 0.83. The characteristics of these studies are summarized in Table 1.

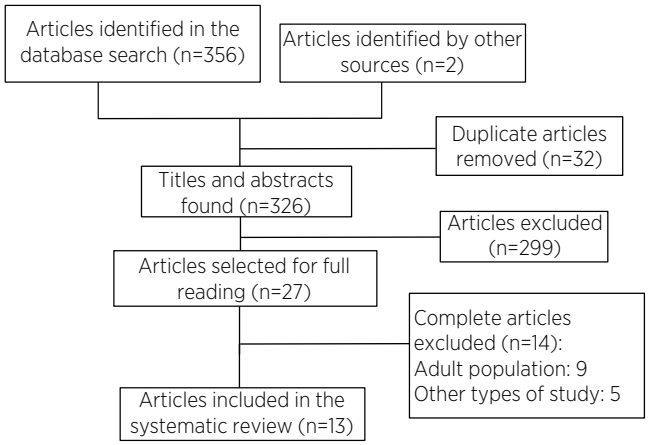

Figure 1. Study flowchart

According to the studies found, 18 barriers were cited to performing EM, namely: insufficient number of professionals (69.2%); team's insecurity (61.5%); need for consent from parents/guardians and motivation of the child (53.8%); need for medical order/prescription and unavailability of equipment (38.5%); lack of communication/knowledge and patient instability (30.8%); inadequate sedation and absence of guidelines/consensus (23.1%); culture of non-acceptance (15.4%). Other less mentioned barriers (7.7%): patient's age and sleep schedule; unexpected visits from family members; patient out of bed; low patient severity; normal basal motor function; and medical order of bed rest (Figure 2).

Table 1. Characteristics of the included studies

Author/ Year	Type of Study	Main Diagnoses	Details of the Study/ Intervention	Barriers	Facilitators
Choong[15] 2017**	RCT	Various diagnoses (mostly respiratory failure)	30 patients aged 3 to 17 years, with a stay of 48 hours or more in the PICU. The study compared conventional physical therapy versus conventional physical therapy associated with an upper limb cycle ergometer, 5x/week for 30 minutes a day.	Parent/patient refusal due to the patient's sleep schedule; generation of emotional stress and the possibility of causing pain to the patient; insufficient number of professionals.	Establishing an institutional practical guideline; involving other professionals and caregivers to perform EM.
Fink[16] 2019	RCT	Head trauma, cardiac arrest, stroke, brain mass, or central nervous system infection	58 children aged 3 to 17 years old, with a stay of 48 hours or more at the PICU. Performed EM versus usual care.	Patient out of room; request from nursing, parents, and/or patient; subjective complaint; unexpected visits from family members; abnormal intracranial pressure (instability).	Promoting improvement in team education, care delivery, and coordination; promoting practice based on personalized protocols.
Zheng[17] 2018**	RCT	Various diagnoses (mostly respiratory failure)	A semi-structured interview was carried out with doctors, caregivers, family members ,and patients aged 8 years or over, who took part in a clinical trial of EM in critically ill children.	EM is not seen as a priority; concern for patient safety; insufficient number of physical therapists; lack of patient motivation.	Trust in the health team; belief in the importance of physical activity; engagement of the health team; engagement in research.
Choon[18] 2014	Retrospective cohort	Various diagnoses	600 patients aged 0 to 17 years old, with a stay of 24 hours or more at the PICU. Main outcome was to characterize the type of EM, time of onset, and eligible patients.	Parental and/or patient refusal; lack of medical prescription; need for a medical order not to perform the EM; patient's condition; insufficient staff; presence of a long-term catheter; insufficient equipment.	Physical therapist autonomy; elaboration of guidelines for practice.
Choong[19] 2015	Retrospective cohort	Various diagnoses (mostly post-operative period)	25 patients, aged 3 to 17 years old, with a stay of more than or equal to 24 hours at the PICU. The study compared two methods (passive mobilization versus interactive video game), applied for a maximum of 2 days, lasting 20 minutes.	Improperly sized equipment; parent/patient refusal.	Educating the team; influencing a cultural change about EM; establishing EM protocols; encouraging research.
Abdulsatar[20] 2013	Case series	Various diagnoses	8 patients divided into two groups, aged between 3 and 18 years old, with a stay of 48 hours or more at the PICU. The study used Nintendo Wii™ Boxing for at least 10 min, 2x/ day for 2 days.	Lack of parental consent; refusal/lack of patient motivation; sedation; the non-specific game for rehabilitation; insufficient number of physical therapists.	Pleasant techniques for obtaining parental/patient approval; low cost of video game.

(continues)

Table 1. Continuation

Author/ Year	Type of Study	Main Diagnoses	Details of the Study/ Intervention	Barriers	Facilitators
Betters[4] 2017	Case series	Various diagnoses (mostly respiratory disease)	74 patients, aged 0 to 21 years, under MPV, with a hospital stay of 72 hours or more. Intervention lasting 30 minutes.	Deep sedation or neuromuscular block; *delirium*; work overload of physical therapists; culture of non-acceptance by the team for fear of adverse events; reduced number of physical therapists on weekends.	Physical therapist hired only to perform EM; multidisciplinary team training; pre-intervention safety checklist; protocol for EM.
Colwell[21] 2018	Case series	Various diagnoses	The study implemented an EM protocol and evaluated the protocol's effectiveness for nine months, according to patient age and disease severity.	Patient instability; insufficient staff; parent/patient refusal; admission time; concern about the severity of the patient; concern about medical equipment.	Increasing the team's adherence to the EM protocol and promoting institutional education; understanding the family's perception of EM.
Cui[22] 2017	Case series	Various diagnoses	40 patients aged 14 days to 18 years old, with a stay of 72 hours or more at the PICU. The study characterized the patients, the physical therapy and OT sessions, and the adverse effects of EM, with each session lasting 20 minutes.	Patient's sleep schedule; prohibition by nursing staff; absence of a protocol for EM; delay to start mobilization; lack of clarity about EM risks and benefits; low prioritization of doctors for EM; interruption in sedation; parental prohibition; age.	Training of the multidisciplinary team and family members; showing family members the potential benefits of EM; contribution and collaboration of nursing.
Miura[23] 2018*	Case series	Various diagnoses	100 patients aged 1 to 17 years old. The study analyzed how many children received EM in the first 3 days of hospitalization and characterized the predictors for this.	Patient with normal baseline function; low severity score; physical therapist exclusivity and lack of professional; restricted knowledge about EM benefits.	Implementation of a EM program and optimization of EM culture at the PICU.
Parisien[24] 2016	Case series	Intubated and post-surgical patients	4 children under the age of 3 years old. An interview was conducted to explore the parents' experience.	Need for medical prescription; equipment unavailability; absence of practical guidelines; ineffective communication between health professionals and family members; inadequate staff training; insufficient number of professionals; concern with: orotracheal tube, risk of dislodgement of devices or catheters.	Family participation; awareness of the importance of EM and clarification of questions for family members; staff training; daily interruption of sedation; effective communication between health professionals; implementation of practical EM guidelines.
Tsuboi[25] 2017	Case series	After liver transplants	57 patients under 16 years old. The study evaluated the effectiveness of an EM protocol.	Absence of practical guidelines; lack of knowledge about the benefits of EM; need for medical prescription; conflicting perceptions regarding EM safety.	Adequate analgesia and sedation; training of the multidisciplinary team; team cultural transformation; setting goals for each patient daily; establishing an EM protocol.
Wieczorek[26] 2016*	Case series	Various diagnoses	100 patients aged 0 to 17 years old. EM performed in the first 72 hours at the PICU. The study assessed the results of implementing an EM program.	Procedure conduction; patient severity; bed rest orders; lack of specific equipment for the patient's age and size; need for medical prescription; insufficient staff.	Creation of a measure package for EM; staff training; discussion among professionals; safety assessment to perform EM.

MPV: mechanical pulmonary ventilation; EM: early mobilization; PICU: pediatric intensive care unit; OT: occupational therapy; RCT: randomized clinical trial.

* Represent different reports from the same article; ** Represent different reports from the same article.

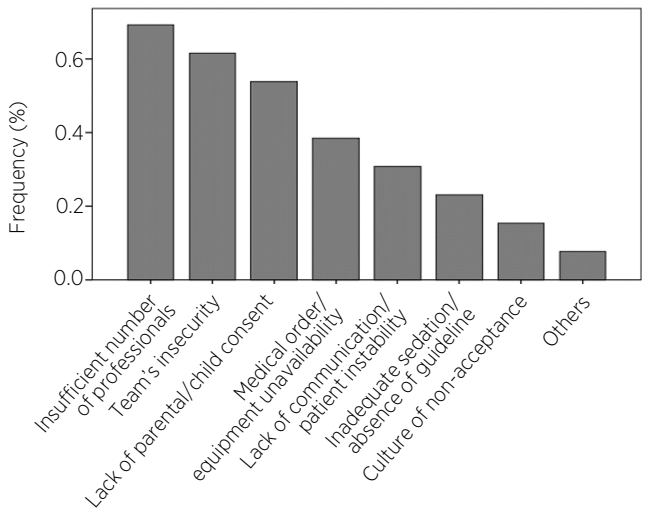

Figure 2. Barriers to carrying out early mobilization and frequency in which they were found in the articles

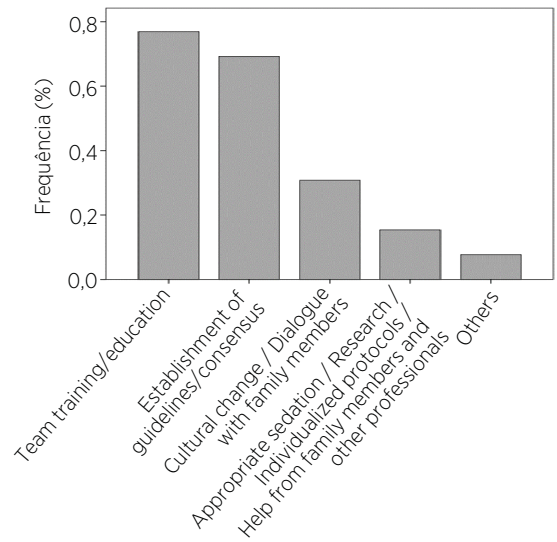

Figure 3. Facilitators for carrying out early mobilization and frequency in which they were found in the articles.

Facilitators totaled 11, namely: team training/education (76.9%); establishment of guidelines/consensus (69.2%); influence of cultural change and dialogue with family members (30.8%); appropriate sedation/analgesia; team engagement; individualized protocols; and help from other professionals and family members (15.4%). Other less mentioned facilitators (7.7%) are: use of low-cost materials; physical therapist exclusively for EM; and physical therapist autonomy (Figure 3).

The risk of bias of the cohort studies and case series were assessed according to the NOS. The quality score ranged from 3 to 5 for the case series, which are considered to be of low to moderate quality. The cohort studies presented scores 6 and 7, being considered of high quality. Regarding the two RCTs, one study presented low risk of bias for all domains, and the other presented high risk only in the domains "blinding of participants and professionals" and "blinding of outcome evaluators." The data are described in Table 2.

Table 2. Methodological evaluation of included studies

Cochrane Risk-of-Bias Scale							
Author/Year	**Random sequence generation**	**Allocation concealment**	**Blinding of participants and professionals**	**Blinding of outcome evaluators**	**Incomplete outcome data**	**Selective outcome report**	**Other sources of bias**
Fink[5] / 2019	+	+	+	+	+	+	+
Choong[14] / 2017	+	+	-	-	+	+	+

Newcastle-Ottawa Scale for Cohort Studies									
Author (year)	**Selection**				**Comparability**	**Outcome**			**Score**
	Representativeness of the exposed group	Selection of the unexposed group	Exposure verification	Demonstration that the outcome was not present at baseline	Based on design or analysis	Outcome assessment	Sufficient follow-up	Follow-up losses	
Choong[17] / 2014	+	+	+	-	+	+	+	+	7
Choong[18] / 2015	-	+	+	+	+	+	-	-	6

Newcastle-Ottawa Scale for Case Series						
Author/Year	**Selection**			**Outcome**		**Score**
	Representativeness of cases	Proper case definition	Proper exclusion of other cases	All relevant data reported	Correct outcome assessment	
Abdulsatar[19] / 2013	+	+	+	+	+	5
Betters[4] / 2017	-	+	+	-	+	3
Colwell[20] / 2018	+	+	+	-	+	4
Cui[21] / 2017	-	+	-	-	+	2
Parisien[23] / 2016	-	+	-	-	+	2
Tsuboi[24] / 2016	-	+	-	+	+	3
Wieczorek[25] / 2016	-	+	+	-	+	3

DISCUSSION

To our knowledge, this is the first review to update the evidence on the need for EM in critically ill pediatric patients, emphasizing the barriers and facilitators for it to be performed. Our results showed more barriers (18) than facilitators (11) for it to occur effectively at the PICU.

The most cited barriers were: insufficient number of professionals, team's insecurity, need for consent from parents/guardians, child motivation, need for medical order/prescription, unavailability of equipment, lack of communication/knowledge, patient instability, inadequate sedation, absence of guideline/consensus, and culture of non-acceptance. To reverse this, the most cited facilitators were: team training/education, establishment of guidelines/consensus, influencing cultural change and dialogue with family members, adequate sedation/analgesia, team engagement/research, individualized protocols, and help from other professionals and family members.

Studies in the adult population also mention similar barriers[27-29]. The study by Fontela, Forgiarini, and Friedman[29] with the Brazilian population in Intensive Care Units corroborates the findings of this study by reporting that the most cited barriers were: unavailability of professionals in the team and of sufficient time to routinely mobilize patients; excessive sedation; unavailability of physical resources; and work overload for the multidisciplinary team.

Aquim et al.[3] found different and specific barriers in their review with the adult population, such as hemodynamic instability, respiratory dysfunction using the prone position, high inspired oxygen fraction; and extracorporeal membrane oxygenation. These barriers to EM have not yet been mentioned for the pediatric population, however, few studies have addressed this issue.

Some safety criteria for starting EM in mechanically ventilated adult patients were reported by Conceição et al[31]. Cardiovascular criteria were the most cited, and hemodynamically unstable patients, that is, those who need high doses of vasopressors, are not able to initiate or progress EM[32].

Dubb et al.[30] reviewed this topic in the adult population and divided the barriers according to: patients, structure, and culture of the ICU, and found the factors related to patients as the most potentially limiting. According to this study, the same does not occur in the child population, since factors related to the ICU team and culture were the highlights, while patient-related barriers, such as instability, were reported in only 30.8% of the studies. It is clear that the difference between the child and adult population is a cultural issue more commonly related to staff insecurity than to patient instability.

Thus, these aforementioned authors cite facilitators similar to those found in this review, such as multidisciplinary meetings for education and improvement of team communication and protocols for EM, including verification of patient safety after each step of the intervention. In addition, authors suggest guiding and encouraging patients and family members, and possibly hiring specialized professional and materials for the practice of EM[30].

Cuello-Garcia et al.[6] reviewed EM in pediatrics, addressing protocols and onset time, without specifically focusing on barriers and facilitators. Within the aforementioned protocols, some barriers were found confirming our results. The main barriers include: limited physical resources, need for patient cooperation, excessive sedation, and insecurity with EM expressed by health personnel and caregivers/family members.

Two interesting studies conducted interviews with health professionals about the topic[33,34]. Joyce et al.[33] questioned about beliefs and concerns regarding EM in the child population and obtained similar results to ours, evidencing concerns about the team's work overload; unavailability of equipment; patient sedation level; and lack of knowledge, training, and interest by the multidisciplinary team.

Choong et al.[34] interviewed physicians and physical therapists about the barriers to performing EM, and obtained reports that confirmed our results. They mention the absence of practical guidelines and medical order to start EM; unavailability of equipment; inadequate physical space; clinical instability of the patient; risk of displacement of devices; delay in medical recognition of the need for EM; nursing concern with patient safety; inadequate nutrition and analgesia; excessive sedation; ineffective communication between the team; and insufficient number of professionals. In addition, these two studies reported the establishment of EM guidelines and protocols as facilitators to be routinely established at the PICU.

The scarcity of physical resources and excessive sedation are barriers that can be overcome using low-cost resources, associated with playful games that lead

to entertainment and daily awakening from sedation, minimizing hospitalization time and mortality, causing less withdrawal later[34]. The insecurity of professionals can be reduced with training and institution of protocols, which would consequently reduce the insecurity of parents for being met by a professional well-prepared to perform the EM. Aquim et al.[3] also reported that adverse events related to EM occur at a low frequency and are reversible with the interruption of the intervention.

It is known that the pediatric population presents particularities, such as a wide range of cognitive and developmental ages, in addition to frequently having previous pathologies, especially basic functional deficiencies. Despite this, in this study, most barriers found were related to the multidisciplinary team and not directly to the patient. This fact further highlights the need for new clinical trials, with limited age and specific diseases, which generate protocols aimed at the acceptance and knowledge of the multidisciplinary team, and answering questions such as "is the team prepared?," "which resources are really needed?," "is this possible in the daily practice of the PICU?."

Limitations of this study include the possibility of bias in the review process, which can occur in any review. To avoid this, screenings, data extraction, and risk of bias assessment were carried out in a transparent manner in duplicate and with a third evaluator when discrepancies were found. Another possible limitation to this study is the wide variety of health diagnoses included, which is due to the mixed profile found in the PICUs.

Based on this review, we conclude that there are still many barriers that can and must be broken in the PICU so that an effective EM can be carried out; however, many already known facilitators need to be implemented. It is known that EM is viable at the PICU and its implementation benefits the pediatric population. This review emphasizes that EM is still not a reality in clinical practice, mainly due to a cultural issue related to the team rather than barriers imposed by the patient. For this, further studies are needed, mainly to establish guidelines and protocols on the subject.

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