Review Paper

A Review of the Management, Outcomes, and Barriers to Rehabilitation in Patients With Post-intensive Care Syndrome

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ABSTRACT

Objectives: Post-intensive care syndrome (PICS) is a multidimensional problem comprising physical, cognitive, and psychological symptoms experienced by patients during and after intensive care. Symptoms can persist for years and impact patients and their families. Rehabilitation programs were recognized as a preventive and management strategy for PICS; however, several obstacles to their implementation exist. Therefore, this study aimed to determine the interventions, outcomes, and barriers to rehabilitation in patients with PICS.

Methods: A review study was conducted from November 2020 to January 2021 by analyzing articles selected from Google Scholar and PubMed databases.

Results: Twenty-two studies were eligible for inclusion. Rehabilitation interventions for patients with PICS were performed through the ABCDE bundle, which consistes of A, airway management, assessment, prevention, and management of pain; B, breathing trials, including daily interruptions of mechanical ventilation, spontaneous awakening trials, and spontaneous breathing trials; C, choice of analgesia and sedation, coordination of care, and communication; D, delirium assessment, prevention, and management; and E (ABCDE), early mobility and exercise, physical therapy, early mobilization, cognitive and psychological approaches, intensive care unit (ICU) diary, education, consultation, and follow-up management. The outcomes included improvements in physical and cognitive function anddecreased psychological symptoms. Barriers to rehabilitation were patient-related, structural, and cultural.

Discussion: Rehabilitation interventions for patients with PICS employ a multidimensional approach, demonstrating positive impacts on physical, cognitive, and psychological function. However, the presence of barriers hinderes adequate management.

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Highlights

- Implementing rehabilitation programs for PICS begins with preventive measures.
- Rehabilitation interventions in patients with PICS improve physical, cognitive, and psychological function.
- Barriers to implementing rehabilitation include patient, structural, and cultural barriers.

Plain Language Summary

We reviewed articles on post-intensive care syndrome (PICS), a set of disorders found after ICU admission. These disorders include physical, cognitive, and mental disorders that cause long-term disabilities. Rehabilitation is one of the interventions provided to these patients, and from this review, we know that this program is beneficial for its prevention and management. However, implementation of rehabilitation still faces some obstacles, such as severe illness, lack of devices, and lack of guidelines or protocols.

Introduction

Advances in knowledge and technology of intensive care unit (ICU) management have facilitated an increased survival rate from critical illnesses. However, many of these survivors often have long-term complications [1]. Physical, cognitive, and psychological dysfunctions, known as post-intensive care syndrome (PICS), are types of ICU-related dysfunctions caused by the severity of critical illness and the use of mechanical ventilation. PICS can also extend to affect the family, leading to PICS family (PICS-F) [2, 3].

The most common physical dysfunction found in PICS is ICU-acquired weakness (ICU-AW), a weakness of skeletal muscles that occurs during an ICU admission [3]. ICU-AW incidence increased by 24%-55% among patients with 7-10 days of care [4]. Cognitive dysfunctions associated with PICS include impairment of memory, executive function, language, attention, and visuospatial ability [5]. After three years, 15% of ICU survivors were diagnosed with new-onset dementia [6]. One study found that 74% of 821 ICU patients experienced delirium during hospitalization [7]. Another study reported that nearly 80% of patients experienced cognitive impairment three months after ICU stay [8]. Psychological disorders found in PICS included anxiety (70%), depression (30%), and post-traumatic stress disorder (PTSD) (10-50%) [5]. A study by Vlake et al. found that 59% (95% CI, 44% to 74%) of patients experienced psychological PICS in the form of depression, PTSD, or both. The incidence of PTSD and depression was higher in psychological PICS than in non-psychological PICS [9].

The impact of PICS extends well beyond the ICU, affecting patients' quality of life. A previous study found that ICU-AW symptoms lasted 2-5 years in 85-95% of patients [10]. Cognitive impairment affected 70% of patients one year after ICU care [8]. Depression, anxiety, and sleep disturbances lasted more than a year in 10-50% of patients, while PTSD symptoms persisted for over four years in 33% of family members [10].

One of the preventive measures for PICS is the implementation of rehabilitation programs through early mobilization in the ICU. Physical rehabilitation performed immediately after ICU admission improves functional outcomes [11]. A previous review found that the incidence of muscle weakness was lower in the early rehabilitation group. However, no significant changes were found in cognitive and psychological functions [12].

Currently, no standard guidelines exist for the management of PICS. The increasing number of ICU survivors poses a significant challenge to rehabilitation. This review aimed to explore the rehabilitation management of PICS, focusing on interventions, outcomes, and barriers.

Materials and Methods

This study systematically reviewed articles on the rehabilitation management of patients with PICS. Articles published within the last five years were searched using the Google Scholar and PubMed databases. The keywords used included "PICS," "post-intensive care syndrome," "rehabilitation," "physical," "cognitive, and psychological disorders," "intensive care unit-acquired weakness," "ICU-AW," "interventions," "outcomes," "barriers," "physical impairment," "cognitive impairment," "dementia," "delirium,"

"psychological impairment," "anxiety," "depression," "post-traumatic stress disorder," "PTSD," "management," "early mobilization," "early rehabilitation," and "physical therapy." The types of articles analyzed were original and review papers written in English. Meanwhile, those irrelevant to the topic and unavailable or could not be accessed in full text were excluded. The extracted data included interventions, outcomes, and barriers to rehabilitation. The articles were first filtered based on titles and abstracts, then the full text was read, and filtration was performed based on publication periods and inclusion or exclusion criteria

Results

Based on the titles and abstracts, 22 articles relevant to the topic were selected from 128 (Figure 1). Eighteen articles discussed rehabilitation interventions for patients with PICS (Table 1), 16 discussed rehabilitation outcomes (Table 1), and seven discussed barriers (Table 2). Table 3 presents a summary of this review.

Discussion

Interventions and outcomes of rehabilitation in patients with PICS

The management of PICS was implemented to prevent disability and worsening of patients' or their families' functional disorders [3]. ICU rehabilitation aims to restore patients' physical, psychological, and cognitive functions [13]. Preventive measures to reduce the risk of PICS include the A, airway management, assessment, prevention, and management of pain; B, breathing trials; C, choice of analgesia and sedation, coordination of care and communication; D, delirium assessment, prevention, and management; and E, early mobility and exercise (ABCDE) bundle, early mobilization and physical therapy, cognitive and psychological rehabilitation, education, as well as follow-up management. The forms of intervention and outcomes/effects of rehabilitation were discussed in 18 articles (Table 1).

The ABCDE bundle was applied to prevent PICS by reducing sedation and immobilization among patients admitted to the ICU [3, 5, 24]. The components consist of ABCDE [5].

Physical rehabilitation's goals include decreasing the duration of immobilization, maintaining or restoring the patient's ability to perform daily activities, and improving the quality of life [4, 5]. This was achieved through early mobilization, active and passive exercise programs, ambulation, and occupational therapy.

Early rehabilitation initiated within seven days of ICU admission has increased physical function (measured by the medical research council) and decreased ICU-AW incidence. However, cognitive function and mental status did not improve significantly [12]. One of the crucial components of rehabilitation intervention is to conduct spontaneous breathing trials to determine the readiness of patients to breathe without support, thereby preventing prolonged use of ventilator [13].

Physical exercise in ICU patients includes passive and active mobilization. Passive exercises, such as passive range of motion (ROM), were performed for unconscious patients [4]. In addition, an ergometer is another suitable intervention. One study found that the 6-minute walking distance and isometric quadriceps strength were increased in the intervention group who received the bedside ergometer intervention [13]. Early administration of neuromuscular electrical stimulation (NMES) intervention in the ICU proved beneficial and effective in improving short-term outcomes [15].

Active mobilization is performed with ROM exercises, early mobilization, and ambulation. Early mobilization consists of sitting upright and on the edge of the bed, shifting and transferring, standing, moving from the bed, sitting on a chair, and walking [4, 24] Ambulation was performed when patients can stand with balance, march in place, and perform balance exercises with weight shifting [13].

Mobilization and rehabilitation improve physical function and reduce activity limitations in ICU patients. These two aspects were evaluated by muscle strength and walking ability assessment [17]. The early rehabilitation program enhanced physical function after discharge from the ICU. However, little or no difference was observed in the mortality and quality of life [22].

A previous study provided physical therapy accompanied by cognitive therapy for patients in the ICU. Physical function was assessed using the physical function measurement tool, and cognitive function using the mini-mental state examination. The intervention group showed a significant effect, with a higher improvement in physical function than the control group. It was concluded that regular physical exercise increases neuromuscular activity and prevents apoptosis in the muscle. In addition, cognitive function improved significantly in the intervention group [19].

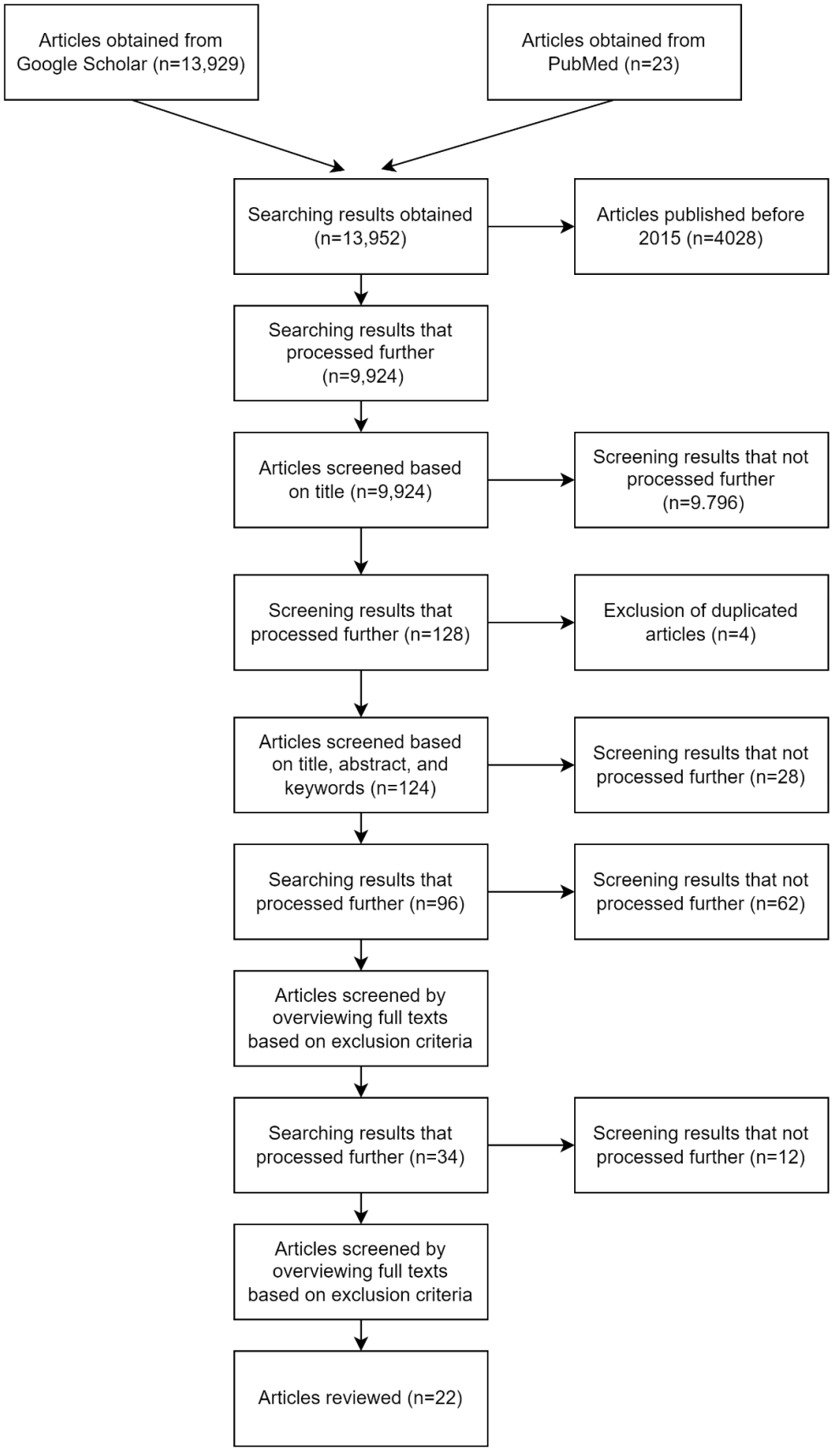

Figure 1. The included studies flow diagram

Table 1. Research on rehabilitation interventions and outcomes in post-intensive care syndrome patients

Author(s), Year	Rehabilitation Intervention	Outcomes
Clancy et al. 2015 [14]	Neurorehabilitation strategies include diaries, follow-ups, and cognitive rehabilitation.	ICU diaries would create emotional feelings due to awareness of the situation at hand and feeling connected to their loved ones, decrease symptoms, and increase HRQoL. Patients reported a positive impact of follow-up, specifically on their physical, emotional, and psychological recovery. The information provided would help patients understand their experiences in the ICU.
Hermans & Vanden Berghe 2015 [4]	Early rehabilitation (according to the patient's muscle strength and medical condition). Exercises are performed in stages (from passive ROM, active exercises, bed mobility, sitting upright, moving exercises, and walking).	Patients who received passive or active exercise with a bedside ergometer exhibited increased quadriceps strength. Occupational therapy and early mobilization within 72 hours of the use of a ventilator improved patient outcomes and functional status.
Sosnowski et al. [13]	Spontaneous breathing trials, gradual mobilization from sitting to walking, and exercise using a bedside ergometer.	Early ICU rehabilitation can prevent neuromuscular disorders and improve functional status. The six-minute walking distance and isometric quadricep strength showed better results in the intervention group, using the bedside ergometer.
Connolly et al. 2016 [15]	Physical rehabilitation and NMES intervention.	This is effective in increasing short-term results.
McPeake et al. 2017 [16]	The rehabilitation program will last 5 weeks (including physiotherapy classes and consultations with health professionals). Group activities included psychological sessions.	A multifaceted intervention can improve the patient's quality of life.
Tipping et al. 2017 [17]	Active mobilization and rehabilitation.	Enhancement of body function and reduction of activity limitations measured by muscle strength and walking ability.
Rawal et al. 2017 [3]	Limiting sedation, early mobilization, physical and occupational therapy, ABCDE bundles, ICU diaries, post-ICU Clinics, and education to maintain nutritional status and adequate sleep time.	Early mobilization in the ICU and less sedation should help to stop PICS. Efforts should focus on preventing PICS by reducing sedation and promoting early mobilization in the ICU.
Fuke et al. 2018 [12]	Early rehabilitation (including physiotherapy, occupational therapy, and palliative care).	The intervention group showed increased physical function or muscle strength and decreased ICU-AW incidence. No significant improvement in the patient's cognitive and mental status.
Hanifa et al. 2018 [18]	Follow-up consultation after ICU treatment.	The importance of post-ICU follow-up in patients and their relatives. Furthermore, return visits to the ICU would help patients understand their condition and symptoms and offer a feeling of belonging with other post-ICU patients.
Suwardianto et al. 2018 [19]	Physical therapy interventions (such as regular physical exercise) and cognitive therapy.	The improvement in physical and cognitive function in the intervention group was better than that of the control group.
Cairns et al. 2019 [20]	SAF-T includes written training on awareness of negative biological sensations related to stress.	The SAF-T intervention reduced stress on the patient's spouse and improved patient and family outcomes after ICU care.
Halm, 2019 [21]	Psychosocial intervention with ICU diaries and follow-up consultations.	Positive impact on anxiety, depression, HRQoL outcomes, and PTSD in the patient's relatives with ICU diaries. Follow-up consultations had a positive impact on PTSD.
Taito et al. 2019 [22]	Physical rehabilitation	In patients who underwent mechanical ventilation, physical rehabilitation improved outcomes after discharge from the ICU but had little or no difference in quality of life and mortality.
Inoue et al. 2019 [5]	The application of ABCDEFGH bundle activities, such as sitting, standing, ambulation, ROM, and ergometer exercises as passive exercise, nutritional therapy to prevent PICS, specifically ICU-AW, environmental management, nursing care, ICU diaries, and ICU follow-up clinics.	Patients who sleep using noise-reduction devices have better sleep quality.

Author(s), Year	Rehabilitation Intervention	Outcomes
Chanpura et al. 2020 [23]	Education (focused on identifying PICS symptoms and solutions) of doctors, nurses, social workers, and patients' family/caregivers.	Interventions can increase family and caregiver awareness of PICS.
Lee et al. 2020 [24]	Five stages of early mobilization and the ABCDE bundle.	The application of the ABCDE bundle could prevent PICS by reducing sedation and immobilization in ICU patients.
Sayde et al. 2020 [25]	Psychoeducation regarding PTSD (given to patients and family members) with or without ICU diaries.	ICU diaries had no benefits compared to education in reducing PTSD symptoms.
Zante et al. 2020 [26]	Improving information delivery, optimizing communication between ICU staff and patients' relatives, rehabilitation programs, coping skills training/educational programs on psychological stress, family-written diaries, and family gatherings in palliative care.	The diary written by the nurse could help the patient's relatives deal with the situation during patient care. No decrease in anxiety, depression, and PTSD prevalence in the patient's family, but the symptoms were reduced. Family meetings in palliative care are known to exacerbate PTSD.

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Abbreviations: ICU: Intensive care unit; HRQoL: Health-related quality of life; ROM: Range of motion; ICU-AW: Intensive care unit-acquired weakness; SAF-T: Sensation awareness focused training; PTSD: Post-traumatic stress disorder; ABCDEFGH: ABCDE plus F: Family involvement; follow up referrals, and functional reconciliation; G: Good handoff communication; H: Handout materials on PICS and PICS F; PICS: Post-intensive care syndrome; ABCDE: A: Airway management, assessment, prevention, and management of pain; B: Breathing trials; C: Choice of analgesia and sedation, coordination of care and communication; D: Delirium assessment, prevention, and management; E: Early mobility and exercise.

Psychological rehabilitation helps patients cope with their psychological trauma and vulnerability and restore independence after a critical illness [14]. The use of the ICU diary is known to positively impact patients and families. This diary is a note written by family, doctors, or medical personnel to record a patient's condition during ICU care. It could demonstrate the orientation, assist relatives in coping with treatment, and prevent PICS by relieving anxiety, depression, and PTSD symptoms [5, 26]. The ICU diaries positively impacted health-related quality of life (HRQoL) [21]. Although the use of an ICU diary may not reduce the prevalence of anxiety, depression, and PTSD in the patient's family, it can mitigate PTSD symptoms [26].

Consistent follow-up and consultations after ICU discharge will help patients and relatives understand the critical illness's condition and symptoms. This can aid patients in returning to work and achieving their previous level of functionality [18, 21]. In several countries across Europe and America, healthcare providers have developed post-ICU follow-up clinics to provide support to survivors. This clinic offers counselling, rehabilitation support, cognitive function assessment, mental health care, and assistance for patients and their families [3, 5].

The intensive care syndrome: Promoting independence and return to employment program was developed over five weeks and consisted of physiotherapy classes and meetings with healthcare workers, pharmacists, and physiotherapists. Patients and caregivers also attended group discussions, which included psychological sessions. The results showed that this program improved patients' quality of life and functional abilities. However, further investigation was needed to evaluate its full impact [16].

Educational sessions in the management of PICS are given to patients and their families, focusing on psychoeducation regarding psychological stress, PTSD, and training in coping skills [25, 26]. One study provided education to patients' families/caregivers. The participants in the educational sessions included doctors, nurses, and social workers. Each session was conducted once a week for 45 minutes. The education was focused on identifying symptoms of PICS and its solutions and providing education for the family/caregiver that could increase their awareness of this syndrome [23]. However, another found that providing educational interventions alongside an ICU diary did not yield significantly different benefits compared to education alone for reducing PTSD symptoms associated with intensive care [25].

Barriers to rehabilitation in PICS patients

The identified barriers to the management of patients with PICS were included patient, structural, and culture-related (Table 2). Patients admitted to the ICU require intensive therapy to support their body functions, such as mechanical ventilation or other supporting devices. The disease severity and other medical conditions, including

Table 2. Summary of barriers to rehabilitation in post-intensive care syndrome patients

Author(s), Year	Barriers to Rehabilitation
Sosnowski et al. 2015 [13]	Delirium and sedation would limit the effectiveness of early exercise. Neurocognitive impairment associated with sedation often interferes with the patient's activity sessions. Cardiovascular and respiratory instability are barriers to rehabilitation. The availability of occupational and physical therapists is a significant barrier to providing rehabilitation services.
Harrold et al. 2015 [27]	Sedation, instability of physiological functions of the cardiovascular and central nervous systems, and use of endotracheal tubes in patients reportedly hamper early mobilization.
Hopkins et al. 2015 [28]	Barriers to the implementation of early rehabilitation in pediatrics include patients, providers, institutions, and knowledge, as described below: Children who require cardiorespiratory support with invasive equipment cannot be safely mobilized.A few physiotherapists. A limited number of equipment is available for pediatrics in the PICU.There is little evidence-based information regarding practice in managing critical conditions in pediatric patients. There is a need for modification in the use of sedation. The family or caregiver's role is to provide feedback on patient care.
Dubb et al. 2016 [30]	Patients-related barriers; Physical conditions include disease severity, unstable respiratory parameters, pain, poor nutritional status, and immobilization. Neuropsychological conditions such as sedation, delirium, anxiety, lack of motivation, fatigue, and palliative care. ICU equipment. Structural barriers; Limited number of staff. Time constraints. Lack of initial mobility program/protocol, limited guidelines. Inadequate staff training. Limited number of equipment. Patients completed their care before mobilization. ICU cultural barriers; Limited knowledge among staff about the risks and benefits of mobility. Limited staff support for patients. Lack of knowledge among patients and their families. Barriers in the service process.
Lee et al. 2020 [24]	Time limitations, lack of manpower, differences in medical conditions, poor communication between medical staff, and lack of knowledge about ABCDE.
Sayde et al. 2020 [25]	Certain doubts exist among patients and their family members regarding interactions with mental health providers.
Rai et al. 2020 [29]	Medical conditions, weakness, and fatigue hinder rehabilitation in inpatients after ICU discharge. Inadequate staff numbers and lack of mobilization instructions are institutional barriers. Weakness, cardiovascular instability, agitation, and delirium are barriers to patient mobilization.

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Abbreviations: PICU: Pediatric intensive care unit; ICU: Intensive care unit; ABCDE: A: Airway management, assessment, prevention, and management of pain; B: Breathing trials; C: Choice of analgesia and sedation, coordination of care and communication; D: Delirium assessment, prevention, and management; E: Early mobility and exercise.

immobilization, instability of cardiovascular and respiratory functions, and weakness may interfere with rehabilitation programs [24, 27, 29, 30]. based on the early ABCDE bundle (admitted to the ICU from June – August 2013 In addition, neuropsychological and cognitive conditions associated with sedation, anxiety, and delirium also interfere with rehabilitation programs [13, 29, 30]. A previous study found that the endotracheal tube insertion hindered early mobilization [27]. there is little data on baseline mobilisation practises and the barriers to them for patients of all admission diagnoses. Methods: The objectives of the study were to (1 Children reliant on invasive support for cardiorespiratory functions might not be mobilized safely [28].

Limited numbers of staff and therapists are structural barriers associated with the rehabilitation of PICS [13, 24, 28]. Other barriers include a lack of training and direction for the mobilization program and the unavailability of equipment. Some pediatric ICUs lack specialized equipment for pediatric patients, thereby limiting the implementation of rehabilitation programs [28-30].

Rehabilitation practice remains limited due to the lack of guidelines/protocols regarding early mobilization.30 Limited evidence also exists regarding managing patients with critical conditions, specifically in children. In pediatric rehabilitation, the family is crucial in providing information about treatment and patient comfort. The family or caregiver could also facilitate communication with the patient and participate in physical therapy and mobilization programs [28].

Table 3. Interventions, outcomes, and barriers to rehabilitation in post-intensive care syndrome patients

Rehabilitation Management in PICS Patients		
Interventions	**Outcomes**	**Barriers**
ABCDE bundle; physical rehabilitation: Early mobilizatio; passive or active mobilization; ergometer; NMES; passive or active ROM exercise; ambulation; physical-cognitive therapy; psychological intervention	The ABCDE bundle prevents PICS. Physical rehabilitation and mobilization improved activity limitations and physical function. Early rehabilitation decreases the incidence of ICU-AW. NMES was effective in improving short-term outcomes. Physical and cognitive therapy improved physical and cognitive functions. The ICU diary positively impacted physical, psychological, and cognitive functions. Education improves patients' and families' awareness.	Patient-related: Immobilization; physical conditions; neuropsychological and cognitive conditions; anxiety; delirium; the use of a supporting device; Structural- and cultural-related: Time constraints; limited number of staff; limited number of equipment; inadequate training of staff; inadequate instruction to mobilize patients early; limited guideline/protocol; lack of knowledge among the patient and family; lack of knowledge among healthcare workers; poor communication between staff

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Abbreviations: PICS: Post-intensive care syndrome; NMES: Neuromuscular electrical stimulation; ROM: Range of motion; ICU-AW: Intensive care unit-ackquired weakness; ICU: Intensive care unit; ABCDE: A: Airway management, assessment, prevention, and management of pain; B: Breathing trials; C: Choice of analgesia and sedation, coordination of care and communication; D: Delirium assessment, prevention, and management; E: Early mobility and exercise.

The lack of knowledge among patients, families, and medical staff about PICS and its risks or benefits constitutes a cultural barrier [24, 30]. One study found that implementing the ABCDE bundle faced barriers of limited time, lack of human resources, variable patient conditions, poor communication between medical personnel, and lack of knowledge about the program [24].

Conclusion

In conclusion, rehabilitation for patients with PICS is essential to prevent the progression of disorders, disability, and restore functional status. Rehabilitation management should begin with a preventive approach using the ABCDE bundle, early physical mobilization, and cognitive or psychological therapy. The use of ICU diary, education, consultations, and post-ICU follow-up contributed to rehabilitation success. Rehabilitation programs improved patients' conditions and reduced symptoms of PICS. However, various barriers to its implementation have been identified, including patient, structural, and cultural barriers. These barriers included a lack of equipment, limited human resources, and a lack of awareness among patients, their families, and health care professionals.

Ethical Considerations

Compliance with ethical guidelines

This article is a review of literature with no human or animal sample.

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Authors' contributions

Conceptualization, methodology, data collection, funding acquisition and resources: Arnengsih Nazir and Shofiyyah Sayyidah; Supervision: Arnengsih Nazir and Lynna Lidyana; Investigation, data analysis and writing: All authors.

Conflict of interest

The authors declared no conflict of interest.

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