

Post-intensive care syndrome: a state-of-the-art review

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Abstract

Post-intensive care syndrome (PICS) refers to a constellation of chronic symptoms and deficits experienced by both adult and paediatric survivors of critical illness. These may include impairment in physical, cognitive and mental domains several months after admission to the intensive care unit. Affected patients may experience chronic pain, sleep disturbances and swallowing dysfunction, which may impact their quality of life. Beyond the medical consequences, PICS poses psychological and financial challenges to both patients and their caregivers. This state-of-the-art review provides a comprehensive overview of current evidence on PICS, including key risk factors, screening instruments and potential treatment strategies. Future efforts should prioritise standardised data collection, family-centred care and restoration of health-related quality of life.

Keywords: Critical illness, post-intensive care syndrome, rehabilitation, survivorship

INTRODUCTION

Post-intensive care syndrome (PICS) refers to a constellation of chronic symptoms and deficits experienced by adult (PICS *per se*) and paediatric (PICS-p) survivors of critical illness, as well as the families of ICU survivors (PICS-F),^[1,2] affecting their quality of life (QOL). Post-intensive care syndrome is defined as new-onset or worsening impairment in the physical, cognitive and mental domains after the initial intensive care unit (ICU) stay. Given the complex multidisciplinary nature of PICS, this state-of-the-art review aims to holistically summarise current evidence on PICS, including the risk factors, diagnosis and prevention [Figure 1]. We searched PubMed for PICS-related literature published in the past 5 years and supplemented this with papers from personal collections.

COMMONLY IMPAIRED DOMAINS

Post-intensive care syndrome is a multifaceted syndrome rather than a single disease entity, and its effects cannot be explained solely by the underlying critical illness. Symptoms may persist for months after the initial ICU stay and can include chronic pain, sleep disturbances and swallowing dysfunction, posing financial challenges to both patients and caregivers.^[3]

Risk factors for PICS are categorised into patient, disease and ICU-related factors for each impairment domain [Box 1]. Some risk factors are common across domains, such as delirium and premorbid mental or cognitive issues.^[4]

Physical domain

Survivors of critical illness experience persistent, significant skeletal muscle weakness and physical functional deficits, lasting up to 5 years post-ICU stay.^[9] The most prevalent physical manifestation of PICS is ICU-acquired weakness (ICU-AW), affecting 25%–75% of mechanically ventilated patients.^[10] In paediatric populations, physical impairment may manifest as growth disturbances and developmental delays. Beyond ICU-AW, fatigue is common among survivors, with worse physical, cognitive and mental health symptoms associated with greater fatigue.^[11] While PICS-F is primarily

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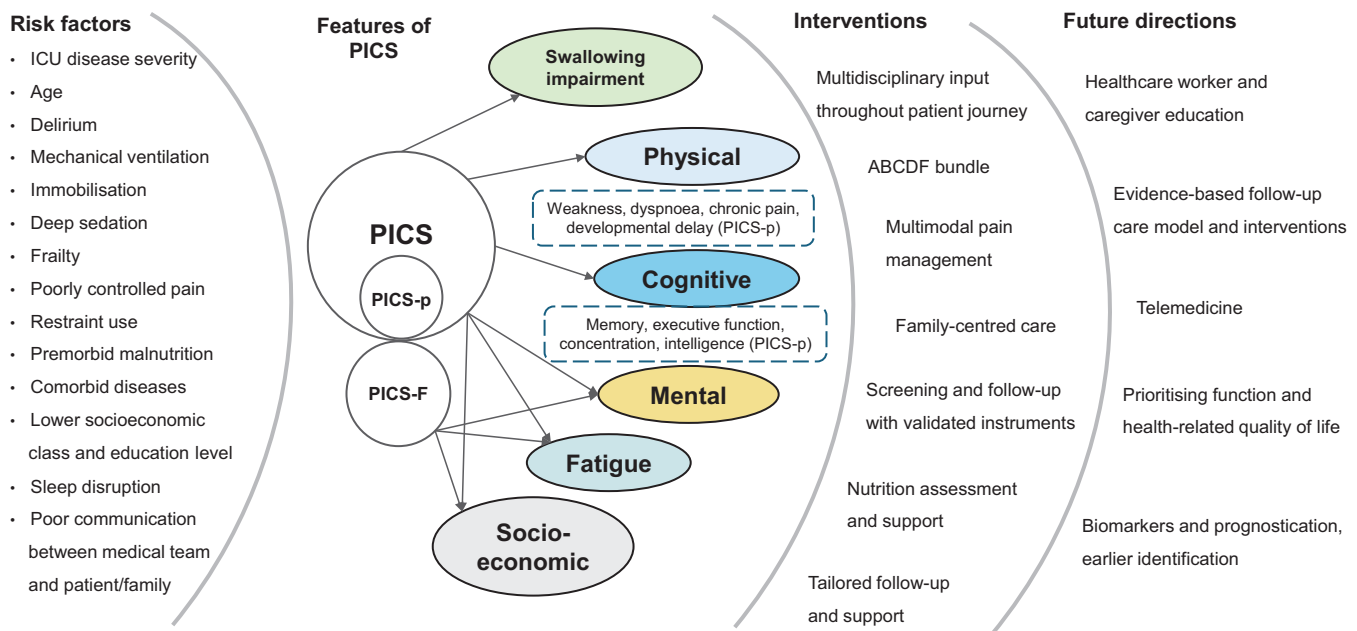


Figure 1: Overview of post-intensive care syndrome (PICS) risk factors, features, possible interventions and future directions for management. ICU: intensive care unit, PIC-F: PIC-family, PICS-p: PIC-paediatric

known for mental domain effects,^[2] caregivers may also experience physical symptoms such as fatigue and chronic pain from headaches and muscle tension.^[12]

During critical illness, systemic inflammation, and even short durations of immobility increase the vulnerability of skeletal muscle to atrophy, reducing muscle strength.^[5] This results in respiratory and diaphragm muscle dysfunction, which can delay ventilator liberation and ICU discharge. These impairments may lead to long-term reductions in aerobic capacity, affecting basic activities of daily living (ADL) and QOL.^[9] A 5-year follow-up study of early versus late parenteral nutrition in critically ill adults (EPaNIC) showed that over a third of ICU survivors had reduced peak oxygen consumption during exercise (VO_2) compared to controls due to muscular limitations, and this was associated with impaired exercise capacity.^[13] Musculoskeletal complications such as joint stiffness, pain, dental loss, frozen shoulder, skin damage due to fluid overload, surgical scars, burns, vocal cord injury due to endotracheal intubation, ventilator- and oxygen-induced lung injury and chronic pain further compromise patient function and QOL,^[14] with chronic pain prevalence ranging from 14% to 77%.

Early mobilisation (within 24–72 h of ICU admission) is associated with improved ventilator-free days, reduced hospital length of stay (LOS) and greater muscle strength at discharge.^[15] However, higher-intensity active mobilisation has not demonstrated superior long-term outcomes and has been associated with more adverse events.^[16] This is likely because early mobilisation, which has been backed by an enormous body of evidence,^[17] is now incorporated into standard care. The caveat now is that high-dose and high-intensity physical therapy is not necessary to improve long term outcomes.

Various methods of early mobilisation exist. Device-assisted rehabilitation can complement conventional physiotherapy and occupational therapy to improve sensorimotor function and cardiopulmonary exercise capacity;^[18] however, robust evidence of their effect on PICS-specific outcomes remains limited due to the small study populations. The use of virtual and augmented reality-assisted rehabilitation in ICU can play a role, but both remain in the exploratory stages.^[19]

Several tools have been used to diagnose and assess the severity of ICU-AW [Table 1 and Table S1, Supplemental Digital Appendix]. The condition is clinically diagnosed using the Medical Research Council sum score (MRC-SS)^[20] or by measuring grip strength.^[21] The 2014 American Thoracic Society guideline recommends MRC-SS as the best available bedside test for diagnosing ICU-AW.^[22] However, this assessment requires patient cooperation and does not differentiate between central and peripheral causes of weakness. It is also a purely objective strength measure without evaluating for overall functional ability and is less sensitive unless there are large strength changes.

To measure physical function beyond muscle strength, more sensitive scales are used, such as the Physical Function in Intensive Care Test-scored (PFIT-s). This multidimensional test requires patient cooperation, is designed to detect small functional changes and can predict ICU discharge function, readiness to wean, LOS and mortality.^[24] The Chelsea Critical Care Physical Assessment Tool is primarily a broader functional assessment that includes evaluation of respiratory support.^[25] It incorporates observable tasks, with grip strength assessment requiring patient cooperation, and relies on clinical judgement. It is less specific and less well validated

Box 1. Risk factors for PICS.**Physical**

- Age
- Organ dysfunction requiring neurological/respiratory support including mechanical ventilation
- Multiorgan failure
- Corticosteroid use
- Use of muscle relaxants
- Immobility
- Presence of catabolic and proinflammatory cytokines^[5]
- Inadequately managed pain

Cognitive

- Mechanical ventilation
- Duration of stay
- Unplanned admissions
- High emotional distress^[6]
- Immobilisation

Mental

- Lack of social support
- Prior illicit drug use
- Bad experience in ICU^[6]

PICS-paediatric

- Pre-existing illnesses
- Age
- Parental socioeconomic status

PICS-family

- Caregiver factors: Younger age, female gender, caring for a spouse, low education level, pre-existing physical illness, family history of mental illness, lack of social and professional support, caregiving for >100 h/mth^[7]
- ICU factors: Limited ICU visiting hours, perception of patients being near death and poor communication with ICU physicians^[7]
- Patient factors: Prolonged time in ICU and prolonged ventilation time^[8].

ICU: intensive care unit, PICS: post-intensive care syndrome

for predicting discharge outcomes. A practical challenge that limits the widespread adoption of this score is the need for trained staff and access to a handgrip dynamometer, even beyond the ICU if post-ICU measurements are required. Simpler scores such as the ICU Mobility Scale^[23] characterise mobility milestones, help evaluate rehabilitation activities and facilitate further research. This is a simple ordinal scale with excellent inter-rater reliability and is the least time-consuming of the tools discussed. In addition, it has predictive ability for 90-day mortality and discharge destination. Fatigue can be assessed with the Functional Assessment of Chronic Illness Therapy-Fatigue Scale,^[32] and if present, it is strongly recommended to look for coexisting mental, cognitive and physical domain deficits.

While the choice of assessment tools may be unique to the ICU patient population and unit preference, tools that record the baseline status prior to ICU admission, before acute hospital discharge and at intervals (typically 1–2 weeks, 3 months, 6–12 months) after ICU discharge are important to understand

Table 1. Examples of validated instruments used to assess post-intensive care syndrome (PICS) domains in adults, PICS-p and PICS-F.

Domain/ assessment tool	Use
Physical	
MRC-SS ^[20]	Screens ICU-acquired weakness
IMS ^[23]	Records the highest level of mobility achieved
PFIT-s ^[24]	Measures physical function and endurance
CPAX ^[25]	Assesses physical function across multiple domains, including handgrip strength ^[21]
5TSTS ^[26]	Assesses functional lower extremity strength, balance and fall risk
FSS ^[27]	Measures physical impairment post-ICU
FIM ^[29]	Assesses basic activities of daily living in rehabilitation settings
WeeFIM ^[30]	Paediatrics; evaluates functional independence
MBI ^[31]	Assesses basic activities of daily living in acute hospital and home
FACIT-F ^[32]	Assesses fatigue
Cognitive	
MoCA ^[33]	Screens for mild cognitive impairment
SDQ ^[34]	Paediatrics; screens for cognitive and emotional difficulties, attention issues (non-diagnostic)
POPC ^[35]	Paediatrics; evaluates overall functional morbidity including physical and cognitive aspects
Mental	
IES-R ^[37]	Screens for PTSD (non-diagnostic)
HADS ^[38]	Screens for anxiety and depression in hospitalised patients
PHQ-9 ^[39]	Screens and monitors depression
GAD-7 ^[40]	Screens and monitors anxiety
Quality of life	
SF-36 ^[41]	Assesses eight dimensions of health
EQ5D-5L ^[42]	Screens HRQOL across five domains
PedsQL ^[43]	Paediatrics; assesses physical functioning and emotional and overall well-being
PICUPS ^[44]	PICS screening, support transitions from ICU
Caregiver burden	
ZBI-12 ^[45]	Screening of caregiver burden

5TSTS: Five Times Sit to Stand Test, CPAX: Chelsea Critical Care Physical Assessment Tool, EQ5D-5L: European Quality of Life 5 Dimensions 5 Level, FACIT-F: Functional Assessment of Chronic Illness Therapy-Fatigue Scale, FIM: Functional Independence Measure, FSS: Functional Status Scale, GAD-7: Generalized Anxiety Disorder-7, HADS: Hospital Anxiety and Depression Scale, HRQOL: health-related quality of life, ICU: intensive care unit, IES-R: Impact of Event Scale-Revised, IMS: ICU Mobility Scale, MBI: Modified Barthel Index, MMSE: Mini-Mental State Examination, MoCA: Montreal Cognitive Assessment, MRC-SS: Medical Research Council-sum score, PedsQL: Pediatric Quality of Life Inventory, PFIT-s: Physical Function in Intensive Care Test-scored, PHQ-9: Patient Health Questionnaire-9, PICS-F: PICS experienced by families of ICU survivors, PICS-p: PICS experienced by paediatric patients and their families, PICUPS: Post-ICU Presentation Screen, POPC: Paediatric Overall Performance Category, PTSD: post-traumatic stress disorder, SDQ: Strengths and Difficulties Questionnaire, SF-36: Short Form-36, WeeFIM: Functional Independence Measure for Children, ZBI-12: Zarit Burden Interview (short form, 12-items)

the PICS trajectory. Inherent floor/ceiling effects are limitations of ICU assessment tools. Critically ill patients may be deeply sedated and may not be mobilised early in severe critical illness, thus limiting their eligibility for assessment. When patients are improving, they may face the ceiling effect of ICU assessment tools, as more comprehensive tests are only done in rehabilitation settings post-ICU. However, the tools mentioned are some examples to provide a benchmark to track functional progress over time, communicate with post-ICU providers and facilitate clinical pathways and research.

Cognitive domain

High levels of physical and psychological stress in the ICU may cause survivors to experience cognitive impairment, which can persist months to years after hospital discharge.^[47] Common deficits may include executive dysfunction, language impairment, attention deficits and visual-spatial difficulties. These have been associated with poorer function and QOL. A significant number of ICU survivors experience cognitive impairment ranging from mild forgetfulness to severe dementia.^[48]

Delirium during ICU stay has been found to be the strongest predictor of persistent cognitive dysfunction.^[4] Tools to assess for cognitive impairment require the patient to be out of delirium. Delirium is screened with tools like the Confusion Assessment Method for Intensive Care Unit (CAM ICU)^[49] or Intensive Care Delirium Screening Checklist for patients in the ICU and the Abbreviated Mental Test-4^[50] for general ward patients. The CAM ICU may miss a proportion of patients with incident delirium and thus should be combined with another instrument, such as the Nursing Delirium Screening Scale, when accurate detection is required.^[51] Once patients are out of delirium, the Montreal Cognitive Assessment^[33] or Mini-Mental state Examination^[52] is commonly used for cognitive assessment [Table 1].

Prevention of delirium is crucial to prevent longer-term cognitive impairment post-ICU. The PADIS (Prevention and Management of Pain, Agitation/Sedation, Delirium, Immobility and Sleep Disruption in Adult Patients in the ICU) guidelines^[53] and the ABCDEF bundle^[54] provide structured strategies for delirium prevention. Dementia or pre-existing cognitive dysfunction can lead to delirium being missed.

Cognitive impairment post-ICU is often overlooked.^[53] Once identified, a functional cognitive assessment should be considered, and occupational therapists (OTs) play an important role in facilitating the test. Functional cognition may be missed with only a self-report screening tool. Cognitive deficits that are subtle may still impair complex instrumental ADL such as social engagement, planning and community participation. If referred to OTs, they may conduct an assessment and recommend cognitive rehabilitation or additional support if required.

Early detection leading to cognitive stimulation, cognitive retraining and structured occupational therapy sessions in the ICU has been shown to significantly reduce the severity, incidence and duration of delirium,^[55] but studies remain limited. Dexmedetomidine has been found to reduce delirium, compared to commonly used sedatives such as propofol and benzodiazepines,^[56] and guidelines recommend its use for patients at risk of delirium or when light sedation is the intended goal,^[57] which may help mitigate the risk for longer-term cognitive impairment. Sleep hygiene and environmental factors, such as minimising noise, reducing light exposure and temperature control, may also benefit patients at risk of cognitive impairment and delirium.^[58,59]

In the ICU, non-immersive virtual reality (VR)-based neurocognitive stimulation may help improve short-term working memory outcomes in survivors of critical illness, but larger studies are needed to confirm its effectiveness and benefits. Of importance, there is suggestion that such interventions must be implemented early, when the patient is still in the ICU.^[60]

Mental domain

Depression, anxiety and post-traumatic stress disorder (PTSD), characterised as intrusive memories that arise from a combination of true events after ICU discharge, are major mental illnesses in PICS. Depression is present in approximately 25%–46%, anxiety in 30%^[61] and PTSD in about 20% of adult ICU survivors.^[62] The use of physical restraints in the ICU may be associated with PTSD, delirium and longer duration of mechanical ventilation; this may be reduced with nursing education and family presence.^[63]

Screening tools for PICS and PTSD in ICU survivors have unclear validity and often limited feasibility. Few tools have been used for PICS-F, with most comprising self-reported questionnaires used for screening rather than diagnostic assessments, which require more specialised training [Table 1].^[64]

The evidence regarding follow-up for cognitive and mental health domains in PICS is limited. Follow-up for ICU patients that focused on education and psychological intervention resulted in little to no difference in QOL and prevalence of depression and PTSD among patients; it did, however, increase the prevalence of depression and PTSD among informal caregivers.^[65] The IMPROVE (Improving Recovery and Outcomes Every Day After the ICU) trial, which tested a 12-week web-based physical and cognitive training intervention for ICU delirium survivors, failed to show benefit in cognitive function at 3–6 months in the intervention group; paradoxically, some groups declined more than the control, with no differences in physical or mental QOL.^[66] This was postulated to be due to methodological limitations, including inadequate sample size, non-personalised interventions and higher attrition in the intervention arms. The cognitive training

tool also required web-based modules, which were validated in healthy adults but not ICU survivors.

The evidence for ICU diaries is inconsistent. Some studies show a reduction in anxiety or depression and improvement in health-related QOL (HRQOL) among survivors, but not reduction in anxiety among patient families. It may not reduce PTSD incidence in survivors, but may reduce PTSD symptoms in their next of kin. Writing and reading ICU diaries can evoke intense emotions, but no studies have reported associated harm. While qualitative evidence remains uncertain, some studies suggest the benefits of writing and reading ICU diaries as coping strategies outweigh any potential harm.^[67] One explanation for the lack of strong evidence of benefit is that many patients or family members diagnosed with PTSD face barriers to accessing appropriate therapy and clinical attention, suggesting that ICU diaries should be accompanied by access to supportive therapy.^[68]

Nutrition in the post-intensive care unit period

While nutrition is a key aspect of ICU care, achieving higher energy and protein delivery in the first week of ICU admission does not improve clinical outcomes. The limited effectiveness in fully overcoming muscle wasting is due to the complex physiological responses to critical illness.^[69,70] The chronic phase of critical illness, beyond the first week, may be a more physiologically favourable window to process nutrients for muscle recovery.^[71] Despite this, there are currently no guidelines for the nutritional management of patients during the chronic phase of critical illness and beyond ICU discharge due to the lack of targeted research. Evidence from non-ICU settings show promise for sustained interventions throughout the hospitalisation period and beyond discharge.^[72,73] Future studies should investigate the impact of nutrition in the post-acute phase and continued through recovery to optimise long-term outcomes in ICU survivors.

Available evidence suggests that ICU survivors may be heterogeneous. Observational studies have shown wide variability in measured energy expenditure (EE), including prolonged state of hypermetabolism.^[74] Increase in EE may not be matched with adequate energy and protein intake. Oral intake has been found to be substantially lower than the estimated requirements, with those on diet only meeting one-third to two-thirds of their estimated energy requirement (EER) and estimated protein requirement (EPR).^[75-77] Food fortification and oral nutritional supplement increase this to three-quarters of EER and EPR, and combining oral intake with enteral nutrition nearly meets 100% of EER and EPR.^[75-78] Barriers to adequate nutrition delivery include early nasogastric tube removal.^[79]

Swallowing dysfunction and communication challenges

Post-extubation dysphagia affects 36%–44% of patients.^[80] Early swallowing assessment post-extubation and initiation of swallowing therapy help to reduce dysphagia severity, time to oral intake and risk of aspiration pneumonia and improve QOL among patients.^[81] Clinical pathways should include

bedside screening tests^[82,83] of swallowing function. Given the evidence for faster return to oral intake and dysphagia improvement, speech therapists (STs) should be engaged for their expertise in the assessment and management of dysphagia^[84] and communication impairments. Early return to speech^[85] and access to communication aids^[86] can restore a sense of autonomy and self-esteem.^[87]

Speech therapists bring advanced competencies to the management of ICU patients who have tracheostomy or endotracheal tubes. Patients should receive intensive therapy sessions using devices such as the Iowa Oral Pressure Instrument^[88] and Expiratory Muscle Strength Trainer,^[89] alongside traditional swallowing exercises to accelerate recovery. Patients should be followed up even after discharge to maximise functional swallowing outcomes, as up to 23% of patients have persistent dysphagia even after 6 months post-discharge.^[90] However, STs remain underutilised in the intensive care setting due to manpower and resource constraints^[91] and a lack of awareness.^[92]

Additionally, STs should advocate access to advanced Alternative Augmentative Communication (AAC) devices to support effective communication. With technological advancements, patients and healthcare staff are more willing to explore AAC options such as eye-tracking software and light-touch switches over more traditional methods like pen and paper or picture communication charts to regain their 'voice'.

Quality of life

Beyond assessing the separate domains, PICS programmes should incorporate holistic assessment of function and HRQOL in patients and caregivers [Table 1]. Health-related QOL is multidimensional and found to be negatively associated with PICS-related physical, cognitive and mental domains.^[93] Functional assessment should extend beyond physical function to include both basic and instrumental ADL.

POST-INTENSIVE CARE SYNDROME–PAEDIATRIC

Over the past few decades, survival rates for paediatric critical illness have improved significantly.^[94,95] Thus, there is growing recognition of the substantial morbidity experienced by critically ill children and their families. At least 50% of children experience long-term physical impairments 6 months after discharge, while 25% endure psychological sequelae lasting years post-paediatric ICU (PICU) admission. In addition, these children often exhibit lower intelligence quotient scores compared to their healthy peers.^[96-98] Up to 8% of these impairments may be directly linked to the interventions received during PICU care.^[99] Recent studies report that overall neurodevelopmental impairment occurs in around 30% of PICU survivors, with higher rates in younger children (<5 years: 33% vs. ≥5 years: 24%) and a strong association with poorer HRQOL.^[100] New neurocognitive concerns have been identified in over one-third of children as early as 1–3

months after discharge.^[101] Despite growing international interest, assessments remain heterogeneous, with over 100 instruments in use and no consensus methodology, limiting direct comparisons across studies.^[102]

Building on the adult PICS framework, PICS-p integrates the family unit into the recovery narrative, with the child at its centre.^[103] Therefore, PICS-F is automatically incorporated into PICS-p. Unlike the adult framework, PICS-p uniquely considers the child's baseline health status and development, accounting for their diverse needs from infancy to adolescence.^[103] It includes consideration of social health, that is, the ability of children and their families to interact and form meaningful relationships, participate in age-appropriate social roles, and adapt to social situations and activities after a critical illness. This approach underscores the interconnected nature of a child's recovery and family dynamics, highlighting the enduring developmental effects of critical illness during key growth stages.

Much of the existing research has focused on specific patient groups, such as those with traumatic brain injury, acute respiratory distress syndrome or congenital heart disease, often using cross-sectional designs that restrict broader applicability.^[104] A recent mixed-methods study examined the long-term physical, cognitive, emotional and social health outcomes of children and parents in the first 6 months after discharge. This study identified three distinct recovery trajectory groups. While most children and parents in the mild and moderate groups returned to baseline health, a smaller severe group experienced significantly worse health outcomes at 6 months.^[105,106] These findings must be interpreted considering the limited empirical data available since the inception of the PICS-p framework. Nevertheless, ongoing multicentre initiatives are expected to provide a clearer picture of recovery trajectories.^[107-110]

POST-INTENSIVE CARE SYNDROME–FAMILY

A loved one being admitted to ICU may lead to psychological, physical and socioeconomical burdens on the patient's family. Depression is the most common symptom, followed by anxiety. Protective factors against PICS-F may include individual factors such as resilience, modifiable factors such as caregiver support, and environmental factors that ensure the welfare and support of visiting family members.^[12]

Recognising the critical role families play in supporting recovery after discharge and addressing their needs can positively influence patient outcomes. In paediatric survivors, family-centred care (FCC) has been shown to improve family engagement and feelings of being valued while reducing stress and anxiety for both patients and their families.^[111] Implementing FCC in the ICU involves family presence, effective communication, family-centred rounding and open visitation policies.^[112,113]

Proactive communication and provision of information may be pivotal for PICS-F treatment.

The vulnerability of individuals to PICS-F should be identified and managed early, even while the patient is in ICU. Interestingly, some interventions, such as condolence letters and meetings without the presence of ICU physicians, were shown to increase PTSD.^[114] Some studies show that cognitive behavioural therapy delivered through mobile apps is effective in reducing PICS-F symptoms.^[115] In a multicentre study, ICU-virtual reality (ICU-VR) did not significantly improve mental health distress symptoms among relatives 6 months after a patient's discharge. However, relatives highly endorsed ICU-VR, citing improvement in their understanding of ICU treatment.^[116]

Targeted ICU-specific education, such as providing information leaflets, communication facilitators or even grief support after death, may help with PICS-F.^[12] A recent study reported reduced PICS-F symptoms compared to controls using a caregiver pathway that included (a) mapping caregivers' needs within the first days of ICU admission; (b) providing a supportive card upon ICU discharge; (c) offering a phone call after ICU discharge; and (d) a follow-up conversation within 3 months of ICU discharge.^[117]

DISCUSSION

Since its recognition just over a decade ago, PICS has become an increasingly important focus of critical care research. Despite growing awareness and more research [Figure 2], progress has been modest, reflecting the inherent complexity and heterogeneity. The breadth of PICS makes comparisons across studies challenging. Additionally, awareness among clinicians and patients may be inadequate, leading to survivors and their families being underdiagnosed and undertreated.

Some interventions have paradoxically led to mixed or worse symptoms. For example, structured follow-up clinics and web-based rehabilitation trials have not consistently improved PICS domains and QOL, and in some cases, they are associated with increased psychological distress (PTSD). This could be due to methodological issues (e.g. small samples, high attrition in intervention groups, poor tailoring to individual needs); it also highlights the need for interventions to be carefully designed and accompanied by appropriate psychological support. Evidence of the long-term effects of ICU care bundles remains inconclusive due to methodological bias and implementation challenges, and few units have reported PICS-specific care bundles.^[119] Similarly, ICU diaries — while safe and often valued by patients and families — have shown inconsistent quantitative benefit, suggesting they should be embedded in broader multidisciplinary programmes rather than being used in isolation.

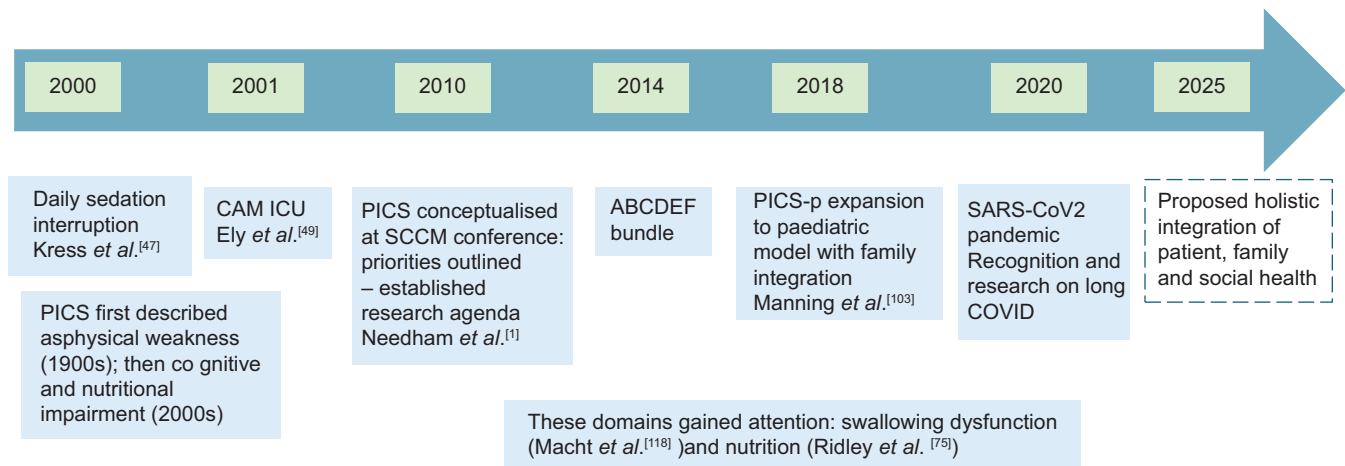


Figure 2: Landmark studies on post-intensive care syndrome (PICS) and its related domains. CAM ICU: confusion assessment method for the intensive care unit, PICS-p: PICS experienced by paediatric patients and their families, SARS-Cov2: severe acute respiratory syndrome coronavirus 2, SCCM: Society of Critical Care Medicine

The first PICS follow-up clinic was established in the UK in 1993. Follow-up interventions usually include mediation, rehabilitation, nutrition therapy and screening for PICS domain deficits.^[120,121] However, the evidence remains conflicting. A recent randomised controlled trial showed that a hospital-based, face-to-face, intensivist-led multidisciplinary consultation programme was associated with poorer outcomes 1 year after ICU discharge.^[122] Yet, a meta-analysis for post-ICU follow-up on survivor outcomes reported that post-ICU follow-up models focusing on physical therapy were associated with fewer depression symptoms and better mental HRQOL scores in the short term, while models focusing on psychological or medical management interventions were associated with fewer PTSD symptoms.^[123] These suggest that routine follow up after ICU and referrals for therapy without ensuring compliance may capture health status, but will not improve outcomes.

PRIORITIES FOR FUTURE WORK

Prevention during intensive care unit stay

Upstream mitigation of risk factors and implementation of evidence-based care bundles (e.g. ABCDEF), delirium prevention and early mobilisation, and reducing restraint use can reduce downstream PICS burden. Future studies should examine how these bundles can influence long-term outcomes when delivered reliably. Future studies could also evaluate the pathophysiological mechanisms and treatment options to attenuate the deleterious effects of persistent inflammation and restore immune homeostasis at specific time points for specific patients.^[124] There remains a need for robust studies that investigate the impact of nutrition and PICS interventions in the post-acute phase and throughout the recovery process. Wider awareness of PICS is needed among other healthcare workers to ensure timely referral for multidisciplinary assessment and interventions.

Standardisation of assessments and outcomes

Development of standardised core outcome sets and harmonised follow-up schedules is urgently needed to enable meaningful multicentre collaboration and research. Tools for the screening of patients at risk may be challenging to administer without dedicated caregivers or staff to facilitate them. If post-ICU follow-up requires electronic mail or digital apps, services will need to factor in assistance in completing questionnaires and providing digital literacy to patients.^[120] The use of telemedicine was postulated to improve follow-up and detection of PICS, but was found to have no significant effect on follow-up rates, possibly due to parental factors such as cultural background, educational levels or personal preferences.^[125]

Family-centred and community-based care

Like PICS-p, PICS in adults should also consider family, caregiver and social health to help patients reintegrate as active members of their social networks. Supporting FCC through effective education for families and healthcare teams, as well as smooth transitions across phases of care, requires further development. In addition, tertiary hospital-based follow-up may be a stressor; community-based healthcare, improved primary health services and adoption of emerging technology such as telemedicine may play a bigger role in creating more sustainable and accessible follow-up. Education on ICU processes can alleviate both PICS and PICS-F by reducing anxiety, and empowering patients and their next of kin with knowledge about their condition and the recovery process.^[111]

Innovation and technology

Machine learning, research on biomarkers and screening of patients and family psychological profiles further identify patients at risk and aid prognostication. Healthcare systems should embrace technology that facilitates timely tracking of

relevant PICS domain outcomes. Accurate tracking of recovery trajectories could lead to prioritisation of the currently limited resources for patients who will stand to benefit the most.

CONCLUSION

Since PICS was first described, core outcome sets and interventions have been increasingly well studied, with mixed results reported regarding its effectiveness. Given its heterogeneity, there is no universal treatment for PICS. Urgent action is needed to establish standardised data collection on the various domains to establish best practices and investigate interventions in the local context. Preventive strategies, education of multidisciplinary teams and caregivers, early detection and risk stratification are crucial to mitigate PICS. The importance of patient-centred care and FCC is relevant to all ICU survivors. Critical care must not only result in prolonging life, but also go on to restore the patient to the best possible function and QOL.

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Supplemental digital content

Appendix at <http://links.lww.com/SGMJ/A255>

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APPENDIX

Table S1 (Full): Examples of validated instruments used to assess Post-ICU syndrome domains in adult, paediatric patients (PICS-p) and patient families (PICS-p, PICS-F). Key: 6MWT: Six-minute walk test; BADLs: basic activities of daily living; GAD: generalised anxiety disorders; HRQOL: health-related quality of life; MCI: mild cognitive impairment; MMSE: Mini-mental state examination; PTSD: post-traumatic stress disorder; VAS: visual analogue scale

	Instrument type	Use	Subjects	Interpretation	Strengths/ Remarks
Physical					
Medical Research Council-Sumscore (MRC- Sumscore ^[20])	Adds up scores from assessing 6 muscle groups bilaterally	Screen ICU-acquired weakness	Adults Patients with Guillain-Barre syndrome	Scored 0 to 60 <48 =ICU acquired weakness <36= severe weakness	Needs patient cooperation; ceiling and floor effects, does not assess respiratory muscles or fine motor skills.
Handgrip strength ^[21]	Assessed with handgrip dynamometer	Assess upper extremity muscle strength	Adult ICU patients; outpatient and rehabilitation settings	Measured in kilograms. Lower values indicate weakness, compared to age and gender, ethnicity-based norms. (< 7 kg in women and < 11 kg in men) = ICU acquired weakness	Requires handgrip dynamometer and simple training; can be used post-ICU; independently associated with hospital mortality
ICU Mobility scale (IMS) ^[23]	Documented by trained healthcare workers	Records highest level of mobility achieved	ICU patients	11-point scale 0 (passive exercises in bed) to 10 (independent ambulation without a gait aid)	Focuses on gross mobility only and may have floor/ceiling effect. Requires patient cooperation
The Physical Function in		Physical function and endurance	ICU patients	Scored 0- 10 10= highest function, 0= inability to	Useful for patients who are not able to reach submaximal exercise tests such as

Intensive Care Test scored (PFIT-s) ^[24]				perform tasks	6MWT
Chelsea critical care physical Assessment tool (CPAX) ^[25]	Administered by trained therapists	Assess physical function across multiple domains	ICU to general ward patients	Scored 0-50 Higher scores implying better function	Can be used post ICU, requires handgrip dynamometer and training
Five Times Sit to Stand Test (5TSTS) ^[26]	Physical test	Assess functional lower extremity strength, balance, and fall risk	Older adults, individuals with neurological conditions,	Time (seconds) taken to achieve 5 repetitions; >12 seconds implies higher risk of falls	Short, minimal training required
Functional Status Scale (FSS) ^[27]	6 domains	Measure of physical impairment post-ICU, not designed to predict long term outcomes	Paediatrics, suitable from newborns to adolescents	Higher scores= better function. 6 domains, scored 1-5 each	Concise, tracks new or worsening morbidity; not designed for prognostication. Free access. Has advantages over WeeFIM for more severely injured patients ^[30]

Functional Independence Measure (FIM) ^[29]	Assessed by trained healthcare professionals based on direct observation and patient interviews	Assessing BADLs in rehabilitation settings	Adults	18 items with 2 domains: Motor (13 items) Cognitive (5 items)	Useful to assess independence level in BADLs and determine level of disability and assistance required. Limitations: proprietary and more time-intensive
WeeFIM (Functional Independence Measure for Children) ^[30]	Same as above	Evaluates functional independence, including cognition, motor and self-care skills	Paediatrics (age up to 7 years)	Scored 18-126; higher scores= greater independence	Can be used in inpatient and outpatient settings, assess burden of care, Floor effects in patients with severe disability. Limitations: proprietary and more time intensive.
Modified Barthel Index (MBI) ^[31]	Assessed by trained healthcare professionals based on direct observation and patient interviews	Assess BADLs, in acute hospital and home assessments	Adults	10 items, only motor and BADLs, no cognitive assessment 0-100 (higher = more independent)	Shorter than FIM, however does not assess the cognitive domain

Functional Assessment of Chronic Illness Therapy-Fatigue Scale (FACIT-F) ^[32]	Self-report	Assess fatigue	Adults, Diverse populations	3-item Evaluates fatigue symptoms experienced over the past 7 days five-point Likert scale score (0-100) with score ≤ 68 : significant fatigue	
Cognitive					
Montreal Cognitive Assessment (MoCA) ^[33]	Administered	Screening for mild cognitive impairment (MCI)	Adults	Cutoff score of 26/30 detects 90% of MCI Repeated assessments within a short period of time to allow washout. (Allow at least 3 to 6 months in between assessments)	More sensitive than MMSE ^[35] at detecting MCI
Strengths and Difficulties Questionnaire (SDQ) ^[34]	Completed by child (age 11-17), parents or teachers 25 items	Screens for cognitive and emotional difficulties, attention issues (non-diagnostic)	Paediatrics Age 2-17 years	Scored 0-40 Higher scores= greater difficulties	Quick and user friendly, allows multiple sources for triangulation of data, free to access. Self-report bias. Limitation: it is meant for screening only, floor and ceiling effect
Paediatric Cerebral Performance Category (PCPC) ^[35]	Cognitive and neuro only	Broad assessment of cognitive and functional status post-ICU. Subset of POPC. Screening only;	Used across paediatric age groups (newborns to adolescents)	Scored 1-6 1= good, 6= brain death/ Scored 1-6 1= good, 6= death	Correlates well with neuropsychological tests. Can be used for follow up. Does not fully account for age-specific cognitive norms or developmental stages Simple, can be done retrospectively with

Paediatric Overall Performance Category (POPC) ^[35]		non diagnostic Evaluates overall functional morbidity including physical and cognitive aspects		Scored 1-6 1= good, 6= brain death/ Scored 1-6 1= good, 6= death	chart review. Correlates with measurements of morbidity e.g. length of stay. Less precise than more granular tools like Functional status scale
Rivermead Behavioural Memory Test (RBMT-3) ^[36]	Administered by trained therapist	Assesses memory in daily tasks associated with verbal, spatial, and pictorial recall and recognition	Adults, children	14 subtests with simulated everyday tasks	Useful to assess cognition in daily function Can be time intensive
Mental					
Impact of Event Scale- Revised (IES-R) ^[37]	Self-report 22 questions	Screening for PTSD (not diagnostic)	Adult patients, family; paediatrics (IES-R 8)	Scored 0-88; higher scores indicating higher levels of post-traumatic stress symptoms; ≥24 = concerning for PTSD 24	Short Repeated use possible Translated into several languages
Hospital Anxiety and Depression Scale (HADS) ^[38]	14 questions, 7 each for anxiety and depression	Screening for anxiety and depression in hospitalised patients	General medical population; caregivers and parents of	Different cut-off points are used, but in general a score ≤7 corresponds to “no depression or anxiety,” 8–10 = minor depression/anxiety, 11–15=	Subjective, lacks specificity, ceiling, and floor effect, may miss mild distress.

			paediatric patients	moderate depression/anxiety, ≥ 16 = severe depression/anxiety	
Patient Health Questionnaire - 9 (PHQ9) ^[39]	Self-report 9 questions	Screen and monitor depression	Adult, PICS-F, primary care settings, Caregivers and parents of paediatric patients	Scored 0-27; ≤ 4 : minimal depression; higher score indicates greater severity of depression	Translated into several languages
Generalized anxiety disorder -7 (GAD-7) ^[40]	Self-report 7 questions	Screen and monitoring for anxiety	Adult, family members, primary care settings	Scored 0-21; higher score = greater severity of anxiety, correlates with disability and functional impairment. Most patients (89%) with GAD had GAD-7 scores of ≥ 10 , whereas most patients without GAD had scores < 10 .	Self-reporting, subject to bias, non-diagnostic
Quality of life					
Short Form-36 (SF-36) ^[41]	In-person, online, mobile	Assessing 8 dimensions of health Can be used for assessing burden of specific diseases	Adult, Family members	Scored 0-100 Higher scores indicate better health	Clinic-based interviews may exaggerate health status compared to self-assessment
EQ5D-5L ^[42]	Self-rated questionnaire and health	Screening of health-related quality of life across 5 domains	Adult, Family members	Each respondent's responses form a 5-digit code representing their health state VAS scored 0-100	Validated in several languages and can be administered electronically. Can be used to detect changes over time

	visual analogue scale (VAS)			0 = worst health imaginable and 100= best health imaginable	
PedsQL (Pediatric Quality of Life Inventory) ^[43]	Self-rated	Assesses physical functioning and emotional and overall well-being	Paediatrics	Scored 0-100; higher scores= better QOL	Holistic, tailors for different age groups, validated in multiple languages
Post-ICU Presentation Screen (PICUPS) ^[44]	14 items	Screening of PICS, support triage and handover of patients from ICU to ward and rehabilitation	ICU patients	Informs rehabilitation needs after ICU	Simple, supports early intervention. May need facilitation by staff or caregivers; lacks specificity
Caregiver Burden					
Zarit-12 (Zarit Burden) ^[45]	Short version: 12 questions, self-administered	Screening of caregiver burden	Family members, caregivers	Screening version with 4 questions available	Subjective, limited scope of burden (e.g. physical, financial, social isolation)