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Current strategies and future directions to enhance recovery following critical illness

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ABSTRACT

Improvements in critical care treatments have led to an increased number of survivors of critical illness and an enhanced recognition of the problems which these patients encounter. Despite this, the ideal strategies to both prevent and manage the problems which people face are yet to be fully elucidated. This review explores the current methods employed to help mitigate problems encountered by survivors of critical illnesses and current barriers that limit their implementation. We will explore the effect of these issues on under-represented communities and the feasibility of delivering these strategies globally, as well as recent advances in mechanistic research and methodological innovation as promising areas for further work. In doing so, it summarises the potential avenues for future research with a view to advancing clinical care and outcomes in survivors of critical illness.

INTRODUCTION

With advances in critical care treatments and technology, a growing number of people survive a hospitalisation with a stay in the intensive care unit (ICU).¹ Yet, instead of returning to preillness baseline, many patients suffer new or worsening health problems that are sequelae of critical illness and accompanying treatments.^{2–3} New or worsening health impairments can impact people's physical, cognitive and mental health (figure 1) and may persist for years following critical illness.^{4–6} These impairments have been collectively identified under the umbrella term 'Post-Intensive Care Syndrome', a concept introduced to promote awareness and improve treatment of post-ICU impairments.⁷ These impairments are associated with reduced independence and survival, as well as increased healthcare utilisation and costs.⁶

Among the constellation of issues experienced by survivors of critical illness, physical symptoms persist across a range of organ systems, with patients reporting new or worsening symptoms of dyspnoea, insomnia and muscle weakness contributing to a reduced ability in carrying out day-to-day activities, increasing reliance on carers.^{8,9} New cognitive impairments compound these problems and reduce independence: problems in concentration and memory

are commonly reported alongside a reduced ability to perform higher functioning tasks such as problem solving.^{10,11} Prior work has demonstrated that 26% of patients had global cognition scores similar to patients with Alzheimer's disease at 1 year following discharge.¹² This is coupled with commonly reported long-term psychological problems, including symptoms of post-traumatic stress disorder (PTSD), anxiety and depression.^{13,14} Importantly, as the population ages and treatment of critical illnesses improves, the number of older adults who survive ICU hospitalisation is expected to rise.¹⁵ This can have substantial consequences on the prevalence of these impairments at the population level as older adults are more likely to develop functional decline after critical illness because of baseline vulnerability factors such as frailty, multimorbidity and sensory deficits.¹

In the most recent stakeholder report related to survivorship from critical illness, the social and financial consequences of critical illness survival were acknowledged.¹⁶ These patient level problems mean that family members may become informal carers following hospital discharge.¹⁷ As a result, family members also experience significant strain and emotional problems. Multicentre data have shown that over two thirds of family members experience symptoms of depression in the months following critical care.¹⁸ Social problems are also common, with up to 40% of informal caregivers experiencing financial strain.^{19,20}

These issues not only affect survivors and their family network, but also the healthcare system and society, yet there remains limited evidence to support the implementation of care delivery in this area. This review will discuss potential strategies to mitigate issues related to critical illness survival across the continuum of patient care, alongside future directions for research and methodological innovation.

METHODS

The aim of this review was to describe the current evidence and synthesise this to develop a roadmap for future research in this area. Given the broad literature base which was needed to inform this aim, a narrative review was undertaken using the databases of EMBASE,



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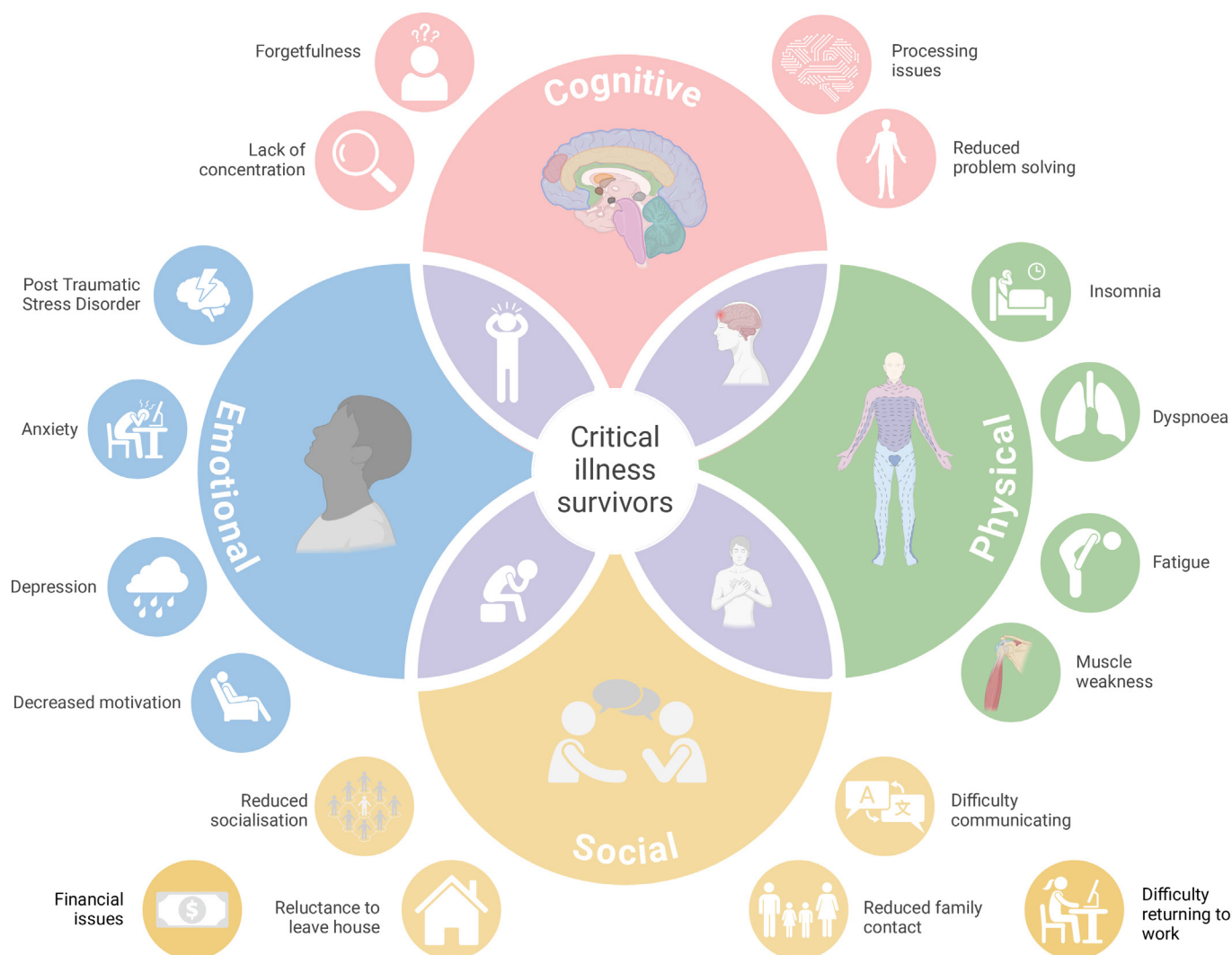


Figure 1 Spectrum of issues affecting survivors of critical illness. Created in BioRender. Andonovic, M (2025) <https://BioRender.com/i29o670>.

MEDLINE and the Cochrane Central Register of Controlled Trials using search terms related to 'critical illness', 'critical care' and 'recovery'.²¹

MITIGATION STRATEGIES

With increased recognition of the problems affecting survivors of critical illness, various strategies to ameliorate their development have been employed. These strategies vary from preventative care approaches employed during critical care admission through to the delivery of multiprofessional recovery services delivered in the posthospital discharge period (figure 2).

In-ICU strategies

Several in-ICU strategies could contribute to improved long-term outcomes after ICU discharge. One structured evidence-based strategy that coordinates the people and processes of critical care delivery to maximise guideline-concordant care is the ABCDEF (A: Assess, prevent and manage pain; B: Both spontaneous awakening and breathing trials; C: Choice of analgesia and sedation; D: Delirium monitoring and management; E: Early mobility and exercise; F: Family engagement) bundle.²² The ABCDEF bundle aims to prioritise alertness,

cognitive engagement and increased physical function by minimising sedative exposure, thus facilitating independent breathing, better participation in mobility activities and the ability to express unmet physical, emotional and spiritual needs.²² While research on the long-term effects of the ABCDEF bundle is limited,²³ higher combined performance of eligible ABCDEF bundle components reduces rates of mechanical ventilation, pain, coma, delirium and restraint use²⁴ as well as ICU readmission and discharge to facilities.²²

Individual components of the ABCDEF bundle have been associated with improvements in short- and long-term outcomes following critical illness. Early mobilisation has received substantial attention for its potential to improve post-ICU outcomes.²⁵ The landmark Schweickert *et al* trial in 2009 demonstrated increased odds of functional independence at hospital discharge for patients randomised to early exercise and mobilisation (OR 2.7 (95% CI 1.2 to 6.1)).²⁶ More recently, Patel *et al* found a reduced rate of cognitive impairment at 1-year follow-up in patients randomised to early physical and occupational therapy compared with those randomised to usual care.²⁷ The Treatment of Mechanically Ventilated Adults with Early Activity and Mobilization (TEAM) Study Investigators found no difference in days alive and out of the hospital in those who received early

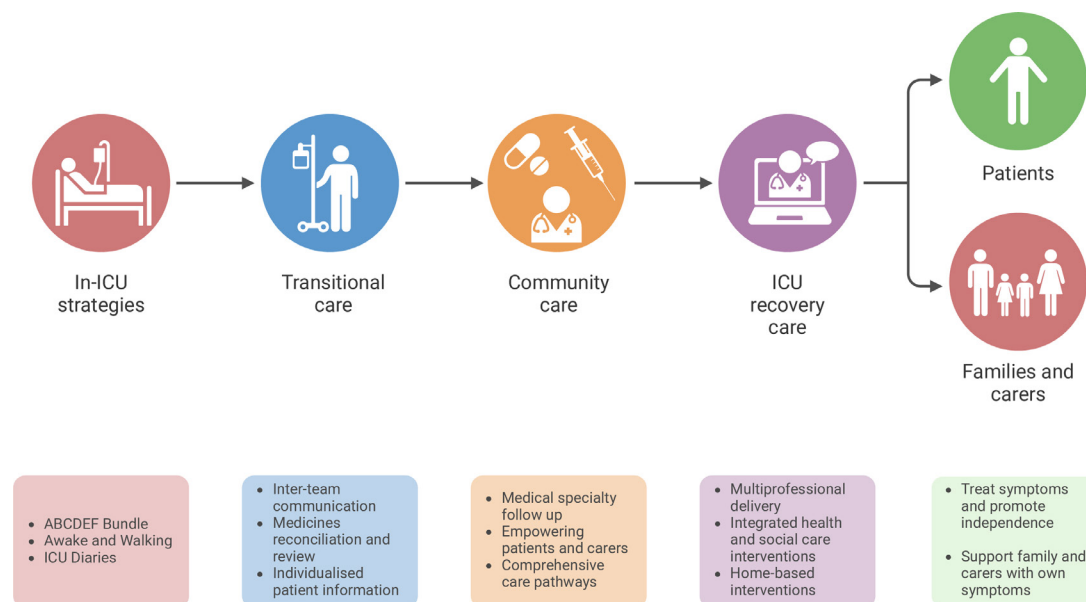


Figure 2 Strategies to mitigate issues throughout the continuum of patient care. Created in BioRender. Andonovic, M (2025) <https://BioRender.com/o47q342>. ABCDEF, A: Assess, prevent and manage pain; B: Both spontaneous awakening and breathing trials; C: Choice of analgesia and sedation; D: Delirium monitoring and management; E: Early mobility and exercise; F: Family engagement; ICU, intensive care unit.

active mobilisation,²⁸ but a subsequent meta-analysis inclusive of this study reported a 75% probability that early mobilisation increased days alive and out of hospital (DAOH).²⁹ These discrepancies may stem from differences in patient selection, timing and fidelity and intensity of mobilisation interventions. Further research is needed to better define the optimal timing, intensity and duration of early mobilisation interventions and identify the patient subgroups most likely to benefit.

Developed from a different paradigm than the ABCDEF bundle, the Awake and Walking ICU approach prioritises no sedative use, always achieving a patient's highest level of mobility from the first ICU day, alongside effective symptom management.³⁰ In-bed cycle ergometry is an approach to critical care rehabilitation that may mitigate common barriers to mobilisation in the ICU, such as invasive mechanical ventilation, sedation, staffing and teamwork.³¹ While a recent randomised controlled trial (RCT) of in-bed cycle ergometry in addition to usual physiotherapy showed no difference in the Physical Function in the ICU Test-Scored at 3 days after ICU discharge compared with usual physiotherapy alone, further research on optimal intensity, timing and coordination with other interventions is needed to understand the potential impact on post-ICU recovery.³² In patients typically considered difficult to mobilise, neuromuscular electrical stimulation has been explored as a potential intervention to prevent muscle wasting. However, evidence remains mixed. Some studies of neuromuscular electrical stimulation have suggested a role in maintaining muscle mass and function,³³ while others found no significant benefit in preventing muscle wasting in critically ill patients.³⁴ While these strategies require further exploration, they represent potential avenues for optimising long-term recovery for patients in the ICU.

A further in-ICU strategy which has shown promise is the ICU diary. ICU diaries were developed to provide a record of events, briefly describing why the patient was admitted to ICU and a narrative of day-to-day activities using plain language.³⁵ Family members may use the diary as a tool to process emotions, gain

insights and track information during critical illness.³⁵ Patients can engage with the diary during their hospitalisation or after discharge to understand and debrief on their ICU experience. Meta-analyses of ICU diary intervention studies indicate use is associated with lower rates of depression, anxiety and PTSD, as well as improved quality of life for patients, following hospital discharge.^{36 37} ICU diary use has also been associated with reduced PTSD for family and carers.³⁶

Transitional care

Survivors of critical care and their caregivers often experience siloed care as they transition from ICU to general and rehabilitation wards and return to the community.³⁸ These siloes of care can be defined as areas within healthcare operating independently from each other and have potentially been driven by disciplines or geography within the health system. Other more recent factors, such as the evolution of multiple electronic medical record systems, where systems are not fully integrated, have potentially compounded this issue.³⁹ These factors contribute to the fragmentation of care—impacting the patient and caregiver experience and potentially causing frustration for clinicians.

The transition from intensive care to the hospital ward presents several challenges for care continuity and safety. High-quality patient care is dependent on effective interaction across the complexity of technology, tasks and healthcare professionals within the healthcare system.⁴⁰ ICU transfer can be particularly complex, involving multiple processes and steps dependent on effective communication and collaboration to provide care continuity.⁴¹ However, patient transfers from ICU to the hospital ward often encounter suboptimal interteam communication with variable quality of patient care summaries.⁴² These contribute to high rates of early post-transfer adverse events, with one-third of these deemed preventable.⁴³ Qualitative studies of patient, family and healthcare staff have identified several factors that affect the quality and safety of ICU transfers

to the hospital ward: these include complexity of process performance; resource availability; time pressures; communication; and institutional culture.^{44 45}

Multiple reviews of the evidence regarding patient transitions from ICU to the general hospital wards have identified several tools and facilitators to improve patient care.⁴⁶ Several of these tools have centred around improved structure and coordination of discharge planning and rehabilitation, with nurse-led intervention programmes demonstrating improved long-term outcomes,⁴⁷ as well as a reduced risk of ICU readmission and improved patient satisfaction associated with critical care transition and hospital rehabilitation programmes.^{48 49} Furthermore, structured discharge reports were shown to reduce preventable adverse events,⁵⁰ with deprescribing guidelines helping to reduce inappropriate medication post-ICU, if coupled with coordinated medication review along the patient's recovery pathway.^{51 52} Other tools have demonstrated benefit in provision of patient discharge information,⁵³ with specific implementation of individualised information shown to improve patient anxiety and depression scores.⁵⁴

Transition from hospital to the community represents further challenges for continuity of care. Although it is rare for survivors with complex care needs to discharge directly from the ICU to primary care, a mixed-methods study demonstrated that information transfer at this interface is often limited.⁵⁵ Recent research has proposed that there may be opportunities to further develop relationships between ICU and primary care.⁵⁶ Multiple observational studies demonstrated that key problems identified in the transfer of care between ICU and primary care include: limited knowledge and recognition of common impairments in survivors of critical illness,^{56 57} a lack of role clarity regarding responsibility for follow-up care,^{56 57} a lack of specificity or tailoring of care to the needs of critical care survivors⁵⁶ and a lack of established and robust mechanisms for bidirectional communication.⁵⁶

Despite these known challenges, primary care could be well-positioned to address the post-ICU care needs of survivors as a multimorbid cohort. There is efficiency in leveraging this present model of care that capitalises on the often pre-existing and longitudinal relationship between patients and their primary care provider and uses the comprehensive care skillsets of primary care clinicians.⁵⁸ However, more intentional relationships ought to be established between intensive care and primary care. The format this takes is still unclear, as a large multicentre study conducted in Germany demonstrated no change in mental health-related quality of life after 6 months, and highlighted the need for further research regarding the optimal pathway for integration of primary care services into recovery care for survivors of sepsis.⁵⁹

As part of this recovery process, multiple solutions have been identified which could facilitate improved support for survivors of critical illness by primary care clinicians. A recent study of primary care clinicians identified key features which could improve follow-up care following a hospitalisation with severe pneumonia: safety assessment; medication management; medical specialty follow-up; rehabilitation follow-up; and consideration for the social context of recovery.⁶⁰ Other recently described practical solutions include developing collaborative relationships between critical care and primary care clinicians, provision of interprofessional education on recovery needs, improving role clarity in recovery care, empowering patients and caregivers in self-management, developing comprehensive care pathways and enhanced support for survivors.⁶¹ Finally, the publication of short guides in primary care journals could help

to support primary care in the long-term management of critical care survivors.⁶²

Recovery programmes

Similar to cardiac and pulmonary rehabilitation programmes, the scope of ICU recovery programmes often spans physical, psychological and cognitive domains anchored on ICU-acquired conditions. However, there is significant variation in how they are delivered, with some services offering support from a single healthcare profession and others offering access to a full health and social care team⁶³ compared with the usual standard of care that also varies, such as an established team of specialists resuming care for pre-existing conditions. As such, systematic evaluations of the effectiveness of ICU recovery programmes are hindered by methodological limitations in study designs, variability among programme components and the limited availability of programmes.⁶⁴

Recent individual studies have reinforced the effectiveness of ICU recovery programmes in different nations. For example, in Scotland, ICU recovery programme components were iteratively refined with five cohorts of ICU survivors, demonstrating feasibility and safety spanning each of the five iterations of modifications.⁶⁵ Subsequently, the full-scale multicentre evaluation of an integrated health and social care intervention for critical care survivors showed an improvement in quality-of-life measures compared with usual care.⁶⁶ Similarly, positive changes occurred in patient-reported physical and mental outcomes in The Netherlands, when home-based interventions were examined with a focus on physical recovery and self-management, demonstrating high adherence and affirming safety in a modest sample of 43.⁶⁷ In France, a randomised examination of quarterly ICU recovery follow-ups during the first year after hospital discharge compared with a single 1-year follow-up evaluation suggested a higher prevalence of anxiety and depression and lower patient-reported quality of life in the group completing the quarterly evaluations.⁶⁸ Considering these mixed results, rigorous and systematic efficacy evaluations of ICU recovery programmes are needed that span the variability in timing, scope of services and mode of delivery for this complex intervention.

Evaluating ICU recovery programmes is complicated by the inherent heterogeneity of critical illness⁶⁹ and compounded by the structures and processes of healthcare delivery that vary by government, geography and access.⁷⁰ Thus, rigorous study design, core outcome measures and systematic reporting are key features which should be employed to expedite efficacy evaluations.

UNDER-REPRESENTED POPULATIONS

Despite the implementation of mitigation strategies to try and improve the issues experienced by survivors, there remain patient populations which experience inequalities in the support of their recovery following critical illness. These include patients living with frailty and multimorbidity, patients from socially disadvantaged backgrounds and those from low- and middle-income countries (LMICs).

Frailty and multimorbidity

As advances in modern medical treatments result in a prolonged life expectancy, critical care is faced with a higher proportion of individuals living with both frailty and multimorbidity.³ Frailty results from collective declines across multiple physiological systems, reaching a threshold near to or past the point of symptomatic failure.⁷¹ It is defined as a state of increased vulnerability

to poor resolution of homeostasis following a stressor event and can result in adverse physical, psychological and cognitive outcomes.⁷¹

In the context of critical illness, frailty is an important prognostic factor that discerns a vulnerable patient cohort who are more susceptible to adverse events in ICU as well as negative outcomes, including higher levels of disability and functional dependence, and a lower quality of life.^{72,73} Given the increasing prevalence of frail patients within critical care,³ this may represent a population which would benefit from multiprofessional targeted interventions. A small RCT involving 117 patients demonstrated improved frailty scores at 3 months with exercise and nutrition interventions, but this was not in a critical care population.⁷⁴ Similarly, a single centre RCT conducted in Australia demonstrated improved frailty scores with interdisciplinary intervention at 12 months, but this was again in a non-critically ill population.⁷⁵ Indeed, a recent systematic review of critical care RCTs found that most do not examine for subgroup effects by frailty or multimorbidity,⁷⁶ which emphasises the importance of further work on this subgroup of patients. Frailty is also known to intersect with health inequalities, and there is significant interplay between lower socioeconomic status and increased prevalence of frailty.⁷²

Racial, ethnic and socioeconomic disparities

Social determinants of health play an important role in the onset of critical illness, and racial, ethnic and socioeconomic disparities related to the treatment of critically ill patients have long been identified.⁷⁷ Factors, such as economic stability, education, healthcare and neighbourhood environment, are formed by systemic inequities.⁷⁸ These inequities result in routine exposure to risk factors that predispose certain communities to disease or to worse outcomes from disease. During the COVID-19 pandemic, an observational study demonstrated that indigenous ethnic groups, such as American Indians in the USA, First Nations persons in Australia and individuals of black African descent in South Africa had the highest rates of mortality within their respective countries.⁷⁹ Systemic inequities also limit access to high-quality healthcare.⁸⁰ For example, critically ill patients identified as black or Hispanic in the USA are more likely to receive care in 'minority-serving' hospitals, which are associated with higher rates of mortality.⁸¹

Fortunately, most critically ill individuals survive their ICU hospitalisation. However, survivors of critical illness continue to be burdened by the same systemic inequities that contributed to the development of their critical illness. Yet, large knowledge gaps remain about how societal structures impact long-term survivorship. For example, a review identified eight studies in the USA, France and Scotland that examined relationships between social determinants and critical illness recovery.¹⁶ Critically ill patients with more socioeconomic disadvantage had more long-term disability and cognitive impairment.⁸² Lower levels of education were also associated with increased incidence of cognitive impairment. However, less is known about the relationships between race/ethnicity and long-term outcomes after critical illness.²

The paucity of data on systemic inequities and long-term recovery after critical illness hampers attempts to improve the lives of survivors. However, there are several approaches that could contribute to more equitable gains in survivorship. First, more studies are needed in critical care measuring long-term, patient-important outcomes, such as quality of life, physical function, cognitive ability and mental health. These studies must also

collect relevant data related to social determinants, like income, employment, wealth, education, as well as information about family and community networks. A recent review found fewer than half of critical care recovery trials reported any marker of socioeconomic status: only 15% included ethnicity data, one-third did not collect comorbidity data and no trial risk-stratified for these characteristics.⁸³ Second, there has been renewed focus on societal interventions, aimed at expanding access to income, food, housing and safe communities, to improve public health.⁸⁴ Finally, there is increasing recognition of the utility of post-ICU clinics to aid recovery after critical illness, although these clinics tend to be in urban, academic centres, which may limit access to certain groups.⁸⁵ There could be a vital role for these types of interventions to benefit ICU survivors.

ICU recovery in LMICs

The increasing number of critical illness survivors globally has highlighted the complex recovery needs of these patients, particularly in LMICs. While professional society guidelines recommend post-ICU rehabilitation programmes,⁸⁶ delivering such care in LMICs remains challenging due to resource limitations and fragmented healthcare systems. However, innovative solutions are emerging from LMICs, such as home care, task-shifting and mobile Health (mHealth) platforms, providing valuable models for adapting post-ICU care to resource-constrained settings.

In Brazil, the *Melhor em Casa* ('Better at Home') programme,⁸⁷ a government-led home care initiative, has been particularly beneficial for ICU survivors. This multiprofessional programme provides home-based care, including physiotherapy, nursing and medical consultations. The programme has reported high satisfaction levels, with 93.7% of older adults and 90.2% of caregivers expressing contentment,⁸⁸ as well as a reduction in hospitalisation costs by up to 10%.⁸⁹ By delivering care directly to patients' homes, *Melhor em Casa* addresses common barriers such as transportation challenges and mobility limitations, which are particularly relevant for vulnerable post-ICU patients.⁹⁰

In rural Bangladesh, task-shifting—the delegation of healthcare tasks from doctors to nurses and paramedics—has been used to improve sepsis management,⁹¹ a leading cause of mortality among ICU survivors.⁹² By reallocating tasks from physicians to paramedics and nurses, this approach facilitates the rapid identification and treatment of sepsis. The task-shifting model can also be adapted for post-ICU care, ensuring timely follow-up and easing the burden on overstretched healthcare systems in LMICs.

Another promising strategy is the use of mHealth platforms—mobile-based systems using smartphones and tablets to deliver healthcare services. In Uganda, the Smart Discharges Programme implemented an mHealth platform to identify children at high risk of postdischarge mortality and provide enhanced follow-up care. A qualitative study of caregivers and nurses involved in the programme revealed improved caregiver knowledge, changes in care behaviour and increased male caregiver involvement.⁹³ While primarily focused on paediatric care, the success of the Smart Discharges Programme demonstrates the potential of mHealth platforms to enhance postdischarge care for ICU survivors if adapted for adult patients.

These global examples illustrate how LMICs can leverage innovative models to build more resilient healthcare systems. These approaches ensure survivors receive the necessary rehabilitation and follow-up care, with the potential to improve

Future directions

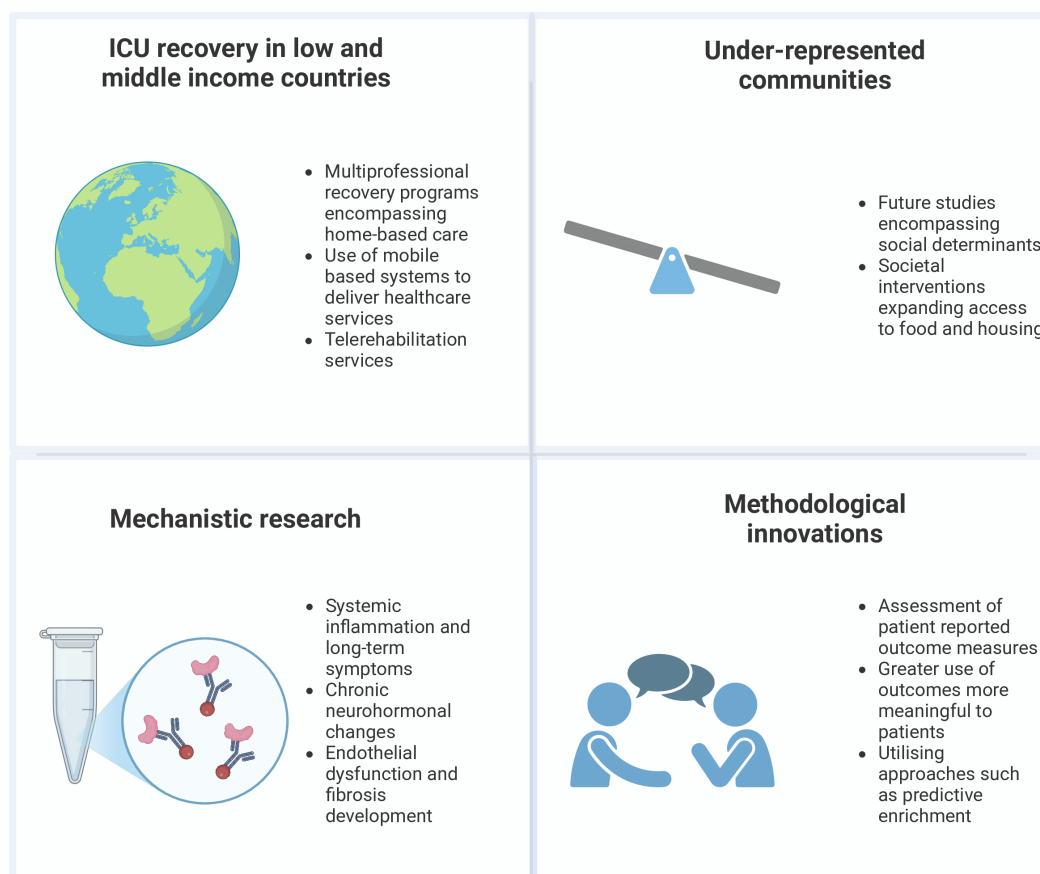


Figure 3 Future directions to enhance recovery following critical illness. Created in BioRender. Andonovic, M (2025) <https://BioRender.com/g90c557>. ICU, intensive care unit.

long-term outcomes, reducing the burden on health and social care infrastructures.

The wider social unit

Family members and informal carers of critical care survivors are also known to experience long-term issues following critical illness.⁹⁴ These issues can be multifaceted in nature and include emotional problems such as PTSD, anxiety and depression, alongside social issues such as reduced employment and financial stress.⁹⁵ These issues can have a significant impact on the family unit but can also have an impact on the healthcare system, with recent evidence suggesting that caregiver strain could be associated with increased healthcare resource utilisation (including emergency department use) in critical care survivors.²⁰

Therefore, it is crucial that family members also receive support to enable optimal outcomes. Several interventions have shown promise in this cohort, including integrated health and social care support; in a multicentre non-randomised interventional study in the UK, this integrated intervention showed potential improvements in family sleep patterns and symptoms of caregiver strain.⁹⁶ In another multicentre RCT from Europe, the use of an ICU diary was associated with improved PTSD

symptomology in family members in a small subgroup analysis.³⁵ However, optimal timing of intervention delivery alongside global applicability requires future investigation.

FUTURE DIRECTIONS

Acknowledging the challenges facing certain patient populations only serves to highlight the need to provide interventions tailored to individual patient need. This individual tailoring could be achieved through personalised medicine approaches and methodological innovation (figure 3).

Mechanistic research

While recovery from critical illness is associated with the acquisition of a wide constellation of symptoms, the underlying mechanisms of these issues are less clear.² While a single unifying theory for these impairments is inherently attractive, their development is likely heterogeneous in nature and dependent on the variation in demographics, illness severity and socioeconomic differences inherent to the critical care population.

Despite this heterogeneity, there are shared biological mechanisms underlying impairments which represent potential common

pathways towards improving recovery following critical illness. There is a growing body of evidence that dysregulated systemic inflammation is associated with long-term outcomes.⁹⁷ Systemic inflammation is important, not only for the resolution of the initial insult of critical illness, but also for longer term recovery. Low levels of proinflammatory cytokines such as interleukin-1 and interleukin-6 are known to regulate neural plasticity.⁹⁸ However, when levels of these inflammatory cytokines are high, this delicate balance is disrupted with negative impacts on cognitive function. As such, sepsis has been shown to be an independent risk factor for the development of cognitive dysfunction.⁹⁹ Moreover, recent observational work has shown higher levels of inflammatory biomarkers have been associated with poorer mobility and grip strength 3 months following ICU discharge.¹⁰⁰ The relationship between systemic inflammation and recovery following critical illness is undoubtedly highly complex. Future research should develop our understanding of the pathways involved in regulating this and the effects on recovery.

Some of the symptoms experienced by critical illness survivors relate to the development of long-term organ dysfunction, and understanding these pathways could help to intervene at an earlier stage, ameliorate the effects and improve recovery. Yet, while inflammation or neurohormonal changes likely play a role in the pathophysiology of symptoms following critical illness, the literature is limited by the fact that many of the associations are inconsistent and not reproducible; a detailed understanding of the pathways involved is lacking.¹⁰¹ Subsequently, therapeutics targeting the molecular mechanisms of inflammation to prevent or treat these symptoms remain a long way off. A personalised approach to recovery could enable the initiation of prompt treatments for those most likely to benefit.

Methodological innovations

Integral to improving recovery in patients following critical illness is the identification of outcomes which will best capture the problems experienced by critical care survivors and their carers. Detailed research spanning quantitative and qualitative methods has identified a range of problems experienced by patients after critical illness. These problems are organised into domains that broadly correspond to patient-related and family-related outcomes.⁴ Core outcome sets (COS) have been developed in trial settings, providing robust definitions of outcomes and enabling harmonisation across studies.¹⁰² Some COSs capture long-term patient outcomes relevant to postintensive care sequelae,¹⁰³ while others in development include COSs for families and caregivers.¹⁰⁴ The most recent and ambitious COS has defined and internationally validated six outcome domains for adult patients on general ICUs,¹⁰⁵ which aim to identify outcomes most relevant to the people affected. The use of such COSs is the most promising approach to measuring holistic and meaningful outcomes. However, further consensus is required to define the optimal outcome measurement instruments and the timing of their use.

To accomplish the goal of measuring more patient-centred outcomes, efficient approaches to data collection must be employed. Two contrasting approaches to measuring post-ICU outcomes are: the leveraging of routine data and assessment of patient-reported outcome measures (PROMs). The latter enables more complete capture of an individual's status but is non-specific and more difficult to map to defined outcomes. When studying non-mortality outcomes in the context of critical care populations, death is a competing risk that must be considered.¹⁰⁶ While mortality is lower in a critical care survivor population defined at hospital discharge, it is still higher

than for the general population.¹⁰⁷ One method for addressing this is the use of endpoints which explicitly incorporate mortality in the measure, such as using DAOH.¹⁰⁸ In addition to incorporating mortality within the outcome, DAOH is a broad measure reflecting time spent in good health and could be meaningful to patients. However, it is also influenced by factors (eg, delayed hospital discharge) which are not necessarily related to patient status.

When considering ways in which we can improve future trials on patient recovery, it is important to consider appropriate subgroups defined by baseline demographic or clinical features when evaluating the heterogeneity of treatment effects. In addition, factors such as socioeconomic status and ethnicity may be of importance if interventions are complex or if their effectiveness relies on specific contexts.¹⁰⁹ Furthermore, approaches such as predictive enrichment, which targets enrolment to a trial population to those who may be most likely to benefit, may allow greater efficiency in trial design; such an approach requires observational data to identify such groups, as well as sound mechanistic rationale. Trials which embed rapid biomarker profiling at recruitment to achieve predictive enrichment are currently targeted at interventions delivered within the ICU,¹¹⁰ but this approach may be applicable to interventions in ICU survivor populations.

CONCLUSION

While the past decade has seen increased awareness of the spectrum of issues experienced by survivors of critical illness, strategies to mitigate these remain challenging. Despite a wide range of techniques used to date, ranging from preventative measures within ICU and at transitions of care to management employed following discharge, the paucity of high-quality evidence and significant barriers to implementation have limited their adoption. Given the substantial variation in post-ICU care globally, opportunities exist to learn from other healthcare systems (both high-income and low-income settings) which may be more advanced in the care of multimorbid populations that have parallel care needs similar to ICU survivors. Furthermore, intensive care medicine may need to consider whether new models of care are warranted or whether existing specialties and infrastructure could be leveraged—that includes the integration of care for survivors into other clinical specialists such as internal medicine where transitional care programmes have a long and established history. Future research may benefit from the use of PROMs, as well as further studies to understand the underlying mechanism behind these issues, which cause significant burden to survivors.

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