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Towards definitions of critical illness and critical care using concept analysis

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Abstract

Objective

As “critical illness” and “critical care” lack consensus definitions, this study aims to explore how the concepts’ are used, describe their defining attributes and propose potential definitions.

Design

We used the Walker and Avant stepwise approach to concept analysis. The uses and definitions of the concepts were identified through a scoping review of the literature and an online survey of 114 global clinical experts. Through content analysis of the data we extracted codes, categories and themes to determine the concepts’ defining attributes and we proposed potential definitions. To assist understanding, we present model, related and contrary cases concerning the concepts, we identified antecedents and consequences to the concepts, and defined empirical referents.

Results

The defining attributes of critical illness were a high risk of imminent death; vital organ dysfunction; requirement for care to avoid death; and potential reversibility. The defining attributes of critical care were the identification, monitoring and treatment of critical illness; vital organ support; initial and sustained care; any care of critical illness; and specialized human and physical resources. Our proposed definition of critical illness is, "*a state of ill health with vital organ dysfunction, a high risk of imminent death if care is not provided and the potential for reversibility*". Our proposed definition of critical care is, "*the identification, monitoring and treatment of patients with critical illness through the initial and sustained support of vital organ functions*."

Conclusion

The concepts critical illness and critical care lack consensus definitions and have varied uses. Through concept analysis of uses and definitions in the literature and among experts we have identified the defining attributes of the concepts and propose definitions that could aid clinical practice, research, and policy making.

Strengths and Limitations of the Study

- This concept analysis is the first study to systematically describe the uses and definitions of the concepts *critical illness* and *critical care*
- The study uses a scoping review of the literature and input from over one hundred clinical experts from diverse settings globally to identify the defining attributes and provide proposed definitions of the concepts
- Some uses and definitions of the concepts in languages other than English, in unpublished grey literature and from clinical experts not included in the study may have been missed
- As current usage of the concepts is diverse, the proposed definitions may not be universally accepted and are aimed to stimulate further discussion

Introduction

The concepts *critical illness* and *critical care* are commonly used in healthcare. In PubMed, both are Medical Subject Headings (MeSH) terms, and searches for "critical illness" or "critical care" return 40,000 and 220,000 articles respectively. While it may seem evident that the concepts concern patients with very serious illness and their care, there is a lack of consensus around their precise definitions.

This causes problems for clinical practice, research, and policy making. For the clinician, discordant interpretations of when a patient is critically ill can lead to differing clinical assessments and treatments despite similar states: when should a patient be regarded as critically ill so that an alarm should be triggered and when is admission to an intensive care unit warranted? For the researcher, it can be difficult to design a study or interpret findings: studying the effect of a treatment for critical illness requires clear eligibility criteria and translating the findings to another patient group requires that the groups have similar clinical conditions. For the policy maker, prioritising programmes and investments designed to improve care for very sick patients relies on comparisons between similar groups and clearly defined interventions.

Even quantifying the total global burden of critical illness has been challenging due to the lack of an agreed definition. Proxies have been used instead, for example summing up syndromes considered to comprise critical illness such as sepsis and acute lung injury– resulting in estimates of up to 45 million critical illness cases each year.(1) Low- and middle-income countries are suspected to have the highest burden (2), but the lack of a definition has hampered comparisons across settings.

Studying the care for critically ill patients has also been problematic. Studies have focused on care provided in hospital locations such as in intensive care or emergency units, which exclude care provided in hospitals lacking such units, and to critically ill patients in general hospital wards. (3–5) In the COVID-19 pandemic, there have been great efforts to describe, scale-up and improve care for critically ill patients throughout the world (3,5) and a lack of agreement around critical care has hampered these efforts.

These examples illustrate how important concepts are as the building blocks of theories and communication. Ideally, concepts are clearly defined and their use well described for unambiguous communication and an understanding about exactly what is being described or explained. (6) *Concept analysis* is a method for investigating how concepts are used and understood. Concept

analyses have been conducted in diverse fields such as in teamwork (7), postoperative recovery(8) and bioterrorism preparedness(9), all with the aim of providing basic conceptual understanding and facilitating communication. In this paper, we have used concept analysis, following the stepwise approach described by Walker and Avant(6). The first two steps in the approach are to choose the concept and determine the aim of the analysis. Our chosen concepts are *critical illness* and *critical care* and our aims are to explore the uses and definitions of the concepts in published sources and by global clinical experts, leading to a description of the defining attributes of the concepts and to proposed definitions.

Methods

The Walker & Avant approach to concept analysis uses the following steps: identifying the uses of the concept; determining the concept's defining attributes; presenting a model case, identifying related and contrary cases; identifying antecedents and consequences; and defining empirical referents.(6)

Identifying the uses of the concept

We identified the uses of the concepts of critical illness and critical care through a scoping review of the literature and a web-based survey of global experts.

Scoping Review

We used the Arksey and O'Malley framework for scoping reviews(10). Relevant studies in English were identified in the PubMed and Web of Science databases. To include publications that were not found through the database searches, hand-searching of publication lists of intensive care medicine, and emergency medicine societies was performed. Duplicates were removed using the online software program Rayyan(11). The publications were examined through title, then abstract review and lastly by full-text review.

Critical Illness

The search terms used were terminolog*, etymolog*, nomenclatur*, definition*, plus emergency, critical*, acute*, sever*, ill, illness. A total of 9323 articles were identified using these critical illness terms in the databases and an additional two articles were identified through hand-searching. Of these, 1126 articles were identified as duplicates and the remaining 8199 articles were screened by title and abstract review by two of the authors (TT and HM). 8168 articles were

excluded as they did not concern critical illness, were not written in English or were not available in full text online, leaving 31 articles for inclusion for full-text review. In the full-text review, 22 articles were excluded as they did not define critical illness, and so nine articles were included in the analysis (Supplementary Table 1).

Critical Care

The search terms used were terminolog*, etymolog*, nomenclatur*, definition*, plus critical care, intensive care, emergency care, acute care. A total of 7286 articles were identified using these critical care terms in the databases and an additional six articles were identified through hand-searching. Of these, 1964 were identified as duplicates and the remaining 5322 articles were screened by title and abstract review by two of the authors (TT and HM). 5269 articles were excluded as they were not concerning critical illness, not written in English or not available in full text online, leaving 59 articles for inclusion for full-text review. In the full-text review, 46 articles were excluded as they did not define critical care and so 13 articles were included in the analysis (Supplementary Table 2).

Expert survey

The survey used open-ended questions to gather information about the experts' definitions of critical illness and critical care, and how they see the relationship of the concepts to connected concepts in order to provide context. The survey included the questions: i. *How would you define critical illness*?, ii. *How would you define critical care?,* iii. *Do critical care and intensive care differ*? *If yes, in what way?* iv. *Do critical care and emergency care differ and if yes, in what way?* v. *Do critical care and acute care differ and if yes, in what way*?

The inclusion criterion for an expert to be invited to participate in the survey was experience in any medical specialty that includes care of patients with acute, severe illness. Experts were identified from a stakeholder mapping of global critical care done by one of the authors (TB, unpublished), and those known to the researchers to be global experts in the field of critical care. Purposive sampling was used to invite experts with the aim of including 100 experts with a balance between specialties, geographical locations, health worker cadres and gender. In total 146 experts were invited to take part, and 113 completed the survey (77% response rate) (Table 1).

Table 1: Characteristics of the experts who participated in the survey

Variable	Frequency (%)
All	114
Gender	
Male	80 (70.2)
Female	34 (29.8)
Continent	
Africa	42 (36.8)
Europe	29 (25.4)
North America	26 (22.8)
Asia	12 (10.5)
South America	3 (2.6)
Australia	2 (1.8)
Cadres*	
Physician	93 (53.1)
Researcher	62 (35.4)
Nurse	12 (6.9)
Policy Maker	5 (2.9)
Other	3 (1.7)
Specialty*	
Anaesthesia/Intensive Care	75 (59.1)
Emergency Care	20 (15.8)
Medicine	12 (9.5)
Paediatrics	7 (5.5)
Surgery	6 (4.7)
Obstetrics and Gynaecology	2 (1.6)
Other	5 (3.9)

* As the experts were asked to select all that apply, the sum may exceed 100%

Analysis and determining the defining attributes

The definitions of critical illness and critical care from the scoping reviews and the expert survey were charted and analysed using a content analysis based on methods developed by Erlingsson & Brysiewicz.(12) First, the data from any parts of the literature and from the expert survey that concerned the uses or definitions of the concepts were extracted. The data were coded and the codes analysed iteratively by the study team. Redundant codes were removed and similar codes were arranged into categories. The data were revisited when new categories arose or when diverse opinions with contrasting attributes were identified. Through the process, themes emerged that captured the defining attributes of the concepts. Using the defining attributes, definitions of the concepts were constructed by the research team to be coherent and useful.

Presenting a model case, related and contrary cases, identifying antecedents and consequences, and defining empirical referents

The model cases, related, and contrary cases were developed by the researchers to provide examples to illustrate the defining attributes of the concepts that emerged from the concept analysis. Model cases were developed to be clinically realistic and to include all the defining attributes. Related cases were developed that include some, but not all, of the defining attributes, and contrary cases that are clearly "not the concept", containing none of the defining attributes. For simplicity in this study, we limited our cases to examples of patients with respiratory disease. Antecedents and consequences were identified as events that occur prior to the occurrence of each concept and as the outcomes of each concept respectively. Empirical referents were identified as phenomena that demonstrate the occurrence of each concept "in real life".

Ethical considerations: Informed consent was provided by all of the experts. The Research Ethics Committee of the London School of Hygiene and Tropical Medicine approved the study (Reference number 22661).

Results

The results relate to steps 4-8 in the Walker and Avant approach, as steps 1-3 have been described in the introduction and methods.

Critical Illness

Defining attributes

A total of 48 codes were identified from the uses and definitions of critical illness from the scoping review and expert survey. The codes were analysed into 14 categories and 4 themes. (Table 2). The themes represent the defining attributes of critical illness: *high risk of imminent death*; *vital organ dysfunction*; *requirement for care to avoid death;* and *potential reversibility*. (Figure 1)

Table 2. Content analysis for the concept *critical illness*

Code	Category	Theme
Severe illness	Severe illness	**High risk of imminent death**
Process of increasing severity		
Imminent risk of death	High risk of imminent death	
Enough severity to lead to death rapidly		
Can kill within a short time		
Medical condition that results in short term mortality		
Sudden onset illness or acute deterioration		

Acute life-threatening illness	Acute onset or deterioration	
An episode of acute illness		
Increased risk of death	Life-threatening	
Continuous threat to life and well-being		
Life-threatening or potentially life-threatening disease		
High probability of life-threatening deterioration		
Acutely life-threatening injury or illness		
At least one and often multiple organ dysfunction	Organ dysfunction or failure	**Vital organ dysfunction**
Failure in one or more organ systems that needs support		
Hemodynamic instability, respiratory failure, seizure, disorders of consciousness		
Diseases with vital organ failures as complications		
Threatened organ failure	Threatened organ dysfunction	
Potential disturbances of vital organ functions		
Threatened end-organ damage		
Deranged vital parameters	Vital signs derangements	
Physiologic reserve is diminished, as manifested by abnormal vital signs		
NEWS2 ≥ 7		
Associated with significant morbidities if untreated	Treatment needed to avoid death	**Requirement for care to avoid death**
Decline in a patient's ability to survive on their own		
Conditions requiring rapid intervention to avert death or disability		
An illness which without rapid treatment would result in death or disability.		
Needs prompt and sustained intervention to avert death or lifelong disability		
If no intervention is made, death is certain		
Requiring minute-by-minute nursing and/or medical care	Requirement for immediate treatment	
Requires a rapid diagnosis and response to ensure good outcomes		
Illnesses where timely care can reduce the chances of death and disability		
Requires immediate intervention		
The illness needs close monitoring and prompt management		
Treatment delays of hours or less make interventions less effective		
Requiring organ support	Requirement for organ support	
Requiring vital organ support		
Requiring intensified patient monitoring and organ support		
Critical care services	Requires critical care	
ICU admission		
Illness that results in need for more than standard of care	Need for specific care	
Acute disease that needs specific treatment alongside the disease itself		
Some element of treatability	Reversible with treatment	**Potential reversibility**
Any treatable life-threatening reversible illness		
Reversible life-threatening organ failure	Potentially reversible	
Life-threatening situation, illness or disease that is potentially reversible		
Acute potentially reversible illness		

Figure 1

Proposed operational definition

The proposed definition for critical illness is "*Critical illness is a state of ill health with vital organ dysfunction, a high risk of imminent death if care is not provided and the potential for reversibility.*"

Cases

A model case of critical illness (a case including all the defining attributes)

A woman has a viral pneumonia. She is breathless and hypoxic with a low oxygen level in her blood (oxygen saturation) of 74%. Her lungs are dysfunctional, and she has a life-threatening condition that is likely to lead to her death in the next few hours. She requires care to support her lungs (oxygen therapy) and if she receives that care, she has a chance of recovery.

A related case for critical illness (a case including some of the defining attributes but not the attribute of "imminently life-threatening")

A man has a chest infection. He has a fever, is coughing up green sputum and feels short-of-breath when walking. He has an oxygen saturation of 91%. He has a serious condition, but it is not imminently life-threatening. He requires treatment, likely with antibiotics, but it is uncertain whether he requires any organ support such as oxygen. His condition is potentially reversible, and he can recover.

A contrary case for critical illness (a clear example of "not the concept")

A woman has lung cancer. She is coughing up small amounts of blood but is able to walk to the hospital. She has an oxygen saturation of 94%. She is sick and she requires treatment. However, her illness is not imminently life-threatening, she has no dysfunctional vital organ and she does not require immediate care. Her condition may or may not be reversible.

Antecedents and consequences of Critical Illness

The antecedents of critical illness are the onset of illness, in mild or moderate form, with progressing severity. The consequences of critical illness are either recovery or death.

Empirical Referents

There are an estimated 30-45 million cases of critical illness globally each year(1). Many patients are cared for in hospitals with illnesses that are causing vital organ dysfunction and that are imminently life-threatening. There is much work done to identify patients with critical illness such as the use of single severely deranged vital signs(13), or compound scoring systems such as the National Early Warning Score (NEWS) and The Sequential Organ Failure Assessment score (SOFA) (14,15) . In hospitals, the severity of patients' conditions can be assessed using tools such

as the Acute Physiology and Chronic Health Evaluation (APACHE) (16) and the Simplified Acute Physiology Score (SAPS)(17).

Critical Care

Defining attributes

A total of 60 codes were identified from the definitions of critical care from the scoping review and expert survey. The codes were analysed into 13 categories and 5 themes. (Table 3) The themes represent the concept's defining attributes: *identification, monitoring and treatment of critical illness*; vital *organ support*; *initial and sustained care; any care of critical illness*; and *specialized human and physical resources*. (Figure 2)

Table 3: Content analysis for the concept *critical care*

Codes	Category	Theme
Identifying and addressing critical illness	Identification and monitoring of critical illness	**Identification, monitoring and treatment of critical illness**
Medical care with timely monitoring		
Appropriate monitoring of critical illness		
Management of critically ill patients	Treatment of critical illness	
Treat critical illness		
Care given to the critically ill		
Services required to stabilize critical illness		
Reduce the risk of death from a critical illness		
Care dedicated to patients with severe illness or potentially severe condition		
Managing life-threatening condition	Addressing life-threatening condition	
Preventing the occurrence of life-threatening conditions		
Treatment and management due to the threat of imminent deterioration		
Medical care required to reduce the risk to the patient's life		
Care to sustain cardiopulmonary functions	Supporting vital functions	**Vital organ support**
Support the patient's hemodynamic or cardiorespiratory status		
Supportive care in critical illness to enable body's systems to continue functioning before definitive treatment can work		
Care of vital organ failure		
Focus of care on supporting vital organs until improvement		
Providing organ support	Organ support	
Main focus on organ-supporting treatment.		
Support of vital organ function, or reverse specific organ dysfunctions		
Supportive care for organs that are failing		
Provision of support to dysfunctional body systems		
Early management for saving and maintaining life	Timely care	**Initial and sustained care**
Rapid and timely intervention that is administered in critical illness		
From admission until the course of illness ends, either in full recovery or death	From start of critical illness until the patient is no longer critically ill	
From home through to discharge from hospital		
From the time of first contact with healthcare services through to stabilization		
To the point where the illness or injury is no longer acutely life-threatening		

Critical care could be over days to weeks	Sustained care	
Constant monitoring		
Irrespective of the location of the patient within the health system	Any location	**Any care of critical illness**
Anywhere in the emergency or inpatient setting		
Any care provided to critically ill patients	Any care provided to critically ill patients	
Can be specialized care but depends on the level of resources		
Usually located in an area with infrastructure to support these activities	Specific area	**Specialized human and physical resources**
Inside a healthcare facility, outside the emergency department		
High dependency care		
Care in ICU or Critical care unit		
A place where equipment, staff and environment is ready to save patients with life-threatening disease		
Multidisciplinary care	Multi-disciplinary and specialist staff	
Specially trained staff		
Essentially a team-based and multi-professional care		
Requires the grouping of special facilities and specially trained staff		
Higher level of care than is available on a general ward	High-intensity care	
Minute-by-minute nursing and/or medical care		
Advanced respiratory support / mechanical ventilation		
Nursing 24/7		
High nurse: patient ratio no lower than 1:2		

Figure 2:

Proposed operational definition of *Critical care*

The proposed definition for critical care is "*Critical care is the identification, monitoring and treatment of patients with critical illness through the initial and sustained support of vital organ functions.*"

Cases

A model case of critical care (a case including all the defining attributes)

A woman with a viral pneumonia is rapidly identified as critically ill when she arrives at the hospital. She is immediately admitted to a unit with supplies for managing critically ill patients and treatment is started. Nurses and doctors who have been trained in the care of critical illness monitor her regularly, and provide continuous care, titrating the treatments as needed. Continuous oxygen therapy is provided for her life-threatening hypoxia, supporting her respiratory dysfunction, until she has recovered and is no longer critically ill.

A related case of critical care (a case including some of the defining attributes but not the attribute of "vital organ support")

Care in a hospital is provided to a man with a chest infection. A nurse assesses him at arrival to hospital. A doctor admits him to the ward, prescribes antibiotics and decides he is not critically ill and does not require support for any of his vital organs. After four days the doctor discharges him from hospital.

A contrary case of critical care (a clear example of "not the concept")

In the outpatient department, care is provided to a woman with lung cancer. A doctor and a nurse do some investigations and prescribe some medications. She is sent home with a follow-up appointment two weeks later.

Antecedents and consequences of critical care

The antecedents of critical care are the contact of the patient with the healthcare system and may include other care of a patient who has not deteriorated to the point of becoming critically ill. The consequences of critical care are either the patient's recovery or death.

Empirical Referents

Many hospitals have wards or units for the provision of critical care, such as Emergency Units, High Dependency Units or Intensive Care Units (ICUs) (18). Critical care can also be provided in general wards, and a recent global consensus specified the care that should be included for all patients with critical illness in any hospital location (19). Rapid Response Teams or Medical Emergency Teams have been introduced into some hospitals, often consisting of staff from the ICU responding to calls from the wards when a critically ill patient has been identified, and providing either critical care on the ward, or transferring the patient to the ICU (20).

Discussion

We have described how the concepts *critical illness* and *critical care* are used and defined in the literature and by global experts using a concept analysis approach.

Our proposed definition for critical illness of, "*a state of ill health with vital organ dysfunction, a high risk of imminent death if care is not provided and the potential for reversibility*", is similar to those in some key publications. Chandrashekar et al state that, *"Critical illness is any condition requiring support of failing vital organ systems without which survival would not be possible"*

(21) . Painter et al write that, *"A critically ill or injured patient is defined as one who has an illness or injury impairing one or more vital organ systems such that there is a high probability of imminent or life-threatening deterioration in the patient's condition"*(22) . Indeed, we found widespread agreement in the literature and expert sources that critical illness concerns life-threatening illness with organ dysfunction.

However, we found diverse and varied usage of the concept concerning the attribute of reversibility and the interface between critical illness and the natural process of dying. Some uses included only illness that was potentially reversible – these sources regarded that for critical illness there should be a possible chance of recovery. Without this, critical illness would be a concept that encompasses the dying process – everyone would be critically ill immediately before death – which would conflict with many clinical uses and understandings of the term., Others had a wider interpretation including all life-threatening illness and did not include reversibility in the definition as it is difficult to identify in the clinical setting, and the concept risks becoming context dependent, (high-resource interventions may reverse some critical illness which would not be possible in low-resource healthcare). Our iterative content analysis method led to our interpretation that reversibility should be included as one of the defining attributes, and this conclusion should be seen as one possible interpretation that can stimulate further discussion.

It is hoped that the proposed definition of critical illness assists communication in the field. Previously, studies about critical illness have focused on patients in certain hospital units, or with diseases or syndromes as proxies for critical illness that exclude some critically ill patients.(1) Our definition of critical illness is not diagnosis or syndrome specific and can be due to any underlying condition. The definition could facilitate the specification of clinical criteria for the identification of critical illness, estimates of the overall burden of critical illness, assessments of outcomes for patients with critical illness across centres and settings, and interventions to improve outcomes.

For critical care, there was greater diversity around its use and definition. There was widespread agreement that critical care is the care of critically ill patients including the support of vital organs. However, there were differing uses around the location of the care and the need for specialized resources. Some sources considered critical care to be only the care provided in certain locations, (such as ICUs or critical care units), or to be care that is always highly specialized or resource-

intensive. The World Federation of Societies of Intensive and Critical Care Medicine have suggested that critical care is synonymous with intensive care and is, "*a multidisciplinary and interprofessional specialty dedicated to the comprehensive management of patients having, or at risk of developing, acute, life-threatening organ dysfunction. [Critical care] uses an array of technologies that provide support of failing organ systems, particularly the lungs, cardiovascular system, and kidneys*."(18) In contrast, other sources used critical care to be inclusive of any care for patients with critical illness, irrespective of location or resources. The Joint Faculty of Intensive Care Medicine of Ireland state that critical care units are those that, "*provide life sustaining treatment for critically ill patients with acute organ dysfunction due to potentially reversible disease*",(23) and in Belgium, critical care beds have been defined as any beds "*for patients with one or more organ functions compromised*"(24) Hirshon et al strike a balance between these two contrasting views, "*[Critical care is] the specialized care of patients whose conditions are life-threatening and who require comprehensive care and constant monitoring, usually in intensive care units*." (25)

Our proposed definition of, "*the identification, monitoring and treatment of patients with critical illness through the initial and sustained support of vital organ functions*", aims to be inclusive. Critical care may include the use of specialized resources but it is not a requirement. We see this as a strength in the definition, as it maintains a patient-centred rather than setting-dependent focus. Critical care when defined in this way can be provided anywhere and does not have to be resource-intensive – it includes both high-resource care in ICUs and lower resource care in other settings. Indeed, critical care can even be provided in general wards, in small health facilities, in the community or in ambulances. High-resource intensive care may not be possible in low-resource settings, but such settings care for many critically ill patients who require critical care(4,26,27). The definition focuses on supporting vital organ functions, emphasising that critical care's primary focus is treating the critical condition of the patient rather than definitive care for the underlying condition(28,29). Critical care, as we have defined it, can be seen as a system of care of patients with critical illness throughout the course of their illness, from the time of their first contact with healthcare through to resolution of the critical illness or death. Critical care is part of the wider concept of acute care which also includes prehospital care, emergency care, trauma and surgery care, as well as in-patient care in medical, surgical, pediatric, obstetric and other wards(29).

Strengths and Limitations

To our knowledge, this is the first study attempting to describe the uses and definitions of the concepts *critical illness* and *critical care*, and to identify the defining attributes leading to proposed definitions of the concepts. A strength is the use of both a scoping review of the literature and the inclusion of over one hundred clinical experts as sources. The findings of the analysis should be seen as a first step and we recognise that the use of concepts is fluid and changes over time (6). We were limited to including literature in English and to published studies and guidelines and we may have missed relevant publications in other languages or in other grey literature. Our sample of experts was purposively selected and had global representation but was not perfectly symmetrical to continents, specialty, cadre or gender and we are likely to have missed experts who could have provided valuable contributions. We acknowledge that the proposed definitions may not be universally accepted, and we hope our analysis and findings move the conversation forwards, providing input about how to communicate and collaborate around these vitally important concepts, and ultimately how to improve the care and outcomes for critically ill patients.

Conclusion

The concepts critical illness and critical care lack consensus definitions and have varied uses. Through concept analysis of the uses in the literature and among experts we propose the definitions: "*Critical illness is a state of ill health with vital organ dysfunction, a high risk of imminent death if care is not provided and the potential for reversibility*" and "*Critical care is the identification, monitoring and treatment of patients with critical illness through the initial and sustained support of vital organ functions*."

Figure 1 : The defining attributes of critical illness

Figure 2: The defining attributes of critical care

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Patient and Public Involvement: No patient involved.

References

1. Adhikari NK, Fowler RA, Bhagwanjee S, Rubenfeld GD. Critical care and the global burden of critical illness in adults. The Lancet. 2010 Oct;376(9749).

2. Vukoja M, Riviello ED, Schultz MJ. Critical care outcomes in resource-limited settings. Current Opinion in Critical Care. 2018 Oct;24(5):421–7.

3. Biccard BM, Gopalan PD, Miller M, Michell WL, Thomson D, Ademuyiwa A, et al. Patient care and clinical outcomes for patients with COVID-19 infection admitted to African high-care or intensive care units (ACCCOS): a multicentre, prospective, observational cohort study. The Lancet. 2021 May;397(10288):1885–94.

4. Murthy S, Leligdowicz A, Adhikari NKJ. Intensive Care Unit Capacity in Low-Income Countries: A Systematic Review. PLOS ONE. 2015 Jan 24;10(1):e0116949.

5. Arabi YM, Azoulay E, Al-Dorzi HM, Phua J, Salluh J, Binnie A, et al. How the COVID-19 pandemic will change the future of critical care. Intensive Care Medicine. 2021 Mar 22;47(3):282–91.

6. Walker LO, Avant KC. Strategies for Theory Construction in Nursing. 5th Edition. Pearson; 2011.

7. Xyrichis A, Ream E. Teamwork: A concept analysis. Journal of Advanced Nursing. 2008 Jan;61(2):232–41.

8. Allvin R, Berg K, Idvall E, Nilsson U. Postoperative recovery: a concept analysis. Journal of Advanced Nursing. 2007 Mar;57(5).

9. Rebmann T. Defining bioterrorism preparedness for nurses: concept analysis. Journal of Advanced Nursing. 2006 Jun;54(5).

10. Arksey H, O'Malley L. Scoping studies: towards a methodological framework. International Journal of Social Research Methodology. 2005 Feb;8(1).

11. Ouzzani M, Hammady H, Fedorowicz Z, Elmagarmid A. Rayyan—a web and mobile app for systematic reviews. Systematic Reviews. 2016 Dec 5;5(1).

12. Erlingsson C, Brysiewicz P. A hands-on guide to doing content analysis. African Journal of Emergency Medicine. 2017 Sep;7(3).

13. Schell CO, Castegren M, Lugazia E, Blixt J, Mulungu M, Konrad D, et al. Severely deranged vital signs as triggers for acute treatment modifications on an intensive care unit in a low-income country. BMC Research Notes. 2015 Dec 25;8(1).

14. Seymour CW, Liu VX, Iwashyna TJ, Brunkhorst FM, Rea TD, Scherag A, et al. Assessment of Clinical Criteria for Sepsis. JAMA. 2016 Feb 23;315(8).

15. Smith GB, Redfern OC, Pimentel MA, Gerry S, Collins GS, Malycha J, et al. The National Early Warning Score 2 (NEWS2). Clinical Medicine. 2019 May 15;19(3).

16. Knaus WA DEWDZJ. APACHE II: a severity of disease classification system. Critical Care Medicine. Critical Care Medicine. 1985;

17. Moreno RP, Metnitz PGH, Almeida E, Jordan B, Bauer P, Campos RA, et al. SAPS 3 - From evaluation of the patient to evaluation of the intensive care unit. Part 2: Development of a prognostic model for hospital mortality at ICU admission. Intensive Care Medicine. 2005;31(10):1345–55.

18. Marshall JC, Bosco L, Adhikari NK, Connolly B, Diaz J v., Dorman T, et al. What is an intensive care unit? A report of the task force of the World Federation of Societies of Intensive and Critical Care Medicine. Journal of Critical Care. 2017 Feb;37:270–6.

19. Schell CO, Khalid K, Wharton-Smith A, Oliwa J, Sawe HR, Roy N, et al. Essential Emergency and Critical Care: a consensus among global clinical experts. BMJ Global Health. 2021 Sep 21;6(9).

20. Maharaj R, Raffaele I, Wendon J. Rapid response systems: a systematic review and meta-analysis. 2015;

21. Chandrashekar M, Shivaraj BM, Krishna VP. A study on prognostic value of serum cortisol in determining the outcome in the critically ill patients. Journal of Evolution of Medical and Dental Sciences. 2015 Jul 17;4(58).

22. Painter JR. Critical Care in the Surgical Global Period. Chest. 2013 Mar;143(3).

23. Joint Faculty of Intensive Care Medicine of Ireland. National Standards for Adult Critical Care Services 2011. 2011.

24. Wunsch H, Angus DC, Harrison DA, Collange O, Fowler R, Hoste EAJ, et al. Variation in critical care services across North America and Western Europe*. Critical Care Medicine. 2008 Oct;36(10):2787-e8.

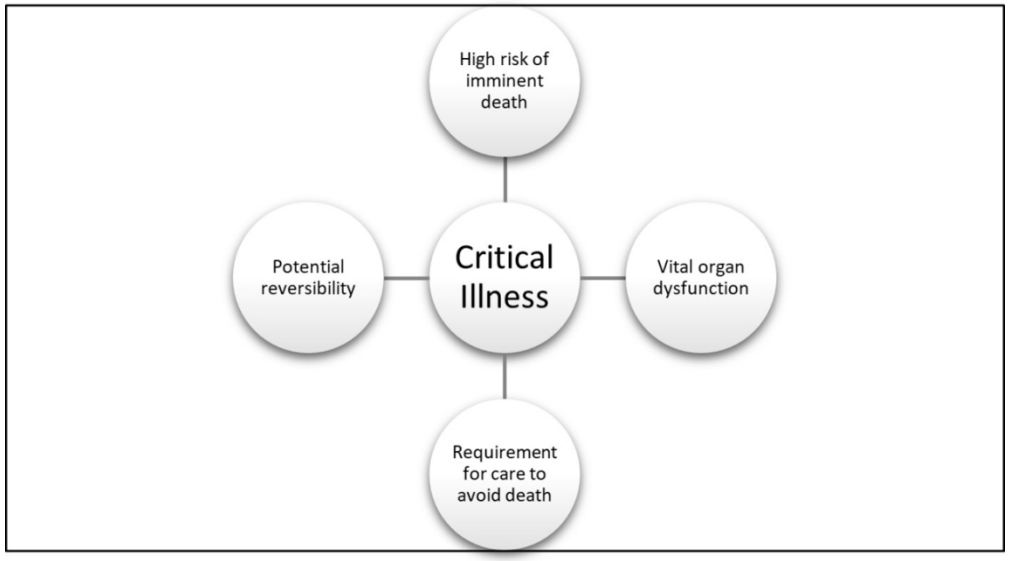
25. Hirshon JM, Risko N, Calvello EJ, Stewart de Ramirez S, Narayan M, Theodosis C, et al. Health systems and services: the role of acute care. Bulletin of the World Health Organization. 2013 May 1;91(5):386–8.

26. Prin M, Wunsch H. International comparisons of intensive care. Current Opinion in Critical Care. 2012 Dec;18(6):700–6.

27. Manda-Taylor L, Mndolo S, Baker T. Critical care in Malawi: The ethics of beneficence and justice. Malawi Medical Journal. 2017 Nov 24;29(3):268.

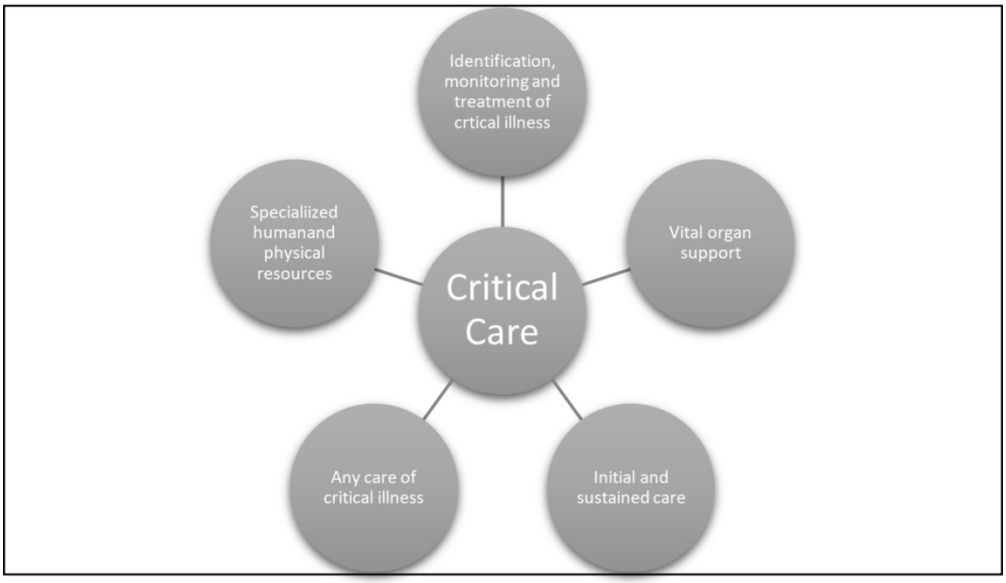
28. Schell CO, Gerdin Wärnberg M, Hvarfner A, Höög A, Baker U, Castegren M, et al. The global need for essential emergency and critical care. Vol. 22, Critical Care. BioMed Central Ltd.; 2018.

29. Baker T, Schell CO, Petersen DB, Sawe H, Khalid K, Mndolo S, et al. Essential care of critical illness must not be forgotten in the COVID-19 pandemic. The Lancet. 2020 Apr;395(10232).



The Defining attributes of critical illness

107x61mm (300 x 300 DPI)



The defining attributes of critical care

114x67mm (300 x 300 DPI)

Supplementary Table 1 Literature with definitions of critical illness

	First Author and Publication Date	Country	Reference
1	Kievlan 2016	United States	Kievlan DR, Martin-Gill C, Kahn JM, Callaway CW, Yealy DM, Angus DC, et al. External validation of a prehospital risk score for critical illness. Crit Care. 2016;20(1):255.
2	Warttig 2018	United Kingdom	Warttig S, Alderson P, Evans DJW, Lewis SR, Kourbeti IS, Smith AF. Automated monitoring compared to standard care for the early detection of sepsis in critically ill patients (Review). Cochrane Database of Syst Rev. 2018(6):28.
3	Rodriguez 2018	United States	Rodriguez RM, Greenwood JC, Nuckton TJ, Darger B, Shofer FS, Troeger D, et al. Comparison of qSOFA with current emergency department tools for screening of patients with sepsis for critical illness. Emerg Med J. 2018;35(6):350-6.
4	Benneyworth 2015	United States	Benneyworth BD, Bennett WE, Carroll AE. Cross-sectional comparison of critically ill pediatric patients across hospitals with various levels of pediatric care. BMC Res Notes. 2015;8:693.
5	Hsu 2016	Taiwan	Hsu CW, Lin CS, Chen SJ, Lin SH, Lin CL, Kao CH. Risk of type 2 diabetes mellitus in patients with acute critical illness: a population-based cohort study. Intensive Care Med. 2016;42(1):38-45.
6	Painter 2013	United States	Painter JR. Critical Care in the Surgical Global Period. Chest. 2013;143(3):851-5.
7	Chandrashekar 2015	India	Chandrashekar M, Shivaraj BM, Krishna VP. A study on prognostic value of serum cortisol in determining the outcome in the critically ill patients. JEMDS. 2015;4(58):10130-5.
8	Liao 2014	United States	Liao MM, Lezotte D, Lowenstein SR, Howard K, Finley Z, Feng ZP, et al. Sensitivity of systemic inflammatory response syndrome for critical illness among ED patients. Am J of Emerg Med. 2014;32(11):1319-25.
9	Valentin 2011	23 countries	Valentin A, Ferdinande P, Improvem EWGQ. Recommendations on basic requirements for intensive care units: structural and organizational aspects. Intensive Care Med. 2011;37(10):1575-87.

Supplementary Table 2 Literature with definitions of critical care

	First Author and Publication Date	Country	Reference
1	Wunsch 2008	United States, France, UK, Canada, Belgium	Wunsch H, Angus DC, Harrison DA, Collange O, Fowler R, Hoste EA, et al. Variation in critical care services across North America and Western Europe. Crit Care Med. 2008;36(10):2787-93, e1-9
2	Prin 2012	United States	Prin M, Wunsch H. International comparisons of intensive care: informing outcomes and improving standards. Curr Opin Crit Care. 2012;18(6):700-6
3	Painter 2013	United States	Painter JR. Critical care in the surgical global period. Chest. 2013;143(3):851-5
4	Royal College of Anaesthetists 2018	England	https://www.rcoa.ac.uk/sites/default/files/documents/2020-06/EMC-Guidelines2018.pdf
5	Joint Faculty of Intensive Care Medicine of Ireland and Intensive Care Society of Ireland 2019	Ireland	https://jficmi.anaesthesia.ie/wp-content/uploads/2019/09/National-Standards-for-Adult-Critical-Services-2019.pdf
6	Marshall 2017	Many countries	Marshall JC, Bosco L, Adhikari NK, Connolly B, Diaz J v., Dorman T, et al. What is an intensive care unit? A report of the task force of the World Federation of Societies of Intensive and Critical Care Medicine. Journal of Critical Care. 2017 Feb;37:270–6.
7	The International Surgical Outcomes Study 2016	Many countries	International Surgical Outcomes Study g. Global patient outcomes after elective surgery: prospective cohort study in 27 low-, middle- and high-income countries. Br J Anaesth. 2016;117(5):601-9
8	Benneyworth 2015	United States	Benneyworth BD, Bennett WE, Carroll AE. Cross-sectional comparison of critically ill pediatric patients across hospitals with various levels of pediatric care. BMC Res Notes. 2015;8:693.
9	Kievlan 2016	United States	Kievlan DR, Martin-Gill C, Kahn JM, Callaway CW, Yealy DM, Angus DC, et al. External validation of a prehospital risk score for critical illness. Crit Care. 2016;20(1):255.
10	Boyle 2008	Australia	Boyle M, Butcher R, Conyers V, Kendrick T, MacNamara M, Lang S. Transition to intensive care nursing: establishing a starting point. Aust Crit Care. 2008;21(4):190-8.
11	Hirshon 2013	United States	Hirshon JM, Risko N, Calvello EJ, Stewart de Ramirez S, Narayan M, Theodosis C, et al. Health systems and services: the role of acute care. Bull World Health Organ. 2013;91(5):386-8
12	McCarthy 2013	United States	McCarthy C, O'Rourke NC, Madison JM. Integrating advanced practice providers into medical critical care teams. Chest. 2013;143(3):847-50
13	Intensive Care Society 2009	United Kingdom	https://icmwk.com/wp-content/uploads/2014/02/Revised-Levels-of-Care-21-12-09.pdf

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Towards definitions of critical illness and critical care using concept analysis

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Abstract

Objective

As "critical illness" and "critical care" lack consensus definitions, this study aimed to explore how the concepts' are used, describe their defining attributes, and propose potential definitions.

Design and Methods

We used the Walker and Avant approach to concept analysis. The uses and definitions of the concepts were identified through a scoping review of the literature and an online survey of 114 global clinical experts. We used the Arksey and O'Malley framework for scoping reviews and searched in PubMed and Web of Science with a strategy including terms around critical illness/care and definitions/etymologies limited to publications in English since 2008. The experts were selected through purposive sampling and snowballing, with 36.8% in Africa, 25.4% in Europe, 22.8% in North America, 10.5% in Asia, 2.6% in South America and 1.8% in Australia. They worked with Anaesthesia or Intensive Care (59.1%), Emergency Care 15.8%, Medicine 9.5%, Paediatrics 5.5%, Surgery 4.7%, Obstetrics and Gynaecology 1.6% and other specialties

3.9%. Through content analysis of the data we extracted codes, categories, and themes to determine the concepts' defining attributes and we proposed potential definitions. To assist understanding, we developed model, related and contrary cases concerning the concepts, we identified antecedents and consequences to the concepts, and defined empirical referents.

Results

Nine and 13 articles were included in the scoping reviews of critical illness and critical care respectively. A total of 48 codes, 14 categories and 4 themes were identified in the uses and definitions of critical illness and 60 codes, 13 categories and 5 themes for critical care. The defining attributes of critical illness were a high risk of imminent death; vital organ dysfunction; requirement for care to avoid death; and potential reversibility. The defining attributes of critical care were the identification, monitoring and treatment of critical illness; vital organ support; initial and sustained care; any care of critical illness; and specialized human and physical resources. The defining attributes led to our proposed definitions of critical illness as, "*a state of ill health with vital organ dysfunction, a high risk of imminent death if care is not provided and the potential for reversibility*", and of critical care as, "*the identification, monitoring and treatment of patients with critical illness through the initial and sustained support of vital organ functions*."

Conclusion

The concepts critical illness and critical care lack consensus definitions and have varied uses. Through concept analysis of uses and definitions in the literature and among experts we have identified the defining attributes of the concepts and proposed definitions that could aid clinical practice, research, and policy making.

Strengths and Limitations of the Study

- This concept analysis is the first study to systematically describe the uses and definitions of the concepts *critical illness* and *critical care*
- The study uses a scoping review of the literature and input from over one hundred clinical experts from diverse settings globally to identify the defining attributes and provide proposed definitions of the concepts
- Some uses and definitions of the concepts in languages other than English, in unpublished grey literature and from clinical experts not included in the study may have been missed

- As current usage of the concepts is diverse, the proposed definitions may not be universally accepted and are aimed to stimulate further discussion

Introduction

The concepts *critical illness* and *critical care* are commonly used in healthcare. In PubMed, both concepts are Medical Subject Headings (MeSH) terms, and searches for "critical illness" or "critical care" return 40,000 and 220,000 articles respectively. While it may seem evident that the concepts concern patients with very serious illness and their care, there is a lack of consensus around their precise definitions.

This causes problems for clinical practice, research, and policy making. For the clinician, discordant interpretations of when a patient is critically ill can lead to differing clinical assessments and treatments despite similar states: for example, Doctor A interprets Patient B's low blood oxygen level as critical illness, triggers an alarm and admits the patient to an intensive care unit, only for Doctor C to reverse the decision and discharge the patient as she interprets the illness as non-critical. For the researcher, it can be difficult to design a study or interpret findings: for example studies into the effect of dexamethasone for critical COVID-19, or of another treatment for all patients with critical illness, require clear eligibility criteria and translating the findings to another patient group requires that the groups have similar clinical conditions. For the policy maker, prioritising programmes and investments designed to improve care for very sick patients relies on comparisons between similar groups and clearly defined interventions.

Even quantifying the total global burden of critical illness has been challenging due to the lack of an agreed definition. Proxies have been used instead, for example summing up syndromes considered to comprise critical illness such as sepsis and acute lung injury – resulting in estimates of up to 45 million critical illness cases each year.(1) Low- and middle-income countries are suspected to have the highest burden (2), but the lack of a definition has hampered comparisons across settings(3).

Studying the care for critically ill patients has also been problematic. Studies have focused on care provided in hospital locations such as in intensive care or emergency units, which exclude care

provided in hospitals lacking such units, and to critically ill patients in general hospital wards.(4–6) In the COVID-19 pandemic, there have been great efforts to describe, scale-up and improve care for critically ill patients throughout the world,(4,6) and a lack of agreement around the concept of critical care has hampered these efforts.

These examples illustrate how important concepts are as the building blocks of theories and communication. Ideally, concepts are clearly-defined and their uses well-described for unambiguous communication and an understanding about exactly what is being described or explained.(7) *Concept analysis* is a method for investigating how concepts are used and understood. Concept analyses have been conducted in diverse fields such as in teamwork(8), postoperative recovery(9) and bioterrorism preparedness(10), all with the aim of providing basic conceptual understanding and facilitating communication. In this paper, we have used concept analysis, following the stepwise approach described by Walker and Avant(7). The first two steps in the approach are to choose the concept and determine the aim of the analysis. Our chosen concepts are *critical illness* and *critical care* and our aims are to explore the uses and definitions of the concepts in published sources and by global clinical experts, leading to a description of the defining attributes of the concepts and to proposed definitions.

Methods

Concepts are the basic building blocks in theory construction, research, and communication. A concept analysis aims to define the concept's attributes and facilitate decisions about which phenomena match the concept, and which do not. In this study, Walker and Avant's method for concept analysis was chosen as a systematic approach used previously in similar studies.(7)The approach consists of eight steps: 1) Select the concept; 2) Determine the aim of analysis; 3) Identify all uses of the concept that you can discover; 4) Determine the defining attributes; 5) Identify a model case; 6) Identify borderline, related, contrary, invented, and illegitimate cases; 7) Identify antecedents and consequences; 8) Define empirical referents. In this paper steps 1 and 2 are described in the introduction section, step 3 in the method section and steps 4-8 in the results section. Thus, the continuation of this article addresses steps 3-8 in Walker and Avant's method. (7)

Step 3: Identifying the uses of the concepts

We identified the uses of the concepts of critical illness and critical care through a scoping review of the literature and a web-based survey of global experts.

Scoping Review

We used the Arksey and O'Malley framework for scoping reviews(11). Relevant studies published in English since 2008 were identified in the PubMed and Web of Science databases. To include publications that were not found through the database searches, we hand-searched publication lists and grey literature of intensive care medicine and emergency medicine societies. Duplicates were removed using the software Rayyan(12). The publications were examined through title, then abstract review and lastly by full-text review. The scoping review protocols were published in advance on the www.protocols.io database.

Critical Illness

The search strategy used the terms terminolog*, etymolog*, nomenclatur*, OR definition*, AND emergency, critical*, acute*, OR sever*, AND ill OR illness. A total of 9323 articles were identified using these critical illness terms in the databases and an additional two articles were identified through hand-searching. Of these, 1126 articles were identified as duplicates and the remaining 8199 articles were screened by title and abstract review by two of the authors (TT and HM). 8168 articles were excluded as they did not concern critical illness, were not written in English or were not available in full text online, leaving 31 articles for inclusion for full-text review. In the full-text review, 22 articles were excluded as they did not define critical illness, and so nine articles were included in the analysis (Figure 1 and Supplementary Table 1).

Figure 1. Study Flow Chart

Critical Care

The search strategy used the terms terminolog*, etymolog*, nomenclatur*, OR definition*, AND critical care, intensive care, emergency care, OR acute care. A total of 7286 articles were identified using these critical care terms in the databases and an additional six articles were identified through hand-searching. Of these, 1964 were identified as duplicates and the remaining 5322 articles were screened by title and abstract review by two of the authors (TT and HM). 5269 articles were excluded as they were not concerning critical care, not written in English or not available in full text online, leaving 59 articles for inclusion for full-text review. In the full-text review, 46 articles were excluded as they did not define critical care and so 13 articles were included in the analysis (Figure 1 and Supplementary Table 2).

Expert survey

The survey used open-ended questions to gather information about the experts' definitions of critical illness and critical care, and how they see the relationship of the concepts to connected concepts in order to provide context. The survey included the questions: i. *How would you define critical illness*?, ii. *How would you define critical care?,* iii. *Do critical care and intensive care differ*? *If yes, in what way?* iv. *Do critical care and emergency care differ and if yes, in what way?* v. *Do critical care and acute care differ and if yes, in what way*?

The inclusion criterion for an expert to be invited to participate in the survey was experience in any medical specialty that includes care of patients with acute, severe illness. Experts were identified from a stakeholder mapping of global critical care done by one of the authors (TB, unpublished), and those known to the researchers to be global experts in the field of critical care. Purposive sampling was used to invite experts with the aim of including 100 experts with a balance between specialties, geographical locations, health worker cadres and gender. In total 146 experts were invited to take part, and 114 completed the survey (78% response rate) (Figure 1 and Table 1).

Table 1: Characteristics of the experts who participated in the survey

Variable	Frequency (%)
All	114
Gender	
Male	80 (70.2)
Female	34 (29.8)

Continent	
Africa	42 (36.8)
Europe	29 (25.4)
North America	26 (22.8)
Asia	12 (10.5)
South America	3 (2.6)
Australia	2 (1.8)
Cadres*	
Physician	93 (53.1)
Researcher	62 (35.4)
Nurse	12 (6.9)
Policy Maker	5 (2.9)
Other	3 (1.7)
Specialty*	
Anaesthesia/Intensive Care	75 (59.1)
Emergency Care	20 (15.8)
Medicine	12 (9.5)
Paediatrics	7 (5.5)
Surgery	6 (4.7)
Obstetrics and Gynaecology	2 (1.6)
Other	5 (3.9)

* As the experts were asked to select all that apply, the sum may exceed 100%

Step 4: Analysis and determining the defining attributes

All the definitions and usages of critical illness and critical care from the scoping reviews and the expert survey were charted and analysed using a content analysis based on methods developed by Erlingsson & Brysiewicz.(13) First, the data from any parts of the literature and from the expert survey that concerned the uses or definitions of the concepts were extracted. The data were coded, and the codes analysed iteratively by the study team. Repeated and redundant codes were removed and similar codes were arranged into categories. The data were revisited when new categories arose or when diverse opinions with contrasting attributes were identified. Through the process, themes emerged that captured the defining attributes of the concepts. Using the defining attributes, definitions of the concepts were constructed by the research team to be coherent and useful.

Steps 5-8: presenting a model case, related and contrary cases, identifying antecedents and consequences, and defining empirical referents

The model cases, related, and contrary cases were developed by the researchers to provide examples to illustrate the defining attributes of the concepts that emerged from the concept analysis. Model cases were developed to be clinically realistic and to include all the defining

attributes. Related cases were developed that include some, but not all, of the defining attributes, and contrary cases that are clearly "not the concept", containing none of the defining attributes. For simplicity in this study, we limited our cases to examples of patients with respiratory disease. Antecedents and consequences were identified as events that occur prior to the occurrence of each concept and as the outcomes of each concept respectively. Empirical referents were identified as phenomena that demonstrate the occurrence of each concept "in real life".

Ethical considerations: Informed consent was provided by all of the experts. The Research Ethics Committee of the London School of Hygiene and Tropical Medicine approved the study (Reference number 22661).

Patient and Public Involvement: No patient or public involvement in this study

Results

The results relate to steps 4-8 in the Walker and Avant approach, as steps 1-3 have been described in the introduction and methods.

Critical Illness

Step 4: The defining attributes

A total of 48 codes were identified from the uses and definitions of critical illness from the scoping review and expert survey. The codes were analysed into 14 categories and 4 themes. (Table 2). The themes represent the defining attributes of critical illness: *high risk of imminent death*; *vital organ dysfunction*; *requirement for care to avoid death;* and *potential reversibility*. (Figure 2)

Table 2. Content analysis for the concept *critical illness*

Code	Category	Theme
Severe illness	Severe illness	**High risk of imminent death**
Process of increasing severity		
Imminent risk of death	High risk of imminent death	
Enough severity to lead to death rapidly		
Can kill within a short time		
Medical condition that results in short term mortality		
Sudden onset illness or acute deterioration	Acute onset or deterioration	
Acute life-threatening illness		
An episode of acute illness		
Increased risk of death		

Continuous threat to life and well-being	Life-threatening	
Life-threatening or potentially life-threatening disease		
High probability of life-threatening deterioration		
Acutely life-threatening injury or illness		
At least one and often multiple organ dysfunction	Organ dysfunction or failure	**Vital organ dysfunction**
Failure in one or more organ systems that needs support		
Hemodynamic instability, respiratory failure, seizure, disorders of consciousness		
Diseases with vital organ failures as complications		
Threatened organ failure	Threatened organ dysfunction	
Potential disturbances of vital organ functions		
Threatened end-organ damage		
Deranged vital parameters	Vital signs derangements	
Physiologic reserve is diminished, as manifested by abnormal vital signs		
NEWS2 ≥ 7		
Associated with significant morbidities if untreated	Treatment needed to avoid death	**Requirement for care to avoid death**
Decline in a patient's ability to survive on their own		
Conditions requiring rapid intervention to avert death or disability		
An illness which without rapid treatment would result in death or disability.		
Needs prompt and sustained intervention to avert death or lifelong disability		
If no intervention is made, death is certain		
Requiring minute-by-minute nursing and/or medical care	Requirement for immediate treatment	
Requires a rapid diagnosis and response to ensure good outcomes		
Illnesses where timely care can reduce the chances of death and disability		
Requires immediate intervention		
The illness needs close monitoring and prompt management		
Treatment delays of hours or less make interventions less effective		
Requiring organ support	Requirement for organ support	
Requiring vital organ support		
Requiring intensified patient monitoring and organ support		
Critical care services	Requires critical care	
ICU admission		
Illness that results in need for more than standard of care	Need for specific care	
Acute disease that needs specific treatment alongside the disease itself		
Some element of treatability	Reversible with treatment	**Potential reversibility**
Any treatable life-threatening reversible illness		
Reversible life-threatening organ failure	Potentially reversible	
Life-threatening situation, illness or disease that is potentially reversible		
Acute potentially reversible illness		

Figure 2. The defining attributes of critical Illness

Proposed operational definition

The proposed definition for critical illness is "*Critical illness is a state of ill health with vital organ dysfunction, a high risk of imminent death if care is not provided and the potential for reversibility.*"

Cases

Step 5: ***A model case of critical illness (a case including all the defining attributes)***

A woman has a viral pneumonia. She is breathless and hypoxic with a low oxygen level in her blood (oxygen saturation) of 74%. Her lungs are dysfunctional, and she has a life-threatening condition that is likely to lead to her death in the next few hours. She requires care to support her lungs (oxygen therapy) and if she receives that care, she has a chance of recovery.

Step 6: A related case for critical illness (a case including some of the defining attributes but not the attribute of "imminently life-threatening")

A man has a chest infection. He has a fever, is coughing up green sputum and feels short-of-breath when walking. He has an oxygen saturation of 91%. He has a serious condition, but it is not imminently life-threatening. He requires treatment, likely with antibiotics, but it is uncertain whether he requires any organ support such as oxygen. His condition is potentially reversible, and he can recover.

A contrary case for critical illness (a clear example of "not the concept")

A woman has lung cancer. She is coughing up small amounts of blood but is able to walk to the hospital. She has an oxygen saturation of 94%. She is sick and she requires treatment. However, her illness is not imminently life-threatening, she has no dysfunctional vital organ and she does not require immediate care. Her condition may or may not be reversible.

Step 7: Antecedents and consequences of Critical Illness

The antecedents of critical illness are the onset of illness, in mild or moderate form, with progressing severity. The consequences of critical illness are either recovery or death.

Step 8: Empirical Referents

There are an estimated 30-45 million cases of critical illness globally each year(1). Many patients are cared for in hospitals with illnesses that are causing vital organ dysfunction and that are imminently life-threatening. There is much work done to identify patients with critical illness such as the use of single severely deranged vital signs(14), or compound scoring systems such as the National Early Warning Score (NEWS) and The Sequential Organ Failure Assessment score (SOFA) (15,16) . In hospitals, the severity of patients' conditions can be assessed using tools such as the Acute Physiology and Chronic Health Evaluation (APACHE)(17) and the Simplified Acute Physiology Score (SAPS)(18).

Critical Care

Step 4: The defining attributes

A total of 60 codes were identified from the definitions of critical care from the scoping review and expert survey. The codes were analysed into 13 categories and 5 themes. (Table 3) The themes represent the concept's defining attributes: *identification, monitoring, and treatment of critical illness*; vital *organ support*; *initial and sustained care; any care of critical illness*; and *specialized human and physical resources*. (Figure 3)

Table 3: Content analysis for the concept *critical care*

Codes	Category	Theme
Identifying and addressing critical illness	Identification and monitoring of critical illness	**Identification, monitoring, and treatment of critical illness**
Medical care with timely monitoring		
Appropriate monitoring of critical illness		
Management of critically ill patients	Treatment of critical illness	
Treat critical illness		
Care given to the critically ill		
Services required to stabilize critical illness		
Reduce the risk of death from a critical illness		
Care dedicated to patients with severe illness or potentially severe condition		
Managing life-threatening condition	Addressing life-threatening condition	
Preventing the occurrence of life-threatening conditions		
Treatment and management due to the threat of imminent deterioration		
Medical care required to reduce the risk to the patient's life		
Care to sustain cardiopulmonary functions	Supporting vital functions	**Vital organ support**
Support the patient's hemodynamic or cardiorespiratory status		
Supportive care in critical illness to enable body's systems to continue functioning before definitive treatment can work		
Care of vital organ failure		
Focus of care on supporting vital organs until improvement		
Providing organ support	Organ support	
Main focus on organ-supporting treatment.		
Support of vital organ function, or reverse specific organ dysfunctions		
Supportive care for organs that are failing		
Provision of support to dysfunctional body systems		
Early management for saving and maintaining life	Timely care	**Initial and sustained care**
Rapid and timely intervention that is administered in critical illness		
From admission until the course of illness ends, either in full recovery or death	From start of critical illness until the patient is no longer critically ill	
From home through to discharge from hospital		
From the time of first contact with healthcare services through to stabilization		
To the point where the illness or injury is no longer acutely life-threatening		
Critical care could be over days to weeks	Sustained care	
Constant monitoring		
Irrespective of the location of the patient within the health system	Any location	**Any care of critical illness**
Anywhere in the emergency or inpatient setting		
Any care provided to critically ill patients		

Can be specialized care but depends on the level of resources	Any care provided to	
Usually located in an area with infrastructure to support these activities	Specific area	**Specialized human and physical resources**
Inside a healthcare facility, outside the emergency department		
High dependency care		
Care in ICU or Critical care unit		
A place where equipment, staff and environment is ready to save patients with life-threatening disease		
Multidisciplinary care	Multi-disciplinary and specialist staff	
Specially trained staff		
Essentially a team-based and multi-professional care		
Requires the grouping of special facilities and specially trained staff		
Higher level of care than is available on a general ward	High-intensity care	
Minute-by-minute nursing and/or medical care		
Advanced respiratory support / mechanical ventilation		
Nursing 24/7		
High nurse: patient ratio no lower than 1:2		

Figure 3. Defining attributes of critical care

Proposed operational definition of *Critical care*

The proposed definition for critical care is "*Critical care is the identification, monitoring, and treatment of patients with critical illness through the initial and sustained support of vital organ functions.*"

Cases

Step 5: A model case of critical care (a case including all the defining attributes)

A woman with a viral pneumonia is rapidly identified as critically ill when she arrives at the hospital. She is immediately admitted to a unit with supplies for managing critically ill patients and treatment is started. Nurses and doctors who have been trained in the care of critical illness monitor her regularly, and provide continuous care, titrating the treatments as needed. Continuous oxygen therapy is provided for her life-threatening hypoxia, supporting her respiratory dysfunction, until she has recovered and is no longer critically ill.

Step 6: A related case of critical care (a case including some of the defining attributes but not the attribute of "vital organ support")

Care in a hospital is provided to a man with a chest infection. A nurse assesses him at arrival to hospital. A doctor admits him to the ward, prescribes antibiotics and decides he is not critically ill and does not require support for any of his vital organs. After four days the doctor discharges him from hospital.

A contrary case of critical care (a clear example of "not the concept")

In the outpatient department, care is provided to a woman with lung cancer. A doctor and a nurse do some investigations and prescribe some medications. She is sent home with a follow-up appointment two weeks later.

Step 7: Antecedents and consequences of critical care

The antecedents of critical care are the contact of the patient with the healthcare system and may include other care of a patient who has not deteriorated to the point of becoming critically ill. The consequences of critical care are either the patient's recovery or death.

Step 8: Empirical Referents

Many hospitals have wards or units for the provision of critical care, such as Emergency Units, High Dependency Units or Intensive Care Units (ICUs) (19). Critical care can also be provided in general wards, and a recent global consensus specified the care that should be included for all patients with critical illness in any hospital location(20). Rapid Response Teams or Medical Emergency Teams have been introduced into some hospitals, often consisting of staff from the ICU responding to calls from the wards when a critically ill patient has been identified, and providing either critical care on the ward, or transferring the patient to the ICU (21).

Discussion

We have described how the concepts *critical illness* and *critical care* are used and defined in the literature and by a selection of global experts using a concept analysis approach.

Our proposed definition for critical illness of, "*a state of ill health with vital organ dysfunction, a high risk of imminent death if care is not provided and the potential for reversibility*", is similar to those in some key publications. Chandrashekar et al state that, *"Critical illness is any condition requiring support of failing vital organ systems without which survival would not be possible"* (22) . Painter et al write that, *"A critically ill or injured patient is defined as one who has an illness or injury impairing one or more vital organ systems such that there is a high probability of imminent or life-threatening deterioration in the patient's condition"*(23) . Indeed, we found

widespread agreement in the literature and expert sources that critical illness concerns the attributes "life-threatening illness" and "organ dysfunction".

However, we found diverse and varied usage of the concept concerning the attribute of reversibility and the interface between critical illness and the natural process of dying. Some uses included only illness that was potentially reversible – these sources regarded that for critical illness there should be a possible chance of recovery. Without this, critical illness would be a concept that encompasses the dying process – everyone would be critically ill immediately before death – which would conflict with many clinical uses and understandings of the term. Others had a wider interpretation including all life-threatening illness and did not include reversibility in the definition as it is difficult to identify in the clinical setting, and the concept risks becoming context dependent, (high-resource interventions may reverse some critical illness which would not be possible in low-resource healthcare). Our iterative content analysis method led to our interpretation that reversibility should be included as one of the defining attributes. This conclusion should be seen as one possible interpretation that can stimulate further discussion.

It is hoped that the proposed definition of critical illness assists communication in the field. Previously, studies about critical illness have focused on patients in certain hospital units, or with diseases or syndromes as proxies for critical illness that exclude some critically ill patients.(1) Our definition of critical illness is not diagnosis or syndrome specific and can be due to any underlying condition. The definition could facilitate the specification of clinical criteria for the identification of critical illness, estimates of the overall burden of critical illness, assessments of outcomes for patients with critical illness across centres and settings, and interventions to improve outcomes.

For critical care, there was greater diversity around its use and definition. There was widespread agreement that critical care included the attributes of, "care of critically ill patients", and the "support of vital organs". However, there were differing uses around the location of the care and the need for specialized resources. Some sources considered critical care to be only the care provided in certain locations, (such as ICUs or critical care units), or to be care that is always highly specialized or resource intensive. The World Federation of Societies of Intensive and Critical Care Medicine have suggested that critical care is synonymous with intensive care and is, "*a multidisciplinary and interprofessional specialty dedicated to the comprehensive management*

of patients having, or at risk of developing, acute, life-threatening organ dysfunction. [Critical care] uses an array of technologies that provide support of failing organ systems, particularly the lungs, cardiovascular system, and kidneys."(19) In contrast, other sources used critical care to be inclusive of any care for patients with critical illness, irrespective of location or resources. The Joint Faculty of Intensive Care Medicine of Ireland state that critical care units are those that, "*provide life sustaining treatment for critically ill patients with acute organ dysfunction due to potentially reversible disease*",(24) and in Belgium, critical care beds have been defined as any beds "*for patients with one or more organ functions compromised*"(3) Hirshon et al strike a balance between these two contrasting views, "*[Critical care is] the specialized care of patients whose conditions are life-threatening and who require comprehensive care and constant monitoring, usually in intensive care units*." (25)

Our proposed definition of, "*the identification, monitoring, and treatment of patients with critical illness through the initial and sustained support of vital organ functions*", aims to be inclusive. Critical care may include the use of specialized resources, but it is not a requirement. We see this as a strength in the definition, as it maintains a patient-centred rather than setting-dependent focus. Critical care when defined in this way can be provided anywhere, and does not have to be resource-intensive – it includes both high-resource care in ICUs and lower resource care in other settings. Indeed, critical care can be provided in general wards, in small health facilities, in the community or in ambulances. High-resource intensive care may not be possible in low-resource settings, but such settings care for many critically ill patients who require critical care(5,26,27). The definition focuses on supporting vital organ functions, emphasising that critical care's primary focus is treating the critical condition of the patient rather than definitive care for the underlying condition(28,29). Critical care, as we have defined it, can be seen as a system of care of patients with critical illness throughout the course of their illness, from the time of their first contact with healthcare through to resolution of the critical illness or death. Critical care is part of the wider concept of acute care which also includes prehospital care, emergency care, trauma and surgery care, as well as in-patient care in medical, surgical, pediatric, obstetric and other wards(25).

The word "crisis" is the root for the word critical and has its origin from the Greek word "krisis" referring to a "turning point" or "act of separation", and later in English in a medical context when a crisis refers to the decisive point at which a patient either improves or deteriorates.(30)The

concepts critical illness and critical care could be regarded as remaining true to these origins as they refer to the point in a patient's "journey" through their illness where they are so severely ill that the situation has become a crisis, and managing the crisis is necessary to direct the patient towards improvement rather than towards deterioration.

Strengths and Limitations

To our knowledge, this is the first study attempting to describe the uses and definitions of the concepts *critical illness* and *critical care*, and to identify the defining attributes leading to proposed definitions of the concepts. A strength is the use of both a scoping review of the literature and the inclusion of over one hundred clinical experts as sources. The findings of the analysis should be seen as a first step towards consensus and we recognise that the use of concepts is fluid and changes over time (7). We were limited to including literature in English and to published studies and guidelines and we may have missed relevant publications in other languages or in other grey literature. Our sample of experts was purposively selected and had global representation but was not perfectly symmetrical to continents, specialty, cadre or gender. There are many more experts than we were able to include, and we are likely to have missed experts who could have provided valuable contributions. We acknowledge that the proposed definitions are due to one possible interpretation of the data and may not be universally accepted. We hope our analysis and findings move the conversation forwards, providing input about how to communicate and collaborate around these vitally important concepts, and ultimately how to improve the care and outcomes for critically ill patients.

Conclusion

The concepts critical illness and critical care lack consensus definitions and have varied uses. Through concept analysis of the uses in the literature and among experts we propose possible definitions for the concepts: "*Critical illness is a state of ill health with vital organ dysfunction, a high risk of imminent death if care is not provided and the potential for reversibility*" and "*Critical care is the identification, monitoring, and treatment of patients with critical illness through the initial and sustained support of vital organ functions*."

Figure 1: Study Flowchart

Figure 2 : The defining attributes of critical illness

Figure 3: The defining attributes of critical care

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Patient Consent for Publication: Not required

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Provenance and Peer Review: Not commissioned, externally reviewed

Data Availability Statement: The study data are available from the corresponding author on reasonable request

Supplementary Files: Supplementary Tables 1 and 2

References

1. Adhikari NK, Fowler RA, Bhagwanjee S, Rubenfeld GD. Critical care and the global burden of critical illness in adults. The Lancet. 2010 Oct;376(9749).
2. Vukoja M, Riviello ED, Schultz MJ. Critical care outcomes in resource-limited settings. Current Opinion in Critical Care. 2018 Oct;24(5):421–7.
3. Wunsch H, Angus DC, Harrison DA, Collange O, Fowler R, Hoste EAJ, et al. Variation in critical care services across North America and Western Europe*. Critical Care Medicine. 2008 Oct;36(10):2787-e8.
4. Biccard BM, Gopalan PD, Miller M, Michell WL, Thomson D, Ademuyiwa A, et al. Patient care and clinical outcomes for patients with COVID-19 infection admitted to African high-care or intensive care units (ACCCOS): a multicentre, prospective, observational cohort study. The Lancet. 2021 May;397(10288):1885–94.
5. Murthy S, Leligdowicz A, Adhikari NKJ. Intensive Care Unit Capacity in Low-Income Countries: A Systematic Review. PLOS ONE. 2015 Jan 24;10(1):e0116949.
6. Arabi YM, Azoulay E, Al-Dorzi HM, Phua J, Salluh J, Binnie A, et al. How the COVID-19 pandemic will change the future of critical care. Intensive Care Medicine. 2021 Mar 22;47(3):282–91.
7. Walker LO, Avant KC. Strategies for Theory Construction in Nursing. 5th Edition. Pearson; 2011.
8. Xyrichis A, Ream E. Teamwork: A concept analysis. Journal of Advanced Nursing. 2008 Jan;61(2):232–41.
9. Allvin R, Berg K, Idvall E, Nilsson U. Postoperative recovery: a concept analysis. Journal of Advanced Nursing. 2007 Mar;57(5).
10. Rebmann T. Defining bioterrorism preparedness for nurses: concept analysis. Journal of Advanced Nursing. 2006 Jun;54(5).
11. Arksey H, O'Malley L. Scoping studies: towards a methodological framework. International Journal of Social Research Methodology. 2005 Feb;8(1).
12. Ouzzani M, Hammady H, Fedorowicz Z, Elmagarmid A. Rayyan—a web and mobile app for systematic reviews. Systematic Reviews. 2016 Dec 5;5(1).
13. Erlingsson C, Brysiewicz P. A hands-on guide to doing content analysis. African Journal of Emergency Medicine. 2017 Sep;7(3).
14. Schell CO, Castegren M, Lugazia E, Blixt J, Mulungu M, Konrad D, et al. Severely deranged vital signs as triggers for acute treatment modifications on an intensive care unit in a low-income country. BMC Research Notes. 2015 Dec 25;8(1).

15. Seymour CW, Liu VX, Iwashyna TJ, Brunkhorst FM, Rea TD, Scherag A, et al. Assessment of Clinical Criteria for Sepsis. JAMA. 2016 Feb 23;315(8).

16. Smith GB, Redfern OC, Pimentel MA, Gerry S, Collins GS, Malycha J, et al. The National Early Warning Score 2 (NEWS2). Clinical Medicine. 2019 May 15;19(3).

17. Knaus WA DEWDZJ. APACHE II: a severity of disease classification system. Critical Care Medicine. Critical Care Medicine. 1985;

18. Moreno RP, Metnitz PGH, Almeida E, Jordan B, Bauer P, Campos RA, et al. SAPS 3 - From evaluation of the patient to evaluation of the intensive care unit. Part 2: Development of a prognostic model for hospital mortality at ICU admission. Intensive Care Medicine. 2005;31(10):1345–55.

19. Marshall JC, Bosco L, Adhikari NK, Connolly B, Diaz J v., Dorman T, et al. What is an intensive care unit? A report of the task force of the World Federation of Societies of Intensive and Critical Care Medicine. Journal of Critical Care. 2017 Feb;37:270–6.

20. Schell CO, Khalid K, Wharton-Smith A, Oliwa J, Sawe HR, Roy N, et al. Essential Emergency and Critical Care: a consensus among global clinical experts. BMJ Global Health. 2021 Sep 21;6(9).

21. Maharaj R, Raffaele I, Wendon J. Rapid response systems: a systematic review and meta-analysis. 2015;

22. Chandrashekar M, Shivaraj BM, Krishna VP. A study on prognostic value of serum cortisol in determining the outcome in the critically ill patients. Journal of Evolution of Medical and Dental Sciences. 2015 Jul 17;4(58).

23. Painter JR. Critical Care in the Surgical Global Period. Chest. 2013 Mar;143(3).

24. Joint Faculty of Intensive Care Medicine of Ireland. National Standards for Adult Critical Care Services 2011. 2011.

25. Hirshon JM, Risko N, Calvello EJ, Stewart de Ramirez S, Narayan M, Theodosis C, et al. Health systems and services: the role of acute care. Bull World Health Organ. 2013/05/17. 2013;91(5):386–8.

26. Prin M, Wunsch H. International comparisons of intensive care. Current Opinion in Critical Care. 2012 Dec;18(6):700–6.

27. Manda-Taylor L, Mndolo S, Baker T. Critical care in Malawi: The ethics of beneficence and justice. Malawi Medical Journal. 2017 Nov 24;29(3):268.

28. Schell CO, Gerdin Wärnberg M, Hvarfner A, Höög A, Baker U, Castegren M, et al. The global need for essential emergency and critical care. Vol. 22, Critical Care. BioMed Central Ltd.; 2018.

29. Baker T, Schell CO, Petersen DB, Sawe H, Khalid K, Mndolo S, et al. Essential care of critical illness must not be forgotten in the COVID-19 pandemic. The Lancet. 2020 Apr;395(10232).

30. Merriam-Webster. Merriam Webster Dictionary [Internet]. 2022 [cited 2022 Apr 11]. Available from: https://www.merriam-webster.com/dictionary/crisis

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Figure 1: Study Flowchart

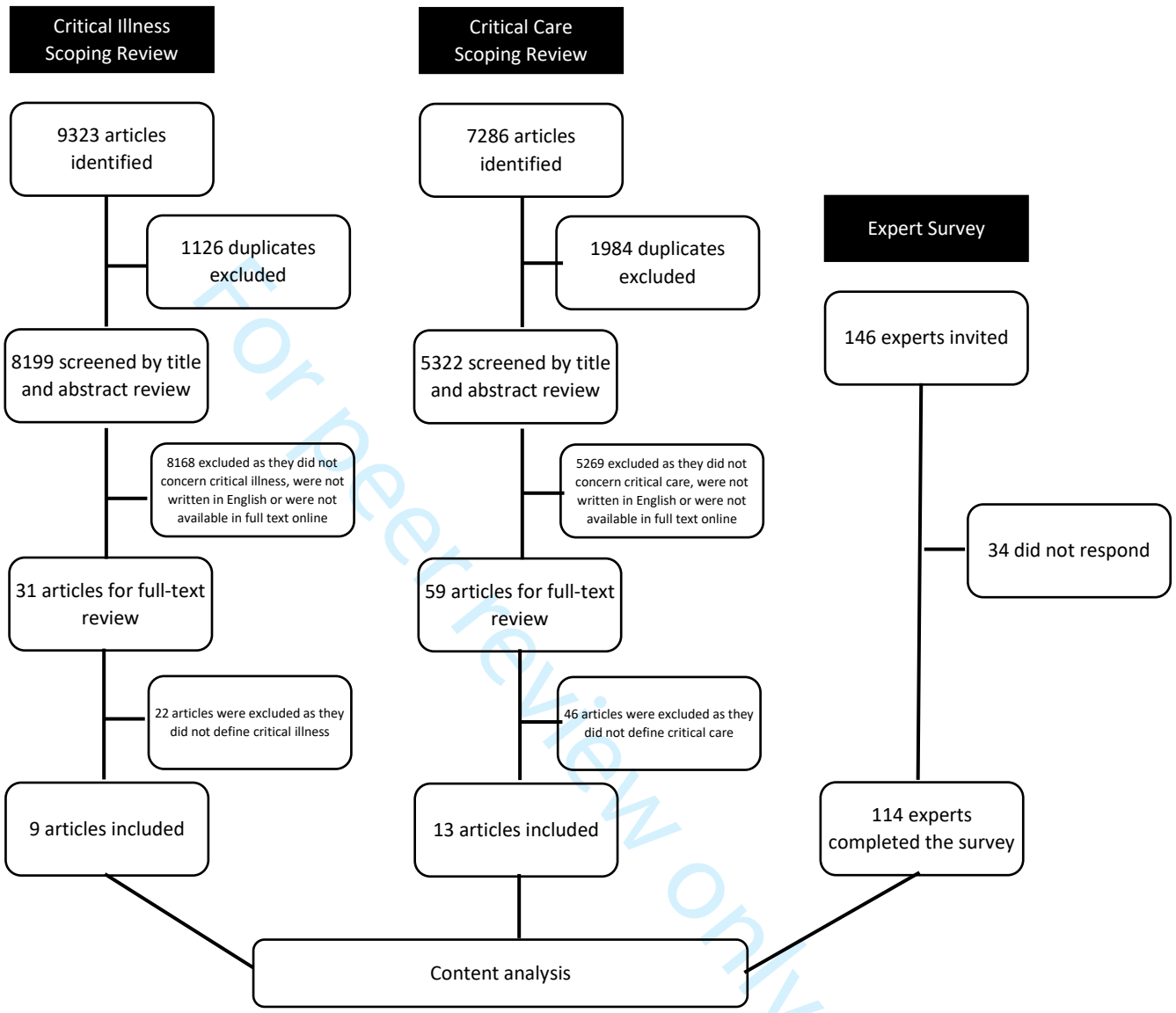


Figure 2: The defining attributes of critical illness

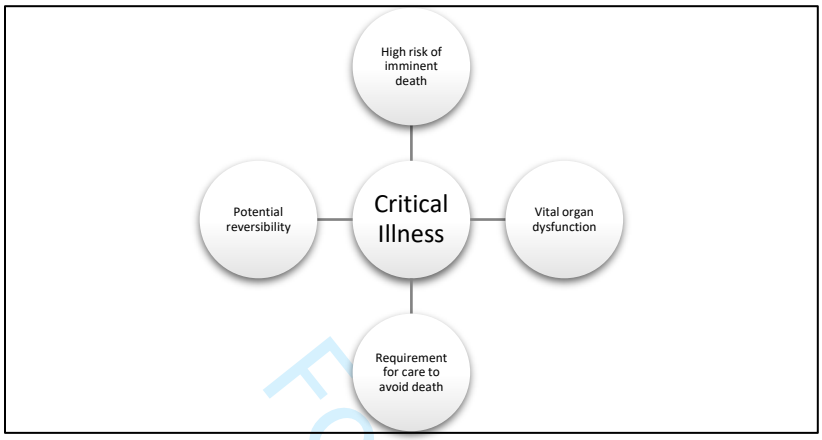
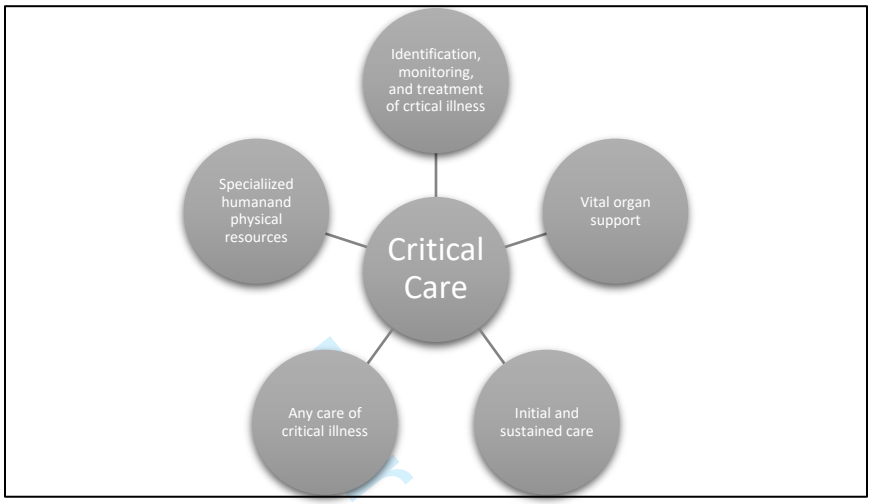


Figure 3: The defining attributes of critical care



Supplementary Table 1 Literature with definitions of critical illness

	First Author and Publication Date	Country	Reference
1	Kievlan 2016	United States	Kievlan DR, Martin-Gill C, Kahn JM, Callaway CW, Yealy DM, Angus DC, et al. External validation of a prehospital risk score for critical illness. Crit Care. 2016;20(1):255.
2	Warttig 2018	United Kingdom	Warttig S, Alderson P, Evans DJW, Lewis SR, Kourbeti IS, Smith AF. Automated monitoring compared to standard care for the early detection of sepsis in critically ill patients (Review). Cochrane Database of Syst Rev. 2018(6):28.
3	Rodriguez 2018	United States	Rodriguez RM, Greenwood JC, Nuckton TJ, Darger B, Shofer FS, Troeger D, et al. Comparison of qSOFA with current emergency department tools for screening of patients with sepsis for critical illness. Emerg Med J. 2018;35(6):350-6.
4	Benneyworth 2015	United States	Benneyworth BD, Bennett WE, Carroll AE. Cross-sectional comparison of critically ill pediatric patients across hospitals with various levels of pediatric care. BMC Res Notes. 2015;8:693.
5	Hsu 2016	Taiwan	Hsu CW, Lin CS, Chen SJ, Lin SH, Lin CL, Kao CH. Risk of type 2 diabetes mellitus in patients with acute critical illness: a population-based cohort study. Intensive Care Med. 2016;42(1):38-45.
6	Painter 2013	United States	Painter JR. Critical Care in the Surgical Global Period. Chest. 2013;143(3):851-5.
7	Chandrashekar 2015	India	Chandrashekar M, Shivaraj BM, Krishna VP. A study on prognostic value of serum cortisol in determining the outcome in the critically ill patients. JEMDS. 2015;4(58):10130-5.
8	Liao 2014	United States	Liao MM, Lezotte D, Lowenstein SR, Howard K, Finley Z, Feng ZP, et al. Sensitivity of systemic inflammatory response syndrome for critical illness among ED patients. Am J of Emerg Med. 2014;32(11):1319-25.
9	Valentin 2011	23 countries	Valentin A, Ferdinande P, Improvem EWGQ. Recommendations on basic requirements for intensive care units: structural and organizational aspects. Intensive Care Med. 2011;37(10):1575-87.

Supplementary Table 2 Literature with definitions of critical care

	First Author and Publication Date	Country	Reference
1	Wunsch 2008	United States, France, UK, Canada, Belgium	Wunsch H, Angus DC, Harrison DA, Collange O, Fowler R, Hoste EA, et al. Variation in critical care services across North America and Western Europe. Crit Care Med. 2008;36(10):2787-93, e1-9
2	Prin 2012	United States	Prin M, Wunsch H. International comparisons of intensive care: informing outcomes and improving standards. Curr Opin Crit Care. 2012;18(6):700-6
3	Painter 2013	United States	Painter JR. Critical care in the surgical global period. Chest. 2013;143(3):851-5
4	Royal College of Anaesthetists 2018	England	https://www.rcoa.ac.uk/sites/default/files/documents/2020-06/EMC-Guidelines2018.pdf
5	Joint Faculty of Intensive Care Medicine of Ireland and Intensive Care Society of Ireland 2019	Ireland	https://jficmi.anaesthesia.ie/wp-content/uploads/2019/09/National-Standards-for-Adult-Critical-Services-2019.pdf
6	Marshall 2017	Many countries	Marshall JC, Bosco L, Adhikari NK, Connolly B, Diaz J v., Dorman T, et al. What is an intensive care unit? A report of the task force of the World Federation of Societies of Intensive and Critical Care Medicine. Journal of Critical Care. 2017 Feb;37:270–6.
7	The International Surgical Outcomes Study 2016	Many countries	International Surgical Outcomes Study g. Global patient outcomes after elective surgery: prospective cohort study in 27 low-, middle- and high-income countries. Br J Anaesth. 2016;117(5):601-9
8	Benneyworth 2015	United States	Benneyworth BD, Bennett WE, Carroll AE. Cross-sectional comparison of critically ill pediatric patients across hospitals with various levels of pediatric care. BMC Res Notes. 2015;8:693.
9	Kievlan 2016	United States	Kievlan DR, Martin-Gill C, Kahn JM, Callaway CW, Yealy DM, Angus DC, et al. External validation of a prehospital risk score for critical illness. Crit Care. 2016;20(1):255.
10	Boyle 2008	Australia	Boyle M, Butcher R, Conyers V, Kendrick T, MacNamara M, Lang S. Transition to intensive care nursing: establishing a starting point. Aust Crit Care. 2008;21(4):190-8.
11	Hirshon 2013	United States	Hirshon JM, Risko N, Calvello EJ, Stewart de Ramirez S, Narayan M, Theodosis C, et al. Health systems and services: the role of acute care. Bull World Health Organ. 2013;91(5):386-8
12	McCarthy 2013	United States	McCarthy C, O'Rourke NC, Madison JM. Integrating advanced practice providers into medical critical care teams. Chest. 2013;143(3):847-50
13	Intensive Care Society 2009	United Kingdom	https://icmwk.com/wp-content/uploads/2014/02/Revised-Levels-of-Care-21-12-09.pdf

Towards Definitions of Critical Care and Critical Illness: A Concept Analysis

Section Item	PRISMA-ScR Checklist Item	Page
Title	Identify the report as a scoping review.	-
Abstract		
Structured summary	Provide a structured summary that includes (as applicable) background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives.	1
Introduction		
Rationale	Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach.	3-4
Objectives	Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives.	4
Methods		
Protocol and registration	Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number.	5
Eligibility criteria	Specify characteristics of the sources of evidence used as eligibility criteria (e.g.,	5

	years considered, language, and publication status), and provide a rationale.	
6 Information sources	Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed	5
Search	Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated.	5
Selection of sources of evidence	State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review.	5
Data charting process	Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators.	7
Data items	List and define all variables for which data were sought and any assumptions and simplifications made.	5
Critical appraisal of individual sources of evidence	If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate).	Not Done
Summary measures	Not applicable for scoping reviews	N/A

Synthesis of results	Describe the methods of handling and summarizing the data that were charted.	7
Risk of bias across studies	Not applicable for scoping reviews	N/A
Additional analyses	Not applicable for scoping reviews.	N/A
Results		
Selection of sources of evidence	Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram.	5-7
Characteristics of sources of evidence	For each source of evidence, present characteristics for which data were charted and provide the citations.	9-13
Critical appraisal within sources of evidence	If done, present data on critical appraisal of included sources of evidence (see item 12).	Not Done
Results of individual sources of evidence	For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives.	9-13
Synthesis of results	Summarize and/or present the charting results as they relate to the review questions and objectives.	9-13
Risk of bias across studies	Not applicable for scoping reviews.	N/A
Additional analyses	Not applicable for scoping reviews.	N/A
Discussion		
Summary of evidence	Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups.	14-17

Limitations	Discuss the limitations of the scoping review process.	17
Conclusions	Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps.	17
Funding	Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review.	18

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Towards definitions of critical illness and critical care using concept analysis

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Abstract

Objective

As "critical illness" and "critical care" lack consensus definitions, this study aimed to explore how the concepts' are used, describe their defining attributes, and propose potential definitions.

Design and Methods

We used the Walker and Avant approach to concept analysis. The uses and definitions of the concepts were identified through a scoping review of the literature and an online survey of 114 global clinical experts. We used the Arksey and O'Malley framework for scoping reviews and searched in PubMed and Web of Science with a strategy including terms around critical illness/care and definitions/etymologies limited to publications in English between 1st January 2008 and 1st January 2020. The experts were selected through purposive sampling and snowballing, with 36.8% in Africa, 25.4% in Europe, 22.8% in North America, 10.5% in Asia, 2.6% in South America and 1.8% in Australia. They worked with Anaesthesia or Intensive Care (59.1%), Emergency Care 15.8%, Medicine 9.5%, Paediatrics 5.5%, Surgery 4.7%, Obstetrics and

Gynaecology 1.6% and other specialties 3.9%. Through content analysis of the data we extracted codes, categories, and themes to determine the concepts' defining attributes and we proposed potential definitions. To assist understanding, we developed model, related and contrary cases concerning the concepts, we identified antecedents and consequences to the concepts, and defined empirical referents.

Results

Nine and 13 articles were included in the scoping reviews of critical illness and critical care respectively. A total of 48 codes, 14 categories and 4 themes were identified in the uses and definitions of critical illness and 60 codes, 13 categories and 5 themes for critical care. The defining attributes of critical illness were a high risk of imminent death; vital organ dysfunction; requirement for care to avoid death; and potential reversibility. The defining attributes of critical care were the identification, monitoring and treatment of critical illness; vital organ support; initial and sustained care; any care of critical illness; and specialized human and physical resources. The defining attributes led to our proposed definitions of critical illness as, "*a state of ill health with vital organ dysfunction, a high risk of imminent death if care is not provided and the potential for reversibility*", and of critical care as, "*the identification, monitoring and treatment of patients with critical illness through the initial and sustained support of vital organ functions*."

Conclusion

The concepts critical illness and critical care lack consensus definitions and have varied uses. Through concept analysis of uses and definitions in the literature and among experts we have identified the defining attributes of the concepts and proposed definitions that could aid clinical practice, research, and policy making.

Strengths and limitations of this study

- This concept analysis is the first study to systematically describe the uses and definitions of the concepts *critical illness* and *critical care.*
- The study uses a scoping review of the literature and input from over one hundred clinical experts from diverse settings globally to identify the defining attributes and provide proposed definitions of the concepts.

- Some uses and definitions of the concepts in languages other than English, in unpublished grey literature and from clinical experts not included in the study may have been missed.
- As current usage of the concepts is diverse, the proposed definitions may not be universally accepted and are aimed to stimulate further discussion.

Introduction

The concepts *critical illness* and *critical care* are commonly used in healthcare. In PubMed, both concepts are Medical Subject Headings (MeSH) terms, and searches for "critical illness" or "critical care" return 40,000 and 220,000 articles respectively. While it may seem evident that the concepts concern patients with very serious illness and their care, there is a lack of consensus around their precise definitions.

Critical illness is a concept concerning a patient's condition that is distinct from the disease diagnosis. It has been argued that clinical practice is overly guided by diagnoses rather than prognoses.(1) We postulate that the lack of consensus around prognostic concepts such as critical illness may be one factor in this and could cause problems for clinical practice, research, and policy making. For the clinician, discordant interpretations of when a patient is critically ill could lead to differing clinical assessments and treatments despite similar states: for example, Doctor A interprets Patient B's low blood oxygen level as critical illness, triggers an alarm and admits the patient to an intensive care unit, only for Doctor C to reverse the decision and discharge the patient as she interprets the illness as non-critical. For the researcher, it could be difficult to design a study or interpret findings: for example studies into the effect of dexamethasone for critical COVID-19, or of another treatment for all patients with critical illness, require clear eligibility criteria and translating the findings to another patient group requires that the groups have similar clinical conditions. For the policy maker, prioritising programmes and investments designed to improve care for very sick patients relies on comparisons between similar groups and clearly defined interventions.

Even quantifying the total global burden of critical illness has been challenging due to the lack of an agreed definition.(2) Proxies have been used instead, for example summing up syndromes considered to comprise critical illness such as sepsis and acute lung injury – resulting in estimates

of up to 45 million critical illness cases each year.(2) Low- and middle-income countries are suspected to have the highest burden (3), but the lack of a definition has hampered comparisons across settings(4).

Studying the care for critically ill patients has also been problematic. Studies have focused on care provided in hospital locations such as in intensive care or emergency units, which exclude care provided in hospitals lacking such units, and to critically ill patients in general hospital wards.(5–7) In the COVID-19 pandemic, there have been great efforts to describe, scale-up and improve care for critically ill patients throughout the world,(5,7) and a lack of agreement around the concept of critical care has hampered these efforts.(8,9)

These examples illustrate how important concepts are as the building blocks of theories and communication. Ideally, concepts are clearly-defined and their uses well-described for unambiguous communication and an understanding about exactly what is being described or explained.(10) *Concept analysis* is a method for investigating how concepts are used and understood. Concept analyses have been conducted in diverse fields such as in teamwork(11), postoperative recovery(12) and bioterrorism preparedness(13), all with the aim of providing basic conceptual understanding and facilitating communication. In this paper, we have used concept analysis, following the stepwise approach described by Walker and Avant(10). The first two steps in the approach are to choose the concept and determine the aim of the analysis. Our chosen concepts are *critical illness* and *critical care* and our aims are to explore the uses and definitions of the concepts in published sources and by global clinical experts, leading to a description of the defining attributes of the concepts and to proposed definitions.

Methods

Concepts are the basic building blocks in theory construction, research, and communication. A concept analysis aims to define the concept's attributes and facilitate decisions about which phenomena match the concept, and which do not. In this study, Walker and Avant's method for concept analysis was chosen as a systematic approach used previously in similar studies.(10)The approach consists of eight steps: 1) Select the concept; 2) Determine the aim of analysis; 3) Identify all uses of the concept that you can discover; 4) Determine the defining attributes; 5) Identify a model case; 6) Identify borderline, related, contrary, invented, and illegitimate cases; 7) Identify

antecedents and consequences; 8) Define empirical referents. In this paper steps 1 and 2 are described in the introduction section, step 3 in the method section and steps 4-8 in the results section. Thus, the continuation of this article addresses steps 3-8 in Walker and Avant's method. (10)

Step 3: Identifying the uses of the concepts

We identified the uses of the concepts of critical illness and critical care through a scoping review of the literature and a web-based survey of global experts.

Scoping Review

We used the Arksey and O'Malley framework for scoping reviews(14). Relevant studies published in English between 1st January 2008 and 1st January 2020 were identified in the PubMed and Web of Science databases. We began the search in 2018 and deemed that articles published prior to 2008 were more than 10 years old and would have less relevance. To include publications that were not found through the database searches, we hand-searched publication lists and grey literature of intensive care medicine and emergency medicine societies. Duplicates were removed using the software Rayyan(15). The publications were examined through title, then abstract review and lastly by full-text review. The scoping review protocols were published in advance on the www.protocols.io database.

Critical Illness

The search strategy used the terms terminolog*, etymolog*, nomenclatur*, OR definition*, AND emergency, critical*, acute*, OR sever*, AND ill OR illness. A total of 9323 articles were identified using these critical illness terms in the databases and an additional two articles were identified through hand-searching. Of these, 1126 articles were identified as duplicates and the remaining 8199 articles were screened by title and abstract review by two of the authors (TT and HM). 8168 articles were excluded as they did not concern critical illness, were not written in English or were not available in full text online, leaving 31 articles for inclusion for full-text review. In the full-text review, 22 articles were excluded as they did not define critical illness, and so nine articles were included in the analysis (Figure 1 and Supplementary Table 1).

Figure 1. Study Flow Chart

Critical Care

The search strategy used the terms terminolog*, etymolog*, nomenclatur*, OR definition*, AND critical care, intensive care, emergency care, OR acute care. A total of 7286 articles were identified using these critical care terms in the databases and an additional six articles were identified through hand-searching. Of these, 1964 were identified as duplicates and the remaining 5322 articles were screened by title and abstract review by two of the authors (TT and HM). 5269 articles were excluded as they were not concerning critical care, not written in English or not available in full text online, leaving 59 articles for inclusion for full-text review. In the full-text review, 46 articles were excluded as they did not define critical care and so 13 articles were included in the analysis (Figure 1 and Supplementary Table 2).

Expert survey

The survey used open-ended questions to gather information about the experts' definitions of critical illness and critical care, and how they see the relationship of the concepts to connected concepts in order to provide context. The survey included the questions: i. *How would you define critical illness*?, ii. *How would you define critical care?,* iii. *Do critical care and intensive care differ*? *If yes, in what way?* iv. *Do critical care and emergency care differ and if yes, in what way?* v. *Do critical care and acute care differ and if yes, in what way*?

The inclusion criterion for an expert to be invited to participate in the survey was experience in any medical specialty that includes care of patients with acute, severe illness. Experts were identified from a stakeholder mapping of global critical care done by one of the authors (TB, unpublished), and those known to the researchers to be global experts in the field of critical care. Purposive sampling was used to invite experts with the aim of including 100 experts with a balance between specialties, geographical locations, health worker cadres and gender. In total 146 experts were invited to take part, and 114 completed the survey (78% response rate) (Figure 1 and Table 1).

Table 1: Characteristics of the experts who participated in the survey

Variable	Frequency (%)
All	114
Gender	
Male	80 (70.2)
Female	34 (29.8)

Continent	
Africa	42 (36.8)
Europe	29 (25.4)
North America	26 (22.8)
Asia	12 (10.5)
South America	3 (2.6)
Australia	2 (1.8)
Cadres*	
Physician	93 (53.1)
Researcher	62 (35.4)
Nurse	12 (6.9)
Policy Maker	5 (2.9)
Other	3 (1.7)
Specialty*	
Anaesthesia/Intensive Care	75 (59.1)
Emergency Care	20 (15.8)
Medicine	12 (9.5)
Paediatrics	7 (5.5)
Surgery	6 (4.7)
Obstetrics and Gynaecology	2 (1.6)
Other	5 (3.9)

* As the experts were asked to select all that apply, the sum may exceed 100%

Step 4: Analysis and determining the defining attributes

All the definitions and usages of critical illness and critical care from the scoping reviews and the expert survey were charted and analysed using a content analysis based on methods developed by Erlingsson & Brysiewicz.(16) First, the data from any parts of the literature and from the expert survey that concerned the uses or definitions of the concepts were extracted. The data were coded, and the codes analysed iteratively by the study team. Repeated and redundant codes were removed and similar codes were arranged into categories. The data were revisited when new categories arose or when diverse opinions with contrasting attributes were identified. Through the process, themes emerged that captured the defining attributes of the concepts. Using the defining attributes, definitions of the concepts were constructed by the research team to be coherent and useful.

Steps 5-8: presenting a model case, related and contrary cases, identifying antecedents and consequences, and defining empirical referents

The model cases, related, and contrary cases were developed by the researchers to provide examples to illustrate the defining attributes of the concepts that emerged from the concept analysis. Model cases were developed to be clinically realistic and to include all the defining

attributes. Related cases were developed that include some, but not all, of the defining attributes, and contrary cases that are clearly "not the concept", containing none of the defining attributes. For simplicity in this study, we limited our cases to examples of patients with respiratory disease. Antecedents and consequences were identified as events that occur prior to the occurrence of each concept and as the outcomes of each concept respectively. Empirical referents were identified as phenomena that demonstrate the occurrence of each concept "in real life".

Ethical considerations: Informed consent was provided by all of the experts. The Research Ethics Committee of the London School of Hygiene and Tropical Medicine approved the study (Reference number 22661).

Patient and Public Involvement: None

Results

The results relate to steps 4-8 in the Walker and Avant approach, as steps 1-3 have been described in the introduction and methods.

Critical Illness

Step 4: The defining attributes

A total of 48 codes were identified from the uses and definitions of critical illness from the scoping review and expert survey. The codes were analysed into 14 categories and 4 themes. (Table 2). The themes represent the defining attributes of critical illness: *high risk of imminent death*; *vital organ dysfunction*; *requirement for care to avoid death;* and *potential reversibility*. (Figure 2)

Table 2. Content analysis for the concept *critical illness*

Code	Category	Theme
Severe illness	Severe illness	**High risk of imminent death**
Process of increasing severity		
Imminent risk of death	High risk of imminent death	
Enough severity to lead to death rapidly		
Can kill within a short time		
Medical condition that results in short term mortality		
Sudden onset illness or acute deterioration	Acute onset or deterioration	
Acute life-threatening illness		
An episode of acute illness		
Increased risk of death		

Continuous threat to life and well-being	Life-threatening	
Life-threatening or potentially life-threatening disease		
High probability of life-threatening deterioration		
Acutely life-threatening injury or illness		
At least one and often multiple organ dysfunction	Organ dysfunction or failure	**Vital organ dysfunction**
Failure in one or more organ systems that needs support		
Hemodynamic instability, respiratory failure, seizure, disorders of consciousness		
Diseases with vital organ failures as complications		
Threatened organ failure	Threatened organ dysfunction	
Potential disturbances of vital organ functions		
Threatened end-organ damage		
Deranged vital parameters	Vital signs derangements	
Physiologic reserve is diminished, as manifested by abnormal vital signs		
NEWS2 ≥ 7		
Associated with significant morbidities if untreated	Treatment needed to avoid death	**Requirement for care to avoid death**
Decline in a patient's ability to survive on their own		
Conditions requiring rapid intervention to avert death or disability		
An illness which without rapid treatment would result in death or disability.		
Needs prompt and sustained intervention to avert death or lifelong disability		
If no intervention is made, death is certain		
Requiring minute-by-minute nursing and/or medical care	Requirement for immediate treatment	
Requires a rapid diagnosis and response to ensure good outcomes		
Illnesses where timely care can reduce the chances of death and disability		
Requires immediate intervention		
The illness needs close monitoring and prompt management		
Treatment delays of hours or less make interventions less effective		
Requiring organ support	Requirement for organ support	
Requiring vital organ support		
Requiring intensified patient monitoring and organ support		
Critical care services	Requires critical care	
ICU admission		
Illness that results in need for more than standard of care	Need for specific care	
Acute disease that needs specific treatment alongside the disease itself		
Some element of treatability	Reversible with treatment	**Potential reversibility**
Any treatable life-threatening reversible illness		
Reversible life-threatening organ failure	Potentially reversible	
Life-threatening situation, illness or disease that is potentially reversible		
Acute potentially reversible illness		

Figure 2. The defining attributes of critical Illness

Proposed operational definition

The proposed definition for critical illness is "*Critical illness is a state of ill health with vital organ dysfunction, a high risk of imminent death if care is not provided and the potential for reversibility.*"

Cases

Step 5: ***A model case of critical illness (a case including all the defining attributes)***

A woman has a viral pneumonia. She is breathless and hypoxic with a low oxygen level in her blood (oxygen saturation) of 74%. Her lungs are dysfunctional, and she has a life-threatening condition that is likely to lead to her death in the next few hours. She requires care to support her lungs (oxygen therapy) and if she receives that care, she has a chance of recovery.

Step 6: A related case for critical illness (a case including some of the defining attributes but not the attribute of "imminently life-threatening")

A man has a chest infection. He has a fever, is coughing up green sputum and feels short-of-breath when walking. He has an oxygen saturation of 91%. He has a serious condition, but it is not imminently life-threatening. He requires treatment, likely with antibiotics, but it is uncertain whether he requires any organ support such as oxygen. His condition is potentially reversible, and he can recover.

A contrary case for critical illness (a clear example of "not the concept")

A woman has lung cancer. She is coughing up small amounts of blood but is able to walk to the hospital. She has an oxygen saturation of 94%. She is sick and she requires treatment. However, her illness is not imminently life-threatening, she has no dysfunctional vital organ and she does not require immediate care. Her condition may or may not be reversible.

Step 7: Antecedents and consequences of Critical Illness

The antecedents of critical illness are the onset of illness, in mild or moderate form, with progressing severity. The consequences of critical illness are either recovery or death.

Step 8: Empirical Referents

There are an estimated 30-45 million cases of critical illness globally each year(2). Many patients are cared for in hospitals with illnesses that are causing vital organ dysfunction and that are imminently life-threatening. There is much work done to identify patients with critical illness such as the use of single severely deranged vital signs(17), or compound scoring systems such as the National Early Warning Score (NEWS) and The Sequential Organ Failure Assessment score (SOFA) (18,19) . In hospitals, the severity of patients' conditions can be assessed using tools such as the Acute Physiology and Chronic Health Evaluation (APACHE)(20) and the Simplified Acute Physiology Score (SAPS)(21).

Critical Care

Step 4: The defining attributes

A total of 60 codes were identified from the definitions of critical care from the scoping review and expert survey. The codes were analysed into 13 categories and 5 themes. (Table 3) The themes represent the concept's defining attributes: *identification, monitoring, and treatment of critical illness*; vital *organ support*; *initial and sustained care; any care of critical illness*; and *specialized human and physical resources*. (Figure 3)

Table 3: Content analysis for the concept *critical care*

Codes	Category	Theme
Identifying and addressing critical illness	Identification and monitoring of critical illness	**Identification, monitoring, and treatment of critical illness**
Medical care with timely monitoring		
Appropriate monitoring of critical illness		
Management of critically ill patients	Treatment of critical illness	
Treat critical illness		
Care given to the critically ill		
Services required to stabilize critical illness		
Reduce the risk of death from a critical illness		
Care dedicated to patients with severe illness or potentially severe condition		
Managing life-threatening condition	Addressing life-threatening condition	
Preventing the occurrence of life-threatening conditions		
Treatment and management due to the threat of imminent deterioration		
Medical care required to reduce the risk to the patient's life		
Care to sustain cardiopulmonary functions	Supporting vital functions	**Vital organ support**
Support the patient's hemodynamic or cardiorespiratory status		
Supportive care in critical illness to enable body's systems to continue functioning before definitive treatment can work		
Care of vital organ failure		
Focus of care on supporting vital organs until improvement		
Providing organ support	Organ support	
Main focus on organ-supporting treatment.		
Support of vital organ function, or reverse specific organ dysfunctions		
Supportive care for organs that are failing		
Provision of support to dysfunctional body systems		
Early management for saving and maintaining life	Timely care	**Initial and sustained care**
Rapid and timely intervention that is administered in critical illness		
From admission until the course of illness ends, either in full recovery or death	From start of critical illness until the patient is no longer critically ill	
From home through to discharge from hospital		
From the time of first contact with healthcare services through to stabilization		
To the point where the illness or injury is no longer acutely life-threatening		
Critical care could be over days to weeks	Sustained care	
Constant monitoring		
Irrespective of the location of the patient within the health system	Any location	**Any care of critical illness**
Anywhere in the emergency or inpatient setting		
Any care provided to critically ill patients		

Can be specialized care but depends on the level of resources	Any care provided to	
Usually located in an area with infrastructure to support these activities	Specific area	**Specialized human and physical resources**
Inside a healthcare facility, outside the emergency department		
High dependency care		
Care in ICU or Critical care unit		
A place where equipment, staff and environment is ready to save patients with life-threatening disease		
Multidisciplinary care	Multi-disciplinary and specialist staff	
Specially trained staff		
Essentially a team-based and multi-professional care		
Requires the grouping of special facilities and specially trained staff		
Higher level of care than is available on a general ward	High-intensity care	
Minute-by-minute nursing and/or medical care		
Advanced respiratory support / mechanical ventilation		
Nursing 24/7		
High nurse: patient ratio no lower than 1:2		

Figure 3. Defining attributes of critical care

Proposed operational definition of *Critical care*

The proposed definition for critical care is "*Critical care is the identification, monitoring, and treatment of patients with critical illness through the initial and sustained support of vital organ functions.*"

Cases

Step 5: A model case of critical care (a case including all the defining attributes)

A woman with a viral pneumonia is rapidly identified as critically ill when she arrives at the hospital. She is immediately admitted to a unit with supplies for managing critically ill patients and treatment is started. Nurses and doctors who have been trained in the care of critical illness monitor her regularly, and provide continuous care, titrating the treatments as needed. Continuous oxygen therapy is provided for her life-threatening hypoxia, supporting her respiratory dysfunction, until she has recovered and is no longer critically ill.

Step 6: A related case of critical care (a case including some of the defining attributes but not the attribute of "vital organ support")

Care in a hospital is provided to a man with a chest infection. A nurse assesses him at arrival to hospital. A doctor admits him to the ward, prescribes antibiotics and decides he is not critically ill and does not require support for any of his vital organs. After four days the doctor discharges him from hospital.

A contrary case of critical care (a clear example of "not the concept")

In the outpatient department, care is provided to a woman with lung cancer. A doctor and a nurse do some investigations and prescribe some medications. She is sent home with a follow-up appointment two weeks later.

Step 7: Antecedents and consequences of critical care

The antecedents of critical care are the contact of the patient with the healthcare system and may include other care of a patient who has not deteriorated to the point of becoming critically ill. The consequences of critical care are either the patient's recovery or death.

Step 8: Empirical Referents

Many hospitals have wards or units for the provision of critical care, such as Emergency Units, High Dependency Units or Intensive Care Units (ICUs) (22). Critical care can also be provided in general wards, and a recent global consensus specified the care that should be included for all patients with critical illness in any hospital location(23). Rapid Response Teams or Medical Emergency Teams have been introduced into some hospitals, often consisting of staff from the ICU responding to calls from the wards when a critically ill patient has been identified, and providing either critical care on the ward, or transferring the patient to the ICU (24).

Discussion

We have described how the concepts *critical illness* and *critical care* are used and defined in the literature and by a selection of global experts using a concept analysis approach.

Our proposed definition for critical illness of, "*a state of ill health with vital organ dysfunction, a high risk of imminent death if care is not provided and the potential for reversibility*", is similar to those in some key publications. Chandrashekar et al state that, *"Critical illness is any condition requiring support of failing vital organ systems without which survival would not be possible"* (25) . Painter et al write that, *"A critically ill or injured patient is defined as one who has an illness or injury impairing one or more vital organ systems such that there is a high probability of imminent or life-threatening deterioration in the patient's condition"*(26) . Indeed, we found

widespread agreement in the literature and expert sources that critical illness concerns the attributes "life-threatening illness" and "organ dysfunction".

However, we found diverse and varied usage of the concept concerning the attribute of reversibility and the interface between critical illness and the natural process of dying. Some uses included only illness that was potentially reversible – these sources regarded that for critical illness there should be a possible chance of recovery. Without this, critical illness would be a concept that encompasses the dying process – everyone would be critically ill immediately before death – which would conflict with many clinical uses and understandings of the term. Others had a wider interpretation including all life-threatening illness and did not include reversibility in the definition as it is difficult to identify in the clinical setting, and the concept risks becoming context dependent, (high-resource interventions may reverse some critical illness which would not be possible in low-resource healthcare). Our iterative content analysis method led to our interpretation that reversibility should be included as one of the defining attributes and to make a distinction between critical illness and illness at the end of life.(27) This conclusion should be seen as one possible interpretation that can stimulate further discussion.

It is hoped that the proposed definition of critical illness assists communication in the field. Previously, studies about critical illness have focused on patients in certain hospital units, or with diseases or syndromes as proxies for critical illness that exclude some critically ill patients.(2,28) Our definition of critical illness is not diagnosis or syndrome specific and can be due to any underlying condition. The definition could facilitate the specification of clinical criteria for the identification of critical illness, estimates of the overall burden of critical illness, assessments of outcomes for patients with critical illness across centres and settings, and interventions to improve outcomes.

For critical care, there was greater diversity around its use and definition. There was widespread agreement that critical care included the attributes of, "care of critically ill patients", and the "support of vital organs". However, there were differing uses around the location of the care and the need for specialized resources. Some sources considered critical care to be only the care provided in certain locations, (such as ICUs or critical care units), or to be care that is always highly specialized or resource intensive. The World Federation of Societies of Intensive and Critical Care Medicine have suggested that critical care is synonymous with intensive care and is,

"*a multidisciplinary and interprofessional specialty dedicated to the comprehensive management of patients having, or at risk of developing, acute, life-threatening organ dysfunction. [Critical care] uses an array of technologies that provide support of failing organ systems, particularly the lungs, cardiovascular system, and kidneys*."(22) In contrast, other sources used critical care to be inclusive of any care for patients with critical illness, irrespective of location or resources. The Joint Faculty of Intensive Care Medicine of Ireland state that critical care units are those that, "*provide life sustaining treatment for critically ill patients with acute organ dysfunction due to potentially reversible disease*",(29) and in Belgium, critical care beds have been defined as any beds "*for patients with one or more organ functions compromised*"(4) Hirshon et al strike a balance between these two contrasting views, "*[Critical care is] the specialized care of patients whose conditions are life-threatening and who require comprehensive care and constant monitoring, usually in intensive care units*." (30)

Our proposed definition of, "*the identification, monitoring, and treatment of patients with critical illness through the initial and sustained support of vital organ functions*", aims to be inclusive. Critical care may include the use of specialized resources, but it is not a requirement. We see this as a strength in the definition, as it maintains a patient-centred rather than setting-dependent focus. Critical care when defined in this way can be provided anywhere, and does not have to be resource-intensive – it includes both high-resource care in ICUs and lower resource care in other settings. Indeed, critical care can be provided in general wards, in small health facilities, in the community or in ambulances. High-resource intensive care may not be possible in low-resource settings, but such settings care for many critically ill patients who require critical care(6,31,32). The proposed definition focuses on supporting vital organ functions, emphasising that critical care's primary focus is treating the critical condition of the patient rather than definitive care for the underlying condition(9,33). Critical care, as we have defined it, can be seen as a system of care of patients with critical illness throughout the course of their illness, from the time of their first contact with healthcare through to resolution of the critical illness or death. Critical care is part of the wider concept of acute care which also includes prehospital care, emergency care, trauma and surgery care, as well as in-patient care in medical, surgical, pediatric, obstetric and other wards(30).

The word "crisis" is the root for the word critical and has its origin from the Greek word "krisis" referring to a "turning point" or "act of separation", and later in English in a medical context when

a crisis refers to the decisive point at which a patient either improves or deteriorates.(34) The concepts critical illness and critical care could be regarded as remaining true to these origins as they refer to the point in a patient's "journey" through their illness where they are so severely ill that the situation has become a crisis, and managing the crisis is necessary to direct the patient towards improvement rather than towards deterioration.

Strengths and Limitations

To our knowledge, this is the first study attempting to describe the uses and definitions of the concepts *critical illness* and *critical care*, and to identify the defining attributes leading to proposed definitions of the concepts. A strength is the use of both a scoping review of the literature and the inclusion of over one hundred clinical experts as sources. The findings of the analysis should be seen as a first step towards consensus and we recognise that the use of concepts is fluid and changes over time (10). We were limited to including literature in English between 2008 and 2019 and to published studies and guidelines and we may have missed relevant publications in other languages or in other grey literature. Our sample of experts was purposively selected and had global representation but was not perfectly symmetrical to continents, specialty, cadre or gender. There are many more experts than we were able to include, and we are likely to have missed experts who could have provided valuable contributions. Our proposed definitions, while based on a content analysis of scoping reviews and an expert survey, are the outputs of one possible interpretation of the data and may not be universally accepted. We hope our analysis and findings move the conversation forwards, providing input about how to communicate and collaborate around these vitally important concepts, and ultimately how to improve the care and outcomes for critically ill patients.

Conclusion

The concepts critical illness and critical care lack consensus definitions and are used in varied ways in the literature and among global experts. Through a concept analysis of scoping reviews and an expert survey we identify common themes in the uses and understandings of the concepts. We propose definitions for the concepts: "*Critical illness is a state of ill health with vital organ dysfunction, a high risk of imminent death if care is not provided and the potential for reversibility*"

and "*Critical care is the identification, monitoring, and treatment of patients with critical illness through the initial and sustained support of vital organ functions*." The proposed definitions could aid clinical practice, research, and policy making.

Figure 1: Study Flowchart

Figure 2 : The defining attributes of critical illness

Figure 3: The defining attributes of critical care

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Provenance and Peer Review: Not commissioned, externally reviewed

Data Availability Statement: The study data are available from the corresponding author on reasonable request

Supplementary Files: Supplementary Tables 1 and 2

References

1. Croft P, Altman DG, Deeks JJ, Dunn KM, Hay AD, Hemingway H, et al. The science of clinical practice: disease diagnosis or patient prognosis? Evidence about "what is likely to happen" should shape clinical practice. BMC Med. 20150130th ed. 2015;13:20.
2. Adhikari NK, Fowler RA, Bhagwanjee S, Rubenfeld GD. Critical care and the global burden of critical illness in adults. Lancet. 2010/10/12. 2010;376(9749):1339–46.
3. Vukoja M, Riviello ED, Schultz MJ. Critical care outcomes in resource-limited settings. Current Opinion in Critical Care. 2018 Oct;24(5):421–7.
4. Wunsch H, Angus DC, Harrison DA, Collange O, Fowler R, Hoste EAJ, et al. Variation in critical care services across North America and Western Europe*. Critical Care Medicine. 2008 Oct;36(10):2787-e8.
5. Biccard BM, Gopalan PD, Miller M, Michell WL, Thomson D, Ademuyiwa A, et al. Patient care and clinical outcomes for patients with COVID-19 infection admitted to African high-care or intensive care units (ACCCOS): a multicentre, prospective, observational cohort study. The Lancet. 2021 May;397(10288):1885–94.
6. Murthy S, Leligdowicz A, Adhikari NKJ. Intensive Care Unit Capacity in Low-Income Countries: A Systematic Review. PLOS ONE. 2015 Jan 24;10(1):e0116949.
7. Arabi YM, Azoulay E, Al-Dorzi HM, Phua J, Salluh J, Binnie A, et al. How the COVID-19 pandemic will change the future of critical care. Intensive Care Medicine. 2021 Mar 22;47(3):282–91.
8. Hvarfner A, Al-Djaber A, Ekström H, Enarsson M, Castegren M, Baker T, et al. Oxygen provision to severely ill COVID-19 patients at the peak of the 2020 pandemic in a Swedish district hospital. PLoS One. 2022/01/21. 2022;17(1):e0249984.
9. Baker T, Schell CO, Petersen DB, Sawe H, Khalid K, Mndolo S, et al. Essential care of critical illness must not be forgotten in the COVID-19 pandemic. The Lancet [Internet]. 2020;395(10232):1253–4. Available from: https://doi.org/10.1016/S0140-6736(20)30793-5
10. Walker LO, Avant KC. Strategies for Theory Construction in Nursing. 5th Edition. Pearson; 2011.
11. Xyrichis A, Ream E. Teamwork: A concept analysis. Journal of Advanced Nursing. 2008 Jan;61(2):232–41.
12. Allvin R, Berg K, Idvall E, Nilsson U. Postoperative recovery: a concept analysis. Journal of Advanced Nursing. 2007 Mar;57(5).
13. Rebmann T. Defining bioterrorism preparedness for nurses: concept analysis. Journal of Advanced Nursing. 2006 Jun;54(5).

14. Arksey H, O'Malley L. Scoping studies: towards a methodological framework. International Journal of Social Research Methodology. 2005 Feb;8(1).

15. Ouzzani M, Hammady H, Fedorowicz Z, Elmagarmid A. Rayyan—a web and mobile app for systematic reviews. Systematic Reviews. 2016 Dec 5;5(1).

16. Erlingsson C, Brysiewicz P. A hands-on guide to doing content analysis. African Journal of Emergency Medicine. 2017 Sep;7(3).

17. Schell CO, Castegren M, Lugazia E, Blixt J, Mulungu M, Konrad D, et al. Severely deranged vital signs as triggers for acute treatment modifications on an intensive care unit in a low-income country. BMC Research Notes. 2015 Dec 25;8(1).

18. Seymour CW, Liu VX, Iwashyna TJ, Brunkhorst FM, Rea TD, Scherag A, et al. Assessment of Clinical Criteria for Sepsis. JAMA. 2016 Feb 23;315(8).

19. Smith GB, Redfern OC, Pimentel MA, Gerry S, Collins GS, Malycha J, et al. The National Early Warning Score 2 (NEWS2). Clinical Medicine. 2019 May 15;19(3).

20. Knaus WA DEWDZJ. APACHE II: a severity of disease classification system. Critical Care Medicine. Critical Care Medicine. 1985;

21. Moreno RP, Metnitz PGH, Almeida E, Jordan B, Bauer P, Campos RA, et al. SAPS 3 - From evaluation of the patient to evaluation of the intensive care unit. Part 2: Development of a prognostic model for hospital mortality at ICU admission. Intensive Care Medicine. 2005;31(10):1345–55.

22. Marshall JC, Bosco L, Adhikari NK, Connolly B, Diaz J v., Dorman T, et al. What is an intensive care unit? A report of the task force of the World Federation of Societies of Intensive and Critical Care Medicine. Journal of Critical Care. 2017 Feb;37:270–6.

23. Schell CO, Khalid K, Wharton-Smith A, Oliwa J, Sawe HR, Roy N, et al. Essential Emergency and Critical Care: a consensus among global clinical experts. BMJ Global Health. 2021 Sep 21;6(9).

24. Maharaj R, Raffaele I, Wendon J. Rapid response systems: a systematic review and meta-analysis. 2015;

25. Chandrashekar M, Shivaraj BM, Krishna VP. A study on prognostic value of serum cortisol in determining the outcome in the critically ill patients. Journal of Evolution of Medical and Dental Sciences. 2015 Jul 17;4(58).

26. Painter JR. Critical Care in the Surgical Global Period. Chest. 2013 Mar;143(3).

27. Sallnow L, Smith R, Ahmedzai SH, Bhadelia A, Chamberlain C, Cong Y, et al. Report of the Lancet Commission on the Value of Death: bringing death back into life. The Lancet [Internet]. 2022;399(10327):837–84. Available from: https://doi.org/10.1016/S0140-6736(21)02314-X

28. Biccard BM, Gopalan PD, Miller M, Michell WL, Thomson D, Ademuyiwa A, et al. Patient care and clinical outcomes for patients with COVID-19 infection admitted to African high-care or intensive care units (ACCCOS): a multicentre, prospective, observational cohort study. The Lancet

[Internet]. 2021;397(10288):1885–94. Available from: https://doi.org/10.1016/S0140-6736(21)00441-4

29. Joint Faculty of Intensive Care Medicine of Ireland. National Standards for Adult Critical Care Services 2011. 2011.

30. Hirshon JM, Risko N, Calvello EJ, Stewart de Ramirez S, Narayan M, Theodosis C, et al. Health systems and services: the role of acute care. Bull World Health Organ. 2013/05/17. 2013;91(5):386–8.

31. Prin M, Wunsch H. International comparisons of intensive care. Current Opinion in Critical Care. 2012 Dec;18(6):700–6.

32. Manda-Taylor L, Mndolo S, Baker T. Critical care in Malawi: The ethics of beneficence and justice. Malawi Medical Journal. 2017 Nov 24;29(3):268.

33. Schell CO, Gerdin Wärnberg M, Hvarfner A, Höög A, Baker U, Castegren M, et al. The global need for essential emergency and critical care. Vol. 22, Critical Care. BioMed Central Ltd.; 2018.

34. Merriam-Webster. Merriam Webster Dictionary [Internet]. 2022 [cited 2022 Apr 11]. Available from: https://www.merriam-webster.com/dictionary/crisis

Figure 1: Study Flowchart

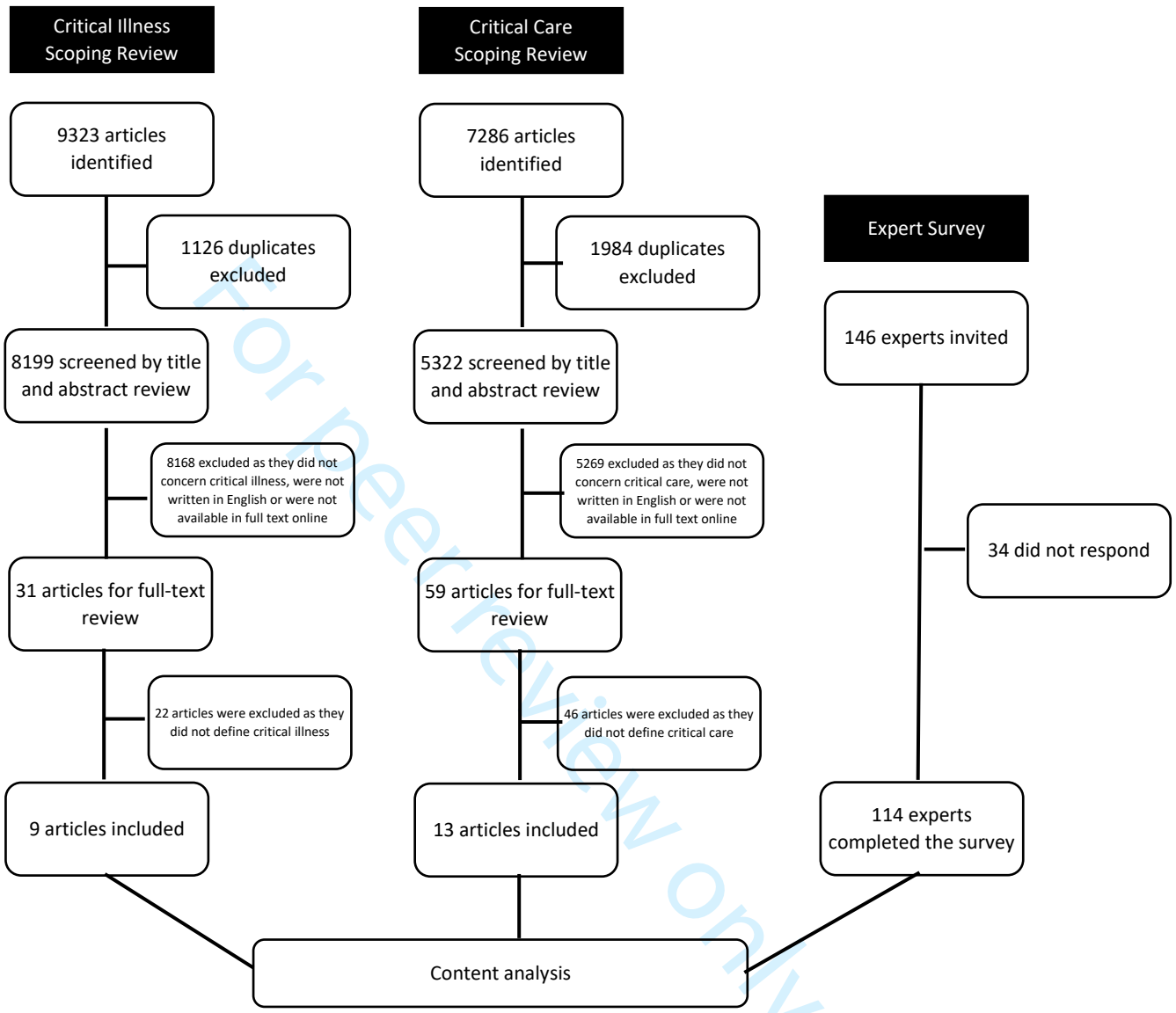


Figure 2: The defining attributes of critical illness

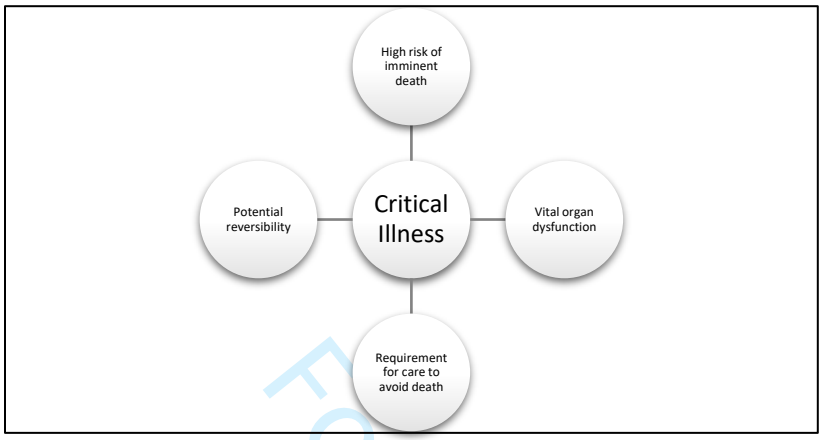
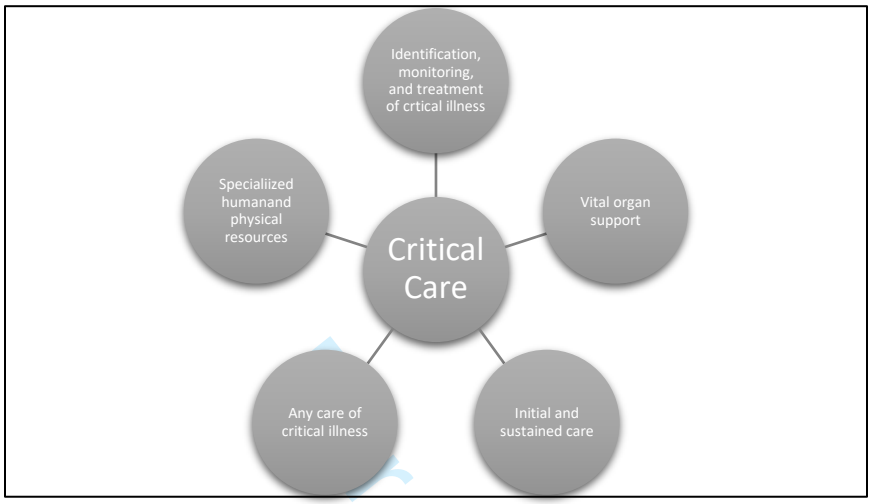


Figure 3: The defining attributes of critical care



Supplementary Table 1 Literature with definitions of critical illness

	First Author and Publication Date	Country	Reference
1	Kievlan 2016	United States	Kievlan DR, Martin-Gill C, Kahn JM, Callaway CW, Yealy DM, Angus DC, et al. External validation of a prehospital risk score for critical illness. Crit Care. 2016;20(1):255.
2	Warttig 2018	United Kingdom	Warttig S, Alderson P, Evans DJW, Lewis SR, Kourbeti IS, Smith AF. Automated monitoring compared to standard care for the early detection of sepsis in critically ill patients (Review). Cochrane Database of Syst Rev. 2018(6):28.
3	Rodriguez 2018	United States	Rodriguez RM, Greenwood JC, Nuckton TJ, Darger B, Shofer FS, Troeger D, et al. Comparison of qSOFA with current emergency department tools for screening of patients with sepsis for critical illness. Emerg Med J. 2018;35(6):350-6.
4	Benneyworth 2015	United States	Benneyworth BD, Bennett WE, Carroll AE. Cross-sectional comparison of critically ill pediatric patients across hospitals with various levels of pediatric care. BMC Res Notes. 2015;8:693.
5	Hsu 2016	Taiwan	Hsu CW, Lin CS, Chen SJ, Lin SH, Lin CL, Kao CH. Risk of type 2 diabetes mellitus in patients with acute critical illness: a population-based cohort study. Intensive Care Med. 2016;42(1):38-45.
6	Painter 2013	United States	Painter JR. Critical Care in the Surgical Global Period. Chest. 2013;143(3):851-5.
7	Chandrashekar 2015	India	Chandrashekar M, Shivaraj BM, Krishna VP. A study on prognostic value of serum cortisol in determining the outcome in the critically ill patients. JEMDS. 2015;4(58):10130-5.
8	Liao 2014	United States	Liao MM, Lezotte D, Lowenstein SR, Howard K, Finley Z, Feng ZP, et al. Sensitivity of systemic inflammatory response syndrome for critical illness among ED patients. Am J of Emerg Med. 2014;32(11):1319-25.
9	Valentin 2011	23 countries	Valentin A, Ferdinande P, Improvem EWGQ. Recommendations on basic requirements for intensive care units: structural and organizational aspects. Intensive Care Med. 2011;37(10):1575-87.

Supplementary Table 2 Literature with definitions of critical care

	First Author and Publication Date	Country	Reference
1	Wunsch 2008	United States, France, UK, Canada, Belgium	Wunsch H, Angus DC, Harrison DA, Collange O, Fowler R, Hoste EA, et al. Variation in critical care services across North America and Western Europe. Crit Care Med. 2008;36(10):2787-93, e1-9
2	Prin 2012	United States	Prin M, Wunsch H. International comparisons of intensive care: informing outcomes and improving standards. Curr Opin Crit Care. 2012;18(6):700-6
3	Painter 2013	United States	Painter JR. Critical care in the surgical global period. Chest. 2013;143(3):851-5
4	Royal College of Anaesthetists 2018	England	https://www.rcoa.ac.uk/sites/default/files/documents/2020-06/EMC-Guidelines2018.pdf
5	Joint Faculty of Intensive Care Medicine of Ireland and Intensive Care Society of Ireland 2019	Ireland	https://jficmi.anaesthesia.ie/wp-content/uploads/2019/09/National-Standards-for-Adult-Critical-Services-2019.pdf
6	Marshall 2017	Many countries	Marshall JC, Bosco L, Adhikari NK, Connolly B, Diaz J v., Dorman T, et al. What is an intensive care unit? A report of the task force of the World Federation of Societies of Intensive and Critical Care Medicine. Journal of Critical Care. 2017 Feb;37:270–6.
7	The International Surgical Outcomes Study 2016	Many countries	International Surgical Outcomes Study g. Global patient outcomes after elective surgery: prospective cohort study in 27 low-, middle- and high-income countries. Br J Anaesth. 2016;117(5):601-9
8	Benneyworth 2015	United States	Benneyworth BD, Bennett WE, Carroll AE. Cross-sectional comparison of critically ill pediatric patients across hospitals with various levels of pediatric care. BMC Res Notes. 2015;8:693.
9	Kievlan 2016	United States	Kievlan DR, Martin-Gill C, Kahn JM, Callaway CW, Yealy DM, Angus DC, et al. External validation of a prehospital risk score for critical illness. Crit Care. 2016;20(1):255.
10	Boyle 2008	Australia	Boyle M, Butcher R, Conyers V, Kendrick T, MacNamara M, Lang S. Transition to intensive care nursing: establishing a starting point. Aust Crit Care. 2008;21(4):190-8.
11	Hirshon 2013	United States	Hirshon JM, Risko N, Calvello EJ, Stewart de Ramirez S, Narayan M, Theodosis C, et al. Health systems and services: the role of acute care. Bull World Health Organ. 2013;91(5):386-8
12	McCarthy 2013	United States	McCarthy C, O'Rourke NC, Madison JM. Integrating advanced practice providers into medical critical care teams. Chest. 2013;143(3):847-50
13	Intensive Care Society 2009	United Kingdom	https://icmwk.com/wp-content/uploads/2014/02/Revised-Levels-of-Care-21-12-09.pdf

Towards Definitions of Critical Care and Critical Illness: A Concept Analysis

Section Item	PRISMA-ScR Checklist Item	Page
Title	Identify the report as a scoping review.	-
Abstract		
Structured summary	Provide a structured summary that includes (as applicable) background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives.	1
Introduction		
Rationale	Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach.	3-4
Objectives	Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives.	4
Methods		
Protocol and registration	Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number.	5
Eligibility criteria	Specify characteristics of the sources of evidence used as eligibility criteria (e.g.,	5

	years considered, language, and publication status), and provide a rationale.	
6 Information sources	Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed	5
Search	Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated.	5
Selection of sources of evidence	State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review.	5
Data charting process	Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators.	7
Data items	List and define all variables for which data were sought and any assumptions and simplifications made.	5
Critical appraisal of individual sources of evidence	If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate).	Not Done
Summary measures	Not applicable for scoping reviews	N/A

Synthesis of results	Describe the methods of handling and summarizing the data that were charted.	7
Risk of bias across studies	Not applicable for scoping reviews	N/A
Additional analyses	Not applicable for scoping reviews.	N/A
Results		
Selection of sources of evidence	Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram.	5-7
Characteristics of sources of evidence	For each source of evidence, present characteristics for which data were charted and provide the citations.	9-13
Critical appraisal within sources of evidence	If done, present data on critical appraisal of included sources of evidence (see item 12).	Not Done
Results of individual sources of evidence	For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives.	9-13
Synthesis of results	Summarize and/or present the charting results as they relate to the review questions and objectives.	9-13
Risk of bias across studies	Not applicable for scoping reviews.	N/A
Additional analyses	Not applicable for scoping reviews.	N/A
Discussion		
Summary of evidence	Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups.	14-17

Limitations	Discuss the limitations of the scoping review process.	17
Conclusions	Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps.	17
Funding	Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review.	18