



BMJ Open Characteristics, outcomes and complications among nonagenarians and centenarians admitted to intensive care: a scoping review protocol

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ABSTRACT

Introduction Nonagenarians and centenarians, compared with other age groups, often exhibit distinct physiological characteristics and a higher prevalence of comorbidities, thus further complicating their care in intensive care unit (ICU) settings. Despite the increasing number of such patients being admitted to ICUs, comprehensive research and studies on their characteristics, outcomes and complications during their ICU stays remain lacking. This scoping review will comprehensively address the following question: What are the characteristics, outcomes, complications and mortality rates among nonagenarians and centenarians admitted to ICUs, including their preadmission health status, reasons for admission, duration of hospital/ICU stays, and factors associated with adverse outcomes? The key objectives are to map the breadth and depth of the available evidence and identify key concepts, gaps and variations in research focus. Finally, we aim to highlight well-studied areas suitable for systematic synthesis, point to underexplored topics warranting further investigation and propose standardised approaches to research design and reporting in this domain.

Methods and analysis We will conduct a systematic search of MEDLINE, Embase and the Cochrane Library in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews guidelines. All studies and publications reporting data on patients aged ≥90 years will be included, from an unlimited timeline to 31 August 2024. Studies reporting the characteristics, outcomes and complications of nonagenarians and centenarians admitted to ICUs will be included. The data will be analysed and summarised descriptively through a narrative approach. Qualitative data related to quality-of-life outcomes will be analysed thematically, as applicable.

Ethics and dissemination Ethics approval was not required. The findings will be disseminated through professional networks, conference presentations and publications in scientific journals.

INTRODUCTION

Over the past few decades, advancements in healthcare, improved living conditions and better disease management have significantly

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ This scoping review protocol is the first to map the comprehensive range of characteristics, complications, and outcomes of nonagenarians and centenarians admitted to intensive care units (ICUs).
- ⇒ This review will employ rigorous methodology, following the standards of Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews.
- ⇒ This review will provide valuable insights into the unique needs and challenges faced by nonagenarian and centenarian patients in ICUs.
- ⇒ Only articles in English will be reviewed, which may limit diverse perspectives from non-English publications.
- ⇒ This review will exclude case reports and case series with less than 30 patients.

increased life expectancy and have markedly increased the number of nonagenarians and centenarians. As medical advancements continue to extend the human life expectancy, the population of individuals 90 years of age or above is growing at an exponential rate.¹ In 2015, the global population included 16.3 million nonagenarians, and this figure is projected to surge to approximately 30.9 million by the year 2030.² Furthermore, innovative breakthroughs in surgery and anaesthesia have resulted in increasing proportions of nonagenarians receiving and undergoing elective surgeries.³

With the exponential population growth and performance of medical procedures among nonagenarians and centenarians, referrals for patients older than 90 years have substantially increased in recent years for some diseases,⁴ and the demand for intensive care unit (ICU) bed days for nonagenarian and centenarian demographics has also increased. This demographic shift presents unique challenges for healthcare systems,

particularly in ICU settings, where the appropriate and comprehensive medical needs of the nonagenarians and centenarians require specialised attention and tailored approaches to care.

Recognising the time course and patterns of these complications enables the development of preventive measures and treatment protocols that improve patient outcomes and decrease healthcare burdens. Overall, a comprehensive understanding of these aspects supports the creation of evidence-based guidelines for healthcare systems, promotes personalised care and aids in the formulation of interventions designed to improve the health and well-being of nonagenarians and centenarians in critical care settings.

To date, systematic or scoping reviews addressing the characteristics, outcomes and complications of nonagenarians and centenarians admitted to ICUs have been lacking. Indeed, although the increased risk of mortality and complications in the nonagenarian and centenarian population has been evaluated,⁵ a substantial gap remains in knowledge regarding the oldest individuals and their medical backgrounds and outcomes in ICUs. Given the low volume of published research on this topic, this scoping review will encompass a wider array of questions to explore the landscape of available research comprehensively, to map the breadth and depth of the available evidence and to identify key concepts, gaps and variations in research focus. We will identify areas where evidence is lacking or inconsistent, such as under-represented regions or healthcare systems. Disparities in outcomes based on gender, socioeconomic status or healthcare delivery models will all be explored within the scope of this review. Further, it will provide a framework and foundation for future, targeted systematic reviews or primary research by highlighting well-studied areas suitable for systematic synthesis, pointing to underexplored topics warranting further investigation and proposing standardised approaches to research design and reporting in this domain.

Identifying research question

What are the characteristics, outcomes, complications and mortality rates among nonagenarians and centenarians admitted to ICUs, including their preadmission health status, reasons for admission, duration of hospital/ICU stays and factors associated with adverse outcomes?

Objectives

The primary objectives are to map the current understanding of characteristics, outcomes and complications among nonagenarians and centenarians admitted to ICUs. Further aims, if possible, include the following:

- ▶ Summarise demographic information for nonagenarians and centenarians, such as sex and age distribution (90–99, 100+ years).
- ▶ Summarise patients' preadmission health status and active medical conditions (eg, cardiovascular disease,

chronic kidney disease, dementia, diabetes or chronic obstructive pulmonary disease).

- ▶ Identify causes and sources of ICU admissions.
- ▶ Identify common ICU-related complications and medical procedural and treatment-related complications, as well as their rates.
- ▶ Identify inpatient, postdischarge 30-day, 1-year, 5-year and 10-year mortality rates.
- ▶ Identify any risk factors associated with mortality or further deterioration.
- ▶ Summarise the duration of total hospital and ICU stays.
- ▶ Identify the effects of ICU admission on patient quality of life.
- ▶ Identify rates of readmission to hospitals or ICUs.
- ▶ Identify gaps in the sociodemographic and health status of nonagenarians and centenarians admitted to ICUs, and determine how these differ across various health domains, countries, ethnicities and sexes.
- ▶ Identify whether pre-existing comorbidities affect patients' complications and mortality rates.
- ▶ Explore how treatment approaches, including life-sustaining interventions and palliative care considerations, differ for this age group.
- ▶ Examine the decision-making processes involved in managing critically ill older patients, addressing the ethical and clinical challenges associated with care for the very old.
- ▶ Examine and synthesise the resource implications, resource allocation and cost-effectiveness of care provided to these patients.
- ▶ Identifying gaps in the current literature to inform future research directions, encouraging the development of tailored clinical guidelines and protocols that specifically address the needs of critically ill nonagenarians and centenarians.

METHODS AND ANALYSIS

The scoping review will be conducted by following the relevant aspects of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension (PRISMA) for Scoping Review Protocols guidelines,⁶ thereby enabling a systematic review of the existing literature to ensure rigour and replicability. Furthermore, the methodological framework described by Arksey and O'Malley⁷ and extended by Levac *et al*⁸ will be used.

Protocol and registration

After discussions with senior intensivists, geriatricians, anaesthetists and epidemiologists working in ICUs and critical care settings, this protocol was developed with a broad research question of describing characteristics, outcomes and complications among nonagenarians and centenarians admitted to ICUs. All studies and publications reporting data on patients aged ≥90 years will be included, from an unlimited timeline to 31 August 2024. Capturing all available studies allows for a more holistic synthesis of evidence across decades, preventing

Table 1 Review of eligibility criteria for the nonagenarian and centenarian population, context, concept and types of evidence

	Inclusion	Exclusion
Population	Human participants 90 years of age or older.	Human participants younger than 90 years Animal studies.
Context	Exploring ICU-admitted nonagenarians and centenarians: <ul style="list-style-type: none"> ▶ Mortality rate. ▶ Length of ICU and hospital stay. ▶ Readmission rates to ICUs. ▶ Patient quality of life after discharge. ▶ ICU-related complications. ▶ Procedural or treatment-related complications during ICU stay. ▶ Source of admission to ICUs. ▶ Baseline health status and comorbidities. 	Exploring any outcomes of nonagenarians and centenarians who are outpatients at any hospitals.
Concept	Studies evaluating health-related characteristics, outcomes and complications of nonagenarians and centenarians admitted to ICUs. Studies collecting and demonstrating any health-related data regarding nonagenarians and centenarians admitted to ICUs.	Studies evaluating non-health-related characteristics, outcomes and complications among nonagenarians and centenarians admitted to ICUs (eg, economic outcomes).
Types of evidence	Primary empirical research studies (eg, randomised controlled trials, cross-sectional studies or cohort studies). Grey literature including government reports, policy papers including guidelines or position statements issued by organisations or agencies, white papers that provide in-depth reports or guidelines that address specific problems or propose solutions for nonagenarians and centenarians admitted to ICU and preprints, that is research articles shared publicly before undergoing peer review.	Case reports and case series with less than 15 patients. Abstracts written in languages other than English. Abstracts or posters, editorial articles, protocols, planned studies and dissertations.

ICU, intensive care unit.

critical gaps in understanding and allowing important temporal trends and evolution analysis to be investigated. Older literature might shed light on historical practices, enabling comparisons with contemporary approaches to managing elderly ICU patient and tracking outcomes over time highlights improvements or persistent challenges, such as mortality rates or quality of life post-ICU.

Search strategy

Eligible published studies will be searched through MEDLINE (OVID interface), Embase (OVID interface) and the Cochrane Central Register of Controlled Trials (Cochrane Library). Additional literature will be discovered through review of the references of relevant studies. Literature search strategies will be developed by using Medical Subject Headings and text words related to older patients admitted to ICUs (see online supplemental file 1).

Type of studies

Primary empirical research studies will be eligible for inclusion, whereas editorials, protocols for planned studies, abstracts and dissertations are planned to be excluded (table 1).

Eligibility criteria

Any studies and publications reporting data on patients 90 years or older will be included from an unlimited timeline. Because the primary aim of this review is to provide a broad overview of ICU outcomes, our eligibility criteria

will include nonagenarians and centenarians admitted to critical care settings including the following:

- ▶ Critical care units.
- ▶ Intensive care units.
- ▶ Coronary care units.
- ▶ Unspecified hospital wards during critical illness.

Abstracts not available in English will be excluded from the review. If an abstract meets the eligibility criteria, but the full manuscript is not in English, we will translate the manuscript into English to include it in the review. Although focusing solely on English-language sources could introduce bias and affect the generalisability of the findings to non-English-speaking regions, this limitation is acceptable, given that the review is scoping in nature rather than being intended to inform evidence-based practice.

Screening procedure

This review will be performed with Covidence systematic review software (Veritas Health Innovation, Melbourne, Australia), an online platform designed for systematic reviews. The screening process will involve three stages: title, abstract and full-text review. Initially, two reviewers (BC and DKL) will independently evaluate the titles and abstracts for eligibility. To enhance the reliability of the screening, a pilot test of the initial screening will be conducted on a random sample of 50 articles by using the predefined eligibility criteria. The kappa statistic will be calculated to assess inter-rater agreement for

study inclusion.⁹ The kappa values will be interpreted as follows: ≤ 0 indicates no agreement, 0.01–0.20 indicates slight agreement, 0.21–0.40 indicates fair agreement, 0.41–0.60 indicates moderate agreement, 0.61–0.80 indicates substantial agreement and 0.81–1.00 indicates almost perfect agreement. A kappa value of 0.8–0.90 (indicating strong agreement) will be the predetermined threshold for acceptance. Any disagreements will be resolved through discussion and, if necessary, by a third reviewer (NR). The data-charting form will be updated to address any discrepancies identified by the third reviewer.

Subsequently, full-text articles of all relevant and potentially relevant studies will be retrieved and independently screened by two reviewers (LW and JMS), and any discrepancies will be resolved by a third reviewer (NR). Studies that do not meet the inclusion criteria will be excluded. To ensure study feasibility and adherence to our data collection instruments and to identify any potential issues or gaps in the scoping review protocol, pilot testing will be conducted on the first 50 records. This process will allow the research team to become familiar with the protocol procedures. The inclusion and exclusion criteria will be refined to ensure consistent application. Reasons for exclusion of studies after full-text assessment will be documented. The entire screening process will be illustrated with a PPRISMA flowchart.

Data extraction

Included studies will be organised into a specially designed data extraction form to ensure that all relevant details are captured. This process will be performed by two reviewers working independently (LW and JMS), and any disagreements will be addressed through consultation with a third reviewer (NR), if needed. To effectively indicate the evidence and meet the review's objectives, summary tables will be created. The data to be extracted will focus on meeting both the primary and secondary aims of the review.

- ▶ First author.
- ▶ Year of publication.
- ▶ Country of ICU admission.
- ▶ Years of data collection.
- ▶ Population size of the studies.
- ▶ Type of studies and research method.
- ▶ Baseline health status before admission.
- ▶ Population demographics (eg, age group, sex, socioeconomic status and ethnicity).
- ▶ Medical or surgical procedures performed during admission.
- ▶ Postdischarge complication rate.
- ▶ Postdischarge mortality rate (eg, inpatient, 30 days, 1 year, 5 years and 10 years).
- ▶ Quality of life outcomes.

Data synthesis

Data analysis will be performed by authors JMS and DKL using statistical software (StataCorp 2023 Stata Statistical Software, V. 18; College Station, Texas, USA:

StataCorp LLC), and the results will be presented in a descriptive manner. Specifically, data will be reported as counts (proportions), medians (interquartile ranges) and ranges (from minimum to maximum values). Study characteristics will be illustrated through both tables and graphs, complemented by a narrative summary in the text. Where appropriate, inferential statistical methods will be applied to evaluate the likelihood of observed differences between groups. Research gaps will be identified through a comparative analysis of both study and participant characteristics.

Qualitative data concerning quality-of-life outcomes, when available, will be analysed through thematic analysis based on Braun and Clarke's inductive–deductive approach.¹⁰ This analysis will be aimed at uncovering recurring themes and patterns associated with how ICU admissions influence quality of life among nonagenarians and centenarians, as well as the implications for health-care resources. In reporting the results, we will highlight both similarities and differences in the selection criteria for nonagenarians and centenarians admitted to ICUs, as well as the risk stratification processes used during their hospital and ICU stays. Specifically, this review will assess the current individual, institutional and system-level quality of care indicators for nonagenarians and centenarians admitted to ICU settings.

Patient and public involvement

This work analyses existing research studies and therefore involves no patients or members of the public.

ETHICS AND DISSEMINATION

Approval from the Human Research Ethics Committee was not required because the proposed study will not involve any unpublished secondary data or human participants. The findings of the scoping review will be disseminated through publications in a scientific journal and presentations in scientific conferences and professional networks.

Implications

This scoping review is aimed at providing an enhanced understanding of the complexities faced by medical physicians treating nonagenarian and centenarian patients admitted to ICUs. The review will consolidate and clarify existing current data, evidence and knowledge regarding key indicators affecting outcomes of critically ill patients, covering all stages of their care, both before and after ICU admission. Notably, knowledge translation will be facilitated by the review by disseminating findings to local, national and international stakeholders.

Enhanced understanding gained from this review could help identify any knowledge gaps and consolidate current evidence bases. Identifying these knowledge gaps would allow anaesthesiologists, intensivists, geriatricians and rehabilitation physicians to better assess any risks associated with ICU admissions and to prepare

and prevent any associated complications within ICU stays. Consequently, physicians would be able to provide patients and their families with valuable outcome data for guiding informed discussions about possible complications and outcomes of ICU stays. Furthermore, the review will help examine the implications of the findings for future healthcare resource planning for nonagenarian and centenarian patients and provide guidance for appropriate directions for future research. By providing a comprehensive summary of both quantitative and qualitative data and outcomes, this review is aimed at advancing understanding among clinicians, patients and hospital administrators and highlighting the healthcare challenges faced by critically ill nonagenarian and centenarian patients admitted to ICUs, thus ultimately enabling improved and tailored care for patients and supporting the formation of a much more efficient healthcare system.

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