Outcome and Quality of Life of Elderly Patients Admitted to the Intensive Care Unit: A Literature Review

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Abstract: The ageing of the global population become a dramatic phenomenon due to a decline in mortality and fertility rate. There has been a significant rise in the probability of survival to an older age, with a significant increase in the total number of older people expected to increase extremely. Intensive care unit and critical care patients not only look to ensure survival and avoid associated complications, but also look to return to the pre-admission level of function. Furthermore, elderly patients who are found to survive critical illness sometimes require advanced care through nursing homes. In light of this view, there is a need to understand the short-term and long-term outcomes of intensive care unit admission for elderly patients. The aims of this literature review were to examine the intensive care unit and critical care related outcomes of the elderly and to identify the differences in the requirements and provisions linked to such care. Through the review 20 articles were selected by rigorous methodology. The review findings show that short term mortality is strongly linked to age. Most studies show significant increase in the long-term rate of mortality. This identifies the need to assess the impact upon of secondary outcomes such as quality of life and activities of daily life. Evidences also show that co-morbidity, length of stay (LOS), sepsis as well as surgery can impact mortality outcomes. Most of the studies indicate low recovery of overall quality of life (QoL) and activity of daily life (ADL) after intensive care unit (ICU) admission. Therefore, this review contends that the rationale for admitting the elderly to the ICU and the rationale for assessing outcomes should not be restricted to short-term outcomes but also be extended to long-term outcomes. In addition, the benefits of an ICU admission are not clear when it comes to patients aged 80 years and older who have been hospitalised for medical reasons or unplanned surgery. There are two reasonable options available for these patients. This can be promoted through the policy of admitting to an acute care for the elderly or a regular ward instead of the ICU as well as admission of selected patients to the ICU along with the promotion of efforts to make sure that the ICU discharge is rapid.

Key words: ICU • Intensive Care Unit • Mortality • Elderly • Quality of Life • Outcome

INTRODUCTION

The ageing of the global population and the accompanying demographic transition due to a decline in mortality and fertility has been well examined in literature [1, 2]. Furthermore, the United Nations [3] reported that there has been a significant rise in the probability of survival to an older age, with a significant increase in the total number of older people expected to increase significantly. The fastest growing population cohort includes those more than 80 years of age. The report identified that there is an estimated 3.8% increase in the global population of those aged more than 80 years by [3]. A similar demographic transition was observed in the UK. As Hood et al. [4] report, patient characteristics within the UK are changing significantly. It is estimated that by 2033, the population aged 65 and above is set to increase to 15.8 million. This is a 32% increase over the population in [5]. The change in demographic has also led to a changing need for provision of healthcare. The ageing of people had led to the presence of complex co-morbidities, disabilities and frailty. An increase in the
complexity of diseases amongst the elderly has also led to an increase in the need for critical care, which in turn leads to an increase in the overall rate of hospitalisation for acute illness amongst the elderly [6].

Many studies have forecast a significant increase in the need for intensive care unit (ICU) and critical care facilities. Bagshaw et al. [7] reported that the general demand for critical care services and admissions to ICU is expected to increase world-wide. The authors argue that by 2015, the admission of the elderly aged 80 and above will increase by 72%. Similarly, Angus et al. [8] reported that in the US it is expected to be a 55% increase in occupancy of ICU beds by patients aged 65 and above by 2020. Additionally, the authors concluded that an estimated 14% of patients above the age of 84 die in the ICU. According to extant literature, these disparities, while being attributed to differences in severity & type of illness, length of follow up [9] and treatment intensity [10], can also be attributed to quality of care and the existence of extended morbidity due to better care conditions. Furthermore, Wunsch et al. [11] argued that though there is a variation in the supply of critical care services across developed countries, there are bound to be proportionate changes. The constraints faced by healthcare financing and uncertainty regarding the actual benefits of ICU care in some instances, highlighted the need for age specific critical care service policies [12]. Additionally, Shoenenberger et al. [13] reported that event after exclusion of patients with no potential indications and adjustment for confounding factors (such as co-morbidities), elderly patients aged 80 years and above with acute myocardial infarction are less likely to receive the recommended medical care. Roch et al. [14] concluded that this is to avoid the inherent risks and costs of treatment. However, as the authors argued, this can cause a decrease in the quality of life.

These policy constraints are reflected in the UK as well. According to the Health Foundation [15], people above the age of 65 account for 51% of local authority spending on social and health care. Additionally, the Department of Health [16] also reported that 70% of health and social care expenditure is on the elderly who have long term conditions. Researchers and policy makers argued that there has been a drop in the level of medical care available to the elderly in the UK [16]. As Beales and Tulloch [17] argued, the National Health Services (NHS) in the UK has been unable to keep up with the shift in demographics. Additionally, Roland and Paddison [18] argued that the increase in co-morbidity and complexity of conditions has led to the need for complex critical and intensive care for the elderly. Additionally, as the Centre for Policy on ageing [19] argues, there is evidence of ageism and age-related discrimination in the UK health and social care system. The report argues that there is a decrease in access to critical care treatment for the elderly. The NHS [20] report further argues that there is a gap in provision of intermediate and long-term support for elderly critical care individuals.

The purposes of this literature review were to examine the ICU and critical care related outcomes of the elderly and to identify the differences in the requirements and provisions linked to such care.

The studies that assessed outcomes of elderly patients included those who have been included in the ICU rather than other elderly who were admitted to the hospital. The probability of under representation of older patients with severe impairments is high when compared to other admitted older patients who don’t have a complex diagnosis, causing the results to be biased. According to Somme et al. [21], even though hospital mortality can be significantly determined by age, severity of the acute illness is the most significant determinant of ICU mortality. According to Boumendil et al. [22], long-term outcomes are majorly affected by severe disability and age.

According to Garrouste-Orgeas et al. [23] who conducted a cohort study on triaged patients, they identified that in addition to self-sufficiency and non-surgical disease, age was an independent attribute for refusal in ICU. The second significant aspect is linked to facilitating the involvement of patients in decisions regarding the treatments they receive in the event of a life-threatening condition. In addition, surviving critical illness among older patients at the cost of self-sufficiency causes frequent distress among them due to the burden they feel they would impose on their family. De Rootj et al. [24] observed that there is ambiguity regarding the wishes of the patients when they are triaged to the ICU due to under-recognition of any existing cognitive impairment [25], the primary-care physician not being present, advance directives being absent and acute cognitive impairment [26].

According to Simchen et al. [27], the wishes regarding ICU admission have no correlation with the patient characteristics such as quality of life and self-sufficiency. The authors further add that admission to
ICU may be desired by patients with minimal chance of recovery.

According to Grimaldi et al. [28], the primary assessment of severity of illness classifies systems for intensive care linked to age as a key factor. It was observed that chronological age acted as a risk factor in the case of death from acute illness. However, the significance of age as a mortality predictor has evolved to be a controversial topic. Hood et al. [4] argued that once suitable adjustments have been made for severity of injury or illness, old age may no longer be an independent risk factor. On the other hand, Fuchs et al. [29] have argued that there is a link between age and a rising risk of in-hospital death.

Nevertheless, in comparison to age, prognosis is impacted more by comorbidities and premorbid functional status [10, 30]. The authors further add that old age should not be taken as a reason for withholding intensive care. The severity of acute illness is a significant attribute of short-term prognosis, regardless of age. The abnormality level of physiological parameters which refers to the divergence level from normal physiological homeostasis can be scored to quantify this severity [29].

When it comes to making decisions regarding the goals of care in the event of critical care, difficult choices are faced by patients and physicians. According to Boumendil et al. [10], it is very common for elderly patients in Western countries to be admitted to the intensive care unit (ICU). Pisani [31] further added that there is a high probability of this situation growing in the future. Researchers argue that, despite this, the physicians are not sure if ICU care should be extended to elderly patients because even if care is provided, there is the inevitability of the poor long-term and false outcomes [32].

It is important to either rule out or confirm the above hypothesis in the case of healthy elderly subjects who have a good pre-morbid status before being admitted to the ICU and for those patients where theoretical long-life expectancy before being admitted to critical care is high [33]. The traditional focus of critical care literature has been on mortality, also referred to as “hard outcomes”, which has implications stronger than the “soft outcomes”. Vest et al. [34] identified physiological or secondary outcomes as common aspects of ICU research. The relevance of these outcomes in terms of patient function after discharge is a major limitation. Pre-morbid functional status, comorbidities and the severity of illness impact upon the mortality in critically ill patients. Azoulay et al. [35] argued that the decision against providing life support has been observed to predict mortality, regardless of the severity of illness and comorbidities. In the case of critically ill older patients, mortality is universally high, even though these factors have considerable variability in mortality.

Reinikainen et al. [36] argued the need to acknowledge that there is an increased number of elderly patients in ICU, given the advancement in surgical and medical treatments, in addition to the increasing proportion of elderly in the population in general. Consequently, the expectation that elderly patients will survive intensive care is high, even though they have low reported rates of long-term survival (34% to 52%) [37]. Nevertheless, the outcomes of intensive care cannot solely be determined by survival rates, thus health-related quality of life (HRQOL) is stressed as a treatment outcome measure [38]. With awareness of HRQOL after intensive care, patient management can be improved in addition to resource allocation, policy making and information given to the survivors and their family.

Survival is not the sole goal of critical care. It also aims at restoring the pre-admission level of function and returning the patient to the living arrangement they had prior to being admitted. According to Rady and Johnson [39], nursing home admission may be required for elderly patients who survive critical illness but suffer undesirable functional impairments. Azoulay et al. [40] further added that although the objective outcome is self-sufficiency, details on outcomes perceived by ICU survivors are provided by quality of life assessments.

The aims of the review were to examine the ICU and critical care related outcomes of the elderly and to identify the differences in the requirements and provisions linked to such care. The objectives include identifying the short term and long-term outcomes of morbidity and mortality indicators amongst elderly patients admitted to the ICU, assessing the quality of life and functional autonomy related outcomes for elderly patients after an ICU stay and exploring the impact of age and other comorbidities on the overall outcome of the patient.

**MATERIALS AND METHODS**

**Search Process:** Electronic databases have been used as the primary source for relevant literature including PubMed, Medline and Science Direct. The key terms were
Fig. 1: Flow diagram of literature Search

developed with the assistance of librarian and included ICU, Intensive care unit, critical care unit, elderly, older population, 65+ population, Morbidity outcome, mortality outcomes, QoL, functional autonomy, quality of life, Functional autonomy. “The Boolean search” indicate of using AND, OR and NOT to structure a term to be able to further produce more relevant results regarding you research topic. In order to ensure the transparency of the research process, information pertaining to the search has been documented in Figure 1.

Inclusion Criteria: Studies available in English, primary research articles, publish between 2004–2015, directly relate to ICU outcomes of elderly, aged 65+ and identify morbidity and mortality indicators or QoL and functional autonomy indicators. The final list of papers which were chosen and the steps taken to arrive at this list of papers is given in Figure 1.

RESULTS

The study used the framework given by Moher et al. [56] to identify the relevant papers for the research. Extraction tool developed by the author were used to explore the different studies identified for each of the outcomes. The overall papers identified for this review number 20. Ten articles exclusively talk about morbidity and mortality factors. It is interesting to see that long-term outcome discussions also discuss morbidity and mortality. Therefore, overall, 17 papers discuss morbidity and mortality. Ten papers discuss long-term outcomes including functional autonomy, adjustment to daily life and quality of life indicators. Finally, three papers discuss some perspectives provided by nurses and doctors regarding the challenges in treating the elderly in ICU units. The analysis of the study type was conducted by making use of the Hierarchy of evidence (HOE) scores summarized in Table 1. It is evident that most of the studies are cohort studies, as the aim was to check outcomes of admission. Therefore, there is no RCT present. Most were cross-sectional cohorts or retrospective cohort studies. However, three studies were prospective in nature. The cross-sectional studies were predominantly linked to the challenge and barrier assessment. It is also observed that there was one observational and one study which reported findings linked to focus group discussion (Table 2).
Table 1: Summary of the included studies

<table>
<thead>
<tr>
<th>Reference</th>
<th>Country</th>
<th>HOE scores</th>
<th>Method</th>
<th>Design</th>
<th>Measured outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuchs et al. [2]</td>
<td>USA</td>
<td>2++</td>
<td>Quantitative</td>
<td>Cohort design</td>
<td>Mortality and length of stay</td>
</tr>
<tr>
<td>Bournemill et al. [6]</td>
<td>France</td>
<td>2++</td>
<td>Quantitative</td>
<td>Observational prospective study</td>
<td>Mortality rate</td>
</tr>
<tr>
<td>Roch et al. [14]</td>
<td>France</td>
<td>2+</td>
<td>Quantitative</td>
<td>Cohort design</td>
<td>Mortality, survival rate, length of stay and acute illnesses</td>
</tr>
<tr>
<td>Maillet et al. [30]</td>
<td>France</td>
<td>2-</td>
<td>Quantitative</td>
<td>Retrospective evaluation</td>
<td>Quality of life, survival rate and chances of surviving infections</td>
</tr>
<tr>
<td>Vest et al. [34]</td>
<td>USA</td>
<td>2-</td>
<td>Quantitative</td>
<td>Cross-sectional study</td>
<td>Quality of life, mortality rate, activities of daily living.</td>
</tr>
<tr>
<td>Huynh et al. [41]</td>
<td>USA</td>
<td>2-</td>
<td>Quantitative</td>
<td>Cross-sectional study</td>
<td>Survival rate</td>
</tr>
<tr>
<td>Andersen et al. [42]</td>
<td>Norway</td>
<td>2-</td>
<td>Quantitative</td>
<td>Cross-sectional study</td>
<td>Mortality, quality of life after admission</td>
</tr>
<tr>
<td>Friedrich et al. [43]</td>
<td>Canada</td>
<td>2-</td>
<td>Quantitative</td>
<td>Cohort design</td>
<td>Hospital mortality, ICU admission, place of residence at hospital discharge, chances of acquiring ICU infections, multiple organ failure</td>
</tr>
<tr>
<td>Tabah et al. [44]</td>
<td>France</td>
<td>2+</td>
<td>Quantitative</td>
<td>Prospective observational study</td>
<td>Quality of life, length of stay and mortality</td>
</tr>
<tr>
<td>Sacanella et al. [45]</td>
<td>Spain</td>
<td>2+</td>
<td>Quantitative</td>
<td>Cohort design</td>
<td>Mortality, functional autonomy and quality of life</td>
</tr>
<tr>
<td>Sodhi et al. [46]</td>
<td>India</td>
<td>2+</td>
<td>Quantitative</td>
<td>Retrospective observational study</td>
<td>Quality of life after tracheostomy, length of stay in ICU, mortality</td>
</tr>
<tr>
<td>Zampieri &amp; Colombari [47]</td>
<td>Brazil</td>
<td>2-</td>
<td>Quantitative</td>
<td>Cross-sectional study</td>
<td>Mortality, performance status and comorbidities</td>
</tr>
<tr>
<td>Chelluri et al. [48]</td>
<td>USA</td>
<td>2++</td>
<td>Quantitative</td>
<td>Prospective, observational cohort study</td>
<td>The primary outcome was one-year mortality rate and secondary outcomes included functional status and depressive symptomatology</td>
</tr>
<tr>
<td>Pavoni et al. [49]</td>
<td>Italy</td>
<td>2+</td>
<td>Quantitative</td>
<td>Cohort design</td>
<td>Life expectancy and quality of life</td>
</tr>
<tr>
<td>Boyd et al. [50]</td>
<td>USA</td>
<td>2-</td>
<td>Quantitative</td>
<td>Observational Study</td>
<td>Mortality and decline in activity of daily life function</td>
</tr>
<tr>
<td>Gill et al. [51]</td>
<td>Connecticut, Haven</td>
<td>2++</td>
<td>Quantitative</td>
<td>Prospective cohort study</td>
<td>Transitions between no disability to mild disability and to severe disability</td>
</tr>
<tr>
<td>De Rooij et al. [52]</td>
<td>Netherlands</td>
<td>2-</td>
<td>Quantitative</td>
<td>Retrospective cohort study</td>
<td>Mortality and factors influencing mortality</td>
</tr>
<tr>
<td>Nielsen et al. [53]</td>
<td>Denmark</td>
<td>2++</td>
<td>Quantitative</td>
<td>Cohort design</td>
<td>Mortality rate</td>
</tr>
<tr>
<td>Heyland et al. [54]</td>
<td>Canada</td>
<td>2+</td>
<td>Quantitative</td>
<td>Cohort design</td>
<td>Physical recovery from critical illness, mortality</td>
</tr>
<tr>
<td>Brandberg et al. [55]</td>
<td>Sweden</td>
<td>2++</td>
<td>Quantitative</td>
<td>Retrospective cohort study</td>
<td>Mortality and morbidity. Factors affecting these were comorbidities, functional status and primary diagnosis</td>
</tr>
</tbody>
</table>

Table 2: Presence of Sepsis amongst Patients Admitted to the ICU

<table>
<thead>
<tr>
<th>Reference</th>
<th>Percentage</th>
<th>Frequency (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roch et al. [14]</td>
<td>10%</td>
<td>29</td>
</tr>
<tr>
<td>Vest et al. [34]</td>
<td>16%</td>
<td>51</td>
</tr>
<tr>
<td>Andersen et al. [42]</td>
<td>8.9%</td>
<td>35</td>
</tr>
<tr>
<td>Zampieri et al. [47]</td>
<td>23%</td>
<td>285</td>
</tr>
<tr>
<td>Sacanella et al. [45]</td>
<td>20%</td>
<td>23</td>
</tr>
<tr>
<td>Heyland et al. [54]</td>
<td>19%</td>
<td>171</td>
</tr>
<tr>
<td>Brandberg et al. [55]</td>
<td>10%</td>
<td>62</td>
</tr>
</tbody>
</table>

Assessment of Mortality: According to Fuchs et al. [29], the raison d’être of intensive care units is to ensure that there is an overall improvement in the clinical outcomes for acutely ill patients. However, as Nguyen et al. [12], there is a need to reach a balance between the judicious use of limited resources and providing optimal care in the case of the elderly. Therefore, as discussed in the background analysis, the assessment of mortality indicators is a key factor which should be part of any ICU related study which examines elderly outcomes. The purpose of assessing mortality related attributes is to identify if age should be the key criterion which impacts decision making. As Bagshaw et al. [7] contend, since many elderly people are able to survive their critical illness, it is important to look beyond age as the sole criterion which excludes the elderly from ICU treatment. Therefore, if one has to look at other aspects such as severity of illness or functional status to determine the prognosis of the elderly ICU patients, it is first important to identify short term and long-term outcomes linked to mortality of the elderly admitted to ICU units. As reported earlier, most of the studies have reported findings of mortality.

The study conducted by Fuchs et al. [2] targeted the ICU admission characteristics and mortality rates amongst the elderly patients. A total of 8,916 admissions were examined across three groups including 2,585 (13.2%) between 65 and 74; 3,003 (15.4%) between 75 and 84; and 1,677 (8.6%) older than 85. The study evidences indicate that the ratio of overall elderly patients within the ICU population was high. The authors argue that age advancement can be a key predictor for ICU mortality. However, they also argue that several prevalent comorbidities and LOS in the ICU can be factors which impact the overall outcome. The study evidences conclude that the maximum mortality rate was highest in the age group 75–84.

In a study conducted by Nielsson et al. [53], they examined the changes in the proportion of elderly ICU patients and assess the direct link between age and mortality. The study examined ICU patients as a single group with a median age of 64 years. The study findings indicate that the overall proportion of elderly patients who died in the ICU increased from 11.7% in 2005 to 13.8% in 2011. Additionally, the mortality was found to be highest linked to medical related factors (43.7%) when compared to surgery (39.6%).

As reported by Roch et al. [14] who aimed at evaluating the short and long-term survival of elderly patients admitted to ICU, the study examined 2144 patients across a six-year period. The average age of the
patients in the study was 84 years. Therefore, it is evident that there is focus on the very elderly in the research. The study findings show that the overall mortality after ICU admission was 55%. The study findings also show that this rate continues to increase when considered from a long-term perspective. The study results show that 79% of the initial cohort showed mortality within two years of admission. Similarly, Heyland et al. [54] aimed at addressing the overall recovery rate of critically ill patients aged 80 and older. The study findings indicate that patients on average were 84 years of age and 14% mortality was found in the ICU unit. However, 26% of deaths were attributed to normal hospital wards after ICU admission. The authors argued that long-term mortality was linked to physical attributes and recovery rates and that routine assessment of the baseline and physical function of the elderly is important to provide information for prognosis and informed decision making. Furthermore, Brandberg et al. [55] aimed at identifying trends in mortality of critically ill patients aged 65 and above. The study findings indicate that mortality was high amongst patients who had other comorbidities. Mortality was found to be at 15.5% in the ICU. All of the above studies identify direct links between age and mortality.

Many studies examined long-term outcomes including quality of life, functional autonomy or activity of daily life (ADL). However, these authors have provided implications regarding mortality [30, 34 & 44-46]. According to Tabah et al. [44] contend that mortality was 37% at ICU discharge but rose to 45.2% at hospital discharge. The authors contend that after one-year self-sufficiency strongly impacted in mortality. Vest et al. [34], in their assessment of QOL and ADL, argued that while there was 17% mortality at ICU discharge, the one-year post admission mortality rose to 45%. The authors argued that ADL disability and low quality of life impacted upon this mortality rate. They also argue that age could be a predictor of mortality; however, there are other factors which impact upon the relationship. Sacanella et al. [45] supported the views of Tabah et al. [44] and Vest et al. [34]. They argued that long-term outcomes of survival are predominantly linked to other attributes, including functional autonomy and overall quality of life. The study evidence indicates that only 48.9% of patients were alive 12 months after discharge.

Researcher in their assessment of age related differences in the outcome of geriatric patients, identify that amongst 2,317 patients admitted into multi-speciality hospitals, with respect to mortality and overall quality of life, age was the predominant factor impacting mortality and morbidity [46]. Other secondary factors include average length of stay, speciality under which the patient was admitted and admitting diagnosis. The study evidence indicates that the overall rate of mortality was 19.6%. Maillet et al. [30] support this assertion. The authors conclude that age was a key indicator of mortality; however, invasive procedures had a further impact on the outcomes.

From the above evidence, it is clear that there is a link between mortality and age. While some studies [2, 13, 53 & 55] contend that this link is direct and that age is the primary predictor of ICU linked mortalities, other researchers find varying evidence. Five studies contend that age is the primary indicator, but other factors including comorbidity and overall quality of life are some additional factors which need to be examined in this relationship [30, 34, 44 & 46].

Length of Stay (LOS): The first attribute examined in this section is LOS. According to Williams et al. [57], long stays in the ICU can be costly and burdensome both to the patients and the healthcare system. Studies showed that between 2 and 11% of critically ill patients required a longer stay in the ICU [58 60]. This can account for 45% of the total ICU days. Evidences from research contend that the longer the LOS in the ICU, the less the chance of early recovery [61, 62]. According to Zimmerman et al. [63], clinicians need to consider multiple factors before they make a decision regarding the LOS in the ICU. These can include age, associated co-morbidities, severity of infection, physiological reserve and response to therapy. Additionally, as Moreno et al. [64] argue, it is possible that prolonging the stay in the ICU can be considered as a risk factor for poor prognosis.

From Fig. 2, some interesting study findings are identified. Most of the studies showed LOS ranging from one to five days. However, there are some studies which show greater LOS. The lowest recorded LOS was evident in the case of Zampieri et al. [47] 1.3 days, while the highest recorded LOS was in the case of Chelluri et al. [48] 12.57 days. It is important to acknowledge, however, that the LOS (mean) has a high standard deviation. For example, both Sodhi et al. [46] SD= 17.41 and Tabah et al. [44] SD = 6.78 identify high levels of standard deviation. This clearly indicates that the LOS needs to be examined from an independent perspective.

Mechanical Ventilation (MV): The next attribute discussed in this research is the impact of MV and its relevance to mortality linked indicators. According to
Frengley et al. [65], individuals who undergo continued MV can have adverse outcomes with respect to morbidity and mortality, especially when there is an increase in age. Esteban et al. [59] also report that information regarding the mortality of patients who require MV can help predict outcomes. Therefore, this report argues that understanding the implications linked to MV and its impact on the elderly mortality rate is a key. Though none of the studies included in this research examined the impact of MV and its link to mortality, prevalence of MV was evident in many patients. For example, Fuch et al. [2] reported that 47% of patients examined as part of the study had MV. Similarly, Brandberg et al. [55] 39.5% and Maillet et al. [30] 67.5% show high incidence of MV in the ICU amongst elderly patients. This research concludes that there can be a link between MV and mortality and morbidity outcomes, given prior evidences.

Sepsis: Sepsis is an important cause of morbidity and mortality in elderly patients. According to Clarke et al. [67], sepsis can be defined as an inflammatory body response to infection wherein severe sepsis and septic shocks can cause serious damage to the organs. Martin et al. [59] further argue that despite current advances linked to the management of septic patients, sepsis can be considered as the second leading cause of death amongst patients in the ICU. Furthermore, Angus et al. [68] reported that the incidence and prevalence of sepsis increases with age. The authors examined discharges in the US and reported that the annual incidence of sepsis was three per 1000 population. However, the incidence of sepsis in older patients was 26.2 cases per 1000. Additionally, Girard et al. [69] argue that previous comorbid illnesses including renal and pulmonary diseases were found to be commonly associated with increased susceptibility to sepsis. The focus of this section of the literature review is to identify findings from research which provide evidence of sepsis in patients.

Surgery: According to Nguyen [12], surgery can have an impact on mortality indicators. The authors argue that ICU linked outcomes should be examined from the perspective of planned and unplanned surgeries. According to Klopfenstein et al. [70], the number of older patients who undergo surgical procedures has been found to increase faster than the rate of population ageing. This has led to the need to look for alternatives to surgical and anaesthetic techniques [71]. Hamel et al. [72] further reported that despite surgical and anaesthetic advances and improvements in care of older surgical patients, there are adverse post-operative outcomes, especially addressing medical complications which can lead to a longer ICU stay. In light of this view, understanding the impact of surgery as a factor which impacts mortality is a key.

Nielsson et al. [53] reported that acute surgery shows a higher rate of mortality when compared to elective surgery. The authors show the 30-day outcomes for both types of surgery. The study evidences show that the individuals who underwent acute surgery (over 80 years, 39.6%; 65–79 years, 26.3%) were found to have a higher rate of mortality when compared to individuals who were scheduled for elective surgery (over 80 years, 11.6%; 65–79 years, 4.6%). Similar trends can be observed in the case of long term outcomes (i.e. one-year results). Tabah et al. [44], on the other hand, reported that surgical outcomes from scheduled and unscheduled surgeries had a lower rate of mortality when compared to surgical outcomes from medical linked admission. Similarly, reported that the crude mortality rate was higher amongst patients who had a medical diagnosis (62%) when compared to patients admitted to the ICU after a surgical
procedure (47%) [55]. Pavoni et al. [49] reported that ICU mortality was higher in medical patients (14.85%) and surgical patients (14.8%). Interestingly, these authors contest the findings of Nielsson et al. [53] by arguing that unplanned surgery mortality was only four per cent. The authors also report that mortality was highest in medical patients (61.1%), followed by surgical patients (51.3% in abdominal surgery, 46.2% in orthopaedic surgery). This review indicates that such variation in outcomes requires discussion on the direct links between surgery and its impact on overall mortality after ICU admission.

Long Term Outcomes: As observed from the above findings, as well as those in research, short term and long-term mortality findings in elderly patients after ICU care is found to be between 11% and 38% [2, 43]. As discussed at length of stay section, this can largely be attributed to the presence of significant differences in the methodology used as well as the types of surgical outcome discussed. However, apart from these factors, long term outcomes including QoL and ADL need to be considered as key elements which influence overall findings [10]. The purpose of this section is to revisit the concepts of QoL (short term and long term), as well as findings linked to activities of daily life and functional autonomy in the chosen studies. The aim is to understand how these attributes may contribute to the study findings.

According to Pavoni et al. [49] who examined 143 survivors and they reported that post-ICU admission, most of the patients reported deterioration of at least one dimension of quality of life, including mobility, self-care, anxiety, depression, pain/discomfort and perceived health status. It is seen that this problem was found to be reported more amongst medical patients (70.4%) when compared to surgical patients (55.0% planned surgical, 52.5% unplanned surgical). It is also observed that the most commonly considered problem in the case of QoL was self-care. It was evident that 100% of medical and orthopaedic patients reported a decrease in self-care capability. One year after ICU discharge, overall satisfaction as perceived by current health status was found to be worse in most patients with respect to both anxiety and depression.

In another study conducted by Boyd et al. [50], they examined recovery in ADL amongst the elderly after ICU admission. The authors report findings which support those of Pavoni et al. [49]. The authors identified that 12 months after discharge, there were multiple ADL related problems. It was reported that amongst the survivors, only 20.1% of individuals were at their baseline function. After discharge, 17.85% of those individuals who died were found to have worsening ADL functions. Furthermore, it was evident that amongst those who were discharged, there was continued presence of new or additional ADL disability. Additional co-morbidities like...
cardiovascular disease, dementia and cancer were factors which impacted overall recovery and ADL baseline value. According to Gill et al. [51], they examined the association between physical frailty, hospitalisation and restricted activity. The impact of ICU admission was considered a key factor which impacted overall recovery. The higher HR associated with ICU admission was linked to lack of recovery in overall QoL.

From these findings, this review indicates that understanding the importance of QoL is important as it can help predict long term outcomes of mortality and morbidity.

**DISCUSSION**

Two primary themes are identified with respect to short term and long-term mortality indicators. Long term mortality indicators can be impacted upon by severity and frailty of the individual. The review findings indicate that ICU associated with long term mortality is positively linked to age. These results can be compared to previous research findings. According to Clark et al. [67] and Rockwood [73], they indicated that long term mortality after ICU discharge was high and age was an important predictor of this finding. In addition, Udekwu et al. [74] present some interesting findings which indicated that this was largely due to an increase in severity of the disease. Chelluri et al. [48], also present some finding which support this argument by further indicating that pre-hospitalisation health status, level of trauma and, more importantly, frailty were additional indicators of long term outcome. Age influences long term outcomes based on quality of life and severity of illness. These findings further support the results that co-morbidity linked factors need to be examined to identify long term results.

Sub-group mortality indicators need to take physician restriction and treatment intensity as key evidences. Results from the research support the view that advanced age alone cannot be considered as a key indicator of successful ICU outcomes [52, 75 & 76]. However, the findings in the current review show that short term indicators are strongly influenced by age as a risk factor. Three authors reported that those aged 80 and above had the highest mortality rate [2,53 & 55]. One factor which has been linked to such high mortality in the elderly population is the intensity of treatment. According to Heyland et al. [77] who acknowledged the relevance of these findings. Long term mortality is linked to physical attributes and recovery rates and routine assessment of the baseline and physical function of the elderly is important to provide information for prognosis and informed decision making. As reported by Boumendil et al. [78] that very elderly patients often receive low treatment intensity, including circulatory and renal support. Wilson et al. [79] further contend that physician restriction of treatment can be linked to this higher mortality rate in the very elderly. Therefore, when evidences are examined across multiple groups within the elderly population, physician restriction as well as treatment intensity should be considered.

Length of stay has a non-linear relationship with mortality. LOS can be a key indicator which impacts on hospital mortality. The current review findings showed some interesting trends which could be linked to mortality indicators. According to Chelluri et al. [48], a 25% mortality indicator and have the highest length of stay at 12.57 days. Therefore, there is a possibility of a link between the variables. However, it is important to note that none of the studies directly assessed causality, i.e. the link between LOS and mortality. There are some studies in the current review which have attempted to arrive at this relationship, providing mixed evidences. As reported by Williams et al. [57], there is no direct link between mortality and ICU length of stay. However, others have identified a direct relationship between LOS and mortality. In Wong et al. [80] study, they reported that short term and immediate term mortality outcomes were worse for patients who had a prolonged stay in the ICU. The primary conclusion that this research presents with respect to LOS is that a prolonged stay in ICU can have an impact on mortality in critically ill patients. However, this relationship can be non-linear. Additionally, given the impact of other factors such as co-morbidities, it is important to consider multiple attributes before deciding on causality.

Planned or unplanned surgery can have an impact on mortality outcomes. Pavoni et al. [49] reported that short term mortality of elderly patients was high and could be directly linked to the reasons for ICU admission. The authors also argued that ICU mortality was higher in patients who had unplanned surgery. On the other hand, Niellson et al. [53] also reported that mortality was found to be highest when it could be linked to medical related factors (43.7%) rather than surgery (39.6%). In the cohort of Tabah et al. [44], one-year mortality was 80% in the sub-group of unscheduled patients while the mortality was only 67% in the sub-group of medical surgery.
Similarly, Roch et al. [14] further contend that the standardised mortality ratio was 2.56 (2.08–3.12) when compared to age and gender adjusted mortality of the general population. The authors argue that this ratio significantly increased when there was a need for unplanned surgery linked admissions. These views can be explained by the findings in literature. Multiple studies in extant literature [22, 44] contend that rather than considering surgery as an indicator of mortality, efforts should be made to consider the type of ICU admission. These authors contend that when surgery is planned, medical related outcomes can at times be more negative.

This supports the evidence gathered by Nielsson et al. [53]. However, Boumendil et al. [78] also contend that the end results for medical related outcomes are better when compared to unplanned surgery amongst the elderly. This proof the findings of Pavoni et al. [49]. Also, De Rooij et al. [24] support these results and argue that ICU mortality is found to be higher amongst unplanned surgical patients as there can be early complications which could not be effectively addressed.

Sepsis can have a non-linear relationship with ICU outcomes. Evidences in some research clearly show that mortality due to severe sepsis in elderly patients is 1.3–1.5 times higher than in younger cohorts [59, 81]. studies further report that elderly patients with sepsis die earlier during hospitalisation and the elderly are more likely to require skilled nursing or rehabilitative care after hospitalisation when compared to young adults [82, 83]. Poor prognosis is linked to elderly patients with sepsis as it can lead to cardiac failure as a result of organ failure and presence of shock [83]. Findings from this literature review indicate supportive evidence which indicates that sepsis can be a key factor which leads to negative outcomes amongst patients admitted to the ICU. According to Roch et al. [14] and Brandberg et al. [55], ten per cent of those who died were found to show signs of sepsis. Vest et al. [34] 16% and Sacanella et al. [45] 20% show higher results. Furthermore, Covinsky et al. [84] reported that the elderly are more likely to have poor functional outcomes in terms of failure to regain daily activities. Therefore, long term prognosis can be impacted upon by sepsis and QoL outcomes. This views perhaps influences the findings of Sacanella et al. [45]. The overall sepsis rate is found to be high in the study. Additionally, the review findings show that even amongst survivors, the QoL improvement is not significantly high. Therefore, this indicates that there is a need to examine the links between sepsis and ICU stay.

The number of patients, particularly the elderly, admitted to the intensive care unit (ICU) is rapidly increasing [7]. According to Herridge. [85], most of these patients are found to have independence before a critical illness or before surgery. When the patients are older, this can cause a negative impact on their basic activities of daily living. These are essential to improve independent living and better quality of life. These activities can include multiple parameters ranging from bathing, dressing, toileting, transferring, continence and feeding as well as instrumental activities such as shopping, preparing a balanced meal and keeping track of current events. As reported by Barnato et al. [32], the presence of disability amongst these patients can cause critical illnesses which can in turn represent an important healthcare problem which disproportionately affects the elderly. The evidences in research clearly support the findings that there is a fall in overall quality of life amongst individuals who have been admitted in the ICU. Furthermore, these findings also highlight the view that the important healthcare and social problem that affects these individuals can be linked to problems associated with. In consequence, new disability in these activities among the large and growing number of patients leaving hospital after critical illness represents an important healthcare and societal problem in years to come that may disproportionately affect the elderly [32]. The findings identified in the current literature indicate similar findings. Most of the studies [45, 48 & 49] indicate low recovery of overall QoL and ADL after ICU admission.

Garrouste-Orgeas et al. [86] conducted an observational French study in fifteen emergency departments from 2004 to 2006 and observed that even though appropriate criteria were given for ICU admission, the emergency physician referred only 40% of the patients aged over 80 to the ICU and admission to ICU was only given to half of them. Discrepancies can also be found between the old and the young in terms of use of recommended guidelines and delay of treatments. This finding is supported in this review. Amongst the studies where there is comparison across different age groups (e.g. Chelluri et al. [48], it is evident that there is a stronger predictor of mortality amongst older adults. In light of this view, this review indicates that there is a need for better care options.

According to Nguyen et al. [12] who observed a large review of people older than 65 years of age suffering from acute myocardial infarction in French, they
reported that compared to younger patients, it was more likely for the elderly to have a longer pre-hospital delay. As reported by Schoenenberger et al. [13], in a multi-centre Swiss cohort, even after patients with potential adjustment and non-indications for confounding factors (like co-morbidities), it was less likely that elderly patients aged 80 years and older would receive the recommended care (beta-blockers, clopidogrel, acetylsalicylic acid) and interventional care (percutaneous coronary intervention and thrombolysis) in cases of acute myocardial infarction.

The intensity of the treatment that is provided also varies in the ICU depending on the age of the patient; these treatments include renal replacement therapy, mechanical ventilation and vasopressor infusion. According to recent data, there is an increase in the intensity of treatment that is provided to patients aged 80 years and older. Similar to younger patients, compared to women, men are admitted more frequently even among the elderly even though there have been no consistent findings of sex-based differences in the provision of care or clinical outcomes. This variation between gender might be because in hospital illness progresses differently for men and women. [87].

CONCLUSIONS

This review contends that the rationale for admitting the elderly to the ICU and the rationale for assessing outcomes should not be restricted to short-term outcomes but also be extended to long-term outcomes. An assessment of the quality of life after ICU amongst the elderly shows multiple and contradictory views. The demand for critical care resources will increase with the increasingly aged population. It is suggested in the current data that ICU care may be beneficial for planned surgical patients aged 80 years and older. This can be promoted through the policy of admitting to an acute care for the elderly or a regular ward instead of the ICU as well as admission of selected patients to the ICU along with the promotion of efforts to make sure that the ICU discharge is rapid.

Abbreviations: NHS National health services, HRQOL Health Related Quality of life, WHO World Health Organization, QoL Quality of life, ICU intensive care unit, HOE Hierarchy of evidence, ADL activity of daily life, LOS length of stay, MV Mechanical ventilation.

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