

REVIEW

The admission of very old patients to our intensive care units: a review

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Abstract

In this review, we discuss several aspects of the decision to admit very old intensive care patients (VOPs) and present national as well as international data concerning outcome of VOPs. A substantial proportion of VOPs will not survive hospitalisation (33 to 42% 30-day mortality) and various studies describe that up to 75% of the patients are suffering from a persisting or severe functional decline after hospital discharge. Many will not be discharged home. Moreover, many elderly patients prioritise 'quality of life' above 'quantity of life.' Therefore, the available outcome data should be used to inform patients or their surrogate decision-makers and enable them to participate in shared decision-making concerning goals of care.

Introduction

The Dutch population is ageing, corresponding to demographic changes observed in many other countries in the Western world [figure 1]. This ageing is a consequence of high birth rates in the period 1945 to 1955 (the 'Baby Boom generation'), increased life expectancy and decreased birth rates in recent decades. Life expectancy is expected to increase to 87 years for males and 90 years for females in the year 2060. The proportion of persons in the Netherlands aged 80 years and older has already risen from 1.0% in 1950 to 4.5% in 2018 and is expected to further increase to 9% in 2040 and 11% in 2055.^[1,2]

Elderly patients are responsible for a substantial proportion of hospital and intensive care unit (ICU) admission days. Obviously, once admitted to the ICU these elderly patients often have a shorter life expectancy than younger patients. Despite advanced treatment modalities, their ICU mortality risk

remains high and when they survive, they more often suffer from functional decline and long-term sequelae. Although survival is conditional for quality of life (QoL), many elderly patients prefer preserving QoL and autonomy above a prolonged survival.^[3,4] The question whether admission of a very elderly patient to the ICU is appropriate and beneficial can be difficult to answer for intensivists. Therefore, the aim of this article is to present Dutch data concerning ICU treatment of very old patients and discuss issues relevant for the decision-making to admit elderly patients to the ICU.

When is a patient a very old ICU patient?

Ageing is defined as a persistent decline in the age-specific fitness components due to internal physiological degeneration^[5] and comprises a complex transition of physiological and cognitive vulnerability, making the individual more prone to diseases and acute medical events.^[6]

Internationally, there is a lack of clear definitions for 'elderly', 'old' or 'very old' patients and different age thresholds have been used. Being old (the biological or physiological age) is more than just the chronological age, depending on many other factors, including frailty, and definitions might be dynamic since life expectancy is increasing. Although using a fixed age threshold might not be the best way to define the very old population, using a clear and objective definition is important to allow comparisons with previously published studies. We will use the contemporary definition for 'very old intensive care unit patients' (often abbreviated to VOPs or VIPs) considering patients to be 'very old' when they are aged 80 years and over.^[7]

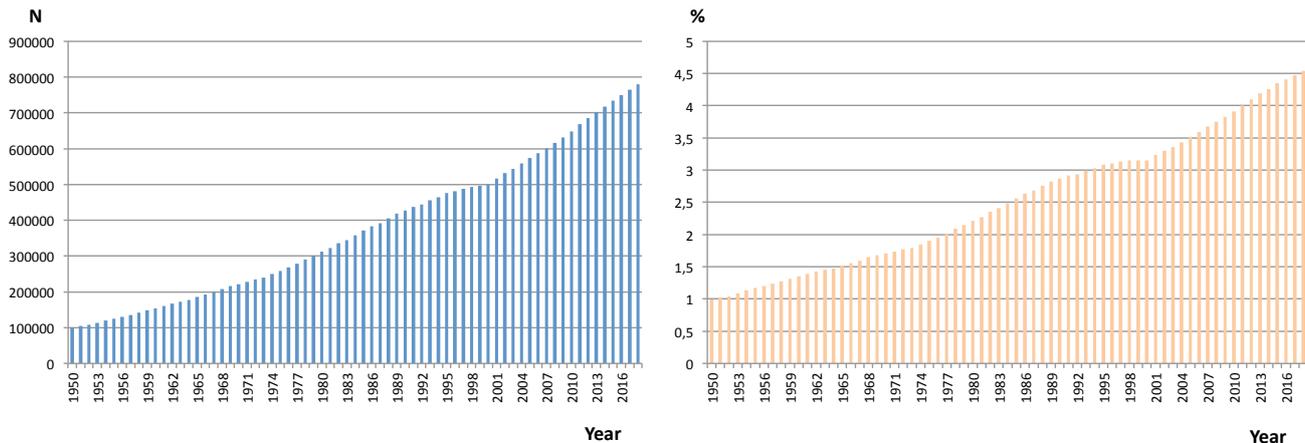


Figure 1. Absolute (a) and relative (b) numbers of persons aged 80 years and older in the Netherlands in the period 1950-2019 (CBS; <https://opendata.cbs.nl/statline/#/CBS/nl/dataset/37296ned/table?ts=1570890280205>).

Health of the very elderly

The very elderly are responsible for a substantial proportion of healthcare use. While around 4% of our population consists of very elderly people, they are responsible for more than 10% of hospital admissions. They are more often admitted to hospital and when admitted, they have an increased length of stay (LOS) in hospital. The proportion of patients with chronic conditions is higher in the very elderly, with 80% of the very elderly having at least one chronic condition and 57% having even two or more chronic conditions, for which they more often use medication. Physical dependency is higher in the elderly, with more use of mobility aids and they more often receive home care. The proportion of patients with a limitation in activities of daily living (ADL) increases with age, 23% have at least one limitation in ADL and 36% in instrumental ADL (iADL), and compared with the non-elderly population, elderly patients less often assess their health as good or very good.^[8]

Current situation regarding very old patients on Dutch ICUs

Both international as national studies have shown a strong increase of the very elderly on the ICU and it is expected that these numbers will further increase.^[7,9]

Previously, we analysed the Dutch situation and demonstrated that the demographic changes occurring in Europe and in other high-income countries are mirrored in the Netherlands and that this resulted in significant increases in the percentage of hospital admissions attributable to the very elderly.^[10] In the period 2004-2013, the percentage of adults aged 80 years and older in the population increased from 4.4% to 5.3% and the percentage of hospital admissions attributable to these very elderly increased from 8.7% to 10.7%. However, in contrast to previous studies in other countries, the percentage of general ICU admissions attributable to the very elderly remained stable in the Netherlands, i.e. at 14%. This finding could be explained by more strict ICU admission policies or more proactive treatment restrictions set on the wards, resulting

from advanced directives and it might illustrate the changing opinions about the benefits of treatment of the very elderly in the ICU. The severity of illness of very elderly patients (expressed by the Acute Physiology and Chronic Health Evaluation (APACHE) IV and the Simplified Acute Physiology Score (SAPS) II - predicted probability of mortality) remained stable in this studied period. However, the percentage of ICU admissions following cardiac surgery attributable to the very elderly did indeed increase significantly in this period from 7% to 11%. This latter finding may be due to improvements in techniques in cardiac surgery and changed ethical reasoning around cardiac surgery in elderly patients and is consistent with other Dutch reports in recent years, describing increases in the mean age of patients undergoing cardiothoracic surgery.

The very old patient requiring ICU treatment

When a very old patient requires ICU treatment, the risks and benefits should be carefully weighed. Although this holds true for all patients, in the very elderly population risks are higher and benefits might be limited. This stresses the need to carefully address prognosis and risk factors and to align treatment goals with the preferences and personal values of the patient.

Mortality

Internationally, documented mortality rates differ, due to differences in patient characteristics and countries (*table 1*).^[11-32] It is important to realise that the majority of these studies exclusively included the patients who were already admitted to the ICU, which suffers from selection bias and makes generalisation difficult.

Very old patients with unplanned admission to the ICU

In the recent large European multicentre VIP-1 study, which included 5021 patients aged 80 years and older from 21 countries, overall ICU and 30-day mortality rates were 22% and 33%.^[28] The 30-day-mortality for the 3730 acutely admitted patients was much higher (i.e. 42%).^[33] Another multicentre

Table 1. Outcome of VOPs internationally, based on large studies in the last decade.

Author	Year	Se/me	Period	Country	N(80+)	%80+	ICU	Hosp	1 Mo	3 Mo	6 Mo	1-Yr
Bagshaw ¹¹	2009	mc	2000-2005	Australia and New Zealand	15640	13	12	24				
Farfel ¹²	2009	sc	2000-2001	Brazil	230 (75+)	27	42	53				
Tabah ¹³	2010	sc	2005-2006	France	106	18.2	37	45.2				68.9
Daubin ¹⁴	2011	sc	2006-2007	France	125 (75+)	19						
Roch ¹⁵	2011	sc	2001-2006	France	299	12.4						
Boumendil ¹⁶	2012	mc	2004-2006	France	2646			27.2			50.7	
Fuchs ¹⁷	2012	sc	2001-2008	USA	1677 (>84)		14.6	27.9	28-d: 34.6			56.1
Pavoni ¹⁸	2012	mc (2)	2000-2005	Italy	288	19.2	14.8	27.7		40.7		61.1
Lown ¹⁹	2013	sc	2005-2010	Australia	506		16.6					46.3
Nielsson ²⁰	2014	mc	2005-2011	Denmark	6266	11.7-13.8	35.1					49.3
Heyland ²¹	2015	mc	2009-2013	Canada	1671		22	35				
Andersen ²²	2015	mc	2000-2012	Norway	395	15.5	24.1	40.5				58
Puchades ²³	2015	sc	2003-2011	Spain	202	11	34.2	44.1				55.4
Andersen ²⁴	2017	mc	2013-2014	Norway	250		28.4	44				60
Docherty ²⁵	2016	mc	2005-2009	Scotland	3865	10 - 8.4	26.5					52.2
Ball ²⁶	2016	mc	2009-2013	Canada	1033		27	41				
Guidet ²⁷	2017	mc	2012-2015	France	3037 (75+)			30; 21			45; 39	
Flaatten ²⁸	2017	mc	2016-2017	21 European countries	5021		22.1		30-d 32.6			
Karakus ²⁹	2017	mc	2008-2014	Netherlands	28284	13.1	15	25		32	35	40
Level ³⁰	2018	sc	2014-2015	France	188 (75+)	82.3	34	42.5				65.5
Pietilainen ³¹	2018	mc	2012-2013	Finland	1827	11.1		21.3				38.2

sc = single centre; mc = multi-centre

study, from Finland, which included 1827 very old ICU patients, reported an overall hospital and 1-year mortality of 21% and 38%, and 28 and 48%, respectively, for acutely admitted patients.^[31]

Elderly patients are responsible for the majority of all episodes of sepsis, with incidences that are still increasing. A systematic review concerning the outcome of VOPs admitted to the ICU with sepsis showed that mortality rates were high, with ICU, hospital and 1-year mortality rates of 43%, 47% and 68% respectively.^[34] Mortality rates of VOPs with sepsis were higher compared with VOPs admitted to the ICU for another reason than sepsis.

Very old patients admitted after planned surgery

Elderly patients admitted after surgical treatment, especially scheduled operative care, have better survival rates than those admitted for a medical reason.^[21,31,35,36] In a large multinational European cohort of very elderly patients, ICU and 30-day mortality were 3% and 8% respectively in patients admitted after elective surgery compared with 14% and 26% in patients admitted after acute surgery and the significant differences persisted even after correction for frailty, age, sex and Sequential Organ Failure Assessment (SOFA) score.^[36] This seems to be a result of better preoperative selection.

Very old patients admitted to Dutch ICUs in the last decade

Previously, we reported mortality trends of ICU patients in the Netherlands for the period 2008 to 2014 and showed that VOPs have benefitted almost equally from improvement in quality of care over time as the younger patients.^[29] We demonstrated that for both groups, the crude and risk-adjusted short- and long-term mortality significantly decreased in this period (ICU mortality decreased from 18% to 13.0%, in-hospital mortality from 31% to 21%, 3-month mortality from 37% to 30%, 6-month mortality from 42% to 34% and the 12-month mortality decreased from 46% to 40%). The decreases in ICU and hospital mortality could not be explained by changes in discharge policies, since mortality after discharge also decreased. The mortality reduction in VOPs could neither be explained by decreased severity of disease.

Data about the case-mix and outcomes of VOPs compared with younger ICU patients admitted to Dutch ICUs in 2018 and in the period 2010-2018 are shown in *table 2* and *figures 2 and 3*. These data are derived from the Dutch National Intensive Care Evaluation (NICE) registry.^[37] The NICE registry is a national quality registry in which currently all Dutch ICUs participate. These ICUs collect demographic, physiological and clinical data

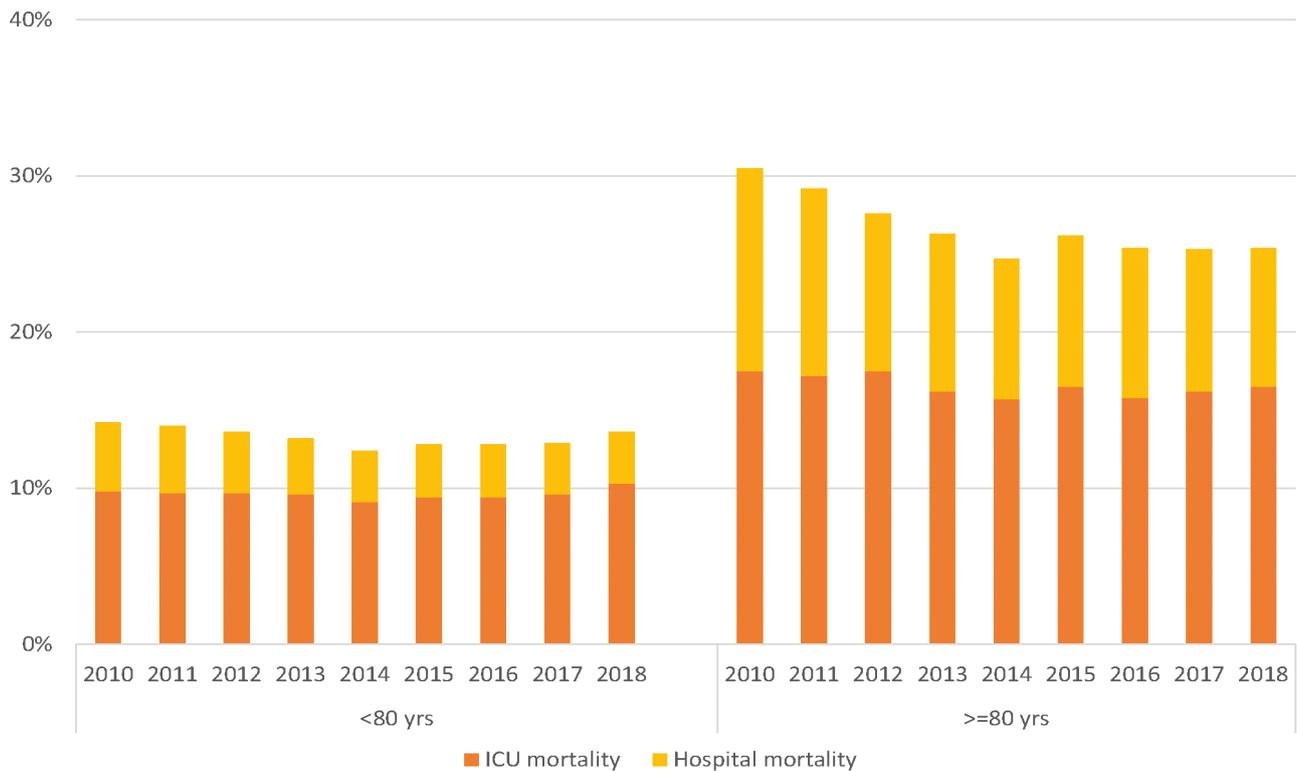


Figure 2. ICU and hospital mortality of VOPs compared with younger ICU patients in the Netherlands in the period 2010-2018 [NICE data]

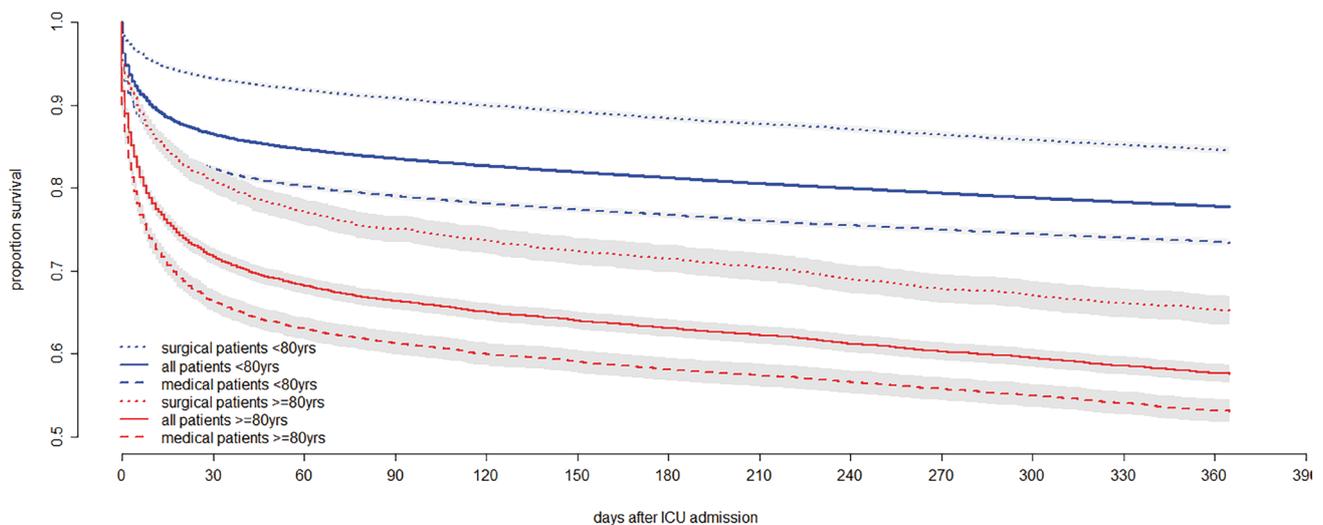


Figure 3. Kaplan-Meier curves of patients aged 80 years and older versus younger patients admitted to the ICU in the Netherlands (in 2017), showing all admissions together, but also surgical and medical patients separated [NICE data]

of all admitted patients, including variables required to quantify the severity of illness and mortality risks based on the APACHE IV prediction model.^[38]

Risk factors for very old patients admitted to the ICU

Several factors have been shown predictive of increased mortality in VOPs, including age, gender, comorbidities,^[39] functional and cognitive decline (frailty),^[28,40] malnutrition,^[41]

mechanical ventilation,^[42] circulatory shock^[43] and acute kidney injury.^[44]

Cognitive impairment is a strong risk factor for delirium and associated with increased mortality rates and further cognitive decline.^[45]

Frailty is a state of vulnerability to poor resolution of homeostasis following stress and is a consequence of cumulative decline in multiple physiological systems over a lifespan.^[46] Frailty is

Table 2. Case-mix and outcomes of very elderly on Dutch ICUs in comparison with younger patients (in 2018) [NICE data]

Characteristic	<80 years	VOPs	
Number	57,836	7,196	
Type of admission (%)			
Medical	62.9	63.4	
Elective surgery	12.3	15.9	
Emergency surgery	24.1	19.9	
First admission	93.6	94.9	
Number of comorbidities (%)			
0	55.2	52.3	
1	27.3	30.1	
≥2	17.5	17.5	
Diabetes mellitus	16.8	20.0	
Severity of illness (%)			
Low mortality risk	78.2	63.8	
Intermediate risk	15.2	26.0	
High mortality risk	6.6	10.2	
Mechanical ventilation (%)	39.0	34.8	
LOS-ICU			
<3 days	74.1	76.6	
3-7 days	14.6	15.5	
>7 days	11.3	7.9	
LOS-hospital			
<7 days	42.7	38.0	
7-14 days	25.6	30.7	
>14 days	31.7	31.3	
Mortality (%)			
ICU	10.3	16.5	
Hospital	12.9	25.3	
3-months	17.7	35.5	
1-year	23.9	44.7	
Mortality subgroups (%) (hospital, 3 months and 1-year)			
	Hosp	3 Mo	1 yr
Cardiosurgery	1.9	2.1	4.1
Trauma	7.8	10.0	12.4
OHCA	46.7	50.4	53.0
Sepsis	22.8	29.2	36.2
Medical	16.9	22.8	28.8
Elective surgery	2.7	5.2	12.8
Emergency surgery	14.2	18.8	23.4
	Hosp	3 Mo	1 yr
Cardiosurgery	4.1	5.0	11.6
Trauma	22.0	34.6	43.7
OHCA	68.5	74.9	77.3
Sepsis	36.4	45.0	53.1
Medical	30.7	41.4	50.1
Elective surgery	7.5	16.1	28.7
Emergency surgery	27.7	38.1	45.2

common in ICU patients and higher frailty scores are associated with increased mortality.^[28,40] However, there is no gold standard for frailty and various frailty scales are used to stratify the older adults, making comparison of these studies difficult.

Functional outcome, cognitive impairment and quality of life

VOPs have an increased risk of developing functional disability.^[47] In a Canadian cohort, only one quarter of octogenarians admitted to the ICU for any reason regained their baseline level of physical function at one year and only half of the survivors returned home.^[21] This is corroborated by an Australian study, which reported that the majority of octogenarians who survived to hospital discharge were discharged to a rehabilitation facility, nursing home, rest home or other healthcare facility.^[48] However, in the more recent Finnish study, 78% of the one-year survivors (62% of the studied patients were alive one year after admission)

had a functional status comparable with the pre-morbid situation and 84% of the one-year survivors were living at home one year after ICU admission.^[31] Survivors of critical illness also have increased risks of moderate to severe cognitive impairment.^[45,47] All of these factors could contribute to a lower QoL for the very elderly after surviving the ICU, but unfortunately, data on the QoL of very elderly survivors are relatively scarce. Quality-adjusted life years were 21% to 35% lower than for the age and gender adjusted general population, although the majority (88%) of the elderly survivors considered their QoL to be good or satisfactory after hospital discharge.^[49]

Prognostication

Knowledge of the mortality risk could guide prognostic discussions and could aid treatment decisions. A reliable tool for outcome prediction in VOPs is desired, particularly to avoid suffering and costs for patients, relatives and society. However, prognostication has shown to be difficult. Several prognostic models are available to predict the likelihood of hospital survival for ICU patients, such as the APACHE IV and SAPS II score, but although these models include age as a risk factor, the performance in older patients is disappointing, since these models do not include the aforementioned elderly-specific risk factors. Recently, the VIP-1 Study Group developed a relatively simple, but reliable cumulative events model using age, sex, ICU admission diagnosis, Clinical Frailty Scale, SOFA score, invasive mechanical ventilation and renal replacement therapy to assess the chances of 30-day mortality in acutely admitted very elderly patients, with an area under the curve (AUC) for a score of 10 or higher of 0.80.^[33] Previously, Ball and colleagues identified high-risk characteristics for hospital mortality of critically ill very elderly patients and developed a clinical prediction tool based on age, serum creatinine, Glasgow Coma Scale, and pH and Heyland and colleagues made a model with a good performance (AUC = 0.81) to predict functional outcome one year after ICU admission in patients aged 80 years or older, but the selected variables (including APACHE II score) are less easily collected at the bedside.^[26,35]

Decision-making

When deciding on ICU treatment, the most important consideration is whether or not the ICU treatment is likely to result in an outcome that is consistent with individual patients' views of an acceptable outcome.^[50] The following items should be addressed in this decision: the patient's attitudes and wishes, the characteristics of the critically ill very elderly patient e.g. comorbidities, functional status, frailty, cognitive and psychiatric disorders, nutritional status, the goals of care, the probability of long-term survival and of reaching a QoL that is acceptable for the patient, but also a level of suffering caused by treatment in the ICU that is tolerable. Consultation of a geriatrician could be of value in the assessment before ICU admission, but for acute admissions the geriatric consultancy might not be available in all hospitals. For

elective ICU admissions after planned surgery, there is more time to gather information and weigh carefully this decision than for the acute admissions. In case of doubt about the beneficence and appropriateness of an ICU admission of a very elderly critically ill patient, an 'ICU trial' can be considered. In that case an elderly patient is admitted to the ICU and receives full ICU treatment, with reassessment of clinical response and appropriateness after two or three days.

The majority of elderly patients would not choose treatment if anticipated survival included severe functional impairment.^[51] However, their opinion about ICU admission is only asked in a minority of cases^[52] and healthcare professionals often do not sufficiently document the patient's wishes about end-of-life issues,^[4] making ICU triage difficult and complex, and highlighting the importance of proactively addressing goals of care in elderly patients.^[53] An Australian study demonstrated that advance care planning improved end-of-life care, patient and family satisfaction and reduced stress, anxiety, and depression in surviving relatives.^[54] In addition, data from the ICE-CUB study demonstrated that ICU admission of patients aged 80 years and older did not improve six-month survival, compared with admission to a standard ward, making triage even more complicated.^[55] In another trial, a program to promote systematic ICU admission of the very elderly increased ICU use, but did not reduce six-month mortality.^[27]

Healthcare costs

The very elderly are responsible for a substantial part of healthcare costs and the ICU is one of the most expensive departments of a hospital, consuming almost 15% of the hospital budget and 1-2% of the gross domestic product (GDP) in Western countries. In addition, after ICU discharge, survivors continue to consume significant healthcare resources.^[56] Dutch VOPs are more expensive in the year before, the year of and the year after ICU admission, compared with younger ICU patients and the very elderly control population not admitted to the ICU.^[57]

Since outcome of very old ICU survivors is worse than for younger patients, cost-effectiveness of ICU admission of the very elderly is frequently questioned. Obviously, in times of increasing pressure on the healthcare budget, discussion about what society should accept to pay for a gained life year (value of the statistical life year, VOSL) and for a quality adjusted life year (QALY) is important. However, QALYs are often based on surveys that incorporate physical functioning, which is often lower in the very elderly, carrying the risk of unjustly suggesting futile care. Several health-related quality of life studies suggest that very old ICU survivors may accommodate to a degree of physical disability and report good emotional and social well-being.

Future

The ageing population will have an increasing impact on ICUs and intensivists will be more involved in the evaluation of elderly patients before they are admitted to the ICU to avoid inappropriate

admissions. Limited ICU capacity will in addition force clinicians to offer ICU treatment only to the patient that is most likely to benefit. Future research should focus on the development of enhanced prognostic tools with good performance in VOPs, in order to better select these VOPs who might benefit from ICU treatment and for whom ICU treatment will be futile. Moreover, questions considering the effect of inclusion of geriatric consultancy, the opinion of octogenarians towards use of critical care resources and the effect of non-pharmacological interventions to reduce functional and cognitive decline after ICU discharge exist and demand for future research.^[7]

Conclusion

The very old patient requiring ICU treatment is an emerging phenomenon and many intensivists struggle with the question of which patients will benefit and for whom ICU treatment will be inappropriate or even harmful. Although both survival and long-term outcomes are often disappointing, reliable models to use in prognostication are still lacking. In order to optimise adequate triage of very old patients and to align intensity of treatment with patient preferences, the pre-admission goal of care discussions and advance directive availability need to be improved.

Disclosures

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