Elderly patients in the Intensive Care Unit

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Abstract

The very old ICU patient, often defined as aged ≥ 80 years, is by no mean a newcomer, but during the last decades their impact on ICU admissions has grown in parallel with the increase in the number of elderly persons in the community. Hence from being a “rarity” they have now been common and constitute one of the largest subgroups within intensive care and may easily be the largest group in 20 years and make up 30-40% of all ICU admissions. Obviously, they are not admitted because they are old, but with various diseases and problems like any other ICU patient. However, their age and presence of common geriatric syndromes like frailty, cognitive decline, reduced activity of daily life and a number of comorbid conditions, makes this group particular challenging, and is accompanied with a high mortality. In this review we will highlight aspects of current and future epidemiology, current knowledge on outcomes and describe the effects of the geriatric syndromes listed above. The major challenge for the coming decades will be the question of whom to treat and the quest for better triage criteria not based on age alone. Challenges with level of care during the ICU stay will also be discussed. A stronger relationship with geriatricians should be promoted to create a better and more holistic care and aftercare for survivors.

Key Words (5)

Intensive Care

Critical Care

Very old

Epidemiology

Outcomes

Introduction

Intensive care deals with many subgroups of patients, each with their specific diagnosis or challenges. Over the years since the "birth" of intensive care in the 1950ties, these subgroups have continuously changed and the initial groups of patients with bulbar paralysis and respiratory failure after poliomyelitis have completely disappeared, thanks to effective vaccination program. Another group that suddenly arrived and then nearly completely have disappeared was patients with AIDS. Some subgroups have been there for decades like sepsis and trauma. Another subgroup of patients found the increasingly the last 30 years is the elderly patients [1]. The refinement of intensive care made this group available for treatment in spite of their age and the associated morbidity and decline in resilience.

In the last decades we have witnessed a dramatic change in demographics in many countries with decreased birth rate and increased life span going on simultaneously. This means that the large birth-cohorts from 1950 and 1960ties will become significantly older than previous cohorts. In addition, we will experience a reduced work-force available for health care as well as for other jobs.

It is not necessary to be a wizard to predict this will very soon create a large deficit in the capacity for intensive care.

This overview of intensive care for the very old will partly focus on various challenges in the treatment of patients in this important subgroup in ICU, and the controversial issue of selection and triage. We will present evidence where we have, also admitting that this field of intensive care at the moment raises more questions than answers.

Epidemiology of the elderly population in ICU

The number of elderlies in populations of many countries increases fast. A recent estimate is an increase of inhabitants in Europe above 80 years from around 6% (2018) to 12% (2050) [2]. Other populations may experience an even larger relative increase. If we assume that a

constant fraction of this population over these 3 decades will receive intensive care as we do today, we must expect a doubling of the number of octo- and nonagenarians in need of intensive care. This estimate may vary, not at least according to the future health status of these population groups, but also other factors.

What about the age distribution within our ICUs? We have data that indicate an increase in the fraction of very old, but with a large span [3]. Most often the elderly > 80 years is reported to constitute around 15% and is slowly increasing. A doubling of this number would mean that up to 30% of the ICU cohort can be above 80 in 2050 [4]. If not enough resources will be distributed to increase the ICU capacity, this must be solved by a decrease in admittance of other ICU groups or that we have to decrease admittance of the very old (Figure 1). None of these options will be easy to implement but scenario A is for several reasons the least possible option. Likely it may be solved by a combination of scenario B and C with a small increase in capacity with an increased triage to no ICU admittance in the very old.

In an interactive session at the ESICM Lives conference 2019, the audience was asked to give feedback if this increase in the number of very old ICU patients could be met with an increased capacity in 2040. Most answered that their ICU would not be able to meet this challenge (Table 1).

Triage & limitation of care

Triage is in many ICUs a daily challenge, and reports on patients that is triaged before ICU admission varies a lot [5,6,7]. In the ICE-CUB1 study [8] details of the trajectories of patients proposed to be admitted or not to an ICU is shown in table 2. Apart from those considered too well, the patients with an ICU admission had less mortality than those not admitted.

Results and outcomes of all groups after pre-ICU triage are not often reported most probably since this is a difficult area to conduct research. Most information is derived from triage of admitted patients from the emergency department (ED), and little from patients admitted from

hospital wards. In many hospitals the latter comprise a large part of ICU admissions. For ED patients a formal triage performed by emergency physicians as well as intensivists is often organized, while on the ward there is a "hidden" triage by ward physicians prior to contact with the intensivists. This concealed triage is as nothing more than a clinical evaluation of the patient with regard to present disease process, past history and a perception that a patient may or may not profit from intensive care. Of course, patients wish, and caregivers' expectations are parts in this clinical judgement. How often this results in a decision not to contact the ICU in case of a deterioration is largely unknown.

At present the triage to admit or not admit very old patients to the ICU is largely clinical funded and as such a subjective judgement of the physician. Traditional scoring systems like SAPS and APACHE has been shown to be poorly calibrated to the very old ICU population [9]. Research to find more scientific evidence to support decision making is ongoing but robust criteria that can be used in the individual prognostication prior to ICU admittance have been difficult to find [10,11]. Machine learning models can be used to predict long-term events and assess how factors interact with each other [12] . Prediction of 6-month mortality for elderly ICU survivors is mainly related to frailty, disability, comorbidity, and patient preferences [13]. In a recent prospective multinational study, the effects of different geriatric "syndromes" (cognition, activity of daily life, comorbidity and frailty) present at ICU admission on 30 days outcomes was studied [14]. This study found that the presence and severity of frailty alone was as good as any combination of the three other syndromes in association of one-month outcomes, but not sufficient to be used in individual decision making alone.

Even if a triage is positive with regard to admittance, the lack of an available ICU bed may still lead to no ICU admittance. There is huge variability in the number of ICU beds per inhabitants across European countries with potential impact on triage. However, a recent

prospective randomised trial in France found no differences in a liberal versus restrictive strategy to admit elderly patients to an ICU with regards to 6 months survival [8].

If accuracy of triage prior to the ICU at present is poorly evidence based, what is the alternative? The concept of an in-ICU-triage: a time limited treatment trial (TLT) [15] has emerged the recent years, and in particular in hemato-oncology and elderly ICU patients [16]. With a TLT we offer an admission to the ICU in order to observe if the patient profit from a full intensive care treatment [17]. A TLT is a formal process that must be discussed and agreed upon with the patient (if possible) or care-givers as well as medical stakeholders like referring physicians. After the time period, usually 2-4 days, a new evaluation is performed with the goal to document if there are objective improvement reflecting effect of the treatment. This can be done in several ways, and objectively a serial measurement of organ dysfunction as with the sequential organ failure assessment (SOFA) score is important to document to avoid bias and subjective judgement. If organ function has improved, then the treatment is considered of value and continued, if organ dysfunction has increased, treatment may be considered futile and life-sustaining therapy withhold or withdrawn with a focus on palliative care. If situation is unaltered a new TLT may or may be offered. A TLT must be explained and agreed on at ICU admission, so that these different trajectories have been described and discussed. The inclusion of a geriatrician will certainly add value to this process, but remains to be demonstrated in a clinical trial.

Age related changes in vital organ functions

Advanced age is closely related to a progressive decline in vital organ function, a process that starts early in life and usually increases after the age of 65 years and is closely linked to the concept of frailty. In a given very old individual, “normal” vital organ decline may be difficult to entangle from concurrent disease in the same organ. Usually the age-related changes also leave the organs more susceptible to injury and disease. Here, briefly pure age-related changes

in the cardiovascular, pulmonary, and renal function is described. The concept of immunosenescence is also briefly mentioned.

Cardiovascular changes

Cardiovascular changes with ageing occur as a mixture of altered senescence, apoptosis and autophagy linked to decreases in sirtuins, cell cycle regulators, mitochondrial dysfunction, activation of inflammatory genes, alterations in nitric oxide production and other factors [18, 19]. Degeneration of pacemaker and conducting pathways develops with slowing heart rate response to stress and increasing the risk of arrhythmias as consequences. The cardiac valves become stiff and calcifies hence increasing afterload, turbulence and risk of valvular incompetence. Both myocyte hypertrophy and increased fibrinous matrix reduce plasticity and hence response to stress. Altered cardiac shape as with septal hypertrophy may reduce efficiency.

Vascular changes affect primarily intima and media with increased thickness, ultimately this leads to a stiffer vascular system. Endothelial inflammatory and changes in endothelial signalling with altered nitric oxide-mediated responses also contribute to dysfunction [20]. In aorta increased pulse wave velocity leads to arrival of the reflected waves arriving during systole rather than diastole, increasing systolic pressure and increasing afterload, while resulting in the loss of augmented diastolic filling.

Pulmonary changes

Pulmonary changes occur in the thoracic cage as well as in the lung parenchyma. Normal pulmonary function is dependent on a normal thoracic anatomy, and increased kyphosis of the thoracic spine is common with ageing. Hypokyphosis is reported in 20-40% in both sexes in the elderly [21] and is associated with decreased FEV1 as well as vital capacity. On the top of this comes a reduced strength in respiratory muscular function with age. A decreased ability to clear secretions with age is a consequence of reduced cough strength but also mucociliary

dysfunction may appear. In the lung parenchyma changes in the connective tissues with a decrease in elasticity. Also, a reduced number of alveoli and increase in alveolar duct size contribute to changes in gas exchange. All these changes contribute to a rise in alveolar closure at a given alveolar volume. This is a major explanation for the increased alveolar-arterial difference found in old age [22].

Renal changes

Renal ageing is complex and far from understood and involves structure, function and metabolism. There is a gradual decline in nephron size and number together with tubular changes and thickening of the glomerular basement membrane with age. Additionally, there is increasing glomerulosclerosis, and is often referred to as nephrosclerosis [23]. In addition to these structural macroscopic changes there is a gradual decrease in glomerular filtration rate with age. This decrease differs in various studies and ranges from 0.4 ml/1.73m^2 to nearly 4 ml1.73m^2 [24] and the decline increases with advancing age. There is also a decrease in tubular function affecting sodium reabsorption and potassium excretion (reduced) leading to a reduction in urine concentrating abilities of the kidney [25]. The renal vasculature is affected as well with increased intrarenal shunting. There is also an increased vasoactive sympathetic activity with following vasoconstriction. Renal blood flow (600 ml/min) is preserved until the fourth decade, and is reduced by approximately 10% per decade

Immunological function

Immunosenescence refers to a gradual age–dependent decline of the immune system brought on by aging process and is associated with a higher level of pro- inflammatory cytokines secretion at baseline (often called inflammageing) compared to young people. Consequences are a decreased ability to stimulate an effective immune response to antigens, which increase the risk of acquiring infections and often their severity.

Immunosenescence can be described as the result of a chronic hyperstimulation of the immune system. This affects cell-mediated immunity and humoral immune responses in particular. There is evidence that this chronic inflammation may play a role in the development of frailty [26] as well as other age-related morbidities. At present no single marker may diagnose or quantify inflammageing, but work is in progress [27].

Significant age specific syndromes

A number so called "geriatric syndromes" have been described, the most often studied are frailty, functional and cognitive decline, sarcopenia and co-morbidity. These syndromes are often found together, and in the recent VIP2 study[14] we found that patients with frailty (CFS ≥ 5) most often also presented with one or more other of the "geriatric syndromes" (Figure 2)

Frailty

There is today agreement that frailty is a condition characterised by loss of biological reserves, failure of homeostatic mechanisms and vulnerability to various adverse outcomes, such as falls, disability, hospitalisation, cognitive decline and requirement for care [28]. Frailty is common with advanced age, but may also appear in younger individuals. It is important to understand that frailty is not a disease in itself, but adds to the present burden of disease (comorbidity) and increase the development of dependency (Figure 3). Frailty is common in the ICU population and seems to increase with age of the patient [29]. The incidence of frailty in the elderly ICU population varies, also related to the method used to measure frailty. Le Maguet et al found 41% to be frail using the Frailty Phenotype and 23% based on the Clinical Frailty Score (CFS) in a cohort of ICU patients ≥ 65 years [30]. Using the CFS in two large European cohorts of ICU patients ≥ 80 years frailty was present in 43.1% [31] and 40.2% [14] and was independently associated with increased one-month mortality in both cohorts.

Sarcopenia

Sarcopenia is the age associated loss of skeletal muscle mass and function and is closely related to frailty [32]. The causes of sarcopenia are multifactorial and often include inactivity, altered endocrine function, chronic diseases, inflammation, insulin resistance, and nutritional deficiencies. Sarcopenia is characterized of slow gait speed and objectively demonstrated loss of muscle mass [32]. Sarcopenia is associated with adverse outcomes in critical illness as after emergency abdominal surgery [33] and as a predictor of mortality in ICU patients [34].

Cognition

Cognitive decline is a common finding in the very old, and poor cognitive function is associated with an increased risk of mortality also in the general population [35]. The mechanisms behind increased mortality are still not revealed. One specific problem is the simultaneous occurrence of several age-related syndromes in a given patient. This was studied in a large prospective European study in elderly ICU patients with assessment of cognition, frailty, activity of daily living and comorbidity at admission [14]. Cognition deficits with IQCODE score ≥ 3.4 was found in 26% of all patients, but overlapped with frailty in 42% (Figure 2). Interestingly, the combination of the other syndromes and frailty did not increase the prognostic ability to predict mortality compared to frailty alone.

Outcome Survival

Survival is the most common endpoint in ICU trials. However, several factors influence survival like: admission and discharge policy, end-of-life decision, quality of care in the wards after an ICU stay. ICU or hospital survival are important to consider but mid- or long-term survival are more relevant to assess whether the ICU admission was justified.

In-ICU mortality is mainly related to severity (high SAPS, APACHE or SOFA scores) while mortality in the long-term is more related to underlying condition (age, comorbidities,

functional status). However, it should be stressed that there is huge heterogeneity reported. When screening the articles published since 2000, we retrieved 111 studies. The in-ICU mortality ranged from 1% to 51%, in-hospital mortality from 10% to 76%, 6-month mortality from 21% to 58% and 1-year mortality from 33 to 72% (personal data). Such large differences in mortality most likely is caused by huge differences in case-mix between the ICUs, and creates difficulties in interpretation of the results if no subgroup analysis is conducted.

In two large prospective European studies in ICU patients ≥ 80, we identified one-month prognostic factors. First, planned admissions have a much better prognosis and these admissions must be analysed separately [36]. The patients admitted after scheduled surgery are highly selected: they agree for a risky surgical procedure, anaesthetist and surgeons agree to perform surgery and very few have a limitation of LST [37]. It should be emphasized that the influence of frailty was more important than age expressed per period of 5 years to predict one-month survival [31]. Moreover, other geriatric symptoms (loss of functional autonomy, cognitive decline), besides frailty did not add to the prediction model of mortality at one month [14]. The latter is important since it implies that frailty should be routinely assessed in order to improve identification of older adult potential candidates for ICU admission.

Several studies have failed to demonstrate long-term benefit of ICU admission in elderly patient [6, 38]. The first ICE-CUB study included 2642 patients in the emergency department of 15 hospitals and failed to demonstrate an improvement of 6-month mortality after ICU admission [39]. The ICE-CUB2 study was a cluster-randomized clinical trial of 3,036 critically ill patients 75 years old or over, showing that a recommendation for systematic ICU admission led to a significantly higher ICU admission rate, but had no significant effect on mortality, functional status or quality of life at 6 months [8].

Another important consideration is the high in-hospital mortality rate following an ICU stay. This percentage is around 5% for patients younger than 80 and more than 10% for patients older than 80 years [40].

There could be several explanations to this high post-ICU mortality.

Older adults are more vulnerable and may benefit from a longer ICU LOS [41]. In fact, often the opposite can be found [42]. This suggests more frequent and earlier decision to limit LST in older patients but can also indicate that we do not allow sufficient time for recovery after an insult in the very old population (trauma, sepsis etc)

The patients are often frail and many have difficulties in an environment with less manpower than in the ICU. Elderly patients discharged from ICU in general will need more resources than younger ones, and adequate healthcare services should be available to ensure appropriate and secure discharge.

The discharge location is not adequately trained nor educated in even basal geriatric care and support, and only infrequently such resources is consulted. Hence, an alternative to a regular ward could be an intermediate care unit [43] or an acute geriatric unit. Discharge to an acute geriatric unit instead of an ordinary orthopaedic ward after hip fracture has been a success, and more patients are discharged alive and with better HRQOL [44]. A Systematic Review and Meta-Analysis analysed Critical Care Transition Programs and the risk of death after discharge from an ICU. No significant reduction in hospital mortality (risk ratio, 0.84 [95% CI, 0.66–1.05]; p = 0.1) associated with a critical care transition program was documented. Noteworthy, none tested the discharge location as a potential variable of interest [45].

Establishing discharge criteria is not as simple as determining whether a patient may enter a phase with a reduced level of care. Many institutional factors may influence this decision. Within any institution, a patient must meet both nursing and medical standards to be

eligible for ICU discharge [46]. However, little is known about how physicians make ICU discharge decisions at the individual level. These decisions are complex and are influenced by several factors including perceived prognosis, severity of illness, physician preferences and experience, bed availability, staffing of the normal hospital ward, and the accessibility to lower level care facilities (e.g., intermediate care units) [47].

In a survey of ICU discharge practice that involved 55 Swiss ICUs [48], 22% of the centres only used written discharge guidelines. There was a huge heterogeneity in the number and type of discharge criteria. The conclusions of the authors were that there is marked heterogeneity in ICUs discharge practices, that discharge decisions may be influenced by institutional factors. Notably, the discharge location was not investigated in this study.

We performed an international survey among ICUs participating in the VIP1 study about various aspects of geriatric intensive care [49]. Major differences between ICUs, that varied according to questions and European regions was found. As an example, 34% disagreed that a consultation of a geriatrician should be sought when deciding to discharge an elderly patient. This survey emphasises the absence of evidence-based data explaining the lack of consensus regarding the possible contribution of geriatrician in the ICU discharge process of critically ill elderly patient

Due to their expertise to assess multi morbid elderly patients including those with acute stress, geriatricians are more experienced to perform a more comprehensive assessment of old patients which may lead to improved care and more coordinated decisions in these patients. Thus, including a geriatrician in shared decision-making for old ICU admitted patients may improve their outcome; yet no large-scale study supports this hypothesis.

A small scale, single-centre study has evaluated changes in the functional autonomy of 45 elderly patients after a stay in a medical intensive care unit (ICU), and the impact of post-ICU management in a geriatric ward [44, 50]. The patients were randomly divided into two post-ICU

management groups: "geriatric ward" and "standard care" in the usual ward. The main endpoint was the change in physical autonomy as assessed by the Barthel index between discharge from the ICU and discharge from the hospital. The study was ended prematurely and did not reach enough patients, but their results indicate an increase in functional capacity and more rapid recovery of autonomy in the geriatric management arm. Also, readmission rate mortality was reduced for the next six months. These results however await confirmation in an adequately powered study. We however tested this hypothesis in retrospect using the medico-administrative database of Saint Antoine hospital in Paris. We excluded surgical patients and included only the first ICU stay over a 3 year period (2014-2016) patients older than 80 years. As it can be seen in the table 3, discharge to an acute geriatric unit compared to other wards in this hospital lead to a reduced hospital LOS, more often discharge to rehabilitation unit and less readmission.

Functional outcome

Elderly ICU survivors frequently suffer from long-term sequelae, poor quality-adjusted survival, cognitive impairment and functional disability [51]. However, many of these events occur beyond the scope of intensive care. It will be important to be able to predict the functional outcome in this very elderly patient group as their focus often is less on “longevity” but more on “quality of life” in their remaining life span.

This reflects the opinions and attitudes of European intensivists, of whom the majority concurs with the notion that “less is more”. [49,52]

The very elderly ICU patient is at risk for complications resulting from heavy sedation, prolonged ventilation, immobilization, lack of nutrients, etc. Thus, several factors contribute to functional decline and poor long-term quality of life. In a prospective study of 6 months survivors in 2,646 elderly patients after an ED visit, only one third was independent for all

activities listed in activity of daily living (Katz's scale), while 16.2% were unable to perform at least one activity that they had been able to perform at the time of the ED visit [6]. Similar results were reported in a Canadian study in elderly patients with ICU length of stay above 24 hours. The survivors reported significantly worse physical functioning after 3, 6, and 12 months compared with age- and gender-matched controls [53]. In the ICE-CUB2 study that included 3036 patients with a mean age of 85 years, ADL decreased in at least one domain in 64% of the patients at 6 months.[8]. However, other studies find better results with only 28% to 37% old patients that do not restore previous functional autonomy [54,55]. At 12 months, 50% of survival patients recovered their previous ADL, IALD and physical capacities [56.] Furthermore, 72 to 77% of patients return at home after ICU. It's interesting to point the lack of data concerning comparison of functional autonomy recovery between "young" and "old" patients while almost 25% of "young" patients do not restore their autonomy after ICU [57].

A decline in functional performance is often accompanied by a decrease in health-related quality of life (HRQoL). This was also found In the ICE-CUB2 study with a reduction in mean SF-12 physical component and mean SF-12 mental component [8]. Lack of improvement in both mental and physical functions from 6 to 12 months has also been documented [58]. In a Scandinavian study, the HRQoL was lower for the very elderly than for younger patients, although 97% of the elderly survivors lived at home and 88% of them considered their QOL to be satisfactory or good after hospital discharge [59]. Indeed, some studies show that the long-term HRQoL appears to be similar to age matched populations, and 88% percent of patients estimate their health state as good or satisfactory [59].

The same study also found the QALYs derived from ICU admission of patients over 80 years was a median of 4.1 years, in the 65-79-year-old group it was 10.2 years and in patients less than 65 years 22 years.

Rehabilitation

A critical illness inevitably leads to a functional decline in elderly patients. In fact, such a decline might be its first symptom. Interventions in intensive care further enhance this decline. This is most pronounced in frail elderly patients who are particularly vulnerable to the physical and cognitive challenges in the ICU. Eventually, functional impairments affect the patients' long term autonomy and quality of life. Thus, interventions for the protection and restoration of functional capacity are crucial components of medical care in and after ICU. Whereas rehabilitation in younger patients is focused on specific deficiencies, such as lower limb strength, rehabilitation in the elderly has to take a holistic view of the patients' conditions to focus on the main aspect of the patients' goals, i.e. quality of life. The concept of geriatric rehabilitation aims at restoring functional ability or enhance residual functional capability [60]. That includes physical, nutritional, cognitive and psychological parameters. Importantly, there is a strong interaction between these parameters in elderly patients. For example, early mobilization appears to support restoration of cognitive functioning [61] and dysphagia-related nutritional deficiencies have to be corrected during physical rehabilitation [62].

Despite the importance of rehabilitation in and after ICU, the evidence to support specific interventions in this setting is not strong [63]. A recent meta-analysis on physical rehabilitation in adult patients after discharge from ICU did not demonstrate a significant impact on their quality of life [64]. Of note, the mean or median age in the analysed studies was only between 40 and 68 years. Although the patients' age is a recognized predictor for functional disabilities [65], there is only scant evidence for rehabilitation in elderly critically ill patients. Martínez-Velilla et al. [66] recently showed that exercise programmes can be effective to reverse the functional decline in acutely hospitalized elderly patients with a mean age of 87 years. This included both physical as well as cognitive impairments. In another study in elderly patients admitted to cardiovascular intensive care [67], early mobilization improved the functional status

in both frail and non-frail patients with a mean age of 77 years. However, more studies specifically designed for frail and multimorbid elderly patients are required to establish an evidence base to guide rehabilitation in the elderly ICU patient.

How to organise care?

The traditional "closed ICU" with extensive collaboration with other specialties when needed is the most common way to organise ICU care in Europe. In this model the intensivists temporarily have the responsibility to coordinate treatment and diagnostic work-up in all ICU patients. Together with the ICU nurses they are the backbone of the unit. However, their competence in geriatric medicine is probably low, and this field, acute geriatric care, has developed at lot the last decade, and to involve geriatrician in ICU care has been suggested [68] and can be important in several phases during the ICU stay. At admission their expertise in geriatric assessment can be valuable in the triage, and during the treatment they could assist in the TLT, where the actual benefit of active ICU care will be formally evaluated after 48-72 hours (see above).

Another important aspect is that also intensivists and intensive care nurses should engage more in post-ICU care. They can contribute with important information from the ICU admission that could be valuable in understanding the complexity of acute disease impact in frail very old patients.

A problem is also lack of evidence-based treatment tailored for the very old, a problem also recently discussed in a review of community acquired pneumonia in the critically ill elderly ICU patients [69] . Many clinical trials exclude inclusions of very old patients, as well as children. We do not know if results based on a population aged 20 to 70 really is valid for those outside this range [70]. Many gradual changes in organ function as well as body composition may alter drug metabolism in very old and may have impact on outcomes.

Recently the recommended transfusion threshold (7g/dl) in very old patients has been questioned and data may indicate that this threshold is too low [71].

Unresolved questions

The last decade has given us a lot more information regarding the old ICU cohort, in particular from large multicentre prospective studies [8, 14, 31, 37, 69, 72, 73, 74] we have a better picture of geriatric conditions like frailty at admission, survival and quality of life after admission in survivors.

There are nevertheless still many remaining questions. Recently an agenda for research in the very old ICU patients was suggested and viewing at the list of proposals much remains to be studied [3]. Some of these suggestions (table 4) are partially studied, the rest remains largely unanswered. This includes very important questions like the opinion in the elderly population with regards to intensive care and LST, effects of ICU admission on the caregivers and the role of co-management from geriatricians both during and after ICU care. A framework for important studies to be performed in this very old intensive care patients (Figure 4) illustrates important steps in the trajectories of the very old ICU patients today and in the future that needs to be studied.

Conclusion

The number of old critically ill patients translates into challenges for the society, the hospital, the intensive care team as well as for patient and care-givers. We need to consider the whole trajectory of the patient and not merely focusing on the ICU stay. In that perspective, transdisciplinary approach should be advocated. We will need to better communicate, to explain what critical care is about, to work on prognostication, to assess long-term outcomes in term of mortality but also health related quality of life in this important group.

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Tables (4) and figures (4)

Table 1: Answers from an audit during the ESICM congress 2019:

The question was: The number of very old patients in our ICU will increase from around 15% to nearly 30% in 2040 putting a huge demand for increased ICU beds. Do you think your ICU will be able to meet this challenge?

Answer	% response
Not at all	30%
Only a moderate increase	37%
Yes probably	27%
Yes certainly	5%
No idea	1%

Table 2: outcomes according to triage decision in the ICE-CUB1 study (6). It was a double triage process with a first step by ED physicians with 3 choices: ICU proposal; No ICU proposal because the patient was considered too well or too sick. Among the patients proposed for an ICU admission, the patients could be refused because considered too well or too sick while others were accepted for ICU admission with or without final admission. Outcomes were hospital, 6-month death, decrease of ADL score (in points).

EMERGENCY DEPARTMENT						
	NO ICU PROPOSAL		ICU PROPOSAL			
	Too well	Too sick	Too sick		ICU admission	
			No	Yes	No	Yes
N=	1339	642	185	70	12	316
Hospital death	8.2%	55.4%	16.8%	68.2 %	41.7%	32.7%
6 months death	28.4%	79.7%	40.8%	86.5%	58.3%	47.5%
ADL at 6 m (n)	696	86	69	16	3	115
ADL ↓ 6 month	-0.62	-0.52	0.001	-0.41	-1.87	-0.44

Table 3: Retrospective data from Saint Antoine hospital in Paris with some outcome data according to discharge unit from the ICU I octogenarians. AGU = Acute Geriatric Unit

		AGU	other wards
Patients (n)		119	375
ICU LOS		6.1	4.9
LOS after ICU discharge		15,0	17.3
Hospital LOS		22.7	25
Hospital discharge location	Home	34%	50%
	Rehabilitation unit	37%	22%
	long term care facility	0	1%
	Other hospital	15%	13%
	Death	13%	14%
ICU readmisssion during the 6 month follow-up		2.9%	3.8%
Death during the 6 month follow-up		2.2%	5.5%

Table 4 Research items covered (from ref.3)

RESEARCH QUESTION: Very old Intensive care patients	**COVERED 2020**
Frailty, Sarcopenia, ADL & Cognition pre and post ICU admission	Good
Opinions among octogenarians about ICU care	Some
Effects of including a geriatrician per and post ICU care	Poor
Effects of non-pharmacological approach to delirium in very old	Poor
Burden of intensive care in care-givers	A bit
Prognostic tools	Some
Sepsis in the very old	A bit
Dementia post intensive care	Poor
Pharmacokinetics of sedatives	Poor
Trajectories after EOL	A bit

Figure 1. Three different scenarios to meet the increase in the number of critical ill elderly patients. 2050 A: increase of elderly in the ICU, no increase in total capacity, 2050 B: no increase in elderly in the ICU, no increase in capacity; 2050 C: Increase of elderly in the ICU and a similar increase in total ICU capacity

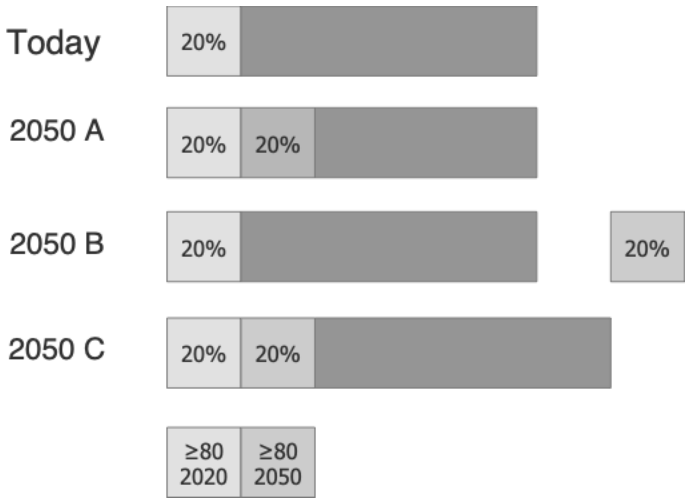

Figure 2. The occurrence of frailty and its co-presence of other common "geriatric" syndromes, data from the VIP2 study. Numbers within the large box is the number of patients with frailty also having the other syndrome. Frailty = Clinical frailty score ≥5; Cognitive decline: IQCODE ≥ 3,4; Activity (ADL) Katz ADL ≤ 4 and co-morbidity as comorbidity and polypharmacy score ≥ 12

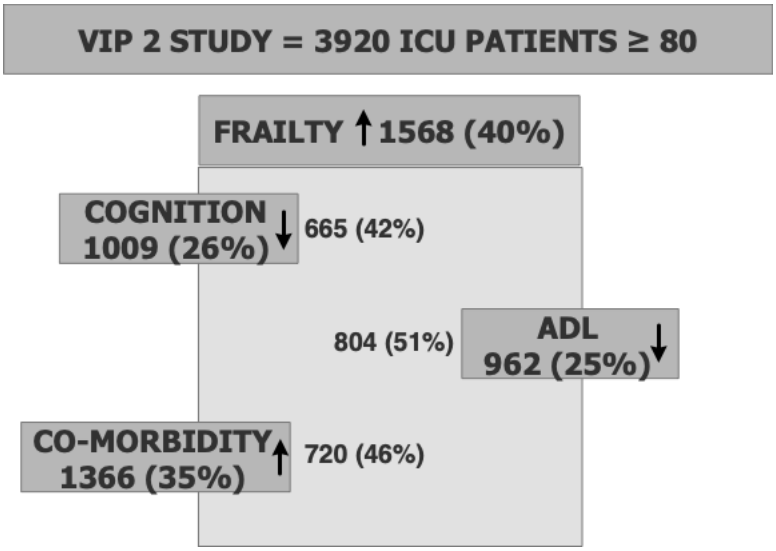

Figure 3: Interplay between the development of frailty and chronic organ disease with regards to patient independence.

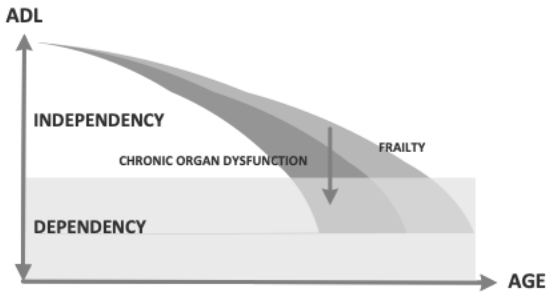

Figure 4. A framework illustrating important issues in future research in the very old ICU patients.