Acta Anaesthesiol Scand 2012; 56: 1298–1305
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ACTA ANAESTHESIOLOGICA SCANDINAVICA
doi: 10.1111/j.1399-6576.2012.02782.x

Do elderly intensive care unit patients receive less intensive care treatment and have higher mortality?

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Background: The number of elderly (≥ 80 years) will increase markedly in Norway over the next 20 years, increasing the demand for health-care services, including intensive care. The aims of this study were to see if intensive care unit (ICU) resource use and survival are different for elderly ICU patients than for younger adult ICU patients.
Materials and methods: A retrospective cohort study comparing ICU patients between 50 and 79.9 years (Group I) with patients over 80 years (Group II) registered in the Norwegian Intensive Care Registry from 2006 to 2009. A subgroup analysis of 5-year age groups was performed.
Results: A total of 27,921 patients were analysed. The ICU/hospital mortalities were 14.3%/21.4% (Group I) and 19.8%/32.4% (Group II). Overall mortality increased with increasing age, and hospital mortality rate increased more than ICU mortality. The observed difference in admission categories could not explain the significant difference in median length of stay (LOS), 2.3 days (Group I) vs. 2.0 days (Group II). The elderly received less mechanical ventilatory support (40.6% vs. 56.1%) and had shorter median ventilatory support time, 0.8 days vs. 1.9 days. Median LOS dropped from around 80 years on, ventilator support time from around 65–70 years.
Conclusion: Octogenarians had shorter ICU stays, had higher overall mortality, had a shift of dying at the ward rather than in the ICU, and received less and shorter mechanical ventilatory support.

Accepted for publication 22 August 2012

The number of elderly will increase markedly in Norway, as in most modern societies, due to a change in age distribution caused by high birth rates during the first two decades post-World War II. According to Statistics Norway, the population over 80 years old will more than double from 221,153 (4.5%) on 1 January 2011 to 450,719 (7.1%) persons by year 2040, estimated from an average national population growth.* Current forecasts from Population Division of the Department of Economic and Social Affairs of the United Secretariat Data from 2010 predict the same increase for Northern Europe by 2050.[1,2]

The elderly consume a high proportion of health-care services in general, and this is also true for intensive care, where age distribution is found to be highly skewed.[3] Data from The Norwegian Intensive Care Registry (NIR) show that median age for intensive care unit (ICU) patients was 64.4 years in 2009, and 25% of all registered patients were 75.5 years or older.† A large multicentre cohort study from Australia and New Zealand, Australian and New Zealand Intensive Care Society Clinical Outcomes and Resource Evaluation (ANZICS CORE) cohort, reported that ICU admission rate of elderly (age ≥ 80 years) increased by 5.6% per year.[4] The life expectancy of the elderly is also increasing,[5] in addition to a growing prevalence of conditions that require ICU treatment.[6]

We are thus facing an increase in demand for health-care services, and also for intensive care. Angus et al. have pointed out that the resources for ICU care must expand during the following years. If not, we have to change our current ICU admission policy.[7] Even today, there is little unused ICU capacity. In Norway, the number of ICU beds per 100,000

*Statistics Norway. Statistikkbanken; 2011. http://ssb.no [Accessed 1 March 2012].

†Norwegian Intensive Care Registry. 2009. http://www.intensivregister.no [Accessed 5 November 2010].

inhabitants vary from 2.9 to 6.9 (Hans Flaatten, chair of the NIR, personal communication). Compared with international data, this ICU bed availability is low.[8]

There is no standard definition of the term elderly, but persons aged 80 years or older will clearly belong to this group. When ICU departments are forced to perform a stricter triage of ICU patients in the years to come, the elderly will obviously be in danger of falling out of any priority list, in particular patients ≥ 80 years old hospitalized for unplanned surgery or medical conditions.[1]

Hence, there are several reasons why we should document results from ICU treatment of elderly patients.

Our primary aim was to compare the hospital survival in two groups of ICU patients in the Norwegian population from 1 January 2006 to 31 December 2009: Group I (50–79.9 years) and Group II (the elderly over 80 years). We also wanted to evaluate if the elderly, once in the ICU, receive less ICU treatment than the younger population.

Materials and methods

The NIR contains data on all ICU stays lasting more than 24 h. In addition, shorter stays that include mechanical ventilation are registered, and also stays where patients die or are transferred to another ICU within the first 24 h. This retrospective cohort study collected data for analysis from NIR for the years 2006 to 2009. During this period, NIR received data on individual admissions from 31 surgical and mixed ICUs (5 university hospitals, 15 secondary hospitals, and 11 primary hospitals). This constituted more than 90% of all patients admitted to Norwegian ICUs.

All registered stays for patients aged 50 years or older were assessed, except readmissions, transfers to other hospitals, and transfers between ICUs within hospitals. The main reason for ICU admittance in NIR is registered according to Simplified Acute Physiology Score II (SAPS II) definitions: planned surgical admissions, unplanned surgical admissions, and medical admissions. Stays with incorrect or unclear data were excluded. For all included stays, we assessed

1. ICU and hospital mortality
2. ICU length of stay (LOS) with calculation of the total accumulated ICU days for each age group. These were divided into three groups: ICU days consumed by patients who died in the ICU (ICU LOS nonsurvivors ICU), by patients who died at the ward after ICU discharge (ICU LOS nonsurvivors ward), and ICU days for hospital survivors (ICU LOS survivors)
3. Mechanical ventilator support time. NIR defines mechanical ventilatory support as respiratory support in a closed system (including non-invasive ventilation)
4. Severity of illness as SAPS II[9] given with and without age points to underline the impact age has on the score
5. The intensity of care measured by the daily Nine Equivalents of nursing Manpower use Score (NEMS)[10] (summarized NEMS points during the stay divided by LOS)

A subgroup analysis was made by dividing the included patients into 5-year age groups.

We got approval from the steering committee in NIR to collect relevant data from the database, and because these registry data are anonymous, no approval from the regional ethics committee was needed.

LOS and mechanical ventilator support time are presented as medians and quartiles because the distribution is highly skewed. Significance was tested with the Kruskal–Wallis test. Other continuous variables are presented as means with standard deviation. Here, we used X^2 test and independent *t*-test. Analysis of variance was used to test differences in the 5-year age groups. Standardized Mortality Ratio – SMR (observed hospital mortality divided by SAPS II estimated mortality) was calculated for the two main groups and the 5-year subgroups, and a Receiver Operating Characteristic (ROC) curve was created for each main group.

To all statistical analyses, we used SPSS version 18.0 (SPSS Inc., Chicago, IL) and Microsoft Excel (Microsoft Corporation, Seattle, WA) for Mac version 14.1.0. *P*-values below < 0.05 were considered statistically significant.

Results

During the 4-year period, 34,912 admitted patients over 50 years old were registered. A total of 4065 patients were not included due to incorrect or unclear data, leaving 30,847 for inclusion. Analysis of admission categories for these 30,847 patients showed that Group I (50–79.9 years, $n = 23,291$) and Group II (≥ 80 years, $n = 7556$) had these frequencies: planned surgical admissions 16.0% vs. 13.0%, unplanned surgical admissions 28.4% vs. 34.4%, and medical admissions 55.6% vs. 52.6%, respectively. A total of 27,921 patients (90.5%) had adequate data for analysis (Fig. 1 and Table 1).

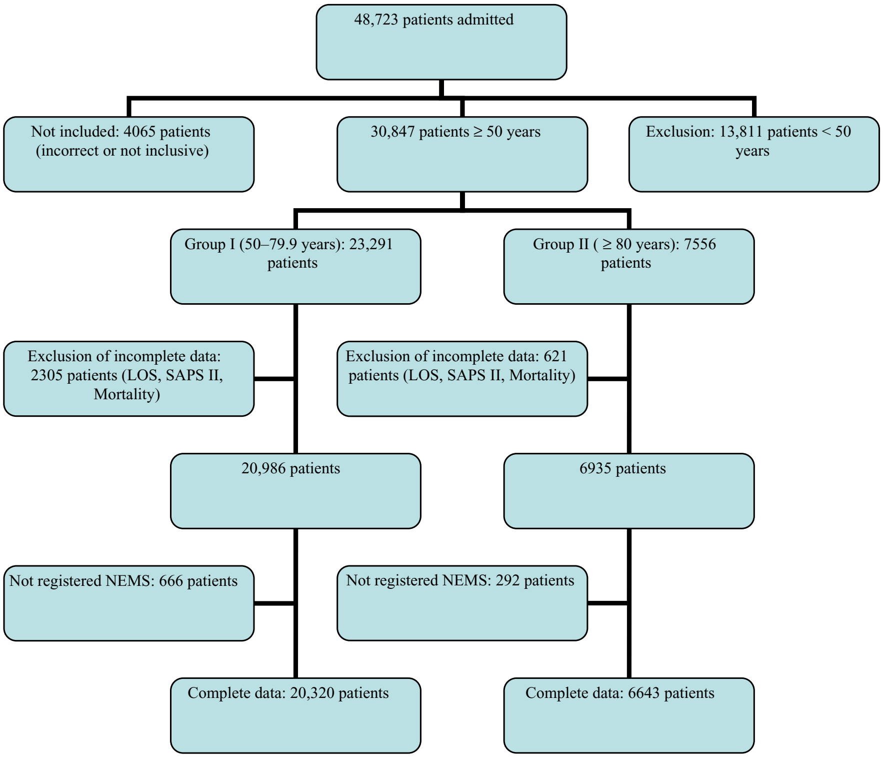

Fig. 1. Collection of data. Included patients ≥ 80 years and < 80 years. LOS, length of stay; SAPS II, Simplified Acute Physiology Score II; NEMS, Nine Equivalents of nursing Manpower use Score.

Table 1

Length of stay (LOS), ventilatory support, Simplified Acute Physiology Score II (SAPS II), admission category and mortality.

	Group I Age: 50–79.9 years $n = 20{,}986$	Group II Age: ≥ 80 years $n = 6935$	P
LOS [median (IQR)]‡	2.3 (1.3–5.1) ($n = 17{,}977$)	2.0 (1.2–3.4) ($n = 5560$)	< 0.001
Ventilator time* [median (IQR)]‡	1.9* (0.6–6.2) ($n = 9294$)	0.8* (0.3–2.7) ($n = 1997$)	< 0.001
Ventilatory support (%)	56.1	40.6	< 0.001
SAPS II (SD)	38.3 (17.6)	44.2 (16.4)	< 0.001
SAPS II without age points (SD)	26.1 (17.3)	26.2 (16.4)	0.70
NEMS/day (SD)†	32.9 (16.8) ($n = 17{,}698$)	31.8 (16.3) ($n = 5608$)	< 0.001
Planned surgical admission (%)	16.0	13.0	< 0.001
LOS [median (IQR)]‡	1.9 (1.1–3.6) ($n = 3992$)	1.8 (1.0–3.1) ($n = 805$)	0.29
Unplanned surgical admission (%)	28.4	34.4	< 0.001
LOS [median (IQR)]‡	2.8 (1.5–6.7) ($n = 4847$)	2.0 (1.2–3.9) ($n = 1831$)	0.03
Medical admission (%)	55.6	52.6	< 0.001
LOS [median(IQR)]‡	2.1 (1.1–5.2) ($n = 9196$)	1.8 (1.0–3.1) ($n = 2757$)	< 0.01
ICU mortality (%)	14.3	19.8	< 0.001
Hospital mortality (%)	21.4	32.4	< 0.001
SMR (95% CI)	0.78 (0.7–0.86)	0.86 (0.64–1.09)	
aROC	0.835	0.806	

*Days (only for patients receiving ventilatory support).
†Only patients with LOS ≥ 1 day.
‡Exclusion of ICU nonsurvivors.
IQR, interquartile range; SD, standard deviation; CI, confidence interval; NEMS, Nine Equivalents of nursing Manpower use Score; SMR, Standardized Mortality Ratio; ICU, intensive care unit; aROC, area under curve for the receiver operating characteristic.

In the age group 50–79.9 years, 20,320 patients (87.2%) had complete data (including NEMS). In the age group over 80 years, 6643 patients (87.9%) had complete data (Fig. 1). The main results in Group I and II are shown in Table 1.

Survival and LOS

The hospital mortality in Group I (50–79.9 years) was 21.4%, and in Group II (over 80 years) 32.4%. ICU mortalities in these main groups were 14.3% and 19.8%, respectively. The subgroup analysis of

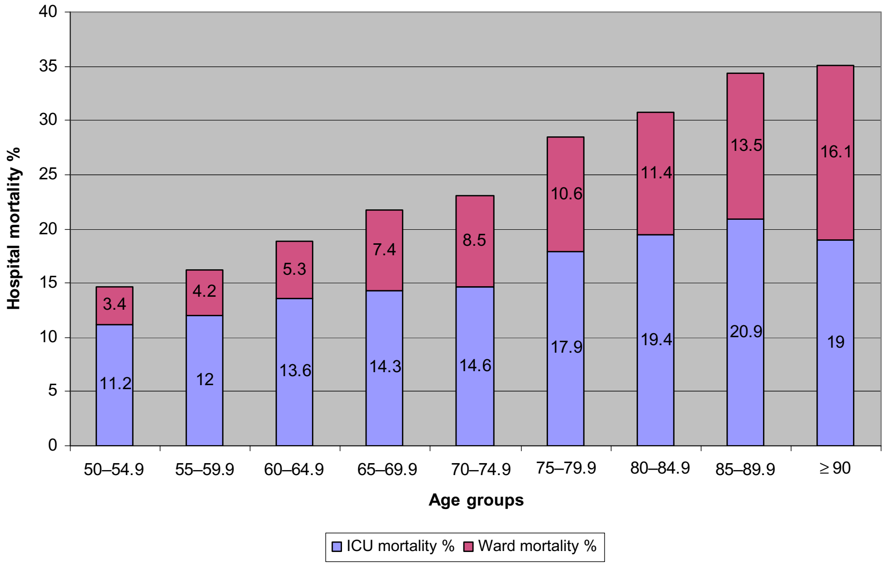

Fig. 2. Mortality: intensive care unit (ICU), ward, and hospital.

5-year groups showed that overall mortality increased with increasing age, and the hospital mortality rate increased more than the ICU mortality. The ratio hospital mortality/ICU mortality increased from 1.29 in the age group 50–54.9 to 1.85 in the patients over 90, meaning that for the older patients, it is more likely that the deaths occurred on the ward rather than in the ICU (Fig. 2). We also analysed patients who died in the ICU with LOS less than 24 h. After 75 years, there was a linear increase, from 4.1% (70–74.9 years) to 10.2% (≥ 90 years). Median stays in all these groups were 0.3 to 0.4 days.

ICU nonsurvivors were excluded from the analysis of LOS. The median ICU LOS in survivors below 80 years was 2.3 days [interquartile range (IQR) 1.3–5.1], which significantly differed from the group over 80 years at 2.0 days (IQR 1.2–3.4). The subgroup analysis of age showed quite stable values for LOS (2.2 to 2.4 days) up to 79.9 years, and then dropped significantly from 80 years on. Median ICU LOS adjusted for type of admission still showed significant shorter stays in Group II regarding unplanned surgical and medical admissions, 2.0 vs. 2.8 days and 1.8 vs. 2.1 days, respectively, while the difference for planned surgery was not significant (1.8 vs. 1.9 days). We also calculated the total accumulated ICU days for each age group (Fig. 3). The age groups from 60 to 80 years consumed most days in ICU, representing 62.5% of the total ICU days in our study (81,534 days). In contrast, patients ≥ 80 years consumed only 17.1% (22,258.3 days). The proportion of ICU days consumed by hospital nonsurvivors was smallest for the age group 50–54.9 (15.8%) and increased for each group up to the age group 75–79.9 years (35.2%). The fraction of ICU days spent on nonsurvivors in the elderly was 33.3% (80–84.9 years), 34.6% (85–89.9 years), and 28.3% (≥ 90 years).

Ventilatory support

We found a significant difference in the fraction of patients receiving mechanical ventilatory support in the two groups; 56.1% for patients below 80 years and 40.6% for patients over 80 years. Subgroup analysis revealed a range from 54% to 58.6% for the age groups from 50 to 79.9 years, and then a marked decrease after the age of 80 years (Table 2).

We then studied further only patients who survived the ICU stay and received mechanical ventilatory support. We found a significant difference in the main groups with median mechanical ventilatory support time of 1.9 days (IQR 0.6–6.2) in the younger group (50–79.9 years) and 0.8 days (IQR 0.3–2.7) in the elderly group. From the age group 65–69.9 years on, there is an almost linear reduction in median time spent with mechanical ventilatory support among ICU survivors (Fig. 4).

Severity of illness (SAPS II)

SAPS II was used for severity scoring, with and without age points. The main results showed an increase in the mean SAPS II score from 38.3 in the younger group to 44.2 in the elderly. After filtering out the age points, there was no difference, with means of 26.1 (50–79.9 years) and 26.2 (≥ 80 years).

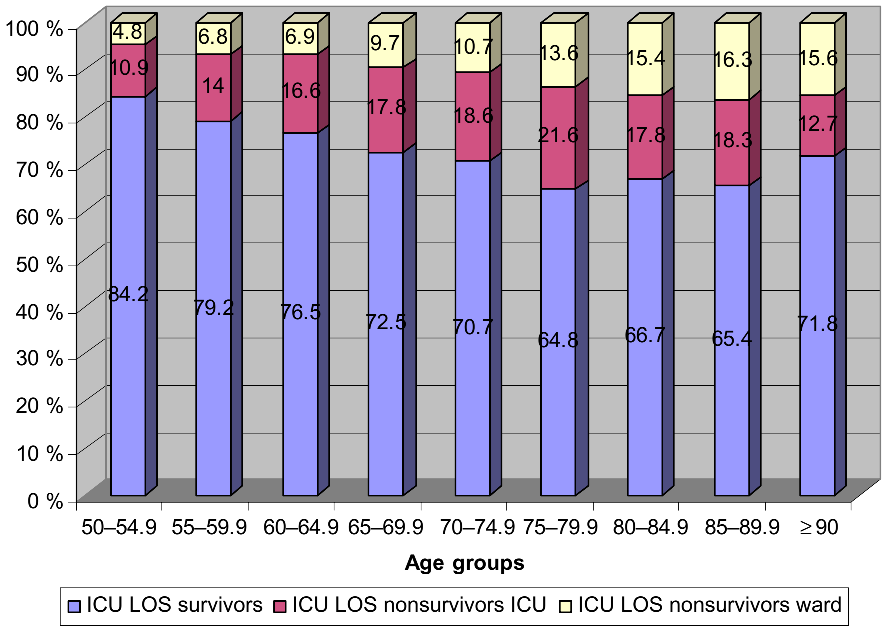

Fig. 3. *Accumulated days in intensive care unit (ICU) [length of stay (LOS)].*

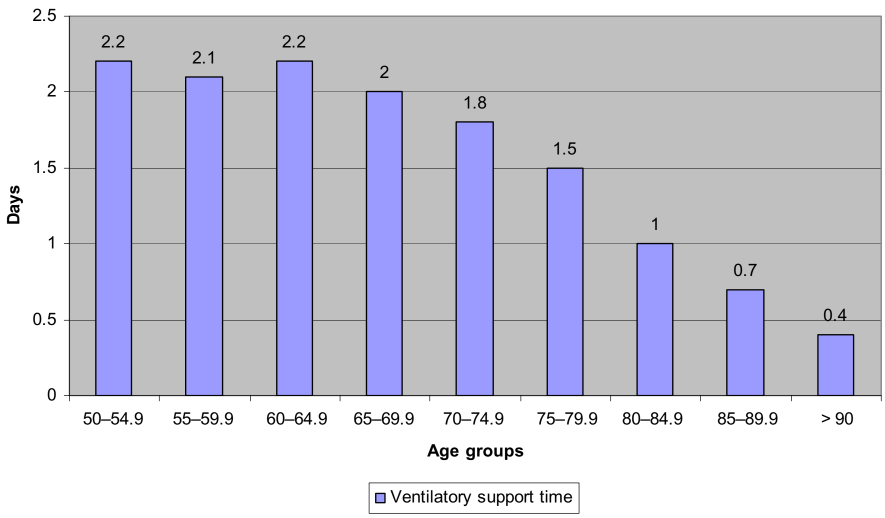

Fig. 4. Median ventilatory support time (days) only for patients receiving mechanical ventilation.

Subgroup analysis showed no significant differences either (Table 2).

NEMS

Intensity of care was measured with daily NEMS. We here excluded patients with no NEMS score and those with LOS less than 1 day, because many of these patients received full daily NEMS score, despite the fact that they had short stays in the ICU. NEMS/day was in these cases often more than the achievable NEMS per day. We excluded a total of 3657 patients (3289 patients < 80 years and 1327 patients ≥ 80 years). There was a significant difference in the main groups regarding NEMS score, with a mean score of 32.9 in the younger group and 31.8 in the elderly group. Subgroup analysis revealed a mean daily NEMS score with the same pattern as the subgroup analysis of median LOS, a steady score in the age groups up to 80 years, and then a marked decrease up to the age group ≥ 90 years (Table 2).

SMR

SMR was used to calibrate the study. The group under 80 years had an SMR of 0.78 (0.70–0.86), and the elderly 0.86 (0.64–1.09). The subgroup analysis with 5-year groups revealed the highest SMR of 0.86 in the youngest group (50–54.9 years) and in the

Table 2

Results subgroups.

Age, years	50–54.9	55–59.9	60–64.9	65–69.9	70–74.9	75–79.9	80–84.9	85–89.9	> 90	*P*
n (%)	2177 (8.2%)	2948 (11.0%)	3817 (14.0%)	3711 (13.6%)	3972 (14.4%)	4360 (15.2%)	3909 (13.4%)	2288 (7.7%)	738 (2.5%)	
LOS, [median (IQR)]‡	2.4 (1.2–5.6) (*n* = 1934)	2.4 (1.3–5.7) (*n* = 2595)	2.3 (1.3–5.5) (*n* = 3297)	2.3 (1.3–5.2) (*n* = 3197)	2.3 (1.3–5.0) (*n* = 3394)	2.2 (1.3–4.8) (*n* = 3578)	2.0 (1.3–3.9) (*n* = 3152)	1.9 (1.2–3.0) (*n* = 1810)	1.7 (1.2–2.6) (*n* = 598)	< 0.001
Mechanical ventilator support time* [median (IQR)]‡	2.2 (0.7–7.2) (*n* = 1012)	2.1 (0.7–6.4) (*n* = 1422)	2.2 (0.6–6.5) (*n* = 1754)	2.0 (0.7–6.0) (*n* = 1638)	1.8 (0.6–6.3) (*n* = 1730)	1.5 (0.5–5.0) (*n* = 1738)	1.0 (0.4–3.7) (*n* = 1279)	0.7 (0.2–1.8) (*n* = 585)	0.4 (0.1–0.8) (*n* = 133)	< 0.001
Mechanical ventilatory support (%)	55.8	58.6	57.6	55.9	55.6	54.0	45.9	36.7	24.4	< 0.001
SAPS II (SD)	32.6 (17.9)	33.8 (17.3)	37.8 (17.4)	37.8 (17.3)	41.0 (17.2)	42.7 (17.0)	44.6 (16.7)	43.9 (16.0)	43.3 (15.4)	< 0.001
SAPS II without age points (SD)	25.6 (17.9)	26.8 (17.3)	25.8 (17.4)	25.8 (17.3)	26.0 (17.2)	26.7 (17.0)	26.6 (16.7)	25.9 (16.0)	25.3 (15.4)	0.055
NEMS/day (SD)†	32.9 (16.9) (*n* = 1790)	32.8 (16.4) (*n* = 2455)	32.8 (16.6) (*n* = 3176)	33.1 (16.0) (*n* = 3169)	32.9 (15.8) (*n* = 3411)	32.8 (18.4) (*n* = 3702)	32.1 (16.1) (*n* = 3249)	31.5 (16.4) (*n* = 1796)	30.6 (16.6) (*n* = 563)	< 0.001
ICU mortality (%)	11.2	12.0	13.6	14.3	14.6	17.9	19.4	20.9	19.0	< 0.001
Hospital mortality (%)	14.5	16.2	19.0	21.8	23.1	28.6	30.8	34.4	35.1	< 0.001
Ratio hospital mortality/ICU mortality	1.29	1.35	1.40	1.52	1.58	1.6	1.59	1.65	1.85	
SMR (95% CI)	0.86 (0.64–1.09)	0.61 (0.49–0.72)	0.61 (0.49–0.72)	0.70 (0.56–0.84)	0.63 (0.52–0.75)	0.74 (0.60–0.89)	0.80 (0.60–1.00)	1.03 (0.61–1.45)	0.8 (0.61–0.99)	

*Days (only for patients receiving ventilator support).
†Only patients with LOS ≥ 1 day.
‡Exclusion of ICU nonsurvivors.
IQR, interquartile range; SD, standard deviation; CI, confidence interval; LOS, length of stay; SAPS II, Simplified Acute Physiology Score II; NEMS, Nine Equivalents of nursing Manpower use Score; ICU, intensive care unit; SMR, Standardized Mortality Ratio.

three groups above 80 years, which all were equal or over 0.80 (Table 2). Discrimination of the study was assessed with the area under curve for the receiver operating characteristic, which was 0.835 in the group 50–79.9 years and 0.806 in patients > 80 years.

Excluded patients

Of the 621 excluded patients over 80 years with incomplete data, we could still analyse 618 of them. The ICU mortality (18.7%) and hospital mortality (30.5%) was quite similar, but median LOS (1.2 days, $n = 521$) and median ventilator time (0.2 days, $n = 402$) were significantly shorter. Only 31.9% received ventilator support ($n = 552$) and the SAPS II without age points was only 22.3 ($n = 224$).

Discussion

The main findings in this study were that the octogenarians had shorter ICU stays, had higher overall mortality, had a shift of dying at the ward rather than in the ICU, and received less and shorter mechanical ventilatory support. We found no significant difference in the mean SAPS II score (after adjusting for age). There was a statistically significant lower daily NEMS score in the age group over 80 years.

Among elderly, there are, in general, more cases of cardiogenic shock and exacerbation of chronic obstructive pulmonary disease, and fewer patients with ketoacidosis, drug overdose, or acute asthma. There is a predominance of women, and there are also fewer patients coming to the ICU after elective surgical procedures.[5] A recent review from Nguyen et al. suggested that planned surgery patients aged 80 years or older may benefit from ICU care.[1]

In our study, we had no access to specific diagnoses. Even though our study shows significant differences in admission categories, these casemix differences are not responsible for the shorter ICU LOS among elderly. The octogenarians had significantly shorter stays within the two dominant admission categories and had shorter stays also among planned surgery patients. The latter was not significant. Similar results regarding median ICU LOS are presented in a Scandinavian study[11] and in a Finnish study.[12] ICU nonsurvivors were excluded from the calculations of LOS to avoid the dependency from ICU mortality. The reason for the shorter LOS among elderly patients may be that they are prematurely discharged from the ICU. It can also be a deliberate policy of offering intensive care to elderly patients only for a limited period of time and to stop if there is no quick response to treatment. ICU days used on hospital nonsurvivors can be seen as futile care, meaning that we use time and resources on patients that eventually die at our hospitals. It can hardly be considered an acceptable quality of life (QOL) to be critically ill in the ICU and to eventually die there or at the ward. In our study, this fraction peaked in the group 75 to 79.9 years (35.2%). After 80 years, the decrease is mainly due to short stays for patients dying in the ICU. It is not easy to define which percentage is acceptable here.

We also found that patients with increasing age die at the ward rather than in the ICU. Thus, hospital mortality/ICU mortality ratio increased with increasing age. However, our data showed a lesser rise in this ratio than found in similar studies on elderly ICU patients in Finland and Australia and New Zealand, where patients over 80 years had a ratio of 2.27[12] and 2.0,[4] respectively. One reason for a higher ratio among elderly in our study could be the fact that they received less aggressive treatment compared with younger patients, despite no significant differences in SAPS II scores without age points. Severity of illness in itself can therefore not explain the lesser content of mechanical ventilation support, increased hospital mortality/ICU mortality ratio, and shorter ICU LOS in the elderly. Octogenarians also had statistically significant lower daily NEMS, however, maybe not clinically relevant. Our data could indicate that Norwegian ICUs treat elderly patients with full intensity for a few days, with an exception of giving less mechanical ventilatory support, and then probably limit the therapy if the critically ill situation does not change to the better. Elderly patients are then probably transferred earlier to post-ICU care, which may account for the higher ward mortality. Because we do not have information of withhold/withdrawal, this ratio should be interpreted with caution.

A lack of ICU beds might cause a stricter triage. In such a setting, the elderly will most likely be refused admission to the ICU in favour of younger patients or be more pre-maturely discharged. The post-ICU care could also be poorer than for younger patients. The elderly are often in need of more nursing and need longer time to recover from critical illness. There is a general lack of intermediate units or step-down units in Norway, which may be preferable for the recovery of older post-ICU patients. Patients' and relatives' wishes for reluctant treatment could be another factor for the shift in the ICU mortality/hospital mortality ratio for the elderly. Another uncertain factor is the ICU capacity when treatment is withdrawn. Units with few/no available ICU beds are probably more likely to transfer old, dying patients to wards.

The physicians' perceptions of patient preferences are decisive when it comes to withholding treatment.[13] Sprung et al. have referred to the importance of religious views in cases with withdrawal of therapy, and that nonreligious or protestant doctors limit treatment earlier than doctors with other religious affiliation and culture.[14,15]

The main strength of this study is the large number of patients included and that we have data from nearly all ICUs in Norway, except neonatal units, paediatric ICUs, and cardiothoracic post-operative departments.

The excluded patients had shorter ICU LOS and ventilator support time, lower fraction of ventilation, lower severity score, but quite similar mortalities. This probably reflects that excluded nonsurvivors either died shortly after ICU admittance or were early discharged to the ward and that survivors were patients with low severity score and short stays in the ICU after planned surgery. These data strengthen our internal validity regarding outcome in patients over 80 years.

ICU admission criteria differ between hospitals and are very dependent of present capacity and the decision of the attending physician. We believe that many possible patients over 80 years were not admitted to the Norwegian ICUs in our study period. A multicentre study from France showed that physicians were extremely reluctant to admit patients over 80 years into the ICUs, despite presence of criteria indicating that ICU admission was certainly or possibly appropriate.[16] Rodriguez-Molinero et al. showed similar results, where the decision to admit elderly to the ICU mainly was based on age and on the physician's estimation of functional and mental status, which again was not concordant with the evaluation of the family.[17]

Current data on 1-year to 6-year mortality for ICU patients over 80 years are depending on reason for admittance, ranging from 43% after planned surgery to 89% for both medical and unplanned surgery admissions.[18] 'Functional status' is considered as one of the major predictors of long-term mortality.[5]

In general, elderly patients discharged from the ICU perceive QOL similar to younger patient groups,[19,20] despite a decrease in activities of daily living.[21] The sample sizes in studies are however small due to high 1-year mortality.

Limitations

A limitation in this study is that we have no data on patients' or relatives' view upon withholding or withdrawing treatment, and neither do we have such data for the caregivers in the actual ICUs. We hence do not know if some of the differences we found between the octogenarians and younger patients were a result of intended and planned treatment limitations. Another study limitation is the proportion of excluded patients (9.5%). The results must therefore be seen with this reservation. Because NIR has no data on long-term mortality, our conclusions regarding mortality outcome are based on short-term mortality only.

Conclusions

This study shows that patients with increasing age have shorter ICU stays, have a higher mortality, have a shift of dying at the ward rather than in the ICU, and receive less and shorter mechanical ventilator support. Hospital mortality alone is of course not enough to conclude about the outcome in the octogenarians.

Acknowledgement

The authors thank Johan Barstad, Helse Møre og Romsdal, for statistical counselling.

Conflicts of interest: We have no conflicts of interest.

Funding: No funding was received for the study.

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