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Analyzing the use of specialized palliative care in intensive care unit patients in Germany: a cross-sectional study

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Abstract

Background Despite rising importance of integration of palliative medicine in treating life-threatening illnesses in intensive care units (ICU), the extent remains unknown. Using billing data, we analysed the frequency of specialized palliative care use in ICU patients in Germany.

Methods Billing data (2019–2022) from the InEK was used in this cross-sectional study on all billed adult ICU cases. Data included case numbers, demographics, diagnoses, treatment procedures, ventilation (≥ 95 h), palliative care frequency.

Results 61,591,299 adult cases were treated, 11.2% (6,912,316) requiring ICU and 499,262 (7.2%) needing long-term ventilation. 44.2% of all ICU cases and 36.2% of long-term ventilated patients were female ($p < 0.0001$). ICU mortality was 11.1%, long-term ventilation mortality was 38.8%; higher in men and patients aged ≥ 65 ($p < 0.001$). Leading diagnoses for ICU deaths: heart failure (6.9%), stroke (6.3%), sepsis (6.2%).

0.8% of ICU cases and 1.4% of long-term ventilated cases received specialized palliative care, with a higher proportion of females ($p < 0.0001$). Most palliative care patients were aged ≥ 65 .

Conclusion From 2019 to 2022, 11.2% of hospital cases required ICU-treatment. Despite suffering from life-threatening conditions and high mortality rates, less than 1% of all ICU cases and 1.4% of long-term ventilated cases received palliative care (differing sexes and ages). This highlights deficiencies in palliative care integration into ICUs to alleviate patients and their families suffering from complex needs. Implementing benchmarking could be beneficial in this process.

Keywords Palliative medicine, Critical care, Interdisciplinary research, Long-term ventilation, Age, Gender, Mortality

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Introduction

Currently, there are compelling discussions surrounding the management of intensive care patients and their access to palliative care [1]. Germany has one of the highest densities of intensive care beds worldwide. However, no standardized criteria exist for inpatient intensive care treatment. ICU patient populations are highly diverse, ranging from critically ill individuals requiring mechanical ventilation or other life-saving organ-support therapies to those needing postoperative or extended monitoring [2]. ICU structures also vary, operating as either multidisciplinary or department-specific units. Multidisciplinary ICUs manage patients from multiple specialties, often with significant involvement from anesthesiologists, while department-specific ICUs focus on fields such as surgery, internal medicine, cardiology, neurology, or infectious diseases. The organization and specialization of ICUs differ across hospitals based on size, resources, and medical focus.

Intensive care units (ICUs) typically cater to patients with potentially life-threatening conditions and a limited prognosis. These patients, along with their families, often experience a significant symptom burden, including physical, psychological, social, spiritual and communication challenges [3–8]. Palliative care aims to address the needs of patients facing life-threatening illnesses and their families. Despite the evident overlap between palliative and intensive care medicine, the concept of integrated palliative and intensive care only began to emerge in the late 1990s [9]. While intensive care treatment focusses on prolonging life through extensive therapy, palliative medicine prioritizes enhancing quality of life with minimal technology use. Nevertheless, both disciplines complement each other [10]. Today, palliative care principles, including thorough symptom management and clear communication, have become integral components of corresponding intensive care recommendations [11, 12]. Moreover, various medical societies and guidelines recommend an early integration of palliative care for seriously ill and ICU patients [11, 13, 14]. In Germany, a recent position paper underscores the importance of timely integration of palliative care in clinical acute, emergency, and intensive care medicine and aims to enhance patients' quality of life and alleviate symptoms [12]. The German Interdisciplinary Association for Intensive Care and Emergency Medicine (DIVI) recommends integrating palliative care into intensive care units and ensuring the availability of simultaneous intensive and palliative care treatments [15].

In Germany, primary care physicians and nurses with basic palliative care training oversee general palliative care. In contrast, specialized inpatient palliative care is delivered by multiprofessional teams. These teams

offer consultation services to general and ICU wards for patients with complex palliative care needs or palliative care treatment on a palliative care ward. Reliable international and German data on the integration of palliative and intensive care medicine are limited. In the mid-2010s, about a quarter of all hospital deaths and nearly 12% of all deaths in Germany occurred in an ICU [16].

A 2017 survey at German Comprehensive Cancer Centers found that 11 out of 15 centers had palliative medicine consultation services, caring for a median of 33 ICU patients and admitting a median of 9 patients to palliative wards annually. Two centers had regular visits from both ICU and palliative care teams [17]. Currently, no data exists on the number of cases involving concurrent palliative and intensive care treatment in Germany. The aim of the present study was to determine the frequency of specialized palliative care treatment in hospitalized patients admitted to German ICUs.

Methods

Study design

In this cross-sectional study, we evaluated data sourced from the Institute for the Remuneration System in the Hospital Sector (InEK GmbH, Siegburg, Germany) covering the period from 01.01.2019 to 31.12.2022. We exclusively relied on public data obtained after approval by the institutional and local ethics committee (study ID: 190032024-ANF, ethics committee of the Brandenburg Medical School, Germany). We followed the STROBE statement (Suppl. Table 3) [18].

Setting and data source

In Germany, all hospitals are reimbursed for their services using a performance-based, flat-rate remuneration system (§ 17b, *Krankenhausfinanzierungsgesetz*, Hospital Financing Act) based on the German Diagnosis Related Groups System (G-DRG). A specific DRG rate is assigned to each inpatient treatment case for reimbursement. It is compulsory for all German Hospitals to send their data (demographics, primary and secondary diagnoses, procedures) to InEK GmbH. InEK GmbH has been legally delegated to implement and maintain this system and aggregate received data making it publicly available via the InEK Browser (§21 Hospital Fees Act).

Cohort / Participants

Data for all billed hospital cases involving ICU care meeting the following criteria was obtained:

1. > 18 years of age
2. total number of hospital cases,
3. total number involving ICU care

4. total number of ICU cases and those ICU cases with > 95 h ventilation

Variables and definitions

We retrieved billing data for German hospital cases and analyzed the number of cases coded per specific code. Thus, our data represent the number of hospital cases in which the respective code was assigned. Diagnoses were classified according to the International Statistical Classification of Diseases and Related Health Problems, 10th Revision, German Modification (ICD-10-GM). In the German DRG system, each case has a single primary diagnosis and may include multiple secondary diagnoses. Medical procedures and treatments were identified using their corresponding procedural codes (*Operationen- und Prozedurenschlüssel*, OPS). Data extracted included:

1. case numbers for each cohort
2. demographics (age groups as predefined by InEK browser, sex distribution classified into female, male, diverse, unknown)
3. case distribution among hospitals according to bed capacity and ownership
4. count of primary diagnoses and treatment procedures
5. Administration of specialized palliative care according to Operations and Procedure Codes (OPS 8–982, 8-98e, 8-98 h) and complex intensive care treatment (OPS 8–980, 8-98f, for code definition see Supplemental Table 1).

Intensive care cases were identified using the InEK data browser, applying the selection criteria for intensive care cases. This approach includes all German ICU cases, regardless of the specialized department. The browser also allows for selecting cases based on ventilation duration. Long-term ventilation was defined according to the G-DRG system as mechanical ventilation lasting more than 95 h in combination with intensive care complex treatment [19].

Bias

We minimized selection bias by including all consecutive adult ICU admissions in Germany from 2019 to 2022, ensuring a comprehensive and representative sample. However, our analysis pertains to hospital cases rather than individual patients. The distinction between hospital and patient cases can introduce bias when assessing the frequency of specialized palliative care for a specific illness. Patients may have multiple hospitalizations but receive palliative care only once. In our study, this distinction is less relevant, as we analyzed the co-occurrence

of intensive care and specialized palliative care within the same hospitalization. Moreover, not all ICU patients have life-threatening conditions, such as those admitted for monitoring after planned surgery. Therefore, we focused on ICU cases with ventilation exceeding 95 h, as these patients inherently face life-threatening conditions. Reported data is complete considering all billed cases reported to and made available by the InEK from all German Hospitals with the exception of potential results of less than four cases for data protection. Considering the high volume of cases analyzed, this small number of cases should not affect the overall outcome. To reduce measurement bias, we extracted data on palliative care consultations and intensive care treatments using predefined OPS and ICD-10 codes, ensuring reliable and consistent identification of in-patient ICU cases receiving specialized palliative care. While OPS and ICD-10 classifications are well established, we cannot entirely rule out misclassifications. Measurement errors are minimal in our study based on billing data. The study aimed to determine the frequency of palliative medical treatment during ICU stays and long-term ventilation, using descriptive statistics, which minimizes the impact of confounding bias. However, information on key demographic and clinical variables, such as age, gender, and severity of illness, are given in detail.

Statistics

Data were obtained from the InEK data browser and organized using Microsoft Excel for Mac (version 16.78, Microsoft Corporation, Redmond, Washington, USA). Statistical analyses and graphical representations were conducted using GraphPad Prism 9 for macOS (version 9.5.0, GraphPad Software, Inc., La Jolla, USA).

Descriptive statistics were utilized to calculate the percentages of patients who passed away and those who received treatment. The Chi-square test with Yates' correction was employed to examine differences in sex distributions across various subgroups [20]. A two-sided significance level of $\alpha=0.05$ was applied, with a Bonferroni correction for multiple comparisons ($n=8$) [21]. Thus, the adjusted significance level was set at 0.006. To assess the association between two categorical variables in 2×2 contingency tables, we calculated odds ratios (OR) along with their corresponding 95% confidence intervals (95%-CI) [22].

Results

Patient cohorts and baseline characteristics

Between 2019 and 2022, Germany had 61,591,299 adult hospital cases. Among these, patients required intensive care in 6,912,316 hospital cases (11.2%), and ventilation > 95 h in 499,262 cases (7.2% of ICU cases). A

complex or specialized ICU therapy (OPS codes 8–980 or 8-98f) was conducted and billed in 2,485,363 ICU cases (35.9%) and in 467,681 ICU cases with long-term ventilation (93.7% of these; Supplement Figs. 1 and 2).

Female patients accounted for 52.7% of all hospital cases (32,449,759 cases) but only 44.2% of ICU cases (3,054,198 patients) and 36.2% of long-term ventilation cases (180,799 cases; $p < 0.0001$, Table 1 and Fig. 1). The age distribution also varied significantly: whilst 26.7% of all hospital patients were ≥ 65 (32,252,121 cases), 63.3% of ICU patients and 61.8% of long-term ventilated patients ($p < 0.0001$) were older than 65 years.

Mortality

770,036 ICU cases resulted in patient mortality, equating to a mortality rate of 11.1% based on the total number of ICU cases (Fig. 2). Among the deceased patients, 42.5% were female (327,556 cases), and 81.1% were ≥ 65 years old. For long-term ventilated patients, the mortality rate increased to 38.8% (193,709 cases). 73% of the long-term ventilated patients were ≥ 65 years (141,410 cases) and 64.1% male (124,104 cases). Women receiving intensive

care and long-term ventilation had significantly lower mortality rates (entire ICU cohort: $p < 0.001$, Chi-square: 947.7; long-term ventilated cohort: $p < 0.001$, Chi-square: 11.9) (Fig. 3).

Main diagnoses

Table 2 summarizes the primary diagnoses. Among all German ICU patients, the most common diagnoses were cerebral insult, acute myocardial infarction, and heart failure (9.5%, 6.1%, 3.5%, respectively). Of those diagnoses resulting in death in ICU cases heart failure, stroke, and sepsis were leading (6.9%, 6.3%, 6.2%, respectively). Viral pneumonia, chronic obstructive pulmonary disease, and acute myocardial infarction were the leading diagnoses among long-term ventilated patients (10%, 5.2%, 5.1%, respectively) as well as leading to fatal outcomes in this group (12.2%, 5.2%, 5.1%, respectively).

Treating hospitals

Hospitals with more than 1,000 beds treated 18.2% of all adult ICU cases (1,257,896 cases), primarily in publicly owned hospitals. These hospitals also treated 24.5%

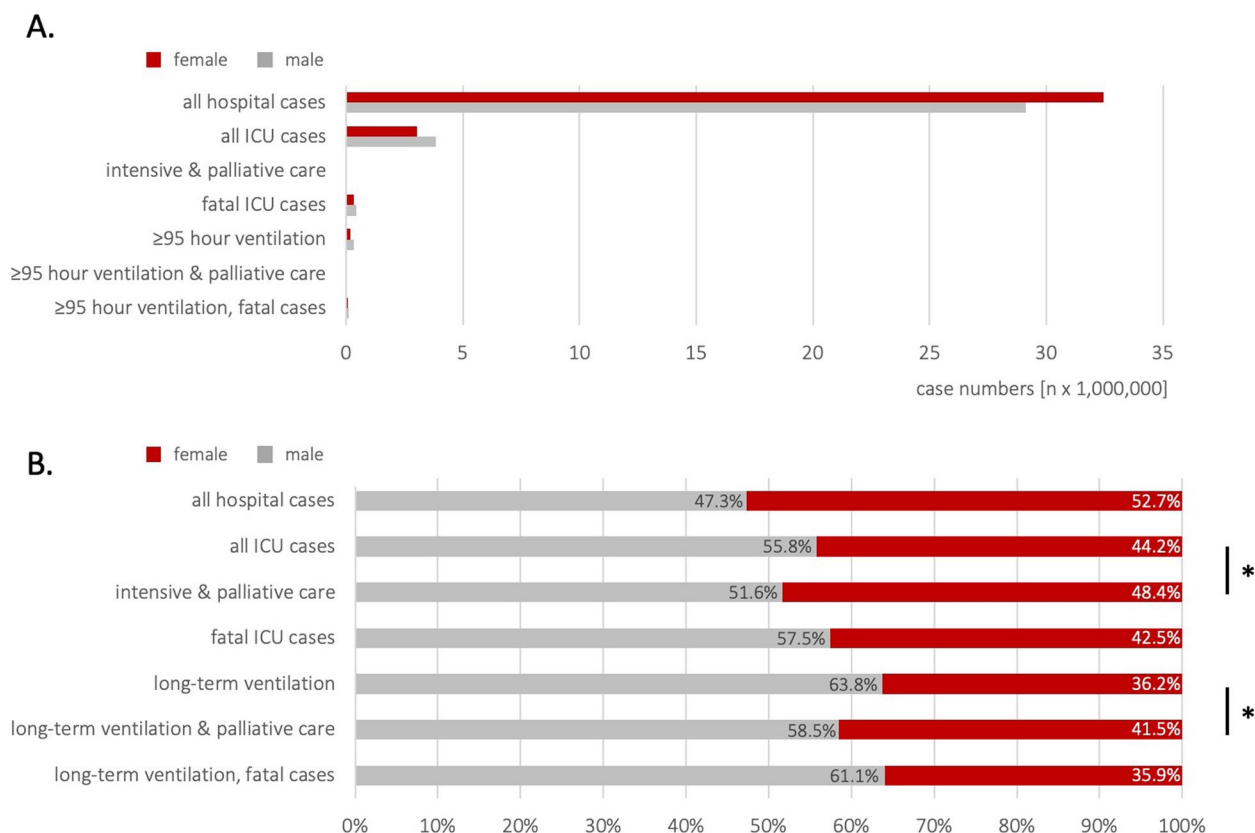


Fig. 1 Sex distribution. The figure illustrates the gender distribution in the analysed hospital case cohorts. Notably, the proportion of cases with female patients receiving palliative care was significantly higher. Once again, the proportion of cases with female patients in long-term ventilated cases receiving palliative care was significantly higher than in the comparison group. *Demonstrates a significant difference ($P < 0.006$)

Table 1 The sex and age distribution of the patients

	2022	2021	2020	2019	2019–2022
All hospital cases in Germany					
Case numbers	14,770,158	14,761,106	14,906,432	17,153,603	61,591,299
Gender					
Male	7,012,466	6,964,983	7,069,275	8,091,024	29,137,749
Female	7,756,869	7,795,307	7,836,419	9,061,164	32,449,761
Diverse	224	155	103	24	506
Unknown	599	661	635	1391	3286
Age groups					
18–29 years	1,050,691	1,088,778	1,109,110	1,338,137	4,586,716
30–39 years	1,336,137	1,402,848	1,378,709	1,538,006	5,655,700
40–49 years	1,079,507	1,127,082	1,142,259	1,352,614	4,701,462
50–54 years	848,133	913,708	953,138	1,133,731	3,848,710
55–59 years	1,192,188	1,221,518	1,234,549	1,400,423	5,048,678
60–64 years	1,363,402	1,333,806	1,323,477	1,477,227	5,497,912
65–74 years	2,904,668	2,804,386	2,752,010	3,097,215	11,558,280
75–79 years	1,422,228	1,462,512	1,662,066	2,092,452	6,639,258
80+ years	3,573,204	3,406,468	3,351,114	3,723,798	14,054,585
All ICU patients in Germany					
Case numbers	1,706,703	1,736,413	1,818,032	1,651,168	6,912,316
Gender					
Male	952,014	969,951	1,015,880	919,834	3,857,681
Female	754,578	766,354	802,063	731,203	3,054,199
Diverse	25	17	8	5	55
Unknown	86	91	81	126	384
Age groups					
18–29 years	57,178	3,288	3,288	62,589	236,257
30–39 years	67,655	3,988	3,999	68,982	278,274
40–49 years	94,954	5,811	5,799	98,088	399,306
50–54 years	88,661	5,579	5,709	96,808	385,966
55–59 years	135,555	8,209	8,179	133,821	560,204
60–64 years	171,201	9,929	9,669	155,123	674,082
65–74 years	398,794	22,859	39,673	356,548	1,551,535
75–79 years	199,663	12,259	21,782	247,338	909,802
80+ years	493,042	28,149	48,567	431,871	1,916,892
ICU patients receiving > 95 h ventilation					

Table 1 (continued)

	2022	2021	2020	2019	2019–2022
Case numbers	118,485	141,175	127,142	112,460	499,262
Gender					
Male	75,335	90,551	81,550	70,982	318,418
Female	43,134	50,612	45,581	41,472	180,799
Diverse	2	0	1	0	3
Unknown	14	12	10	6	42
Age groups					
18–29 years	2189	2179	2050	1925	8343
30–39 years	3571	4062	3481	2862	13,976
40–49 years	6519	8448	6832	5781	27,580
50–54 years	6905	8977	7808	6758	30,448
55–59 years	11,254	13,956	11,903	10,480	47,593
60–64 years	15,433	18,398	15,442	13,343	62,616
65–74 years	35,963	41,927	36,293	31,216	145,399
75–79 years	14,987	18,716	19,453	19,024	72,180
80+ years	21,664	24,512	23,880	21,071	91,127
Deceased ICU patients					
Case numbers	198,387	204,851	194,049	172,749	770,036
Gender					
Male	113,665	119,094	111,750	97,837	442,346
Female	84,672	85,714	82,273	74,897	327,556
Diverse	3	1	2	0	6
Unknown	47	42	24	15	128
Age groups					
18–29 years	933	828	797	822	3380
30–39 years	1966	1979	1791	1587	7323
40–49 years	4349	4868	4373	3857	17,447
50–54 years	5219	6100	5545	5152	22,016
55–59 years	9648	10,648	9513	8651	38,460
60–64 years	15,029	15,768	14,080	11,922	56,799
65–74 years	45,785	47,506	41,019	35,454	169,764
75–79 years	27,420	30,314	31,532	30,704	119,970
80+ years	88,038	86,840	85,399	74,600	334,877
Deceased ICU patients receiving > 95 h ventilation					

	2022	2021	2020	2019	2019–2022
Case numbers	47,198	57,365	48,071	41,075	193,709
Gender					
Male	30,095	63.8%	64.85%	64.47%	62.86%
Female	17,089	36.2%	35.13%	35.52%	37.14%
Diverse	1	0.0%	0.00%	0.00%	0.00%
Unknown	13	0.0%	0.02%	0.01%	0.01%
Age groups					
18–29 years	354	0.8%	0.60%	0.61%	0.69%
30–39 years	740	1.6%	1.42%	1.38%	1.34%
40–49 years	1610	3.4%	3.57%	3.27%	3.21%
50–54 years	1876	4.0%	4.33%	4.11%	4.15%
55–59 years	3377	7.2%	7.35%	6.84%	7.09%
60–64 years	5024	10.6%	10.81%	9.74%	9.66%
65–74 years	14,267	30.2%	30.28%	27.70%	26.65%
75–79 years	7069	15.0%	16.11%	18.30%	19.44%
80+ years	12,881	27.3%	25.54%	28.05%	27.77%

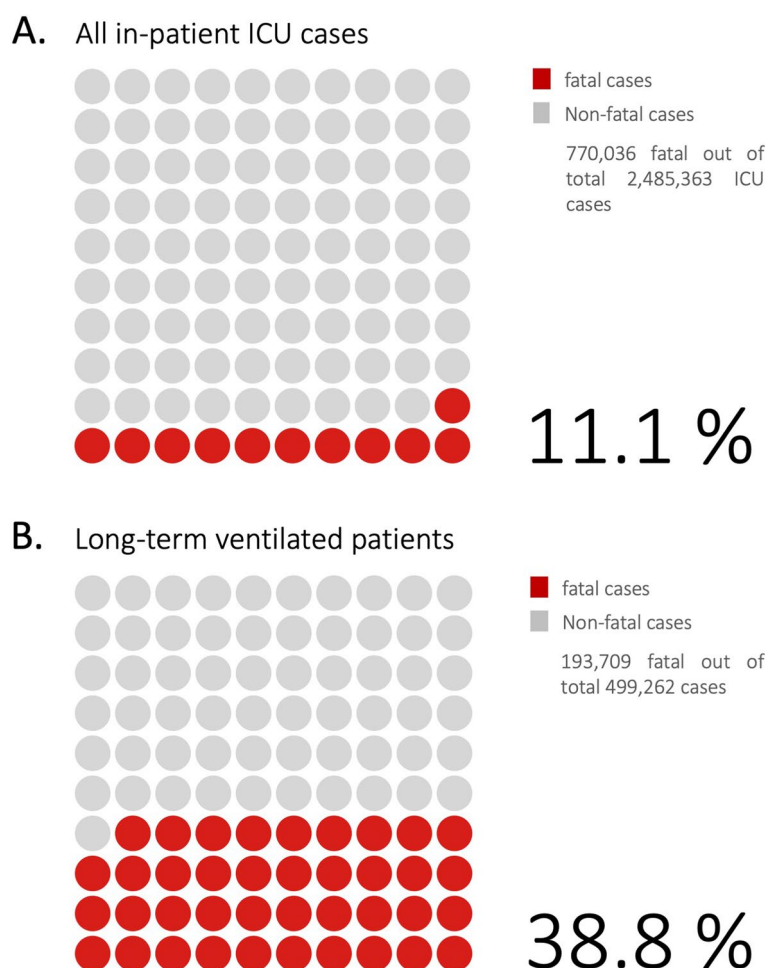


Fig. 2 Mortality

(122,171 cases) of long-term ventilated patients. Supplement Table 2 provides a detailed overview of bed capacities and hospital ownership.

Palliative care treatment of ICU patients

53,875 of the 6,912,316 in-patient ICU cases (0.8%) in Germany received palliative care during the same hospital stay. Among these, 48.4% were female and 71% were aged ≥ 65 years. Female ICU patients received palliative care significantly more often than male ICU patients (OR: 1.18; 95% CI: 1.16 – 1.2; $p < 0.0001$, Table 3). Among the 56,328 palliative care treatments, 32.6% were classified as complex palliative care, 34.3% as extensive specialized palliative care, and 37.6% involved specialized palliative care provided by a consultation service (multiple coding possible).

Among the 7,066 long-term ventilated ICU patients who received palliative care, 67.1% were aged ≥ 65 , and 41.5% were female. The likelihood of long-term ventilated female and elderly patients receiving palliative

care was significantly higher compared to the general ICU population (female: OR: 1.3; 95% CI: 1.19 – 1.31; $p < 0.001$; aged ≥ 65 : OR: 1.42; 95% CI: 1.4 – 1.44; ICU cohort: OR: 1.26; 95% CI: 1.2 – 1.33; $p < 0.001$). Among these cases, 25.4% involved complex palliative medicine, 28.7% specialized palliative medicine, and 49.8% involved palliative medicine consultation services (multiple coding possible, Table 3).

Discussion

This study provides insights into the frequency of ICU-related hospital cases, mortality rates, and the utilization of specialized palliative care in ICUs over four years in Germany. Key findings include:

- Intensive care was required in 11.2% of all hospital cases, with long-term ventilation >95 hours needed in 0.8% of cases.

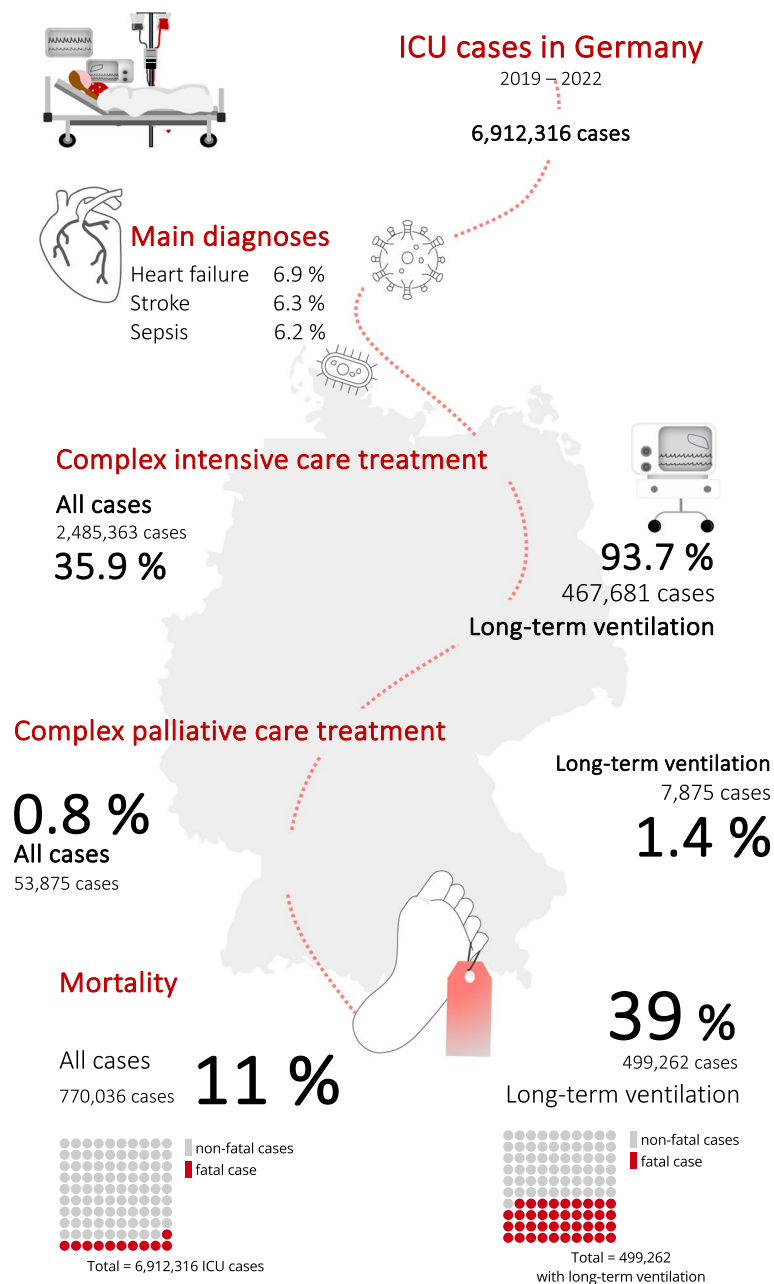


Fig. 3 Infographic. Figure 3 summarizes the main results

- The overall ICU mortality rate was 11.1%, rising to 38.8% for long-term ventilation cases, predominantly among patients aged ≥ 65 and males.
- Complex or specialized palliative care was provided in 53,875 ICU cases (0.8%) and 7,066 long-term ventilation cases (1.4%).

This study examined the frequency of intensive care treatments and long-term ventilation. A previous

German study analyzed hospital remuneration data to assess end-of-life intensive therapy rates between 2007 and 2015 [16]. In 2015, 3.9% of all hospital cases involved intensive care, with 30.5% requiring mechanical ventilation and 16.2% needing ventilation for more than 95 h [16]. ICU cases in Germany more than doubled by 2019, a trend not solely driven by the SARS-CoV-2 pandemic, which led to peak ICU hospitalizations in 2020. Despite the overall rise in ICU cases, long-term ventilation cases

Table 2 Main diagnoses and selected diagnoses

		ICU patients ≥ 18		ICU patients ≥ 18, fatal cases		ventilation ≥ 95 h		ventilation > 95 h, fatal cases		ICU patients ≥ 18, receiving palliative care		ventilation > 95 h, receiving palliative care	
	ICD-10-GM code	cases	%	cases	%	cases	%	cases	%	cases	%	cases	%
	Total case numbers	6,912,316		770,036		499,262		193,709		57,116		7,501	
	Description												
C34	Lung cancer	70,386	1.0%	12,641	1.6%	4,123	0.8%	2,464	1.3%	4,212	7.4%	306	4.1%
I63	Stroke	662,466	9.6%	48,296	6.3%	17,965	3.6%	6,574	3.4%	3,350	5.9%	270	3.6%
I50	Heart failure	243,253	3.5%	53,489	6.9%	20,712	4.1%	9,320	4.8%	1,951	3.4%	163	2.2%
A40-A41	Streptococcal and other sepsis	138,790	2.0%	47,661	6.2%	24,934	5.0%	11,280	5.8%	1,737	3.0%	298	4.0%
C25	Pancreatic malignoma	28,727	0.4%	3,997	0.5%	1,568	0.3%	760	0.4%	1,466	2.6%	60	0.8%
J44		134,503	1.9%	20,920	2.7%	25,945	5.2%	6,696	3.5%	1,338	2.3%	272	3.6%
C79.3	Secondary malignant new formation of the brain and the meninges	19,242	0.3%	1,578	0.2%	638	0.1%	343	0.2%	1,206	2.1%	76	1.0%
C79.5	Secondary malignant new formation of the bone and the bone marrow	10,371	0.2%	1,460	0.2%	362	0.1%	226	0.1%	1,142	2.0%	45	0.6%
C56	Ovarian malignoma	16,068	0.2%	1,146	0.1%	573	0.1%	191	0.1%	956	1.7%	78	1.0%
S72	Fracture of the femur	198,651	2.9%	23,836	3.1%	4,959	1.0%	2,429	1.3%	903	1.6%	31	0.4%
C20	rectum malignoma	38,657	0.6%	2,481	0.3%	1,504	0.3%	619	0.3%	754	1.3%	65	0.9%
S06	Intracranial injury	137,738	2.0%	17,314	2.2%	14,759	3.0%	4,265	2.2%	684	1.2%	173	2.3%
I21	Acute myocardial infarction	401,331	5.8%	46,634	6.1%	25,327	5.1%	10,487	5.4%	668	1.2%	157	2.1%
J09-J12	Viral pneumonia	119,063	1.7%	41,720	5.4%	51,271	10.3%	23,725	12.2%	438	0.8%	204	2.7%
I35	Non-rheumatic aortic valve diseases	122,961	1.8%	5,715	0.7%	5,206	1.0%	1,810	0.9%	140	0.2%	20	0.3%
I48	Atrial fibrillation and atrial flutter	138,509	2.0%	3,545	0.5%	1,375	0.3%	618	0.3%	80	0.1%	0	0.0%
J80	Acute respiratory distress syndrome of children, adolescents and adults [ARDS]	12,371	0.2%	5,731	0.7%	9,399	1.9%	4,243	2.2%	78	0.1%	65	0.9%
I46	Cardiac arrest	17,272	0.2%	14,056	1.8%	3,989	0.8%	2,883	1.5%	76	0.1%	54	0.7%
I25	Chronic ischemic heart disease	110,755	1.6%	3,648	0.5%	4,712	0.9%	1,364	0.7%	56	0.1%	5	0.1%
G62	Other polyneuropathies / Critical illness polyneuropathy	10,950	0.2%	1,331	0.2%	7,148	1.4%	1,089	0.6%	47	0.1%	39	0.5%
G45	Cerebral transient ischemia and related syndromes	393,944	5.7%	1,364	0.2%	205	0.0%	44	0.0%	30	0.1%	0	0.0%
F10	Mental and behavioral disorders caused by alcohol	72,448	1.0%	313	0.0%	523	0.1%	105	0.1%	0	0.0%	0	0.0%
N17	Acute kidney failure	64,266	0.9%	12,841	1.7%	3,548	0.7%	1,706	0.9%	0	0.0%	0	0.0%
I69	Pneumonia caused by solid and liquid substances/vomit	27,583	0.4%	9,598	1.2%	5,845	1.2%	2,256	1.2%	0	0.0%	0	0.0%

Table 3 Palliative and intensive care treatments in hospital cases involving intensive care

Case with patients receiving intensive and palliative care in the same hospital stay										
Case numbers										
Gender	2022	2021	2020	2019						
Male	14,473	13,904	13,935	11,563	53,875					
Female	7383	51.0%	7211	51.9%	5972	51.6%	27,817	51.6%		
Diverse	7087	49.0%	6693	48.1%	6693	48.0%	5590	48.3%		
Unknown	0	0.0%	0	0.0%	0	0.0%	0	0.0%		
	3	0.0%	0	0.0%	0	0.0%	1	0.0%		
Age groups										
18–29 years	102	0.7%	86	0.6%	86	0.6%	98	0.8%	371	0.7%
30–39 years	260	1.8%	247	1.8%	247	1.7%	224	1.9%	970	1.8%
40–49 years	511	3.5%	512	3.7%	512	3.8%	482	4.2%	2030	3.8%
50–54 years	622	4.3%	649	4.7%	649	4.7%	621	5.4%	2548	4.7%
55–59 years	1024	7.1%	1102	7.9%	1102	7.8%	922	8.0%	4134	7.7%
60–64 years	1507	10.4%	1452	10.4%	1452	10.5%	1133	9.8%	5558	10.3%
65–74 years	3746	25.9%	3530	25.4%	3530	24.8%	2845	24.6%	13,571	25.2%
75–79 years	1850	12.8%	1895	13.6%	1895	15.0%	1998	17.3%	7836	14.5%
80+ years	4851	33.5%	4431	31.9%	4431	31.1%	3240	28.0%	16,857	31.3%
Total number of palliative care codes (ICD-10-GM: 8–982, 8-98e, 8-98 h)										
Palliative medical complex treatment										
8-982										
8-982.0	1219	1202	1047	1212	17,555 31.2%					
8-982.1	2138	2014	1743	1616	4680 8.3%					
8-982.2	862	831	728	650	7511 13.3%					
8-982.3	686	609	513	485	3071 5.5%					
Specialized inpatient palliative medical complex treatment on a palliative care unit										
8-98e										
8-98e.0	1321	1862	1873	1928	2293 4.1%					
8-98e.1	1213	1471	1640	1686	18,481 32.8%					
8-98e.2	652	810	771	849	6984 12.4%					
8-98e.3	551	621	612	621	6010 10.7%					
Specialized palliative medical complex treatment by a palliative care service										
8-98 h										
8-98 h.00	579	923	1057	1059	3082 5.5%					
8-98 h.01	1121	1353	1490	1629	2405 4.3%					
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Table 3 (continued)

		2022	2021	2020	2019	
8-98 h.02	Specialized palliative medical complex treatment through a palliative care service: Through an internal palliative care service: 4 to less than 6 h	730	1000	1048	1139	3917 7.0%
8-98 h.03	Specialized palliative medical complex treatment through a palliative care service: Through an internal palliative care service: 6 to less than 9 h	511	769	851	959	3090 5.5%
8-98 h.04	Specialized palliative medical complex treatment through a palliative care service: Through an internal palliative care service: 9 to less than 12 h	247	353	398	453	1451 2.6%
8-98 h.05	Specialized palliative medical complex treatment through a palliative care service: Through an internal palliative care service: 12 to less than 15 h	134	214	218	270	836 1.5%
8-98 h.06	Specialized palliative medical complex treatment through a palliative care service: Through an internal palliative care service: 15 to less than 20 h	126	181	224	222	753 1.3%
8-98 h.07	Specialized palliative medical complex treatment through a palliative care service: Through an internal palliative care service: 20 to less than 25 h	57	104	99	129	389 0.7%
8-98 h.08	Specialized palliative medical complex treatment through a palliative care service: Through an internal palliative care service: 20 to less than 25 h	47	79	76	101	303 0.5%
8-98 h.09	Specialized palliative medical complex treatment through a palliative care service: Through an internal palliative care service: 20 to less than 25 h	32	21	40	32	125 0.2%
8-98 h.0a	Specialized palliative medical complex treatment through a palliative care service: Through an internal palliative care service: 45 to less than 55 h		12	10	12	34 0.1%
8-98 h.0b	Specialized complex palliative care treatment through a palliative care service: Through an internal palliative care service: 55 or more hours	13	14	10	25	62 0.1%
8-98 h.10	Specialized palliative medical complex treatment by a palliative service: By an external palliative service: Up to less than 2 h		19	12	8	39 0.1%
8-98 h.11	Specialized palliative medical complex treatment by a palliative care service: By an external palliative care service: 2 to less than 4 h		24	12	14	50 0.1%
8-98 h.12	Specialized palliative medical complex treatment by a palliative care service: By an external palliative care service: 4 to less than 6 h	7	7			14 0.0%
8-98 h.13	Specialized palliative medical complex treatment by a palliative care service: By an external palliative care service: 6 to less than 9 h	5	6	7		18 0.0%
Case with long-term ventilated patients > 95 h receiving palliative care in the same hospital stay						
Case numbers		1,803	1,949	1,777	1,537	7,066
Gender						
Male						
Female						
Diverse						
Unknown						
Age groups						
18–29 years						
30–39 years						

Table 3 (continued)

		2022	2021	2020	2019	
40–49 years		69	91	67	57	284
50–54 years		93	103	85	98	379
55–59 years		152	184	146	139	621
60–64 years		190	237	199	152	778
65–74 years		569	566	518	425	2078
75–79 years		222	276	275	276	1049
80+ years		431	428	430	324	1613
Total number of palliative care codes (ICD-10-GM: 8–982, 8–98e, 8–98 h)						
8–982	Palliative medical complex treatment					7338
8–982.0	Palliative medical complex treatment: Up to 6 days of treatment	157	164	134	143	1797
8–982.1	Palliative medical complex treatment: At least 7 to a maximum of 13 days of treatment	211	175	165	142	598
8–982.2	Palliative medical complex treatment: At least 14 to a maximum of 20 days of treatment	69	72	60	60	693
8–982.3	Palliative medical complex treatment: At least 21 days of treatment	85	51	61	48	261
8–98e	Specialized inpatient palliative medical complex treatment on a palliative care unit					2025
8–98e.0	Specialized inpatient palliative medical complex treatment: Up to 6 days of treatment	194	266	273	272	1005
8–98e.1	Specialized inpatient palliative medical complex treatment: At least 7 to a maximum of 13 days of treatment	105	115	162	125	507
8–98e.2	Specialized inpatient palliative medical complex treatment: At least 14 to a maximum of 20 days of treatment	62	71	77	62	272
8–98e.3	Specialized inpatient palliative medical complex treatment: At least 21 days of treatment	54	63	66	58	241
8–98 h	Specialized palliative medical complex treatment by a palliative care service					3516
8–98 h.00	Specialized palliative medical complex treatment through a palliative care service: Through an internal palliative care service: Up to less than 2 h	128	144	175	159	606
8–98 h.01	Specialized palliative medical complex treatment through a palliative care service: Through an internal palliative care service: 2 to less than 4 h	206	232	233	242	913
8–98 h.02	Specialized palliative medical complex treatment through a palliative care service: Through an internal palliative care service: 4 to less than 6 h	143	164	182	144	633
8–98 h.03	Specialized palliative medical complex treatment through a palliative care service: Through an internal palliative care service: 6 to less than 9 h	97	114	157	134	502
8–98 h.04	Specialized palliative medical complex treatment through a palliative care service: Through an internal palliative care service: 9 to less than 12 h	56	61	91	80	288
8–98 h.05	Specialized palliative medical complex treatment through a palliative care service: Through an internal palliative care service: 12 to less than 15 h	34	46	54	52	186
8–98 h.06	Specialized palliative medical complex treatment through a palliative care service: Through an internal palliative care service: 15 to less than 20 h	22	33	50	48	153

Table 3 (continued)

		2022	2021	2020	2019	
8-98 h.07	Specialized palliative medical complex treatment through a palliative care service: Through an internal palliative care service: 20 to less than 25 h	8	18	30	40	96 1.3%
8-98 h.08	Specialized palliative medical complex treatment through a palliative care service: Through an internal palliative care service: 20 to less than 25 h	9	23	20	28	80 1.1%
8-98 h.09	Specialized palliative medical complex treatment through a palliative care service: Through an internal palliative care service: 20 to less than 25 h	5	6	12	9	32 0.4%
8-98 h.0a	Specialized palliative medical complex treatment through a palliative care service: Through an internal palliative care service: 45 to less than 55 h					0 0.0%
8-98 h.0b	Specialized complex palliative care treatment through a palliative care service: Through an internal palliative care service: 55 or more hours	6	6		10	22 0.3%
8-98 h.10	Specialized palliative medical complex treatment by a palliative service: By an external palliative service: Up to less than 2 h					0 0.0%
8-98 h.11	Specialized palliative medical complex treatment by a palliative care service: By an external palliative care service: 2 to less than 4 h		5		5	5 0.1%
8-98 h.12	Specialized palliative medical complex treatment by a palliative care service: By an external palliative care service: 4 to less than 6 h					0 0.0%
8-98 h.13	Specialized palliative medical complex treatment by a palliative care service: By an external palliative care service: 6 to less than 9 h					0 0.0%

declined between 2015 and 2019 but peaked again in 2021. The sharp increase in ICU cases from 2015 to 2019 may be partly due to changes in data reporting, complicating direct comparisons. Data from 2007 to 2015 only included patients with a standard length of stay, whereas our dataset covers all ICU patients, regardless of length of stay (short, standard, or extended). Many ICU patients, particularly those requiring long-term ventilation, often exceed the standard length of stay. As ICU hospital cases increased between 2015 and 2019, the mortality rate declined from 14.4% to 11.1% [16]. This rate is consistent with ICU mortality rates reported in other EU member states, the US, Scotland, and Australia/New Zealand, which range from 9 to 12% [23–26].

In this study, we determined the frequency of intensive care treatments and long-term ventilation. A previous German study also analyzed hospital remuneration data to determine end-of-life intensive therapy rates between 2007 and 2015 [16]. In 2015, 3.9% of all hospital cases involved intensive care, with 30.5% needing mechanical ventilation and 16.2% requiring it for >95 h [16]. ICU cases in Germany more than doubled till 2019. This increase is not solely due to the SARS-CoV-2 pandemic, which peaked ICU hospitalizations in 2020. Despite the overall rise in ICU cases, long-term ventilation cases decreased from 2015 to 2019, but peaked in 2021. The sharp increase in ICU cases from 2015 to 2019 might be attributed to changes in data reporting, complicating data comparison. Data from 2007 until 2015 only pertains to patients with a standard length of stay, while our dataset includes all ICU patients (short / standard / long stay). Nonetheless, many ICU patients, especially those on long-term ventilation, require extended treatment beyond the standard length of stay. Between 2015 and 2019, as ICU hospital cases increased, the mortality rate decreased from 14.4% to 11.1% [16]. The latter mortality rate aligns with reported ICU mortalities in other EU member states, the US, Scotland, and Australia and New Zealand, which range from 9 to 12% [23–25, 27].

Achieving seamless integration of palliative care into intensive and emergency medicine remains challenging [9]. In Germany, the rate of ICU cases with patients receiving specialized palliative care averaged 0.8%, and among those on long-term ventilation, it was 1.4%. This frequency has hardly increased compared to the reported 0.7% in 2015 (5,084 out of 736,444 intensive care treatments). Our analysis excludes palliative care units ('special facilities', 'besondere Einrichtungen') that provide specialized palliative care but operate and receive funding outside the DRG system. Approximately 70 of the 350 palliative care units function as these so-called "special facilities." Unlike specialized palliative care provided in dedicated palliative care units, complex palliative

care and consultation services are only captured within the DRG system. Further, patients could be discharged directly from ICU into Specialized Palliative Home Care (SAPV). Since the remuneration of outpatient services is not dealt with by the hospital remuneration system, these cases cannot be accounted for. Other countries and centers reported higher frequencies of palliative care integration into intensive care. A 2013 U.S. study from Columbia University Medical Center found that 88% of elderly ICU patients had potential palliative care needs, with a 6-month mortality rate of 40%. However, only 2.6% received palliative care consultations from a multiprofessional team [8]. Another U.S. study on ventilated patients with high mortality risk reported that 9.4% received palliative care consultations, with older age but not gender influencing the likelihood of receiving palliative care [28].

We found that younger patients (<65 years) and male patients were less likely to receive palliative care on ICU. These findings however do not imply a causal relationship, as critical potential confounding factors could not be analyzed. Nonetheless, our findings are consistent with previous studies reporting similar associations. Previous studies also suggest age and gender differences in access to palliative care, with inconsistent findings. Some studies indicate that women are more likely to access hospice care than men, others show no effect or the opposite [29]. Women may have different symptoms, preferences, and communication patterns in end-of-life care [30]. Access to palliative care varies with age, some studies suggesting limited access for patients over 85 years [29–31].

A core goal of palliative medicine is to enhance the quality of life for patients with potentially life-threatening illnesses. In intensive care, palliative medicine extends beyond end-of-life care — it improves quality of life, reduces the length of ICU stays, and enhances communication and satisfaction among patients and their families [1]. Since our data cannot capture essential aspects of palliative care (eg. symptom burden, quality of life, stress experienced by ICU patients and their families) an accurate assessment of actual palliative care needs is not possible. Additionally, not all ICU patients require specialized palliative care. Part of our observation period includes the SARS-CoV-2 pandemic, which posed unique challenges for patients, families, and healthcare teams. International studies have highlighted barriers to integrating palliative care into ICUs during the pandemic [32–35]. The pandemic introduced significant challenges, leading to fewer patients receiving specialized palliative care in some regions and a reduced assessment of palliative care needs [33]. Additionally, provision of palliative care itself underwent radical changes. Visits from relatives were often impossible, and personal communication

with families and within medical teams was severely limited [36–38]. While new strategies emerged, such web-based communication and platforms, these could only partially compensate for the essential personal interactions in palliative medicine [39]. Moreover, palliative care faced new medical challenges, including the management of SARS-CoV-2 patients requiring extracorporeal membrane oxygenation and experiencing severe symptoms such as weakness, fatigue, shortness of breath, and significant family distress [34].

Limitations

We acknowledge several limitations of our current study:

1. Our data rely on billed hospital cases, which may not directly reflect the number of individual patients.
2. Data collected indicates the rate of ICU—and palliative care during the same hospital stay. No conclusion on temporal association between both treatments (parallel or sequentially) can be drawn. The "real rate" of specialized palliative medical care involvement in ICU patients is likely to be lower, since ICU physicians may provide basic palliative medical treatment themselves.
3. Data spans the duration of the SARS-CoV-2 pandemic in Germany, potentially influencing diagnoses and treatment outcomes. However, data from 2019 (pre-Covid pandemic) is consistent with data from the following pandemic years 2020–2022.

Conclusion

From 2019 to 2022, 11% of the 61.6 million adult hospital cases in Germany required ICU care, and 7% of these ICU cases (499,262 patients) needed long-term ventilation for over 95 h. Despite the severity of their conditions and high mortality rates, only 0.8% of ICU patients and 1.4% of those on long-term ventilation received specialized palliative care. These real-world data reveal the current level of palliative care integration in ICU treatment. There is a need to improve access to palliative care for ICU patients and their families with complex needs. Implementing a benchmarking process could help achieve this goal.

Abbreviations

CI	Confidence Interval
DIVI	Deutsche Interdisziplinäre Vereinigung für Intensiv- und Notfallmedizin (German Society for Intensive Care Medicine and Emergency Care Medicine)
G-DRG	German Diagnosis Related Groups
ICD—10	International Statistical Classification of Diseases and Related Health Problems
ICU	Intensive Care Unit
InEK	Institut für das Entgeltsystem im Krankenhaus (Hospital Remuneration Institute)
OPS	Operationen – und Prozeduren Schlüssel (Operations and Procedural

OR	Catalogue)
SAPV	Odds Ratio
	Spezialisierte Ambulante Palliativversorgung (Specialized Palliative Home Care)
SICSAG	Scotland and Scottish Intensive Care Society Audit Group
STROBE	Strengthening the Reporting of Observational Studies in Epidemiology

Supplementary Information

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Supplementary Material 1: Supplemental Table 1. Definition of OPS-Codes.

Supplementary Material 2: Supplemental Table 2. Hospital. The table presents a breakdown of the number of case treatments categorized by the ownership and bed capacity of the treating hospitals.

Supplementary Material 3: Supplemental Table 3. STROBE checklist.

Supplementary Material 4: Supplemental Fig. 1. OPS Code 8–980. Intensive care complex treatment (basic procedure), Case distribution of all ICU cases / long term ventilation and fatal cases (sum of complexity scores SAPS II and TISS, definition see Supplement Table 1).

Supplementary Material 5: Supplemental Fig. 2. OPS Code 8-98f. Specialized intensive medical treatment (basic procedure), Case distribution of all ICU cases / long term ventilation and fatal cases (sum of complexity scores SAPS II and TISS, definition see Supplement Table 1).

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Authors' contributions

C.S., G.M., M.N. and M.C. had the project idea. C.S., T.T., B.O., D.P., N.E., M.H., L.F., G.M., M.N. and M.K. analyzed and interpreted the data. C.S., T.T., B.O., D.P., N.E., M.H., L.F., G.M., M.N. and M.K. wrote the manuscript. C.S., G.M., M.N. and M.K. prepared the figures and tables. All authors reviewed the manuscript.

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Data availability

The data is available upon request.

Declarations

Ethics approval and consent to participate

We exclusively relied on publicly available data, removing the need for individual patient consent. We followed the ethical principles outlined in the 1964 Helsinki Declaration and its later amendments, and all procedures involving human participants in this study were approved by the institutional and local ethics committee (study ID: 190032024-ANF, ethics committee of the Brandenburg Medical School, Germany).

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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