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RESEARCH



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

Christiane von Saß¹, Theresa Tenge^{2,3}, Birgitt van Oorschot⁴, Dawid Pieper^{5,6}, Nicole Eisenmenger⁷, Martin Heinze⁸, Larissa Fink¹, Guido Michels⁹, Martin Neukirchen^{2,3*†}, and Marcel A. Kamp^{1,10†}

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 (\geq 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 \geq 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 \geq 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

[†]Martin Neukirchen and Marcel A. Kamp contributed equally to this work.

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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
- 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 \geq 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 \geq 65 years (141,410 cases) and 64.1% male (124,104 cases). Women receiving intensive Page 4 of 18

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)

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142228 96% 1,42228 96% 1,462,612 91% 1,662,066 11.5% 2,024,422 12.20% 6539,258 Ants in Germany 3,373,204 2,42% 3,406,468 2,308% 3,351,114 2,24% 1,20% 6,539,558 Ants in Germany 1/706/703 1/706/703 1/736,113 1,51,168 3,571,168 3,571,198 1,034,558 557 0,24 7,323,04 44,13% 80,2063 44,19% 731,203 42,368 3,571,68 557,014 55,86% 969,951 55,86% 10,15,880 55,9% 91,834 5,517,68 5,512,69 5,512,79 5,512,79 5,512	65–74 years	2,904,668	19.7%	2,804,386	19.00%	2,752,010	18.46%	3,097,215	18.06%	11,558,280	18.8%
3,73,2,04 $2,4,2,6$ $3,40,468$ $2,36,1,14$ $2,24,96$ $3,72,3,79$ $21,716$ $1,405,458$ Intel Idemuny $1,706,703$ $1,736,413$ $1,818,032$ $1,651,168$ $21,716$ $1,405,458$ $952,014$ $55,866$ 969951 $55,866$ $1,015,880$ $55,976$ $919,834$ $537,681$ $754,578$ $442,26$ $566,354$ $44,136$ $802,063$ $44,196$ $55,716$ $535,719$ $55,576$ 0096 7 00066 8 00066 5 00066 5 $55,71/8$ $32,896$ $0,116$ $802,063$ $42,196$ $305,4199$ $305,4199$ $57,178$ $34,48$ $766,354$ $44,136$ $802,063$ $62,196$ $305,4199$ $55,178$ $34,96$ $56,384$ $32,896$ $59,962$ $55,716$ $59,962$ $55,719$ $50,3419$ $55,716$ $69,144$ $399,962$ $52,896$ $52,996$ $52,996$ $52,996$ $52,996$	75–79 years	1,422,228	9.6%	1,462,512	9.91%	1,662,066	11.15%	2,092,452	12.20%	6,639,258	10.8%
Instrict Control 1/706/703 1/736/413 1/818/032 1/651/168 691/2316 Ders 1/706/703 1/736/413 1/818/032 1/651/168 691/2316 Ders 1/706/703 1/736/413 1/818/032 1/651/168 55.71% 3.857/681 952/014 55.8% 999/951 55.86% 1/015/880 55.9% 919/834 55.71% 3.857/681 754/57 0.00% 91 0.00% 81 0.00% 5 0.00% 5 86 0.00% 91 0.01% 81 0.00% 5 0.00% 5 3.85% 55.6% 7.41.3% 3.55.7% 3.55.7% 86 0.00% 91 0.01% 81 0.00% 5 3.65.7% 3.55.7% 86 1778 3.40% 56.88% 5.86% 7.41.3% 5.76.7% 3.55.7% 3.55.7% 87 67.05 10.5 5.79% 10.5 5.70% 10.57.55 3.99.6% 5.72.49 3.75.6%	80+years	3,573,204	24.2%	3,406,468	23.08%	3,351,114	22.48%	3,723,798	21.71%	14,054,585	22.8%
Ders 1,706,703 1,736,413 1,818,032 1,651,168 6,912,316 92,014 55,896 69,951 55,86% 1015,880 55,9% 919,334 55,71% 3857,681 754,578 44,296 766,354 44,13% 802,063 44,1% 731,203 44,28% 3054,199 754,578 44,296 76,5354 44,13% 802,063 44,1% 731,203 44,28% 305,4199 754,578 44,296 76,5354 44,13% 802,063 44,1% 731,203 44,28% 305,4199 754,578 0,00% 17 0,00% 81 0,00% 81 731,203 44,28% 305,4199 754,197 366,18 3,28% 65,088 312% 63,082 54,199 355,555 57,178 3,48% 3,28% 69,144 399,960 55,68% 356,56% 356,56% 556,78 356,56% 356,56% 556,78 356,56% 556,78 356,56% 356,56% 356,56% 55,723	All ICU patients in Germany										
952/014 55.8% 96.951 55.86% 1,015,880 55.9% 919,834 55.71% 3857,681 754,578 44.2% 766,334 44.13% 802,063 44.1% 731,203 44.28% 3,657,198 3,657,681 25 0.0% 17 0.00% 8 0.0% 5 0.00% 55 86 0.0% 17 0.01% 81 0.00% 5 0.01% 34 57,178 3.4% 3.28% 56,888 3.28% 59,602 62,589 3.79% 236,723 67,655 4.0% 3.28% 56,888 3.28% 59,602 67,659 3.79% 236,724 57,178 3.4% 3.28% 69,144 3.99% 62,962 4.18% 276,724 56 57,9% 55,966 172,192 96,796 155,123 9.39,306 5135,555 7.9% 82,066 172,192 96,6% 155,123 9.39,966 5136,661 5.2% 55,6% </td <td>Case numbers</td> <td>1,706,703</td> <td></td> <td>1,736,413</td> <td></td> <td>1,818,032</td> <td></td> <td>1,651,168</td> <td></td> <td>6,912,316</td> <td></td>	Case numbers	1,706,703		1,736,413		1,818,032		1,651,168		6,912,316	
952/014 55.8% 969951 55.8% 1/015,880 55.9% 919,834 55.71% 3,857/681 754,578 44.2% 766,354 44.13% 802,063 44.1% 731,203 44.28% 3,054,199 25 0.0% 17 0.00% 8 0.0% 5 0.00% 55 86 0.0% 91 0.01% 81 0.09% 5 0.01% 384 57,178 3.4% 3.28% 56,888 3.28% 59,602 65,599 3,79% 55,57% 67,655 4,0% 3.38% 59,602 65,599 3,99% 55,79% 3,99% 55,79% 3,99% 2,34,59 3,93,556 67,655 4,0% 3,89% 56,888 3,28% 59,602 65,39% 3,99% 5,7493 88,865 5,84% 59,602 5,59% 5,94% 5,94% 5,94% 5,94% 5,94% 5,94% 5,94% 5,94% 5,94% 5,94% 5,94% 5,94% 5,94%	Gender										
754,578 $44,2%$ $766,354$ $44,13%$ $802,063$ $44,1%$ $731,203$ $44,2%$ $3054,199$ 25 $0.0%$ 17 $0.0%$ 8 $0.0%$ 5 $0.0%$ 5 86 $0.0%$ 91 $0.01%$ 81 $0.0%$ 5 $0.0%$ 5 $57,178$ $3.4%$ $3.28%$ $56,888$ $3.28%$ $59,602$ $62,59$ $3.79%$ $236,57$ $67,655$ $4.0%$ $3.98%$ $56,888$ $3.29%$ $57,493$ $68,982$ $41,8%$ $239,306$ $67,655$ $4.0%$ $3.98%$ $51,44$ $3.99%$ $72,493$ $68,982$ $41,8%$ $239,306$ $69,144$ $5.79%$ $67,655$ $4.0%$ $3.98%$ $69,982$ $41,8%$ $239,306$ $69,146$ $5.79%$ $69,147$ $3.99%$ $72,493$ $68,982$ $41,8%$ $239,306$ $69,146$ $5.79%$ $100,696$ $5.79%$ $105,295$ $98,086$ $339,306$ $69,179$ $102,506$ $105,295$ $98,088$ $5.94%$ $326,294$ $177,2101$ $10.0%6$ $5.79%$ $102,706$ $103,710$ $96,808$ $56,024$ $177,2102$ $102,506$ $112,2102$ $65,06%$ $117,766$ $113,729$ $112,976$ $177,2102$ $102,966$ $117,706$ $102,710$ $217,323$ $117,966$ $155,123$ $177,2102$ $192,5076$ $22,5096$ $122,726$ $215,796$ $155,123$ $159,966$ $199,663$ $117,706$ $12,738$ $12,2966$ <	Male	952,014	55.8%	969,951	55.86%	1,015,880	55.9%	919,834	55.71%	3,857,681	55.8%
25 0.0% 17 0.00% 8 0.0% 5 0.0% 55 86 0.0% 91 0.01% 81 0.0% 5 0.00% 55 15 57,178 3.4% 3.28% 56,888 3.28% 59,602 6.2589 3.79% 236,257 16 67,655 4.0% 3.88% 69,144 3.99% 7,2493 68,982 4.18% 278,274 16 67,655 4.0% 3.81% 100,969 5.79% 105,795 98,982 5.94% 399,306 17 94,954 5.6% 5.81% 100,969 5.79% 105,710 96,308 5.94% 395,306 135,555 7.9% 8.20% 142,361 8.17% 143,467 133,821 8.10% 560,204 135,555 7.9% 8.20% 142,361 8.17% 143,467 133,821 8.10% 560,204 171,201 10.09% 992% 142,351 8.17% 143,467	Female	754,578	44.2%	766,354	44.13%	802,063	44.1%	731,203	44.28%	3,054,199	44.2%
86 0.0% 91 0.01% 81 0.0% 126 0.01% 384 15 57,178 3.4% 3.28% 56,888 3.28% 59,602 6.2589 3.79% 236,557 16 67,655 4.0% 3.98% 69,144 3.99% 72,493 68,982 4.18% 278,274 16 67,655 4.0% 3.98% 69,144 3.99% 72,493 68,982 4.18% 278,274 16 67,655 4.0% 3.98% 69,144 3.99% 72,493 68,982 4,18% 278,274 16 94,954 5.2% 5.1% 100,969 5.79% 103,710 96,808 5.94% 395,966 17 135,555 7.99% 8.20% 142,361 8.17% 148,467 133,821 8.10% 560,204 17 135,555 7.99% 82,056 157,123 9.39% 67,082 156,506 157,123 9.39% 66,408 177,201	Diverse	25	0.0%	17	0.00%	8	0.0%	5	0.00%	55	0.0%
15 57,178 3.4% 3.28% 5,6,88 3.28% 5,6,02 6,2,589 3.79% 236,257 15 67,655 4.0% 3.98% 69,144 3.99% 72,493 68,982 4.18% 278,274 15 94,954 5.6% 5.81% 100,969 5.79% 105,295 98,088 5.94% 399,306 15 88,661 5.2% 5.57% 96,787 5.70% 103,710 96,808 5.94% 399,306 15 135,555 7.9% 8.20% 142,361 8.17% 143,467 133,821 8.10% 560,204 17 12 10.0% 9.92% 172,192 966% 175,566 155,123 9.39% 674,082 17 10 10.0% 9.92% 21.07% 21.97% 235,546 1,551,535 9.39% 66,204 17 10 10.2,566 155,123 9.39% 674,082 1,551,535 1,551,535 199,663 11,7% <t< td=""><td>Unknown</td><td>86</td><td>0.0%</td><td>91</td><td>0.01%</td><td>81</td><td>0.0%</td><td>126</td><td>0.01%</td><td>384</td><td>0.0%</td></t<>	Unknown	86	0.0%	91	0.01%	81	0.0%	126	0.01%	384	0.0%
5 57/178 3.4% 3.28% 5.6%88 3.28% 5.6%02 6.5,589 3.79% 236,257 6 6/555 4.0% 3.98% 69,144 3.99% 72,493 68,982 4.18% 236,274 7 94,954 5.6% 5.81% 100,969 5.79% 105,295 98,088 5.94% 399,306 8 8,661 5.2% 5.57% 96,787 5.70% 103,710 96,808 5.86% 385,966 8 135,555 7.9% 8.20% 142,361 8.17% 143,467 133,821 8.10% 560,204 7 17,201 10.09% 992% 172,192 966% 175,566 155,123 9.39% 674,082 398,794 23.4% 22.85% 396,723 21.97% 399,469 356,548 1551,535 199,663 11,7%01 12.25% 21.2782 13.75% 250,019 247,338 14.98% 90,802 199,663 11,7%0 12.25% <td>Age groups</td> <td></td>	Age groups										
5 67,655 4.0% 3.9% 69,144 3.9% 7.2,493 68,982 4.18% 2.78.74 5 94,954 5.6% 5.81% 100,969 5.79% 105,295 98,088 5.94% 399,306 5 88,661 5.2% 5.57% 96,787 5.70% 103,710 96,808 5.94% 399,306 5 135,555 7.9% 8.20% 142,361 8.17% 148,467 133,821 8.10% 560,204 5 17,1201 10.00% 9.92% 172,192 9.66% 175,566 155,123 9.39% 674,082 5 88,661 12.28% 396,723 21.97% 399,469 356,548 1,551,535 5 199,663 11,7% 12.25% 21.2782 13.75% 250,019 247,338 14.98% 90,802 5 199,663 11,7% 12.25% 21.2782 13.75% 250,019 247,338 14.98% 90,802 5 199,7%	18–29 years	57,178	3.4%	3.28%	56,888	3.28%	59,602	62,589	3.79%	236,257	3.4%
5 94,954 5.6% 5.81% 100,969 5.79% 105,295 98,088 5.94% 399,306 8 8661 5.2% 5.57% 96,787 5.70% 103,710 96,808 5.94% 399,306 8 135,555 7.9% 8.20% 142,361 8.17% 148,467 133,821 8.10% 560,204 17 17,201 10.0% 9.92% 172,192 9.66% 175,556 155,123 9.39% 674,082 398,794 23.4% 22.85% 396,723 21.97% 399,469 356,548 1.551,535 1.57,535 199,663 11.7% 12.25% 21.2782 13.75% 250,019 247,338 14.98% 90,902 493,042 28.9% 28.14% 488,567 27.69% 503,411 431,871 26.16% 1,916,892	30-39 years	67,655	4.0%	3.98%	69,144	3.99%	72,493	68,982	4.18%	278,274	4.0%
5 88.661 5.2% 5.57% 96,787 5.70% 103,710 96,808 5.86% 385,966 7 135,555 7.9% 8.20% 142,361 8.17% 148,467 133,821 8.10% 560,204 7 171,201 10.0% 9.92% 172,192 9.66% 175,566 155,123 9.39% 674,082 7 398,794 23.4% 22.85% 396,723 21.97% 399,469 356,548 1,551,535 7 199,663 11.7% 12.25% 212,782 13.75% 250,019 247,338 14.98% 90,9802 493,042 28.9% 28.14% 488,567 27.69% 503,411 431,871 26.16% 1,916,892	40-49 years	94,954	5.6%	5.81%	100,969	5.79%	105,295	98,088	5.94%	399,306	5.8%
5 135,555 7.9% 8.20% 142,361 8.17% 148,467 133,821 8.10% 560,204 5 177,1201 10.0% 9.92% 172,192 9.66% 175,566 155,123 9.39% 674,082 5 396,723 21.97% 399,469 356,548 21.59% 1,551,535 5 199,663 11.7% 12.25% 212,782 13.75% 250,019 247,338 14.98% 909,802 493,042 28.9% 28.14% 488,567 27.69% 503,411 431,871 26.16% 1,916,892	50-54 years	88,661	5.2%	5.57%	96,787	5.70%	103,710	96,808	5.86%	385,966	5.6%
5 171,201 10.0% 9.92% 172,192 9.66% 175,566 155,123 9.39% 674,082 5 398,794 23.4% 22.85% 396,723 21.97% 399,469 356,548 21.59% 1,551,535 5 199,663 11.7% 12.25% 212,782 13.75% 250,019 247,338 14.98% 909,802 493,042 28.9% 28.14% 488,567 27.69% 503,411 431,871 26.16% 1,916,892	55-59 years	135,555	7.9%	8.20%	142,361	8.17%	148,467	133,821	8.10%	560,204	8.1%
398,794 23.4% 22.85% 396,723 21.97% 399,469 356,548 21.59% 1,551,535 5 199,663 11.7% 12.25% 212,782 13.75% 250,019 247,338 14.98% 909,802 5 493,042 28.9% 28.14% 488,567 27.69% 503,411 431,871 26.16% 1,916,892	60-64 years	171,201	10.0%	9.92%	172,192	9.66%	175,566	155,123	9.39%	674,082	9.8%
s 199,663 11.7% 12.25% 212,782 13.75% 250,019 247,338 14.98% 909,802 493,042 28.9% 28.14% 488,567 27.69% 503,411 431,871 26.16% 1,916,892	65–74 years	398,794	23.4%	22.85%	396,723	21.97%	399,469	356,548	21.59%	1,551,535	22.4%
493,042 28.9% 28.14% 488,567 27.69% 503,411 431,871 26.16% 1,916,892	75–79 years	199,663	11.7%	12.25%	212,782	13.75%	250,019	247,338	14.98%	909,802	13.2%
	80+years	493,042	28.9%	28.14%	488,567	27.69%	503,411	431,871	26.16%	1,916,892	27.7%

			1000		0.00		0100		CCAC 010C	
	7777		2021		7020		2013		7707-6107	
Case numbers	118,485		141,175		127,142		112,460		499,262	
Gender										
Male	75,335	63.6%	90,551	64.14%	81,550	64.14%	70,982	63.12%	318,418	63.8%
Female	43,134	36.4%	50,612	35.85%	45,581	35.85%	41,472	36.88%	180,799	36.2%
Diverse	2	0.0%	0	0.00%	-	0.00%	0	%00.0	ſ	0.0%
Unknown	14	0.0%	12	0.01%	10	0.01%	9	0.01%	42	0.0%
Age groups										
18-29 years	2189	1.8%	2179	1.54%	2050	1.61%	1925	1.71%	8343	1.7%
30-39 years	3571	3.0%	4062	2.88%	3481	2.74%	2862	2.54%	13,976	2.8%
40-49 years	6519	5.5%	8448	5.98%	6832	5.37%	5781	5.14%	27,580	5.5%
50-54 years	6905	5.8%	8977	6.36%	7808	6.14%	6758	6.01%	30,448	6.1%
55-59 years	11,254	9.5%	13,956	9.89%	11,903	9.36%	10,480	9.32%	47,593	9.5%
60-64 years	15,433	13.0%	18,398	13.03%	15,442	12.15%	13,343	11.86%	62,616	12.5%
65–74 years	35,963	30.4%	41,927	29.70%	36,293	28.55%	31,216	27.76%	145,399	29.1%
75–79 years	14,987	12.6%	18,716	13.26%	19,453	15.30%	19,024	16.92%	72,180	14.5%
80 + years	21,664	18.3%	24,512	17.36%	23,880	18.78%	21,071	18.74%	91,127	18.3%
Deceased ICU patients										
Case numbers	198,387		204,851		194,049		172,749		770,036	
Gender										
Male	113,665	57.3%	119,094	58.14%	111,750	57.59%	97,837	56.64%	442,346	57.4%
Female	84,672	42.7%	85,714	41.84%	82,273	42.40%	74,897	43.36%	327,556	42.5%
Diverse	С	0.0%		0.00%	2	0.00%	0	0.00%	9	0.0%
Unknown	47	0.0%	42	0.02%	24	0.01%	15	0.01%	128	%0.0
Age groups										
18-29 years	933	0.5%	828	0.40%	797	0.41%	822	0.48%	3380	0.4%
30–39 years	1966	1.0%	1979	0.97%	1791	0.92%	1587	0.92%	7323	1.0%
40-49 years	4349	2.2%	4868	2.38%	4373	2.25%	3857	2.23%	17,447	2.3%
50-54 years	5219	2.6%	6100	2.98%	5545	2.86%	5152	2.98%	22,016	2.9%
55–59 years	9648	4.9%	10,648	5.20%	9513	4.90%	8651	5.01%	38,460	5.0%
60–64 years	15,029	7.6%	15,768	7.70%	14,080	7.26%	11,922	6.90%	56,799	7.4%
65–74 years	45,785	23.1%	47,506	23.19%	41,019	21.14%	35,454	20.52%	169,764	22.0%
75–79 years	27,420	13.8%	30,314	14.80%	31,532	16.25%	30,704	17.77%	119,970	15.6%
80 + years	88,038	44.4%	86,840	42.39%	85,399	44.01%	74,600	43.18%	334,877	43.5%
Deceased ICU patients receiving > 95 h ventilation										

Table 1 (continued)

Case numbers 47,198 57,365 Gender 57,365 57,365 Gender 30,095 63.8% 37,202 64.85% Male 30,095 63.8% 37,202 64.85% Female 17,089 36.2% 20,151 35.13% Diverse 1 0.0% 0 0.00% Unknown 13 0.0% 12 0.02% Age groups 354 0.8% 345 0.60% 18–29 years 3640 1.6% 814 1.42% 40–49 years 1610 3.4% 2046 3.57%	48,071 30,989 17,076 6 6	64.47% 35.52% 0.00% 0.01%	41,075 25,818 15,254 0	62.86% 37.14%	193,709	
30,095 63.8% 37,202 17,089 36.2% 20,151 1 0.0% 0 13 0.0% 12 5 354 0.8% 345 740 1.6% 814 1610 3.4% 2046	30,989 17,076 6 6	64.47% 35.52% 0.00% 0.01%	25,818 15,254 0	62.86% 37.14%		
30,095 63.8% 37,202 17,089 36.2% 20,151 1 0.0% 0 13 0.0% 12 5 354 0.8% 345 740 1.6% 814 5 740 3.4% 2046	30,989 17,076 6 202	64.47% 35.52% 0.00% 0.01%	25,818 15,254 0	62.86% 37.14%		
17,089 36.2% 20,151 1 0.0% 0 13 0.0% 12 5 354 0.8% 345 740 1.6% 814 5 740 3.4% 2046	17,076 0 6	35.52% 0.00% 0.01%	15,254 0	37.14%	124,104	64.1%
1 0.0% 0 13 0.0% 12 5 354 0.8% 345 5 740 1.6% 814 5 740 3.4% 2046	0 0	0.00% 0.01%	0		69,570	35.9%
13 0.0% 12 5 354 0.8% 345 5 740 1.6% 814 5 740 3.4% 2046	6 307	0.01%		0.00%	-	0.0%
354 0.8% 345 5 740 1.6% 814 5 1610 3.4% 2046	COC		m	0.01%	34	0.0%
354 0.8% 345 740 1.6% 814 1610 3.4% 2046	, COC					
740 1.6% 814 1610 3.4% 2046	727	0.61%	285	0.69%	1276	0.7%
1610 3.4% 2046	664	1.38%	550	1.34%	2768	1.4%
	1572	3.27%	1317	3.21%	6545	3.4%
4.0% 2483	1976	4.11%	1 704	4.15%	8039	4.2%
7.2% 4216	3290	6.84%	2913	7.09%	13,796	7.1%
10.6% 6203	4680	9.74%	3968	9.66%	19,875	10.3%
30.2% 17,369	13,317	27.70%	10,946	26.65%	55,899	28.9%
15.0% 9240	8796	18.30%	7987	19.44%	33,092	17.1%
80+years 12,881 27.3% 14,649 25.54%	 13,484	28.05%	11,405	27.77%	52,419	27.1%

(continued)	
Table 1	



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 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 \geq 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 ICUrelated 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

Index contractives Index contractiv			ICU patients≥ 18		ICU patients ≥ 18, fatal cases		ventilation ≥ 95 h	ventilation > 95 h, fatal cases	in > 95 h, s	ICU patients≥18, receiving palliative care	18,	ventilation > 95 h, receiving palliative care	> 95 h, are
GGM cdd Description Cores % % % <th< th=""><th>Total case numbers</th><th></th><th>6,912,316</th><th></th><th>770,036</th><th>499,262</th><th></th><th>193,709</th><th></th><th>57,116</th><th></th><th>7,501</th><th></th></th<>	Total case numbers		6,912,316		770,036	499,262		193,709		57,116		7,501	
Lung cancer Totals Totals Total	ICD-10-GM code	Description	cases	%	-	cases	%	cases	%	cases	%	cases	%
Stoke Stoke <th< td=""><td>C34</td><td>Lung cancer</td><td>70,386</td><td></td><td>—</td><td></td><td>0.8%</td><td>2,464</td><td>1.3%</td><td>4,212</td><td></td><td>306</td><td>4.1%</td></th<>	C34	Lung cancer	70,386		—		0.8%	2,464	1.3%	4,212		306	4.1%
41 Henr falue 243,23 35% 5,348 6,9% 2071 41% 9,320 48% 1951 34% 163 7encreatic malignoma 287,27 04% 3766 5.0% 2768 5.0% 760 4.8% 1951 34% 163 Pancreatic malignoma 287,27 04% 3797 0.5% 5.9% 5.9% 1.3% 2.3%	163	Stroke	662,466				3.6%	6,574	3.4%	3,350		270	3.6%
(4) Streptococcal and other sepsis 138/790 20% 47/661 6.2% 24/934 50% 11/280 5.8% 17/31 30% 298 Pancreatic malgnorm 134/501 19% 20% 55% 5.3% 6.6% 1.4% 1.2% 5.3% 1.2% 1.2% 2.3%	150	Heart failure	243,253		-		4.1%	9,320	4.8%	1,951		163	2.2%
Pancreatic malignoma 23/27 0.4% 1.5% 0.5% 1.5% 0.4% 1.4%6 2.6% 6. Recordary malignant rew formation of the brain and the memiges 134.503 1.9% 0.2% 5.5% 6.696 3.5% 1.3% 2.2% 5.5% 6.696 3.5% 1.3% 2.2% 5.5% 6.5% 6.5% 6.5% 6.5% 6.5% 6.5% 6.5% 6.5% 6.5% 6.5% 2.7%	A40-A41	Streptococcal and other sepsis	138,790				5.0%	11,280	5.8%	1,737		298	4.0%
134.503 19% 20,90 27,94 55,94 53,66 3,56 1,338 23,92 23,92 23,95 52,94 53,66 3,56 1,338 23,95 23,95 25 Secondary malignant new formation of the bain 19,242 0,346 1,578 0,246 53,8 1,138 23,96 23,95 20,95 1,142 2046 45 Secondary malignant new formation of the bone 10,371 0,24 1,46 0,236 1,46 0,24 20,95 1,142 2046 45 Secondary malignant new formation of the bone 10,371 0,24 1,46 0,236 1,46 0,24 20,95 1,472 2046 1,472 206 1,76 31 Coviation malignoma 31,053 1,38 2,346 46,64 1,472 2,495 1,495 1,495 1,495 1,366 1,566 1,76 31 326 Northermalignoma Intracenali injury Acute myocardial infarction 1,137 2596 1,412 206	C25	Pancreatic malignoma	28,727			`	0.3%	760	0.4%	1,466		50	0.8%
Secondary malignant new formation of the brain $19,242$ 0.36 $1,573$ 0.26 0.16 $1,206$ $1,206$ 216° 75° and the meningescondent malrow $10,371$ 0.246 $1,460$ 0.24° 362 0.16° $1,142$ 206° 216° $1,142$ 206° 216° $1,746$ 216° $1,746$ 206° 216° $1,142$ 206° $1,206$ 216° $1,746$ 206° 216° $1,206$ 216° $1,206$ 216° $1,206$ 216° $1,206$ 216°	J44		134,503				5.2%	6,696	3.5%	1,338		272	3.6%
Secondary malignant new formation of the bone 10,371 0.2% 1,460 0.2% 362 0.1% 1,142 2.0% 45 and the bone marrow Ovarian malignoma 16,068 0.2% 1,146 0.1% 573 0.1% 17.1 2.0% 45 Ovarian malignoma 16,068 0.2% 1,146 0.1% 573 0.1% 17.42 2.0% 17.5 Tracture of the fermur 198,651 0.2% 2.435 1.0% 1.7% 78 17.5 78 16 77 16 77 78 75 1.3% 65 17.6 17.5 0.1% 1.7% 17.5 16 17.5 16 17.5 16 17.5 16 17.5 16 17.5 16 17.5 16 17.5 16 17.5 16 17.5 16 17.5 17.5 17.5 17.5 17.5 17.5 17.5 17.5 17.5 17.5 17.5 17.5 17.5 17.5 17.5	C79.3	Secondary malignant new formation of the brain and the meninges	19,242		-		0.1%	343	0.2%	1,206		76	1.0%
Ovarian malignoma16,068 0.26 $1,146$ 0.16 573 0.19 191 0.19 556 1.746 78 Fracture of the femurrecturm malignoma196,651 2.96 2.383 3.16 4.959 1.096 2.429 1.396 903 1.666 3.1 recturm malignoma $38,657$ 0.66 2.481 0.386 1.504 0.396 6.19 0.397 754 1.396 65 Intracranial injury $1.37,738$ 2.066 1.7314 2.296 1.4759 3.096 4.265 2.296 6.147 2.296 1.296 1.73 Acute myocardial infarction $1.19,063$ 1.78 $41,720$ 5.446 $51,271$ 10.38 $23,725$ $1.2,96$ 1.296 1.28 Acute myocardial infarction $1.19,063$ 1.786 4.1720 5.496 5.486 6.18 2.375 2.196 1.286 1.286 1.286 1.286 1.286 1.286 1.286 1.286 1.286 1.286 1.286 1.286 1.286 1.286 1.286 1.286 1.286 1.286 1.286 2.286 1.286 2.286 2.986 2.986 1.986 2.986 1.986 2.986 1.986 2.986 1.286 1.286 1.286 2.286 1.286 2.286 2.986 2.986 2.986 2.986 2.986 2.986 2.986 2.986 2.986 2.986 2.986 2.986 2.986 <t< td=""><td>C79.5</td><td>Secondary malignant new formation of the bone and the bone marrow</td><td>10,371</td><td></td><td></td><td></td><td>0.1%</td><td>226</td><td>0.1%</td><td>1,142</td><td></td><td>45</td><td>0.6%</td></t<>	C79.5	Secondary malignant new formation of the bone and the bone marrow	10,371				0.1%	226	0.1%	1,142		45	0.6%
Fracture of the femur 198,651 29% 238,65 31% 4959 1,0% 2429 1,3% 903 1,6% 31 rectum malignoma 38,657 0.6% 2481 0.3% 1,504 0.3% 619 0.3% 754 1,3% 65 Intracranial injury 38,657 0.6% 2481 0.3% 1,504 0.3% 619 0.3% 754 1,3% 65 Nute myocardial infarction 137,738 20% 1,734 2.2% 14,759 3.0% 4,265 2.2% 684 1.2% 173 Non-theumatic aortic valve diseases 119,063 1,7% 41,720 5.4% 51,271 10,3% 23,725 12,2% 438 0.3% 167 Non-theumatic aortic valve diseases 123,71 0.2% 5,73 0.3% 618 0.3% 204 173 Autie myocardial infarction 119,063 1.7% 41720 5,4% 51,271 10,9% 140 0.2% 204 Autie respiratory distress yndrome of children, adolescents 1237 0.2% 1,3% 0	C56	Ovarian malignoma	16,068				0.1%	191	0.1%	956		78	1.0%
rectum maignoma $38,657$ 0.66 $2,481$ 0.36 $1,504$ 0.366 619 0.366 754 $1,396$ 65 Intracranial injuryintracranial injury $137,738$ 206 $1,7314$ 2.296 $4,759$ 3.06 $4,265$ 2.296 664 1.296 173 Acute myocardial infraction $401,331$ 5.896 $4,6534$ $61,73$ $51,76$ $10,487$ 5.496 668 1.296 127 Acute myocardial infraction $119,063$ $1,78$ $41,720$ 5.496 $51,271$ $10,487$ 5.496 668 1.296 1296 127 Non-rheumatic aortic valve diseases 12961 $1,896$ $5,712$ 0.796 $51,206$ $1,986$ $23,725$ $21,296$ 209 206 Atrial fibrillation and atrial flutter $138,509$ 206 $5,731$ 0.796 $51,80$ $1,996$ $1,40$ 0.296 206 Atrial fibrillation and atrial flutter $138,509$ 206 $5,731$ 0.796 618 $2,296$ 78 201 668 1.296 206 Atrial fibrillation and atrial flutter 12371 0.296 $5,731$ 0.796 618 $20,806$ 206 206 Atrial fibrillation and atrial flutter $1,7312$ 0.296 $1,736$ 618 206 0.296 206 Atrial fibrillation and atrial flutter $1,7272$ 0.296 $1,736$ 206 $1,996$ 206 206 206 Cardia carrest <td>S72</td> <td>Fracture of the femur</td> <td>198,651</td> <td></td> <td></td> <td></td> <td>1.0%</td> <td>2,429</td> <td>1.3%</td> <td>903</td> <td></td> <td>31</td> <td>0.4%</td>	S72	Fracture of the femur	198,651				1.0%	2,429	1.3%	903		31	0.4%
$ \begin{array}{llllllllllllllllllllllllllllllllllll$	C20	rectum malignoma	38,657			—	0.3%	619	0.3%	754		55	0.9%
112Acute myocardial infarction401,3315.8% 4.634 6.1% $25,327$ 5.1% $10,487$ 5.4% 668 1.2% 157 112Viral pneumoniaViral pneumonia119,063 1.7% $41,720$ 5.4% $51,271$ $10,3\%$ $23,725$ $12,2\%$ 438 0.8% 204 Non-theumatic aortic valve diseases122,961 1.8% $5,715$ 0.7% $5,206$ 1.0% $1,810$ 0.9% 410 0.2% 204 Antial fibrillation and atrial flutter138,509 2.0% $5,715$ 0.7% $5,206$ 1.0% $1,810$ 0.9% 40 0.1% 65 Acute respiration value disease123,71 0.2% $5,715$ 0.7% $5,206$ 1.0% $1,810$ 0.2% 206 Acute respiration value disteres syndrome of children, adolescents $12,371$ 0.2% $5,731$ 0.7% $5,206$ 1.9% $7,2\%$ 20% 20% Acute respiration site respiration and atrial flutter $12,771$ 0.2% $5,731$ 0.7% $2,336$ 618 0.3% 206 0.1% 65 Acute respiration value and related syndrome of children, adolescents $17,272$ 0.2% $1,376$ 0.7% $2,383$ 1.5% 2.2% 2.9% </td <td>S06</td> <td>Intracranial injury</td> <td>137,738</td> <td></td> <td></td> <td></td> <td>3.0%</td> <td>4,265</td> <td>2.2%</td> <td>684</td> <td></td> <td>173</td> <td>2.3%</td>	S06	Intracranial injury	137,738				3.0%	4,265	2.2%	684		173	2.3%
J12 Viral pneumonia 119063 1.7% 41,720 5,4% 5,1271 10.3% 23,725 12.2% 438 0.8% 204 Non-rheumatic aortic valve diseases 122,961 1.8% 5,715 0.7% 5,206 1.0% 1810 0.9% 140 0.2% 2 Atrial fibrillation and atrial flutter 138,509 2.0% 5,731 0.7% 9,399 1.9% 618 0.3% 80 0.1% 0 Acute respiratory distress syndrome of children, adolescents 12,371 0.2% 5,731 0.7% 9,399 1.9% 4,243 22% 78 0.1% 65 Acute respiratory distress syndrome of children, adolescents 12,271 0.2% 1,405 1,996 1,996 1,98 20% 1,98 20% 1,98 20% 1,98 20% 1,98 21% 1,98 21% 1,98 21% 1,98 21% 1,98 21% 21% 1,98 21% 21% 21% 21% 21% 21% 21% 21% 21% 21% 21% 21% 21% 21	121	Acute myocardial infarction	401,331				5.1%	10,487	5.4%	668		157	2.1%
Non-rheumatic aortic valve diseases 122/961 1.8% 5,715 0.7% 5,206 1.8/10 0.9% 140 0.2% 20 Atrial fibrillation and atrial flutter 138,509 20% 3,545 0.5% 1,375 0.3% 618 0.3% 80 0.1% 6 Acute respiratory distress syndrome of children, adolescents 12,371 0.2% 5,731 0.7% 9,399 1.9% 4,243 2.2% 78 0.1% 6 Acute respiratory distress syndrome of children, adolescents 17,272 0.2% 1,405 1.9% 4,243 2.2% 78 0.1% 65 Acute respiratory distress syndrome of children, adolescents 17,272 0.2% 14,056 1.9% 3,989 0.8% 2,883 1.5% 76 0.1% 54 Chronic ischemic heart disease 110,755 1.6% 3,648 0.2% 76 0.1% 54 0.1% 65 0.1% 56 0.1% 54 Chronic ischemic heart disease 01,095 0.5%	J09-J12	Viral pneumonia	119,063				10.3%	23,725	12.2%	438		204	2.7%
Atrial fibrillation and atrial flutter 138,509 2.0% 3,545 0.5% 1,375 0.3% 618 0.3% 80 0.1% 65 Acute respiratory distress syndrome of children, adolescents 12,371 0.2% 5,731 0.7% 9,399 1.9% 4,243 2.2% 78 0.1% 65 Acute respiratory distress syndrome of children, adolescents 17,272 0.2% 14,056 1.8% 3,989 0.8% 2,883 1.5% 76 0.1% 54 Cardiac arrest 17,272 0.2% 1,4,056 1.8% 3,989 0.8% 2,883 1.5% 76 0.1% 54 Chronic ischemic heart disease 110,755 1.6% 3,364 0.2% 7/148 1.4% 1,989 0.6% 477 0.1% 54 Chronic ischemic heart disease 110,755 1.6% 3,364 5.748 1.4% 1,989 0.6% 477 0.1% 76 0.1% 54 Chronic ischemic heart disease 010,7% 3,364 5.7% 1,364 0.7% 77 0.1% 77 0.1% <	135	Non-rheumatic aortic valve diseases	122,961				1.0%	1,810	%6.0	140		20	0.3%
Acute respiratory distress syndrome of children, adolescents 12,371 0.2% 5,731 0.7% 9,399 1.9% 4,243 2.2% 78 0.1% 65 and adults [ARDS] Cardiac arrest 17,272 0.2% 14,056 1.8% 3,989 0.8% 2,883 1.5% 76 0.1% 54 Cardiac arrest 17,272 0.2% 1,4056 1.8% 3,989 0.8% 2,883 1.5% 76 0.1% 54 Chronic ischemic heart disease 110,755 1.6% 3,648 0.5% 4,712 0.9% 1364 0.7% 76 0.1% 55 0.1% 54 Chronic ischemic heart disease 110,755 1.6% 3,648 0.5% 7/148 1.4% 1,089 0.6% 477 0.1% 56 0.1% 54 Other polyneuropathies / Critical illness polyneuropathy 10,950 0.2% 1,364 0.7% 76 0.1% 56 0.1% 57 Other polyneuropathies / Critical illness polyneuropathy 10,950 0.2% 1,48 1.4% 0.9% 0.1% 0.1%	148	Atrial fibrillation and atrial flutter	138,509			<i>(</i>	0.3%	618	0.3%	80		0	0.0%
Cardiac arrest 17,272 0.2% 14,056 1.8% 3,989 0.8% 2,883 1.5% 76 0.1% 54 Chronic ischemic heart disease 110,755 1.6% 3,648 0.5% 4,712 0.9% 1,364 0.7% 56 0.1% 54 Other polyneuropathies / Critical illness polyneuropathy 10,950 0.2% 1,331 0.2% 7,148 1.4% 1,089 0.6% 47 0.1% 5 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 Cerebral transient ischemia and related syndromes 393,944 5.7% 1,364 0.7% 44 0.0% 30 0.1% 0 Mental and behavioral disorders caused by alcohol 72,448 1.0% 373 0.0% 523 0.1% 17% 39 0.1% 0	J80	Acute respiratory distress syndrome of children, adolescents and adults [ARDS]	12,371				1.9%	4,243	2.2%	78		55	0.9%
Chronic ischemic heart disease 110,755 1.6% 3,648 0.5% 4,712 0.9% 1,364 0.7% 56 0.1% 5 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 Cerebral transient ischemia and related syndromes 393,944 5.7% 1,334 0.2% 205 0.0% 44 0.1% 39 0.1% 39 Mental and behavioral disorders caused by alcohol 7,2,448 1.0% 313 0.0% 523 0.1% 105 0.1% 0 0.0% 0 0.1% 0	146	Cardiac arrest	17,272				0.8%	2,883	1.5%	76		54	0.7%
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 Cerebral transient ischemia and related syndromes 393,944 5.7% 1,364 0.2% 205 0.0% 44 0.0% 30 0.1% 0 Mental and behavioral disorders caused by alcohol 72,448 1.0% 313 0.0% 523 0.1% 10 0.0% 0 Acute kidney failure 64,266 0.9% 12,841 1.7% 3,548 0.7% 1,706 0.9% 0 0.0% 0 Pneumonia caused by solid and liquid substances/vomit 27,583 0.4% 9,598 1.2% 5,845 1.2% 0.1% 0 0.0% 0 0.0% 0 0.0% 0 0.0% 0 0.0% 0 0.0% 0 0.0% 0 0.0% 0 </td <td>125</td> <td>Chronic ischemic heart disease</td> <td>110,755</td> <td></td> <td></td> <td></td> <td>0.9%</td> <td>1,364</td> <td>0.7%</td> <td>56</td> <td></td> <td>10</td> <td>0.1%</td>	125	Chronic ischemic heart disease	110,755				0.9%	1,364	0.7%	56		10	0.1%
Cerebral transient ischemia and related syndromes 393,944 5.7% 1,364 0.2% 205 0.0% 30 0.1% 0 Mental and behavioral disorders caused by alcohol 72,448 1.0% 313 0.0% 523 0.1% 0 0.0% 0 0.0% 0 0.0% 0 0.0% 0 0.0% 0 0 0.0% 0 0 0.0% 0	G62	Other polyneuropathies / Critical illness polyneuropathy	10,950				1.4%	1,089	%9:0	47		39	0.5%
Mental and behavioral disorders caused by alcohol 72,448 1.0% 313 0.0% 523 0.1% 105 0.1% 0 0.0% 0 Acute kidney failure 64,266 0.9% 12,841 1.7% 3,548 0.7% 1,706 0.9% 0 0.0% 0 Pneumonia caused by solid and liquid substances/vomit 27,583 0.4% 9,598 1.2% 5,256 1.2% 0.0% 0 0.0% 0	G45	Cerebral transient ischemia and related syndromes	393,944				%0.0	44	0.0%	30		0	%0.0
Acute kidney failure 64,266 0.9% 12,841 1.7% 3,548 0.7% 1,706 0.9% 0 0.0% 0 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	F10	Mental and behavioral disorders caused by alcohol	72,448				0.1%	105	0.1%	0		0	%0.0
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	N17	Acute kidney failure	64,266				0.7%	1,706	0.9%			0	%0.0
	169	Pneumonia caused by solid and liquid substances/vomit	27,583		<i>(</i>		1.2%	2,256	1.2%			0	%0.0

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lliative and intensive care treatments in hospital cases involving intensive care	
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		2022	2021	21	2020	(1	2019			
Case with patients r	Case with patients receiving intensive and palliative care in the same hospital stay									
Case numbers		14,473	13,	13,904	13,935		11,563	U I	53,875	
Gender										
Male		7383	51.0% 7211	1 51.9%	% 7211	52.0% 5	5972	51.6% 2	27,817	51.6%
Female		7087	49.0% 6693	3 48.1%	% 6693	48.0% 5	5590	48.3% 2	26,054	48.4%
Diverse		0	0.0% 0	0.0%	0	0.0% 0	0	0.0% 0		0.0%
Unknown		ŝ	0.0% 0	0.0%	0	0.0% 1		0.0% 4		0.0%
Age groups										
18-29 years		102	0.7% 86	0.6%	86	0.6% 9	98	0.8% 3	371	0.7%
30–39 years		260	1.8% 247	7 1.8%	247	1.7% 2	224	1.9% 9	970	1.8%
40–49 years		511	3.5% 512	2 3.7%	512	3.8% 4	482	4.2% 2	2030	3.8%
50-54 years		622	4.3% 649	9 4.7%	649	4.7% 6	621	5.4% 2	2548	4.7%
55-59 years		1024	7.1% 1102	7.9%	1102	7.8% 9	922	8.0% 4	4134	7.7%
60-64 years		1507	10.4% 1452	52 10.4%	% 1452	10.5% 1	1133	9.8% 5	5558	10.3%
65-74 years		3746	25.9% 3530	30 25.4%	% 3530	24.8% 2	2845	24.6% 1	13,571	25.2%
75-79 years		1850	12.8% 1895	95 13.6%	% 1895	15.0% 1	1998	17.3% 7	7836	14.5%
80 + years		4851	33.5% 4431	31 31.9%	% 4431	31.1% 3	3240	28.0% 1	16,857	31.3%
Total number of pal.	Total number of palliative care codes (ICD-10-GM: 8–982, 8-98e, 8-98 h)							4,	56,328	
8–982	Palliative medical complex treatment							-	17,555	31.2%
8-982.0	Palliative medical complex treatment: Up to 6 days of treatment	1219	1202	02	1047	<u> </u>	1212	7	4680	8.3%
8-982.1	Palliative medical complex treatment: At least 7 to a maximum of 13 days of treatment	2138	2014	4	1743	_	1616		7511	13.3%
8-982.2	Palliative medical complex treatment: At least 14 to a maximum of 20 days of treatment	862	831	_	728	U	650	(*)	3071	5.5%
8–982.3	Palliative medical complex treatment: At least 21 days of treatment	686	609	•	513	7	485	()	2293	4.1%
8-98e	Specialized inpatient palliative medical complex treatment on a palliative care unit							-	18,481	32.8%
8-98e.0	Specialized inpatient palliative medical complex treatment: Up to 6 days of treatment	1321	1862	52	1873	<i>(</i>	1928	Q	6984	12.4%
8-98e.1	Specialized inpatient palliative medical complex treatment: At least 7 to a maximum of 13 days of treatment	1213	1471	12	1640	<u>(</u>	1686	Q	6010	10.7%
8-98e.2	Specialized inpatient palliative medical complex treatment: At least 14 to a maximum of 20 days of treatment	652	810	0	771	w	849	(*)	3082	5.5%
8-98e.3	Specialized inpatient palliative medical complex treatment: At least 21 days of treatment	551	621	_	612	V	621		2405	4.3%
8-98 h	Specialized palliative medical complex treatment by a palliative care service							(1)	20,292	36.0%
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	579	923	~	1057	<u> </u>	1059	(*)	3618	6.4%
8-98 h.01	Specialized palliative medical complex treatment through a palliative care service:	1121	1353	53	1490		1679	Ľ	5593	9.9%

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		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	1 000		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		66	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	62		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	œ	39	0.1%
8-98 h.11	Specialized palliative medical complex treatment by a palliative care service: By an exter- nal palliative care service: 2 to less than 4 h		24		12	4	50	0.1%
8-98 h.12	Specialized palliative medical complex treatment by a palliative care service: By an exter- nal palliative care service: 4 to less than 6 h	7	2				14	%0.0
8-98 h.13	Specialized palliative medical complex treatment by a palliative care service: By an exter- nal palliative care service: 6 to less than 9 h	5	9		7		18	%0.0
Case with long-term ve	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		1069	59.3% 1128	57.9%	1037 5	58.4% 899	58.5% 4133	58.5%
Female		734	40.7% 821	42.1%	740 4	41.6% 638	41.5% 2933	41.5%
Diverse		0	0.0% 0	0.0%	0	0.0% 0	0.0% 0	0.0%
Unknown		0	0.0% 0	0.0%	0 0	0.0% 0	0.0% 0	0.0%
Age groups								
18–29 years		27	1.5% 21	1.1%		0.7% 18	1.2% 78	1.1%
30–39 years		50	2.8% 43	2.2%	45 2	2.5% 48	3.1% 186	2.6%

		2022	2021	2020	2019		
40-49 years		69	3.8% 91	4.7% 67	3.8% 57	3.7% 284	4.0%
50-54 years		93	5.2% 103	5.3% 85	4.8% 98	6.4% 379	5.4%
55-59 years		152	8.4% 184	9.4% 146	8.2% 139	9.0% 621	8.8%
60–64 years		190	10.5% 237	12.2% 199	11.2% 152	9.9% 778	11.0%
65-74 years		569	31.6% 566	29.0% 518	29.2% 425	27.7% 2078	29.4%
75–79 years		222	12.3% 276	14.2% 275	15.5% 276	18.0% 1049	14.8%
80+years		431	23.9% 428	22.0% 430	24.2% 324	21.1% 1613	22.8%
Total number of palliat	Total number of palliative care codes (ICD-10-GM: 8–982, 8-98e, 8-98 h					7338	
8–982	Palliative medical complex treatment					1797	24.5%
8–982.0	Palliative medical complex treatment: Up to 6 days of treatment	157	164	134	143	598	8.1%
8–982.1	Palliative medical complex treatment: At least 7 to a maximum of 13 days of treatment	211	175	165	142	693	9.4%
8–982.2	Palliative medical complex treatment: At least 14 to a maximum of 20 days of treatment	69	72	60	60	261	3.6%
8–982.3	Palliative medical complex treatment: At least 21 days of treatment	85	51	61	48	245	3.3%
8-98e	Specialized inpatient palliative medical complex treatment on a palliative care unit					2025	27.6%
8-98e.0	Specialized inpatient palliative medical complex treatment: Up to 6 days of treatment	194	266	273	272	1005	13.7%
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	6.9%
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	3.7%
8-98e.3	Specialized inpatient palliative medical complex treatment: At least 21 days of treatment	54	63	66	58	241	3.3%
8-98 h	Specialized palliative medical complex treatment by a palliative care service					3516	47.9%
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	8.3%
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	12.4%
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	8.6%
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	6.8%
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	3.9%
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	2.5%
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	22	33	50	48	153	2.1%

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	œ	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	6	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	2	9	12	6	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	9	9		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 exter- nal palliative care service: 2 to less than 4 h		2			2	0.1%
8-98 h.12	Specialized palliative medical complex treatment by a palliative care service: By an exter- nal 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%

Table 3 (continued)

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 endof-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 webbased 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	
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- 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 Renumeration Institute)
- OPS Operationen und Prozeduren Schlüssel (Operations and Procedural

	Catalogue)
OR	Odds Ratio
SAPV	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: SupplementalTable 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. hat 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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