



Frequency of discharge of hospitalized patients with stroke to free-standing hospice facilities – a register study from Germany

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Background: Due to a lack of data, it is unknown if and how frequently in-patients with severe stroke are discharged to free-standing hospice facilities in Germany.

Methods: Patients aged 18 or over who had been hospitalized for ischemic stroke (IS) (International Statistical Classification of Diseases, ICD-10: I63), intracerebral bleeding (ICB) (ICD-10: I61), or subarachnoid bleeding (SAB) (ICD-10: I60) were investigated. The analysis was based on data from the Northwest-German Stroke Registry from 2017 to 2020. The aim was to determine the frequency (crude/age-standardized) of hospital discharges to hospices. In addition, factors influencing the primary outcome, hospital discharge to a free-standing hospice, were assessed using multivariate logistic regression.

Results: A total of 339,513 cases of hospitalized patients diagnosed with stroke were recorded, comprising 308,067 (90.7%) with IS, 26,957 (7.9%) with ICB, and 4,489 (1.3%) with SAB. Their mean age was 73.1±13.1 years, and 52.6% were men. During hospitalization, 26,037 patients died (7.7%), including 18,623 with IS, 6,818 with ICB, and 596 with SAB. A total of 497 patients were transferred to a hospice (IS: 414, ICB: 76, SAB: 7). The corresponding (age-standardized) frequencies were as follows [95% confidence interval (CI)]: all patients, 0.05% (0.04–0.06%); IS, 0.05% (0.04–0.06%); ICB, 0.07% (0.05–0.09%); SAB, 0.01% (0.00–0.02%). Independent influencing factors that were identified included nursing-home care prior to hospitalization [odds ratio (OR) 0.34, 95% CI: 0.25–0.44], impaired vigilance on admission (OR 1.71, 95% CI: 1.39–2.10), severe functional impairment at hospital discharge (modified Rankin scale 5 vs. 0–2: OR 34.78, 95% CI: 22.94–52.75), and determination of a palliative care treatment goal during hospitalization (OR 14.22, 95% CI: 11.32–17.87).

Conclusions: In-patients with severe stroke are hardly ever discharged to free-standing hospice facilities in Germany. The reasons for this may be complex, including an acute course in severe stroke, inadequate perception by physicians of these patients' need for palliative care, and structural conditions in long-term care for patients outside the hospital.

Keywords: Stroke; hospital; discharge; hospice; palliative care

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Introduction

Stroke is a common disease, with an estimated 101 million prevalent cases and 12.2 million incident cases worldwide (1). It mainly affects elderly people. Ischemic stroke (IS) is the most common variant at more than 80% of cases, followed by cases of hemorrhagic origin based on intracerebral bleeding (ICB) or subarachnoid bleeding (SAB) (2). Although considerable progress has been made over recent decades in the treatment, diagnosis, and secondary prevention of stroke, severe or fatal courses of the disease are not uncommon. Approximately 11% of all deaths worldwide can be attributed to stroke (3). The mortality rates differ, sometimes significantly, depending on the nature of the stroke. For example, observational studies have put the 1-month mortality rate with IS at between 5.7% and 14.9% (4-9), with ICB at between 29.6% and 46.5% (5,10-12) and SAB at between 19.1% and 33.0% (5,13,14). Patients with cerebral hemorrhage thus have a higher mortality in comparison with IS patients. In Western industrialized countries, the majority of stroke patients die in hospital (15,16). Stroke is also the most common cause of acquired disability in adulthood. Up to 40% of survivors suffer from long-term restrictions in daily life (17-19).

In Germany, just over 300,000 cases diagnosed with stroke are hospitalized annually (20). Analyses of nationwide stroke registries show a very high rate of acute in-patient care for these patients (21-23). However, registry data from Germany also show that about 5% of all stroke patients die in hospital during acute in-patient treatment (21).

Numerous studies have emphasized the need for palliative care and the importance of including palliative care expertise in the treatment of stroke patients with severe disease courses (24-37). Respect for the patient's dignity represents an essential aspect of palliative care here. This palliative care need can manifest itself in different situations during the disease—for example, when there is an initially unfavorable status with disturbed consciousness, when there is a progressive course within the first few weeks (“progressive stroke”), or when there is a lack of response to therapeutic and/or rehabilitative measures that have been initiated. The palliative care approach in hospitals includes the provision of consultation on care for patients by a palliative care team or the transfer of patients to a palliative care unit. Depending on the patient's condition, discharge home or to a long-term care facility with the involvement of a specialized outpatient palliative care team (SOPC) or

transfer of patients to an in-patient hospice may also be considered.

Although transferring patients from the hospital to their own homes for personal, family reasons appears quite reasonable, it is not always possible to implement this model of care in reality, as the amount of care required and the intensity of the patient's care often prove to be too burdensome for family caregivers, despite the involvement of professional outpatient support services. In such cases, patients are preferably transferred to in-patient facilities, where the quality of palliative care can vary widely. In Germany, palliative care in nursing homes is generally rated lower in comparison with in-patient hospices. The main reasons for this are the high workload and the shortage of nursing staff in nursing homes. In contrast, the staffing ratio in in-patient hospices is usually higher, and an SOPC team is also regularly involved in patient care, which is not always the case in nursing homes. Transfer to a hospice can only occur if the patient's life expectancy is less than 6 months, and this has to be confirmed by a physician.

Few data are available worldwide on the prevalence of hospice transfer of hospitalized stroke patients (38-40). In a retrospective single-center study in the United States, Chauhan *et al.* analyzed data from 2,446 patients with IS (38), 4.1% of the affected patients were transferred to hospices. duPreez *et al.* reported data for elderly Medicare-insured patients (≥ 65 years) in the United States who had been hospitalized for ischemic cerebral infarction (39). Among the patients who died within the first 30 days after the event, a total of 23% had been transferred to hospices.

To date, there have been no studies in Germany on the issue of the proportion of stroke patients who are discharged to hospices after hospital admission and a severe disease course. The aim of the present study was therefore to determine the frequency of hospital discharges of stroke patients to in-patient hospices and to identify potential determinants of discharge to hospices. We present the following article in accordance with the STROBE reporting checklist (available at <https://apm.amegroups.com/article/view/10.21037/apm-22-418/rc>).

Methods

Study design

The present study is based on a large stroke quality assurance project, the Northwest-German Stroke Registry (*Qualitätssicherung Schlaganfall Nordwestdeutschland*,

QSNWD), including patients from 2017 to 2020.

Northwest-German Stroke Registry

The QSNWD is one of a total of 10 stroke registries in Germany. With a total of 195 participating hospitals (as of December, 2020) from 8 states, it is the largest stroke registry in Germany. The hospitals are mainly located in the western and northern part of Germany, but hospitals from the former East German states are also included. Participation in the registry is voluntary for hospitals, but mandatory for certification as a stroke unit. Descriptive data from participating hospitals indicate a high quality of medical care for stroke patients in the acute phase of the condition (41). At the time of the study, more than two-thirds of the participating hospitals (n=145) had a certified stroke unit; systemic thrombolysis was performed in 16.9% of cases and surgical thrombectomy in 8.5%.

Observation period

The period of observation was from January 1, 2017 to December 31, 2020. The years 2017, 2018, 2019, and 2020 were intentionally combined into a single overall observation period in order to increase the rate of expected events with the target variable “hospital discharge to a hospice”. This was done due to the assumption that only few transfers per year would be documented in the stroke registry.

Patients in the stroke registry

Stroke patients aged 18 or over were included in the registry. Patients with transient ischemic attacks (TIAs) (ICD-10: G45), SAB (ICD-10: I60), ICB (ICD-10: I61), IS (ICD-10: I63), and strokes not designated as bleeding or infarction (“other”, ICD-10: I64) were documented. Patients with benign or malignant neoplasia in the brain or meninges (ICD-10: D32, D33, C70, C71, C72), patients with other cerebrovascular diseases (ICD-10: I67), and patients with traumatic head or skull injury (ICD-10: S06, S07, S08, S09) were excluded.

It was possible that patients might have been documented more than once in the stroke registry since the patient data were anonymised. It should therefore be noted that the results of this analysis apply exclusively at the case level.

The primary aim of the registry was to record acute inpatient stroke care, corresponding to the interval between

the occurrence of the event and hospital admission within ≤ 7 days. If this definition was met, the admission situation, severity of illness, diagnosis and therapy, and reason for discharge of in-patients with stroke were documented in detail. However, the questionnaire could also be terminated prematurely by the physician if the following conditions were present: if the stroke had occurred more than 7 days earlier, or if there were other reasons (e.g., inpatient admission for early rehabilitation rather than acute treatment of a stroke, or existence of a purely palliative approach even before hospital admission). In cases of early closure of the data set, a “minimal data set (MDS)” was created that included only the items admission date, ICD-10 principal diagnosis, year of birth, sex, and reason for discharge.

Study patients

Study patients were defined as patients (≥ 18 years) with a principal diagnosis of IS (ICD-10: I63), ICB (ICD-10: I61), or SAB (ICD-10: I60). The following variables from the stroke registry were used for analysis: sex, age, time interval event-to-admission (≤ 7 , > 7 days), comorbidity (arterial hypertension, diabetes mellitus, atrial fibrillation, previous stroke), prehospital care (independent at home, requiring home care, institutional care), state of consciousness at admission (clear *vs.* reduced (somnolent, soporic or comatose)), National Institutes of Health Stroke Scale at admission (NIHSS, total score), admission ward (general ward, stroke unit, intensive-care unit, other ward), treatments performed in the hospital (systemic thrombolysis, intra-arterial thrombolysis or thrombectomy, ventilation), complications in the in-patient setting (increased intracranial pressure, symptomatic ICB), determination of a palliative treatment goal during hospitalization (yes *vs.* no), and the modified Rankin scale at discharge from hospital (0, no symptoms; 1, no significant disability; 2, slight disability; 3, moderate disability; 4, moderately severe disability; 5, severe disability).

Outcome

The outcome on which the study focused was the frequency of hospital discharge of stroke patients to a free-standing hospice facility. This information was derived from the item “reason for discharge”. Only patients who had left the hospital alive could thus be included in the analysis.

Statistical analyses

Both descriptive and inferential statistics were investigated. Nominal variables are presented in absolute numbers and relative proportions plus the frequency of missing data. For continuous variables we calculated the mean and standard deviation. Percentages with 95% confidence intervals (CIs) were calculated to determine the prevalence of hospital discharge to an in-patient hospice. The number of cases of stroke (IS, ICB, SAB) at the time of hospital admission formed the basis for this comparison. The prevalence is presented with crude and age-standardized figures, using the “old European population” as the standard population. Tests included whether there were any significant differences among stroke patients in relation to the disease entity (ICB *vs.* IS; SAB *vs.* IS).

For continuous data, the unpaired *t*-test (for parametric data) or Mann-Whitney *U* test (for nonparametric data) were used; for categorical data, the chi-square test or Fisher’s exact test (frequency in cell <5) were used. The significance level was set at $P < 0.05$ (two-sided). Because of multiple testing of the same population, Bonferroni correction was also performed to avoid alpha error accumulation. Factors influencing the target event of post-hospital hospice transfer were calculated using binary multivariate regression modeling. The variable selection was based on clinical considerations. The following were selected as influencing variables: sex (women *vs.* men), age (>80 or 60–80 *vs.* <60 years), disease entity (ICB or SAB *vs.* IS), prehospital care setting (care at home or care in an institution *vs.* independent at home), level of consciousness at admission (reduced *vs.* clear), extent of physical disability at discharge (modified Rankin scale: 5 or 4 or 3 *vs.* 0–2), and physician’s determination of a palliative treatment goal during hospitalization (yes *vs.* no). The quality of the statistical model was expressed using Nagelkerk’s pseudo- R^2 coefficients. The software program IBM SPSS Statistics, version 28, was used for statistical analysis.

Ethics vote

A collaboration agreement was concluded with the Institute of Epidemiology and Social Medicine at the University of Münster, the coordinating center for the Northwest Germany Stroke Registry. The patient data are collected anonymized in the hospitals included in the quality assurance program. Therefore, a consultation with the ethics committee of the Medical Association of Westphalia-

Lippe and the Medical Faculty of the Westphalian Wilhelms University of Münster was not necessary. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013).

Results

Selection of stroke patients documented in the registry

From 2017 to 2020, a total of 462,592 cases of adult patients with stroke were documented in the registry. From these, 339,513 cases with a principal diagnosis of IS, ICB, or SAB were included in the analysis. The frequency distribution of each diagnosis was as follows: IS 90.7% ($n=308,067$), ICB 7.9% ($n=26,957$), and SAB 1.3% ($n=4,489$) (Figure 1).

Characteristics of stroke patients

The mean age of the stroke patients was 73.1 ± 13.1 years (women: 76.0 years, men: 70.5 years) (Table 1). There was a slight predominance of male patients, at 52.6%. The acute stroke had occurred less than 8 days before admission in 93.7% of cases ($n=318,179$); 77.1% of the patients ($n=261,824$) were treated in a stroke unit, and the medical objective was assessed as purely palliative during hospitalization in 10.4% of the cases. A total of 26,037 (7.7%) stroke patients died during their hospitalization.

Patients with ICB or SAB had a more severe course of disease in comparison with patients with IS. This was reflected, among other things, in the frequency of the presence of reduced awareness at admission (ICB or SAB *vs.* IS; 29.3% or 20.5% *vs.* 7.6%, respectively; $P < 0.001$) and in the fatality rate (ICB or SAB *vs.* IS; 25.3% or 13.3% *vs.* 6.0%, respectively; $P < 0.001$). The mean age of patients with SAB was younger than in ICB and IS patients (SAB 63.1; ICB 73.8, IS 73.1 years). The proportion of women was also higher in SAB patients (57.8%) in comparison with ICB patients (47.3%) and IS patients (47.1%).

The documentation for the stroke registry was focused on acute care in hospital (Table S1). The time interval from event admission was ≤ 7 days in 93.7% of the cases ($n=318,179$); the event had occurred more than 7 days previously in 3.6% of cases ($n=12,067$); and other reasons for creating a MDS were reported in 2.7% of cases ($n=9,267$). The mean age of stroke patients with a recent event (≤ 7 days) was higher in comparison with patients with a longer interval (> 7 days). With regard to the frequency of post-hospital hospice transfer, there were no differences between

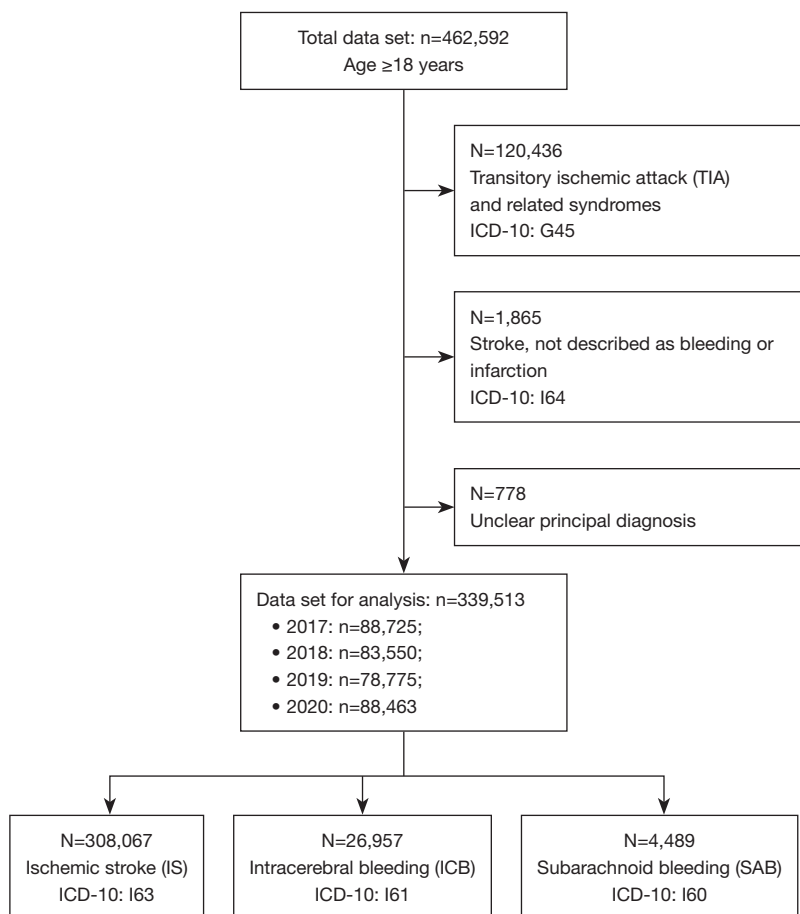


Figure 1 Flow chart.

patients with events ≤ 7 vs. >7 days (0.1% vs. 0.1%; $P=0.529$). Analyses of cases in which the patients were discharged alive vs. deceased showed that deceased hospital patients were older on average, more likely to have cerebral hemorrhage, and more likely to have reduced awareness at admission, and that the majority of these patients had been classified as palliative cases by the physician (Table S2). Table S3 also provides a comparative overview of the characteristics of stroke patients with and without the determination of a palliative treatment goal during their hospital stay.

Frequency of hospital discharge to an in-patient hospice

A total of 497 patients among 339,513 patients with stroke were discharged to free-standing hospices at the end of their in-patient care (Table 2). This represents a crude prevalence of 0.15% (95% CI: 0.13–0.16%) and an age-standardized prevalence of 0.05% (95% CI: 0.04–0.06%). Comparison of

stroke entities showed that patients with ICB had a higher (age-standardized) prevalence of hospice transfer, at 0.07% (95% CI: 0.05–0.09%) than patients with IS, at 0.05% (95% CI: 0.04–0.06%) and SAB, at 0.01% (95% CI: 0.00–0.02%). A proportional relationship was observed between the severity of illness (NIHSS score) and increasing frequency of hospice transfer (Figure 2). In addition, a higher (age-standardized) percentage of patients with reduced awareness at hospital admission were transferred to in-patient hospices in comparison with patients without this clinical symptom (0.16% vs. 0.04%); the percentage was also higher in patients with a palliative treatment goal compared to those without (1.54% vs. 0.01%).

Characteristics of stroke patients with hospice transfer vs. those without

In-patients with stroke who were discharged to hospices had

Table 1 Characteristics of hospitalized stroke patients

Variables	IS (N=308,067)		ICB (N=26,957)		ICB vs. IS P	SAB (N=4,489)		SAB vs. IS P	All cases of stroke (N=339,513)	
	%	N	%	N		%	N		%	N
Sex										
Female	47.1	145,106	47.3	12,738	0.647	57.8	2,597	<0.001*	47.3	160,441
Male	52.8	162,763	52.6	14,204	0.647	42.1	1,888	<0.001*	52.6	178,927
n/a	0.1	198	0.1	15	–	0.1	4	–	0.1	217
Age, years										
Total, mean (SD)	73.1	(13.0)	73.8	(13.0)	0.001*	63.1	(15.5)	<0.001*	73.1	(13.1)
Female, mean (SD)	76.1	(12.9)	76.5	(12.5)	0.198	63.3	(15.5)	<0.001*	76.0	(13.0)
Male, mean (SD)	70.5	(12.5)	71.4	(13.0)	<0.001*	62.7	(15.4)	<0.001*	70.5	(12.6)
18 to <60	16.1	49,700	15.7	4,247	0.106	44.8	2,011	<0.001*	16.5	55,958
60 to <80	47.1	145,200	45.7	12,318	<0.001*	38.8	1,743	<0.001*	46.9	159,261
≥80	36.8	113,167	38.6	10,392	<0.001*	16.4	735	<0.001*	36.6	124,294
n/a	0.0	0	0.0	0	–	0.0	0	–	0.0	0
Disease status										
Event ≤7 days before	95.0	292,371	84.5	22,764	<0.001*	67.8	3,044	<0.001*	93.7	318,179
Event >7 days before	3.5	10,922	3.3	895	0.057	5.6	250	<0.001*	3.6	12,067
Other status	1.5	4,774	12.2	3,298	<0.001*	26.6	1,195	<0.001*	2.7	9,267
Comorbidity										
Arterial hypertension	79.7	245,636	70.4	18,976	<0.001*	34.6	1,554	<0.001*	78.4	266,166
n/a	6.6	20,240	19.5	5,262	–	45.5	2,043	–	8.1	27,545
Diabetes mellitus	27.6	84,987	17.3	4,677	<0.001*	6.6	298	<0.001*	26.5	89,962
n/a	6.6	20,436	19.6	5,273	–	45.6	2,045	–	8.2	27,754
Atrial fibrillation	27.3	83,905	21.6	5,813	<0.001*	6.0	269	<0.001*	26.5	89,987
n/a	6.9	21,363	19.7	5,312	–	45.6	2,049	–	8.5	28,724
Previous stroke	24.1	74,197	17.8	4,801	<0.001*	7.0	313	<0.001*	23.4	79,311
n/a	6.6	20,470	19.6	5,271	–	45.6	2,046	–	8.2	27,787
Prehospital care										
Independent, at home	75.6	232,904	63.7	17,179	<0.001*	61.0	2,738	<0.001*	74.5	252,821
Care at home	10.7	33,004	11.5	3,094	<0.001*	4.4	197	<0.001*	10.7	36,295
Institutional care	8.5	26,272	9.3	2,500	<0.001*	2.5	113	<0.001*	8.5	28,885
n/a	5.2	15,887	15.5	4,184	–	32.1	1,441	–	6.3	21,512
Patient status at hospital admission										
Consciousness										
Clear awareness	87.4	269,063	55.3	14,887	<0.001*	47.6	2,133	<0.001*	84.4	286,083

Table 1 (continued)

Table 1 (continued)

Variables	IS (N=308,067)		ICB (N=26,957)		ICB vs. IS	SAB (N=4,489)		SAB vs. IS	All cases of stroke (N=339,513)	
	%	N	%	N	P	%	N	P	%	N
Reduced awareness	7.6	23,461	29.3	7,878	<0.001*	20.5	920	<0.001*	9.5	32,259
n/a	5.0	15,543	15.4	4,192	–	31.9	1,436	–	6.1	21,171
NIHSS score										
0 point	10.4	32,079	4.6	1,250	<0.001*	26.9	1,206	<0.001*	10.2	34,535
1–4 points	43.8	134,946	20.9	5,635	<0.001*	18.4	827	<0.001*	41.7	141,408
5–15 points	31.0	95,597	33.0	8,885	<0.001*	10.4	467	<0.001*	30.9	104,949
16–20 points	5.8	17,761	10.9	2,928	<0.001*	3.0	134	<0.001*	6.1	20,823
21–42 points	3.8	11,683	15.0	4,031	<0.001*	9.2	411	<0.001*	4.7	16,125
n/a	5.2	16,001	15.7	4,228	–	32.2	1,444	–	6.4	21,673
Mean (SD)	5.9	(6.4)	11.6	(9.8)	<0.001*	6.7	(10.5)	<0.001*	6.4	(6.9)
In-patient treatment										
Ward										
General ward	8.5	26,085	6.4	1717	<0.001*	8.1	365	0.433	8.3	28,167
Stroke unit	79.5	244,840	57.7	15,550	<0.001*	32.0	1,434	<0.001*	77.1	261,824
Intensive-care unit	6.0	18,349	19.7	5,323	<0.001*	26.6	1,196	<0.001*	7.3	24,868
Other ward	0.2	621	0.5	147	<0.001*	1.0	46	<0.001*	0.2	814
n/a	5.9	18,172	15.7	4,220	–	32.3	1,448	–	7.0	23,840
Treatment										
Systemic lysis in hospital	16.8	51,659	0.0	0	–	0.0	0	–	15.2	51,659
n/a	4.9	15,245	15.4	4,152	–	31.9	1,431	–	6.1	20,828
Intra-art. lysis/thrombectomy	3.1	9,677	0.0	0	–	0.0	0	–	2.9	9,677
n/a	5.1	1,5642	15.5	4,187	–	32.2	1,444	–	6.3	21,273
Ventilation	5.2	15,963	12.2	3,299	<0.001*	12.9	580	<0.001*	5.8	19,842
n/a	5.0	15,299	15.4	4,160	–	31.9	1,433	–	6.2	20,892
Complications										
Increased ICP	1.6	4,777	10.1	2,735	<0.001*	6.6	296	<0.001*	2.3	7,808
n/a	93.4	287,606	74.3	20,003	–	61.2	2,748	–	91.4	310,384
Secondary bleeding	1.3	4126	4.8	1,290	<0.001*	2.8	126	<0.001*	1.6	5,542
n/a	93.6	288,249	79.7	21,474	–	65.0	2,918	–	92.1	312,641
Modified Rankin scale at discharge										
0	16.1	49,481	4.2	1,144	<0.001*	14.4	648	0.003*	15.1	5,1273
1	21.1	64,933	8.1	2,182	<0.001*	11.6	521	<0.001*	19.9	67,636
2	21.4	65,871	11.6	3,127	<0.001*	7.0	316	<0.001*	20.4	69,314

Table 1 (continued)

Table 1 (continued)

Variables	IS (N=308,067)		ICB (N=26,957)		ICB vs. IS	SAB (N=4,489)		SAB vs. IS	All cases of stroke (N=339,513)	
	%	N	%	N	P	%	N	P	%	N
3	13.0	40,131	10.8	2,907	<0.001*	4.8	214	<0.001*	12.7	43,252
4	9.2	28,201	11.8	3,181	<0.001*	3.5	157	<0.001*	9.3	31,539
5	7.1	21,758	13.8	3,707	<0.001*	6.5	293	0.169	7.6	25,758
Death	6.0	18,623	25.3	6,818	<0.001*	13.3	596	<0.001*	7.7	26,037
n/a	6.2	19,067	14.4	3,891		38.9	1,744		7.3	24,702
Palliative treatment goal determined during hospital stay										
Palliative treatment	9.6	29,466	20.2	5,453	<0.001*	6.6	295	<0.001*	10.4	35,214
n/a	6.8	21,071	19.7	5,309	–	45.9	2,059	–	8.4	28,439
Post-hospital transfer										
Rehabilitation unit	15.0	46,092	19.2	5,177	<0.001*	8.3	373	<0.001*	15.2	51,641
Other hospital	9.1	28,082	13.4	3,619	<0.001*	23.3	1,048	<0.001*	9.6	32,749
Nursing home	4.2	12,890	4.1	1,113	0.679	1.1	49	<0.001*	4.1	14,052
Hospice	0.1	414	0.3	76	<0.001*	0.2	7	0.678	0.1	497
n/a	5.2	15,965	15.6	4,209	–	32.2	1,447	–	6.4	21,621

*, significant result according to Bonferroni correction. IS, ischemic stroke; ICB, intracerebral bleeding; SAB, subarachnoid bleeding; ICP, intracranial pressure; n/a, not available (data missing); SD, standard deviation; NIHSS, National Institutes of Health Stroke Scale.

a higher mean age (80.0 *vs.* 72.5 years; $P<0.001$), included a higher percentage of women (62.6% *vs.* 47.2%; $P<0.001$) and a higher proportion of ICB patients (15.3% *vs.* 7.9%; $P<0.001$), and more often had reduced awareness at hospital admission (36.8% *vs.* 9.5%; $P<0.001$) (Table 3). In addition, they were significantly more likely to be suffering from severe disability at the time of hospital discharge (modified Rankin scale grade 5: 67.0% *vs.* 7.5%; $P<0.001$).

Factors influencing hospice discharge

In general, the chance of hospice transfer increased with the extent of physical impairment due to stroke (Table 4). The odds of hospice transfer increased by a factor of 3.54 for patients with moderate disability at the time of hospital discharge (Rankin scale grade 3) in comparison with patients with no symptoms or slight disability (grades 0–2), by a factor of 9.06 for higher-grade disability (grade 4), and by a factor of 34.78 for severe disability (grade 5). The physician's determination of a palliative treatment goal during the hospital stay increased the odds of a hospice transfer by a factor of 14.22 compared with patients without

a palliative approach. If patients had reduced awareness at hospital admission, the probability of hospice transfer increased by a factor of 1.71 (OR 1.71; 95% CI: 1.39–2.10; $P<0.001$). Patients who had been cared for in a nursing home before admission to hospital were less likely to be transferred to an in-patient hospice after their hospital stay in comparison with patients who were independent at home (OR 0.34; 95% CI: 0.25–0.44; $P<0.001$).

Discussion

The present study, based on data from the Northwest-German Stroke Registry, indicates that in Germany, only a very small proportion of hospitalized patients with stroke are discharged to free-standing hospices at the end of their hospital stay. This was observed only in 0.05% of all in-patient stroke cases (age-standardized). Age-standardized prevalence was 0.05% for IS, 0.07% for ICB, and 0.01% for SAB.

These results stand in contrast to those of comparable studies, mainly in the United States, which have reported higher hospice transfer rates. For clearer assessment of

Table 2 Crude and age-standardized prevalence of hospice transfer of hospitalized stroke patients

Variables	IS (N=308,067)		ICB (N=26,957)		ICB vs. IS		SAB (N=4,489)		SAB vs. IS		All stroke cases (N=339,513)	
	Prevalence (95% CI) (%)	Transfer to hospice	Prevalence (95% CI) (%)	Transfer to hospice	P	Prevalence (95% CI) (%)	Transfer to hospice	P	Prevalence (95% CI) (%)	Transfer to hospice	P	Prevalence (95% CI) (%)
Total		414		76	<0.001*		7	0.678				497
Crude	0.13 (0.12–0.15)		0.28 (0.22–0.35)			0.16 (0.04–0.27)			0.15 (0.13–0.16)			
Age-standardized	0.05 (0.04–0.06)		0.07 (0.05–0.09)			0.01 (0.00–0.02)			0.05 (0.04–0.06)			
Gender												
Women	N=145,106	264	N=12,738	42	<0.001*	N=2,597	5	0.815	N=160,441	311		
Crude	0.18 (0.16–0.20)		0.33 (0.23–0.43)			0.19 (0.02–0.36)			0.19 (0.17–0.22)			
Age-standardized	0.06 (0.04–0.08)		0.09 (0.07–0.11)			0.02 (0.01–0.03)			0.06 (0.04–0.08)			
Men	N=162,763	148	N=14,204	34	<0.001*	N=1,888	2	0.691	N=178,855	184		
Crude	0.09 (0.08–0.11)		0.24 (0.16–0.32)			0.11 (0.00–0.25)			0.10 (0.09–0.12)			
Age-standardized	0.04 (0.03–0.05)		0.06 (0.04–0.08)			0.00 (0.00–0.00)			0.06 (0.04–0.08)			
n/a	N=192	2	N=15	0	-	N=4	0	-	N=211	2		
Age												
<60 years	N=49,700	18	N=4,247	5	0.031	N=2,011	0	-	N=55,958	23		
Crude	0.04 (0.02–0.05)		0.12 (0.01–0.22)			0.00 (0.00–0.00)			0.04 (0.02–0.06)			
Age-standardized	N=145,200	147	N=12,318	27	<0.001*	N=1,743	5	0.036	N=159,261	179		
Crude	0.10 (0.08–0.12)		0.22 (0.14–0.30)			0.29 (0.04–0.54)			0.11 (0.10–0.13)			
Age-standardized	N=113,167	249	N=10,392	44	<0.001*	N=735	2	0.679	N=124,294	295		
Crude	0.22 (0.19–0.25)		0.42 (0.30–0.55)			0.27 (0.00–0.65)			0.24 (0.21–0.26)			
Age-standardized	N=133	0	N=7	0	-	N=1	0	-	N=144	0		
Prehospital care												
Independent, at home	N=232,904	231	N=17,179	30	0.005*	N=2,738	1	0.532	N=252,821	262		
Crude	0.10 (0.09–0.11)		0.17 (0.11–0.24)			0.04 (0.00–0.11)			0.10 (0.09–0.12)			
Age-standardized	N=33,004	96	N=3,094	15	0.086	N=197	0	-	N=36,295	111		
Crude	0.29 (0.23–0.35)		0.48 (0.24–0.73)			0.00 (0.00–0.00)			0.31 (0.25–0.36)			
Age-standardized	N=93,105		0.19 (0.16–0.22)			0.03 (0.02–0.04)			0.83 (0.77–0.89)			

Table 2 (continued)

Table 2 (continued)

Variables	IS (N=308,067)		ICB (N=26,957)		ICB vs. IS		SAB (N=4,489)		SAB vs. IS		All stroke cases (N=339,513)	
	Prevalence (95% CI) (%)	Transfer to hospice	Prevalence (95% CI) (%)	Transfer to hospice	P	Prevalence (95% CI) (%)	Transfer to hospice	Prevalence (95% CI) (%)	P	Prevalence (95% CI) (%)	Transfer to hospice	
Institutional care	N=26,272	63	N=2,500	12	0.037	N=113	0	N=28,885	-	N=28,885	75	
Crude	0.24 (0.18-0.30)		0.48 (0.21-0.75)			0.21 (0.00-0.63)		0.26 (0.20-0.32)		0.26 (0.20-0.32)		
Age-standardized	0.07 (0.05-0.09)		0.22 (0.19-0.25)			0.00 (0.00-0.00)		0.09 (0.07-0.11)		0.09 (0.07-0.11)		
n/a	N=15,887	24	N=4,184	19	-	N=1,441	6	N=21,463	-	N=21,463	49	
Awareness												
Clear awareness	N=269,063	242	N=14,887	27	0.987	N=2,133	0	N=286,083	-	N=286,083	269	
Crude	0.09 (0.08-0.10)		0.18 (0.11-0.25)			0.00 (0.00-0.00)		0.09 (0.08-0.11)		0.09 (0.08-0.11)		
Age-standardized	0.04 (0.03-0.05)		0.03 (0.02-0.04)			0.00 (0.00-0.00)		0.04 (0.03-0.05)		0.04 (0.03-0.05)		
Reduced awareness	N=23,461	151	N=7,878	31	0.009*	N=920	1	N=32,259	-	N=32,259	183	
Crude	0.64 (0.54-0.75)		0.39 (0.26-0.53)			0.11 (0.00-0.32)		0.57 (0.49-0.65)		0.57 (0.49-0.65)		
Age-standardized	0.18 (0.15-0.21)		0.15 (0.13-0.17)			0.04 (0.03-0.05)		0.16 (0.14-0.18)		0.16 (0.14-0.18)		
n/a	N=15,543	21	N=4,192	18	-	N=1,436	6	N=21,171	-	N=21,171	45	
Modified Rankin scale at hospital discharge												
0-2	N=180,285	26	N=6,453	1	0.613	N=1,485	0	N=188,223	-	N=188,223	27	
Crude	0.01 (0.01-0.02)		0.00 (0.00-0.00)			0.00 (0.00-0.00)		0.01 (0.01-0.02)		0.01 (0.01-0.02)		
Age-standardized	0.00 (0.00-0.00)		0.00 (0.00-0.00)			0.00 (0.00-0.00)		0.00 (0.00-0.00)		0.00 (0.00-0.00)		
3	N=40,131	27	N=2,907	1	0.999	N=214	0	N=43,252	-	N=43,252	28	
Crude	0.07 (0.04-0.09)		0.00 (0.00-0.00)			0.00 (0.00-0.00)		0.06 (0.04-0.09)		0.06 (0.04-0.09)		
Age-standardized	0.03 (0.02-0.04)		0.02 (0.01-0.03)			0.00 (0.00-0.00)		0.02 (0.01-0.03)		0.02 (0.01-0.03)		
4	N=28,201	57	N=3,181	6	0.999	N=157	0	N=31,539	-	N=31,539	63	
Crude	0.20 (0.15-0.25)		0.19 (0.04-0.34)			0.00 (0.00-0.00)		0.20 (0.15-0.25)		0.20 (0.15-0.25)		
Age-standardized	0.09 (0.07-0.11)		0.02 (0.01-0.03)			0.00 (0.00-0.00)		0.08 (0.06-0.10)		0.08 (0.06-0.10)		
5	N=21,758	282	N=3,707	50	0.761	N=293	1	N=25,758	0.192	N=25,758	333	
Crude	1.30 (1.15-1.45)		1.35 (0.98-1.72)			0.34 (0.00-1.01)		1.29 (1.15-1.43)		1.29 (1.15-1.43)		
Age-standardized	0.82 (0.76-0.88)		0.38 (0.28-0.36)			0.13 (0.11-0.15)		0.69 (0.64-0.74)		0.69 (0.64-0.74)		
n/a	N=19,067	22	N=3,891	18	-	N=1,744	6	N=24,702	-	N=24,702	46	

Table 2 (continued)

Table 2 (continued)

Variables	IS (N=308,067)		ICB (N=26,957)		ICB vs. IS		SAB (N=4,489)		SAB vs. IS		All stroke cases (N=339,513)	
	Prevalence (95% CI) (%)	Transfer to hospice	Prevalence (95% CI) (%)	Transfer to hospice	P	Prevalence (95% CI) (%)	Transfer to hospice	P	Prevalence (95% CI) (%)	Transfer to hospice		
Palliative treatment goal determined during hospital stay												
No	N=278,601	111	N=21,504	14	-	N=4,194	0	-	N=304,299	125		
Crude	0.04 (0.03–0.05)		0.07 (0.03–0.10)			0.00 (0.00–0.00)			0.04 (0.03–0.05)			
Age-standardized	0.01 (0.00–0.02)		0.02 (0.00–0.05)			0.00 (0.00–0.00)			0.01 (0.00–0.02)			
Yes	N=29,466	281	N=5,453	44	0.319	N=295	1	0.535	N=35,214	326		
Crude	0.95 (0.84–1.06)		0.81 (0.57–1.04)			0.34 (0.00–1.00)			0.93 (0.83–1.03)			
Age-standardized	1.93 (1.66–2.20)		0.53 (0.39–0.67)			0.09 (0.03–0.15)			1.54 (1.30–1.78)			
n/a	N=21,071	22	N=5,309	18	-	N=2,059	6	-	N=28,439	46		

*, significant result according to Bonferroni correction. n/a, not available (data missing); CI, confidence interval; IS, ischemic stroke; ICB, intracerebral bleeding; SAB, subarachnoid bleeding.

the literature, it should be pointed out that in the United States, the term “hospice” is defined more broadly than in Germany. The term is associated there with hospice home care programs, independent hospice companies with or without in-patient facilities, palliative care departments in a hospital or university, and also palliative care teams that are affiliated to acute care hospitals. In Germany, hospices represent structurally, organizationally, and economically independent free-standing facilities with separate staff and a distinct approach. This distinguishes them from palliative wards, which are units integrated into the hospital. In Germany, there are approximately 250 in-patient hospices (2,550 beds) and approximately 340 palliative care units (2,784 beds) (as of February 2022). The European Association for Palliative Care (EAPC) has called for a standard of 80–100 hospice or palliative-care beds per 1 million population (42). The current actual figures are 30.6 hospice beds and 33.5 palliative-care beds per 1 million population (as of February 2022). The EAPC minimum standard has thus not yet been achieved in Germany. In everyday clinical practice, it is not uncommon for it to take several weeks before a hospice place can be offered after registration.

Comparative studies from the United States show higher rates of hospice transfer of in-patient stroke patients. In a single-center study as part of the “Get with The Guidelines Stroke Study”, Chauhan *et al.* examined 2,446 patients with IS who were hospitalized at the University of Arkansas from 2009 to 2015 (38). The methodology used was very similar to that in the present study. It was reported that 100 stroke patients (4.1%) were transferred to a hospice after their hospital stay. duPreez *et al.* evaluated United States insurance data (Medicare data) for claimants aged 64 years and older who were hospitalized for IS in 2000 and died within 30 days of the event (39). The focus was thus on cerebral infarction patients with a severe disease course. A total of 4,894 patients were identified, among whom nearly one in 4 (23.4%) were transferred to a hospice after discharge. Almost half of all patients who were able to leave the hospital alive (44.0%) were transferred to a hospice.

Frequency of stroke patients cared for in hospices

According to the National Hospice and Palliative Care Organization (NHPCO), just over 1 million people in the United States die in hospices each year, including 29.6% with a diagnosis of malignant tumor disease, 17.4% with cardiovascular disease, and 15.6% with dementia (43). At

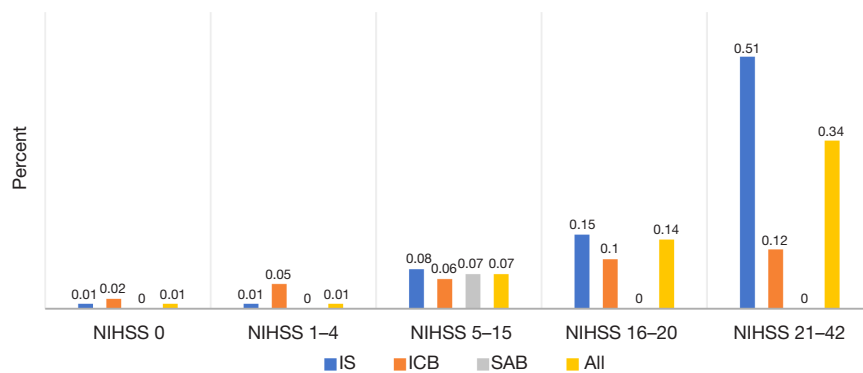


Figure 2 The age-standardized rate (%) of transfer from hospital to hospice among stroke patients stratified by NIHSS score. NIHSS, National Institute of Health Stroke scale; IS, ischemic stroke; ICB, intracerebral bleeding; SAB, subarachnoid bleeding.

Table 3 Hospitalized stroke patients with and without hospice transfer

Variables	Transferred to a hospice (N=497)		Not transferred to a hospice (N=339,016)		P
	%	N	%	N	
Sex					
Female	62.6	311	47.2	160,130	<0.001*
Male	37.0	184	52.7	178,671	<0.001*
n/a	0.4	2	0.1	215	–
Age, years					
Total, mean (SD)	80.0	(10.6)	72.5	(13.1)	<0.001*
Female, mean (SD)	81.3	(10.3)	75.3	(13.1)	<0.001*
Male, mean (SD)	77.7	(10.9)	70.0	(12.5)	<0.001*
<60	4.6	23	16.5	55,935	<0.001*
60 to <80	36.0	179	46.9	159,082	<0.001*
≥80	59.4	295	36.6	123,999	<0.001*
n/a	0.0	0	0.0	0	–
Disease status					
Event ≤7 days before	90.9	452	93.7	317,727	0.013
Event >7 days before	2.8	14	3.6	12,053	0.461
Other status	6.2	31	2.7	9,236	–
Type of stroke					
Ischemic stroke	83.3	414	90.7	307,653	<0.001*
Intracerebral bleeding	15.3	76	7.9	26,881	<0.001*
Subarachnoid bleeding	1.4	7	1.3	4,482	0.842

Table 3 (continued)

Table 3 (continued)

Variables	Transferred to a hospice (N=497)		Not transferred to a hospice (N=339,016)		P
	%	N	%	N	
Comorbidity					
Arterial hypertension	77.7	386	78.4	265,780	0.706
n/a	9.3	46	8.1	27,499	–
Diabetes mellitus	24.5	122	26.5	89,840	0.334
n/a	9.3	46	8.2	27,708	–
Atrial fibrillation	39.5	196	26.4	89,791	<0.001*
n/a	9.7	48	8.5	28,676	–
Previous stroke	27.4	136	23.4	79,175	0.037
n/a	9.3	46	8.2	27,741	–
Prehospital care					
Independent, at home	52.7	262	74.5	252,669	<0.001*
Care at home	22.3	111	10.7	36,198	<0.001*
Institutional care	15.1	75	8.5	28,822	<0.001*
n/a	9.9	49	6.3	21,485	–
Patient status at hospital admission					
Consciousness					
Clear awareness	54.1	269	84.3	285,814	<0.001*
Reduced awareness	36.8	183	9.5	32,076	<0.001*
n/a	9.1	45	6.2	21,126	–
NIHSS score					
0 point	2.0	10	10.2	34,525	<0.001*
1–4 points	10.9	54	41.7	141,354	<0.001*
5–15 points	39.2	195	30.9	104,754	<0.001*
16–20 points	20.1	100	6.1	20,723	<0.001*
21–42 points	17.9	89	4.7	16,036	<0.001*
n/a	9.9	49	6.4	21,624	–
Mean (SD)	13.8	(8.0)	6.4	(6.7)	<0.001*
In-patient treatment					
Ward					
General ward	7.0	35	8.3	28,132	0.369
Stroke unit	70.6	351	77.1	261,473	<0.001*
Intensive-care unit	12.7	63	7.3	24,805	<0.001*
Other ward	0.2	1	0.2	813	0.999
n/a	9.5	47	7.0	23,793	–

Table 3 (continued)

Table 3 (continued)

Variables	Transferred to a hospice (N=497)		Not transferred to a hospice (N=339,016)		P
	%	N	%	N	
Treatment					
Systemic lysis in hospital	10.9	54	15.2	51,605	0.007*
n/a	9.1	45	6.1	20,783	–
Intra-arterial lysis/thrombectomy	7.0	35	2.8	9,642	<0.001*
n/a	9.1	45	6.3	21,228	–
Ventilation	10.5	52	5.8	19,790	<0.001*
n/a	9.1	45	6.1	20,847	–
Complications					
Increased intracranial pressure	9.3	46	2.3	7,762	<0.001*
n/a	81.7	406	91.4	309,978	–
Secondary bleeding	5.4	27	1.6	5,515	<0.001*
n/a	85.5	425	92.1	312,216	–
Modified Rankin scale at discharge					
0	0.8	4	15.1	51,269	<0.001*
1	1.4	7	19.9	67,629	<0.001*
2	3.2	16	20.4	69,298	<0.001*
3	5.6	28	12.8	43,224	<0.001*
4	12.7	63	9.3	31,476	0.011
5	67.0	333	7.5	25,425	<0.001*
Death	0.0	0	7.7	26,037	–
n/a	9.3	46	7.3	24,656	–
Palliative treatment goal determined during hospital stay					
Palliative treatment	65.6	326	10.3	34,888	<0.001*
n/a	9.3	46	8.4	28,393	–

*, significant result according to Bonferroni correction. n/a, not available (data missing); SD, standard deviation; NIHSS, National Institute of Health Stroke scale.

a frequency of 9.5%, stroke patients occupy sixth place in the ranking of the most frequent diagnoses among hospice patients (as of 2018). Unfortunately, no official statistics are available in Germany on the types of patients in free-standing hospices. Data from the National Hospice and Palliative Registry (NHPR), which are only accessible to registry participants, show that it is predominantly (80.6%) oncology patients who are cared for in hospices (as of 2019) (44).

Barriers to hospice transfer

One reason why stroke patients are rarely transferred to a hospice is the acute course of the disease. Studies on the topic of case fatalities show that despite medical advances in the diagnosis and treatment of stroke patients, approximately one in five to six patients die within the first 30 days after the acute event (5,45). The type of stroke strongly influences the risk of death in these cases, with cerebral hemorrhage being associated with a significantly

Table 4 Factors influencing the transfer of hospitalized stroke patients to a hospice

Variables	OR	95% CI	P
Sex			
Women [1] vs. men [0]	1.13	0.92–1.39	0.252
Age, years			
60 to <80 [1] vs. <60 [0]	1.33	0.83–2.13	0.244
≥80 [1] vs. <60 [0]	1.39	0.86–2.24	0.179
Stroke entity			
IS [1] vs. ICB [0]	0.95	0.71–1.27	0.722
SAB [1] vs. ICB [0]	0.28	0.04–2.02	0.207
Prehospital care			
Care at home [1] vs. independent at home [0]	0.91	0.72–1.15	0.441
Institutional care [1] vs. independent at home [0]	0.34	0.25–0.44	<0.001
Consciousness			
Reduced [1] vs. clear awareness [0]	1.71	1.39–2.10	<0.001
Modified Rankin scale at discharge			
3 [1] vs. 0–2 [0]	3.54	2.08–6.03	<0.001
4 [1] vs. 0–2 [0]	9.06	5.72–14.36	<0.001
5 [1] vs. 0–2 [0]	34.78	22.94–52.75	<0.001
Palliative treatment goal determined during hospital stay			
Yes [1] vs. no [0]	14.22	11.32–17.87	<0.001
Goodness of the statistical model			
Nagelkerk R ²		0.298	

[1] factor of influence; [0] reference factor. CI, confidence intervals; ICB, intracerebral bleeding; IS, ischemic stroke; OR, odds ratio; SAB, subarachnoid bleeding.

higher risk of death in comparison with cerebral infarction. Data for the 30-day mortality thus range from 5.7% to 14.9% in patients with IS (4-9), from 29.6% to 46.5% in patients with intracerebral hemorrhage (5,10-12), and from 19.1% to 33.0% in patients with subarachnoid hemorrhage (5,13,14). A significant proportion of patients with stroke thus die in hospital. It is therefore common during inpatient care for stroke patients who are receiving best supportive care to be registered for a hospice, but to die in hospital while waiting for hospice placement. Unfortunately, there are no data on this in the literature.

Another reason for this is insufficient awareness of stroke as a “palliative condition” (26,34,35,45,46). Traditionally, specialized palliative care has mainly been reserved for patients with advanced-stage cancer, with only a small

proportion of non-cancer patients (47,48). For example, analyses of a national hospice and palliative care survey in Germany show that the proportion of non-cancer patients cared for is less than 10% (48). For hospitalized stroke patients, this leads to various problems: firstly, patients are not placed in contact with a collaborating palliative care team at an early stage in the hospital. For example, data from a multicenter study including four major United States hospitals show that palliative consultants became involved for stroke patients with severe disease a median of 2–9 days before the patients’ deaths (37). Only 19.7% of the affected patients received a consultation from the palliative care service. This mainly affected critically ill patients. These research results are confirmed by other studies (49-51). Secondly, patients who are to be transferred from hospital

to home or to a nursing home are not placed in contact with an outpatient specialized palliative care team. Thirdly, hospital physicians do not apply for hospice places for stroke patients at all, or only rarely. When specialized palliative care in a hospice is compared with in-patient nursing homes in Germany, clear advantages in favor of hospice transfer emerge. Hospices generally have a higher staffing ratio, a higher proportion of specialists trained in palliative care, regular involvement of trained palliative care physicians in patient care, and smaller numbers of beds (average 8–16 beds). In addition, unlike nursing homes, their funding is almost entirely covered by health insurance and long-term care insurance. Hospices are therefore also financially attractive. The German parliament recognized the shortcomings of palliative care in long-term in-patient care facilities and attempted to counteract it by passing the Hospice and Palliative Care Act [2015] (52). Among other things, this law makes it mandatory for nursing homes to enter into cooperation agreements with local providers of specialized palliative care. To date, however, national implementation of such obligatory agreements has not been achieved.

The transfer of nursing home patients to a hospice is problematic in everyday practice. Health-insurance companies do not generally recognize the need for hospice care for nursing home residents. They assume that nursing homes can provide comprehensive, palliative end-of-life care themselves, even for seriously ill patients who are approaching death. Although it is possible to circumvent this restrictive regulation by remaining in a palliative ward, transfers from nursing home to hospice continue to be difficult. The present study data confirm the problem. For example, nursing home residents with stroke who were discharged after a hospital stay were transferred back to the nursing home in 33.4% of cases, and only 0.3% were transferred to a hospice. The corresponding percentages were 42.5% and 1.1%, respectively, for stroke patients for whom a palliative treatment goal was established while they were still hospitalized.

To improve palliative care for stroke patients and their families in hospital, the following suggestions might be considered: (I) establishing joint physician rounds involving a palliative care physician or a palliative care nurse in stroke units and neurological/neurosurgical intensive-care units; (II) initiating interdisciplinary case conferences to clarify treatment goals and further care for critically ill stroke patients; (III) providing further training courses for hospital physicians and nurses to intensify their knowledge of

specifically palliative medical and communicative content; and (IV) developing palliative wards and specialized palliative services in hospitals. Data from the German hospital system indicate that there is a structural deficit here. At the beginning of 2022, for example, only 18.3% of all hospitals included a palliative care unit. Only 3.8% had implemented an in-patient palliative service. This deficit in care provision is particularly unfortunate, as it has been demonstrated that including palliative care expertise in in-patient care leads to improved symptom control and increased quality of life for patients and their families (53,54). Some evidence is available that this leads to cost savings in health care, but the findings are not consistent across all of the studies (55).

Neurological factors influencing hospice transfer

The extent of neurological impairment due to stroke is a major determinant of hospice transfer. For example, a positive association has been demonstrated between increasing NIHSS scores and increasing frequency of hospice transfer. Among patients in Germany, the NIHSS score differed only slightly from the data in a controlled study in the United States (38). The presence of impaired consciousness was also associated with hospice transfer. If the patient's awareness was reduced at the time of hospital admission, the chance of hospice transfer increased by a factor of 1.7. These results are not surprising, as they demonstrate a correct medical indication for hospice patients, whose life expectancy should be less than 6 months.

Strengths and limitations

The strength of the present study is the size of the data set (n=339,513) and the consistent collection of data over time. A limitation that should be noted is that the registry data mainly relate to patients who had a stroke event less than 8 days before hospital admission, so that the study primarily reflects cases of acute in-patient care. However, we intentionally included patients in whom the event occurred more than 7 days previously and/or in whom a palliative treatment goal had already been established at the time of hospital admission. Only a MDS was created for these patients, but it explicitly included discharge status. For all the patients in the stroke registry, it was therefore possible for the target event "hospice transfer" to be documented. If only a MDS was created, information on diagnostic

investigation and treatment was missing, among other things, so that many items had a large proportion of missing values.

Participation in the stroke registry was voluntary for the hospitals involved. However, it was mainly hospitals with a stroke unit that took part, as this was mandatory for them in obtaining certification. The selection of participating hospitals can therefore not be considered representative for Germany.

It was not possible to identify some important factors that affect hospice transfer from the registry data. These include co-morbidities (e.g., malignant tumor, pneumonia, sepsis, decubitus ulcer), marital status, current life circumstances, and the availability of an advance health-care directive (living will) stating the patient's wishes regarding performance or omission of life-prolonging measures (do not resuscitate/do not intubate status). Accordingly, the multivariate logistic regression model had limitations relative to the available influencing variables.

Conclusions

In Germany, only a very small percentage of adult stroke patients with a severe disease course are discharged to inpatient hospices at the end of their hospital stays. Although a not insignificant proportion of in-patients with stroke have exclusively palliative care needs, these patients are very rarely discharged to a free-standing hospice after hospitalization. Closer cooperation between various medical disciplines (e.g., neurology, neurosurgery, intensive care) and palliative medicine as well as the involvement of spiritual care (e.g., the hospital chaplaincy) would be desirable in order to contribute to improved, holistic care for seriously ill patients and their relatives at the end of life. It should also be critically called into question whether excluding from hospices those patients who have been receiving long-term nursing-home care—the usual practice in Germany—should continue.

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Table S1 Comparison of stroke patients with an acute event (≤ 7 days) vs. less recent event (> 7 days) and other reasons for creating a MDS

Variables	Event ≤ 7 days (N=318,179)		Creation of a MDS (N=21,334)			Reason for MDS: event > 7 days (N=12,067)			Other reasons for MDS (N=9,267)		
	%	N	%	N	P	%	N	P	%	N	P
Sex											
Female	47.3	150,360	47.3	10,081	0.955	44.6	5,387	<0.001*	50.7	4,694	<0.001*
Male	52.7	167,608	52.7	11,247	0.955	55.3	6,676	<0.001*	49.3	4,571	<0.001*
n/a	0.1	211	0.0	6		0.1	4		0.0	2	–
Age, years											
Total, mean (SD)	73.1 (13.1)		70.6 (13.9)		<0.001*	70.3 (13.2)		<0.001*	70.9 (14.8)		<0.001*
Female, mean (SD)	76.0 (13.0)		72.7 (14.4)		<0.001*	72.3 (13.7)		<0.001*	73.1 (15.0)		<0.001*
Male, mean (SD)	70.5 (12.6)		68.7 (13.2)		<0.001*	68.7 (12.6)		<0.001*	68.6 (14.1)		<0.001*
<60	16.2	51,409	21.3	4,549	<0.001*	20.8	2,504	<0.001*	22.1	2,045	<0.001*
60 to <80	46.8	148,914	48.5	10,347	<0.001*	51.5	6,214	<0.001*	44.6	4,133	<0.001*
≥ 80	37.0	117,856	30.2	6,438	<0.001*	27.8	3,349	<0.001*	33.3	3,089	<0.001*
n/a	0.0	0	0.0	0		0.0	0		0.0	0	–
Posthospital transfer											
Rehabilitation facility	16.2	51,642	0.0	0		0.0	0		0.0	0	–
Other hospital	10.3	32,749	0.0	0		0.0	0		0.0	0	–
Nursing home	4.4	14,052	0.0	0		0.0	0		0.0	0	–
Hospice	0.1	452	0.2	45	0.013	0.1	14	0.529	0.3	31	<0.001*
n/a	0.1	287	99.8	21,289		99.9	12,053		99.7	9,236	–

*, significant result according to Bonferroni correction. MDS, minimal data set; SD, standard deviation; n/a, not available (data missing).

Table S2 Comparison of hospitalized patients diagnosed with stroke who were discharged alive *vs.* those who died

Variables	Alive (N=313,476)		Deceased (N=26,037)		P
	%	N	%	N	
Sex					
Female	46.4	145,595	57.0	14,846	<0.001*
Male	53.5	167,680	42.9	11,175	<0.001*
n/a	0.1	201	0.1	16	–
Age, years					
Total, mean (SD)	72.3 (13.2)		80.2 (10.5)		<0.001*
Female, mean (SD)	75.1 (13.3)		82.5 (9.7)		<0.001*
Male, mean (SD)	69.9 (12.6)		77.3 (10.8)		<0.001*
<60	17.4	54,648	5.0	1,310	<0.001*
60 to <80	48.0	150,585	33.3	8,676	<0.001*
≥80	34.5	108,243	61.6	16,051	<0.001*
n/a	0.0	0	0.0	0	–
Disease status					
Event ≤7 days	94.1	294,837	89.6	23,342	<0.001*
Event >7 days	3.7	11,618	1.7	449	<0.001*
n/a	2.2	7,021	8.6	2,246	<0.001*
Comorbidity					
Ischemic stroke	92.3	289,444	71.5	18,623	<0.001*
ICB	6.4	20,139	26.2	6,818	<0.001*
SAB	1.2	3,893	2.3	596	<0.001*
Arterial hypertension	78.5	246,164	76.8	20,002	<0.001*
n/a	7.9	24,772	10.7	2,773	–
Diabetes mellitus	26.6	83,285	25.6	6,677	<0.001*
n/a	8.0	24,965	10.7	2,789	–
Atrial fibrillation	25.3	79,295	41.0	10,692	<0.001*
n/a	8.3	25,900	10.8	2,824	–
Previous stroke	23.3	72,905	24.6	6,406	<0.001*
n/a	8.0	25,005	10.7	2,782	–
Prehospital care					
Independent, at home	76.4	239,436	51.4	13,385	<0.001*
Care at home	9.9	30,998	20.2	5,247	<0.001*
Institutional care	7.7	24,161	18.0	4,679	<0.001*
n/a	6.0	18,802	10.4	2,710	–
Patient status at hospital admission					
Consciousness					
Clear awareness	87.8	275,319	41.3	10,764	<0.001*
Reduced awareness	6.3	19,670	48.4	12,589	<0.001*
n/a	5.9	18,487	10.3	2,684	–
NIHSS score					
0 points	10.9	34,240	1.1	295	<0.001*
1–4 points	44.4	139,319	8.0	2,089	<0.001*
5–15 points	31.1	97,348	29.2	7,601	<0.001*
16–20 points	4.8	15,181	21.7	5,642	<0.001*
21–42 points	2.7	8,473	29.4	7,652	<0.001*
n/a	6.0	18,915	10.6	2,758	–
Mean (SD)	5.5	(5.9)	17.0	(9.3)	<0.001*
In-patient treatment					
Ward					
General ward	8.3	25,975	8.4	2,192	0.455
Stroke unit	79.0	247,609	54.6	14,215	<0.001*
Intensive-care unit	5.8	18,112	25.9	6,756	<0.001*
Other ward	0.2	747	0.3	67	0.509
n/a	6.7	21,033	10.8	2,807	–
Therapy					
Systemic lysis in hospital	15.3	47,956	14.2	3,703	<0.001*
n/a	5.8	18,167	10.2	2,661	–
Intra-art. lysis/thrombectomy	2.6	7,997	6.5	1,680	<0.001*
n/a	5.9	18,584	10.3	2,689	–
Ventilation	4.1	12,996	26.3	6,846	<0.001*
n/a	5.8	18,226	10.2	2,666	–
Complications					
Increased ICP	0.9	2,767	19.4	5,041	<0.001*
n/a	93.2	292,074	70.3	18,310	–
Secondary bleeding	1.0	3,194	9.0	2,348	<0.001*
n/a	93.0	291,646	80.6	20,995	–
Modified Rankin scale at discharge					
0	16.4	51,273	0.0	0	–
1	21.6	67,636	0.0	0	–
2	22.1	69,314	0.0	0	–
3	13.8	43,252	0.0	0	–
4	10.1	31,539	0.0	0	–
5	8.2	25,758	0.0	0	–
Death	0.0	0	100	26,037	–
n/a	7.9	24,702	0.0	0	–
Palliative treatment goal determined during hospital stay					
Palliative treatment	6.2	19,585	60.0	15,629	<0.001*
n/a	8.2	25,645	10.7	2,794	–
Post-hospital transfer					
Rehabilitation facility	16.5	51,642	0.0	0	–
Other hospital	10.4	32,749	0.0	0	–
Nursing home	4.5	14,052	0.0	0	–
Hospice	0.2	497	0.0	0	–
n/a	6.0	18,926	10.4	2,695	–

*, significant result according to Bonferroni correction. SD, standard deviation; ICB, intracerebral bleeding; SAB, subarachnoid bleeding; ICP, intracranial pressure; NIHSS, National Institutes of Health Stroke Scale; n/a, not available (data missing).

Table S3 Stroke patients with and without determination of a palliative treatment goal during hospitalization

Variables	Determination of a palliative treatment goal during hospitalization							
	Yes (N=35,214)				No (N=275,860)			
	Alive (N=19,585)		Deceased (N=15,629)		Alive (N=268,246)		Deceased (N=7,614)	
	%	N	%	N	%	N	%	N
Sex								
Female	60.9	11,920	60.5	9,457	45.3	121,600	51.1	3,887
Male	39.1	7,648	39.4	6,161	54.6	146,485	48.9	3,724
Age, years								
Total, mean (SD)	80.7 (9.8)		81.8 (9.4)		72.0 (13.1)		78.3 (11.0)	
Female, mean (SD)	82.9 (8.9)		83.7 (8.6)		74.7 (13.2)		80.8 (10.3)	
Male, mean (SD)	77.2 (10.1)		78.9 (9.9)		69.7 (12.5)		75.7 (11.1)	
<60	3.7	734	3.1	487	17.9	48,039	6.8	520
60 to <80	34.6	6,774	29.1	4,550	48.9	131,200	39.9	3,035
≥80	61.8	12,077	67.8	10,592	33.2	89,007	53.3	4,059
Disease status								
Event ≤7 days	100	19,585	100	15,629	100	268,246	100	7,614
Event >7 days	0.0	0	0.0	0	0.0	0	0.0	0
Comorbidity								
Ischemic stroke	91.2	17,860	74.3	11,606	93.8	251,719	76.3	5,811
ICB	8.3	1,623	24.5	3,830	5.4	14,524	21.9	1,671
SAB	0.5	102	1.2	193	0.7	2,003	1.7	132
Arterial hypertension	91.9	17,843	86.9	13,558	84.8	227,447	83.7	6,370
Diabetes mellitus	31.5	6,166	28.2	4,415	28.6	76,780	29.5	2,248
Atrial fibrillation	42.4	8,299	47.8	7,471	26.3	70,693	42.0	3,199
Previous stroke	33.3	6,521	28.8	4,504	24.6	66,121	24.8	1,888
Prehospital care								
Independent, at home	53.7	10,524	54.1	8,454	83.0	222,550	63.7	4,851
Care at home	19.7	3,868	23.9	3,742	9.9	26,596	19.5	1,482
Institutional care	26.2	5,133	21.7	3,396	6.9	18,596	16.7	1,268
Patient status at hospital admission								
Consciousness								
Reduced awareness	17.6	3,442	56.4	8,821	5.4	14,522	48.6	3,699
NIHSS score								
0 points	5.0	988	0.8	127	12.2	32,696	2.1	159
1–4 points	30.9	6,048	7.0	1,100	49.1	131,670	12.8	973
5–15 points	42.7	8,372	30.4	4,747	31.9	85,653	36.9	2,812
16–20 points	12.5	2,452	25.9	4,046	4.3	11,549	20.6	1,565
21–42 points	8.6	1,686	35.5	5,552	2.3	6,047	27.2	2,071
Mean (SD)	9.1	(7.4)	17.8	(9.0)	5.1	(5.5)	15.4	(9.6)
In-patient treatment								
Ward								
General ward	8.1	1,584	9.9	1,542	8.9	23,897	8.4	636
Stroke unit	84.1	16,474	60.4	9,433	84.1	225,553	61.8	4,704
Intensive-care unit	7.3	1,420	28.7	4,488	5.9	15,753	29.4	2,236
Other ward	0.1	11	0.3	42	0.2	431	0.3	21
Therapy								
Systemic lysis in hospital	15.7	3,084	14.7	2,301	15.7	42,173	18.0	1,373
Arterial lysis/thrombectomy	5.3	1,031	6.4	999	2.6	6,929	8.9	678
Ventilation	5.9	1,160	28.6	4,473	4.4	11,817	31.1	2,369
Complications								
Increased ICP	2.0	392	23.3	3,629	0.9	2,367	18.4	1,402
Secondary bleeding	2.5	484	9.7	1,515	1.0	2,697	10.9	831
Modified Rankin scale at discharge								
0	7.3	1,430	–	–	18.5	49,641	–	–
1	12.6	2,462	–	–	24.2	64,850	–	–
2	16.6	3,260	–	–	24.5	65,784	–	–
3	16.2	3,171	–	–	14.9	39,911	–	–
4	16.6	3,254	–	–	10.5	28,141	–	–
5	30.4	5,949	–	–	7.3	19,662	–	–
Post-hospital transfer								
Rehabilitation facility	18.7	3,669	–	–	17.8	47,732	–	–
Other hospital	9.6	1,872	–	–	9.5	25,357	–	–
Nursing home	17.3	3,390	–	–	4.0	10,631	–	–
Hospice	1.7	326	–	–	0.05	125	–	–

*, significant result according to Bonferroni correction. SD, standard deviation; ICB, intracerebral bleeding; SAB, subarachnoid bleeding; ICP, intracranial pressure; NIHSS, National Institutes of Health Stroke Scale; n/a, not available (data missing).