



Research Article

Impact of nursing home admission on in-hospital mortality and morbidity and length of stay: A case-control analysis

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ABSTRACT

Methods: We examined a quality measurement database containing de-identified cases from across Switzerland. All patients with a complete dataset treated between 2015 and 2021 were included. A case-control matching method (same age, comorbidity, sex, diagnosis, admission type, and insurance coverage) was used to evaluate the impact of pre-admission residence. The outcomes measured included complications during hospitalization, in-hospital mortality, and length of stay. Statistical significance was set at a p-value of <0.001 due to our large size of analyzed cases.

Results: We noted a higher prevalence of comorbidities and higher ASA scores among the 2130 (1.9 %) patients admitted from long-term care facilities (LTCFs). Complication rates in the LTCF group were higher than those in the home group (15 % vs. 6.9 %, $p < 0.001$). Pneumonia was the most frequent complication in both groups. The in-hospital mortality rate was also significantly higher in the LTCF group than the home group (5.8 % vs. 1.1 %, $p < 0.001$). However, matched-pair analysis showed no significant difference in complication rates and overall mortality between the two groups. Patients admitted from LTCFs even had a shorter hospital stay (7.5 ± 8.7 days vs. 8.9 ± 7.9 days, $p < 0.004$).

Conclusions: Despite higher complication and mortality rates among LTCF patients, the matched-pair analysis showed no significant differences in these rates between the two groups. However, patients from LTCFs were discharged earlier, indicating the effectiveness of Switzerland's care system for older adults living in nursing homes.

Introduction

The global population is aging rapidly, and with this demographic shift comes an increased demand for care homes and nursing facilities [1,2]. These establishments provide care and support to older adults who may have complex medical needs, reduced functional abilities, or chronic illnesses [3]. Countries around the world are challenged with the task of providing adequate, affordable, and patient-centered health and social care for their aging populations [4]. The population of individuals aged 65 and older in Switzerland is projected to rise by nearly 30 % between 2020 and 2050, in line with the trend observed throughout Europe and globally [5]. Currently one in four patients treated in a Swiss hospital is 70 years or older [6]. Compared to patients

admitted from home, patients admitted from LTCFs often presents with more complex medical needs and suffers more often from multi-morbidity, polypharmacy, and cognitive impairment [7,8]. Due to their diminished physiological resources and reduced functional reserves [9–11], older patients in long-term care facilities (LTCFs) are more prone to complications and age-related morbidity and mortality than those living at home [12,13]. In Switzerland, 30 % residents in a care home have been hospitalized at least once in their last year of life [14]. In this study, we collectively refer to care homes as LTCFs. Residents of LTCFs experience frequent, often avoidable, unplanned hospitalizations [15], with higher risks than their community-dwelling peers [16]. Admission from a nursing home, is even considered a risk factor for mortality in patients after hip fractures [17]. A nursing home is a facility

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offering advanced medical care and 24-hour supervision by healthcare professionals for residents with significant health needs, including those recovering from hospital stays, with chronic conditions, or requiring rehabilitation.

In this matched-pair analysis, we aim to investigate whether LTCF patients exhibit higher morbidity and mortality rates during in-hospital stays compared to their home-dwelling counterparts. By recognizing and comprehending the differences in results between these two groups, we aim to enhance the standard of care for older individuals in both LTCFs and community environments in Switzerland.

Material and methods

Study design

For this investigation, data were obtained from the Swiss working group for quality assurance in surgery (known in German as "Arbeitsgemeinschaft für Qualitätssicherung in der Chirurgie - AQC") [18]. The AQC database contains information on nearly 2 million de-identified surgical in-hospital cases throughout Switzerland from the past 28 years. Data for the AQC database are collected through a general documentation file and an operation-specific file.

This study was approved by the Institutional Review Board, and obtaining specific consent from the local cantonal ethics committee was deemed unnecessary due to the absence of identifiable patient information within the AQC database. The investigation was conducted in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines [19].

Study subjects

We analyzed data between January 1, 2015, and December 31, 2021, which included all patients with a pre-admission stay. We also included patients who were operated on and those who were not operated on. All diagnoses listed in World Health Organization's "International Statistical Classification of Diseases and Related Health Problems" (ICD) were included. We limited our examination to adult patients (> 17 years). Patients with incomplete medical records or missing critical information were excluded, resulting in a final sample of 111,036 patients for analysis.

In this study, complications were classified into three categories. The initial category comprised intraoperative complications, which involved surgery-related occurrences. The second category covered postoperative complications that occurred after the surgical intervention, such as malrotation, impaired wound healing, and hematoma formation. The third category consisted of general complications that arose during the patients' hospital stay, including conditions like pneumonia, allergic reactions, and urinary tract infections.

Statistics

Data were extracted from the AQC database using the evaluation tool *AdjumedAnalyze* (Adjumed Services AG, Zurich, Switzerland) and further processed using the Statistical Package for Social Sciences (SPSS, Version 29, IBM Corp., Armonk, New York, United States). Patients were stratified into two groups based on their location prior to admission: home and LTCFs. Occurrence of any complication during hospitalization was the primary outcome. In-hospital mortality and length of stay were the secondary outcomes.

To assess the impact of pre-admission residence, a case-control matching approach was employed. This method aims to control for confounding variables by accounting for pre-existing differences, thereby reducing selection bias and improving internal validity. Using the case-control-matching functionality in SPSS, we performed a one-to-one matching of our two groups (home-dwelling versus LTCF residents) based on age, sex, American Society of Anesthesiologists status (ASA

status) (ASA I-V, however for ASA status V we had no matches), admission type (emergency or registered/planned), insurance coverage (statutory or private), and the exact diagnosis coded according to the ICD.

A total of 402 pairs met the matching criteria and were selected for further analysis. In the bivariate analysis of the two matched groups, McNemar tests were used for dichotomous categorical variables, and paired *t*-tests were used to compare continuous variables. A *p*-value of <0.001 was considered statistically significant due to our large size of analyzed cases.

Results

Population

This study examined a cohort of 111,036 patients with an average age of 55±21 years. The sex distribution was nearly equal, with 46 % females and 54 % males. The ASA scores were distributed as follows: 39 % patients belonged to ASA-I, 42 % were in ASA-II, 18 % in ASA-III, 1 % in ASA-IV, and only 130 patients were in ASA-V. Forty-four percent of all patients suffered from at least one comorbidity. The most common diagnoses, according to the ICD-10 codes, were concussion (S06.0), inguinal hernia, unilateral or without side indication (K40.90), gallbladder stone with other cholecystitis (K80.10), varices of lower extremities without ulceration or inflammation (I83.9), and acute appendicitis with localized peritonitis without perforation or rupture (K35.30). Only 1.9 % of the study population was admitted from LTCFs. Compared to patients admitted from homes, those admitted from LTCFs had significantly more comorbidities, higher ASA scores, were assigned significantly more often to emergency care, and were more often covered by statutory insurance plans (Table 1).

Complications

Of the total study population, 7 % experienced complications during the hospital stay. Common complications included pneumonia, urinary retention, urinary infection, sepsis, arrhythmias, and ileus. Over the course of hospitalization, a total of 1309 patients (1.2 % of population) passed away. Our study revealed that the incidence of complications in the LTCF group (15 %) was higher than that in the home-based group (6.9 %). The pattern of general complications was comparable across both groups. Pneumonia emerged as the most common complication in both groups. Interestingly, urinary retention was more prevalent among the home group, whereas the LTCF group experienced a slightly higher incidence of urinary tract infection. Sepsis was more common in the home-based group, while cardiac arrhythmias were more common in the LTCF group. Both forms of ileus were more predominantly seen in the home group. The LTCF group exhibited a higher incidence of respiratory insufficiency and multi-organ failure, whereas confirmed pulmonary embolism and gastrointestinal bleeding were more prevalent in the home-based group. Notably, patients in the LTCF group experienced a higher frequency of delirium and myocardial infarction.

In our study, 72 % of the patients admitted from home underwent surgical procedures, compared to 57 % of the patients from LTCFs. We noticed differences in the distribution of intraoperative complications and lesion locations between the two groups. Notably, lesions in the stomach, as well as in the small or large intestine, were more common in the home group, while the LTCF group had a higher incidence of lesions in the liver, liver bed, or bile duct. Both groups exhibited an equal prevalence of arterial and venous lesions. Postoperative complications also differed between the groups. The home group experienced a higher frequency of hematoma and postoperative bleeding, while postoperative delirium and wound dehiscence were more common in the LTCF group.

Table 1
Type of admission; Patient characteristics.

Parameter		Group home (n = 108,906)		Group long-term care facility (n = 2130)		p value
		n	%	n	%	
Age (years)	mean ± SD	55±21		82 ±13		<0.001
Sex	male	59,805	55	716	34	<0.001
	female	49,101	45	1414	66	
ASA	I (healthy person)	43,070	40	95	4.5	<0.001
	II (mild systemic disease)	45,897	42	742	35	
	III (severe systemic disease)	18,395	17	1150	54	
	IV (severe systemic disease that is a constant threat to life)	1426	1.3	132	6.2	
	V (moribund person who is not expected to survive without the operation)	118	0.11	11	0.52	
Type of admission	emergency	59,215	54	1710	80	<0.001
	registered, planned, other and unknown	49,691	46	420	20	
Insurance	statutory	88,499	81	1789	84	<0.001
	private	20,407	19	341	16	
Length of stay (days)	mean ± SD	6.2 ± 9.8		9.0 ± 11		<0.001
Comorbidity	yes	46,859	43	1535	72	<0.001
Complications	yes	7486	6.9	324	15	<0.001
Diagnosis	A00-B99 Certain infectious and parasitic diseases	1378	1.3	33	1.5	<0.001
	C00-D48 Neoplasms	7519	6.9	82	3.9	
	D50-D90 Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism	128	0.12	11	0.5	
	E00-E90 Endocrine, nutritional and metabolic diseases	2248	2.1	26	1.2	
	G00-G99 Diseases of the nervous system	741	0.7	4	0.19	
	I00-I99 Diseases of the circulatory system	4701	4.3	108	5.1	
	J00-J99 Diseases of the respiratory system	940	0.9	17	0.8	
	K00-K93 Diseases of the digestive system	29,243	27	302	14	
	L00-L99 Diseases of the skin and subcutaneous tissue	4734	4.3	74	3.5	
	M00-M99 Diseases of the musculoskeletal system and connective tissue	12,237	11	91	4.3	
	N00-N99 Diseases of the	2748	2.5	38	1.8	

Table 1 (continued)

Parameter	Group home (n = 108,906)		Group long-term care facility (n = 2130)		p value	
	n	%	n	%		
Discharge	genitourinary system Q00-Q99	303	0.28	3	0.14	
	Congenital malformations, deformations and chromosomal abnormalities R00-R99	1956	1.8	54	2.5	
	Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified S00-T98 Injury, poisoning and certain other consequences of external causes	38,138	35	1272	60	
	Z00-Z99 Factors influencing health status and contact with health services	1892	1.7	15	0.70	
	deceased at home	1185	1.1	124	5.8	<0.001
	rehabilitation clinic	95,043	87	293	14	
	nursing home	5071	4.7	60	2.8	
	old people's home	2140	2.0	997	47	
	other / unknown	1513	1.4	589	28	
	other hospital	1393	1.3	20	0.9	
	2561	2.4	47	2.2		

SD: Standard Deviation, ASA: American Society of Anesthesiologists classification system, n.s.: not significant.

Mortality

In-hospital mortality was notably higher in the LTCF group at 5.8 %, compared to 1.1 % in the home group. A significantly greater proportion of women from the LCTF group passed away (80 %), as compared to the home group (46 %). Among the deceased patients, those from LCTFs had a higher ASA score yet a shorter hospital stay duration (11 ± 13 days versus 14 ± 15 days).

In both groups, the most frequent diagnoses were S00-T98, which pertains to injuries, poisonings, and certain other consequences of external causes, and K00-K93, representing diseases of the digestive system. Among the group of deceased patients from LCTFs, the next most common diagnosis was I00-I99, which is indicative of diseases of the circulatory system. Conversely, in the group of deceased patients admitted from home, C00-D48 neoplasms were the second most common diagnosis. Furthermore, there was an increased incidence of complications in the deceased group from LCTFs compared to the deceased home group (66 % versus 56 %).

Length of stay

When we compared all patients, the length of stay was 6.2 ± 9.8 days for the group home versus 9.0 ± 11 days in the patients admitted from LTCFs. When we removed the cases involving patients who passed away from the analysis, the results slightly adjusted to 6.1 ± 9.7 days for the group home versus 8.9 ± 11 days in the group LTCFs with a p of <0.001.

Matched-pair analysis

The matching process resulted in two unique cohorts, with no differences observed in age, sex, ASA status (ASA I-V, with no matches for ASA status V), type of admission (emergency or scheduled), insurance coverage (statutory or private), and precise ICD-coded diagnosis (Table 2). This analysis showed not a significant difference in the duration of hospital stay between the groups, with the patients from LTCFs exhibiting a shorter duration of hospitalization (7.5 ± 8.7 days) than those admitted from home (8.9 ± 7.9 days, $p = 0.004$).

If we excluded the patients that died in our matched pair analysis the

Table 2
Characteristics of matched cases.

Parameter		Group home (n = 402)		Group long-term care facility (n = 402)		p value
		n	%	n	%	
Age (years)	mean ± SD	85		85		1.0
		±9.2		±9.2		
Sex	male	106	26.4	106	26.4	1.0
	female	296	73.6	296	73.6	
ASA	I (healthy person)	3	0.75	3	0.75	1.0
	II (mild systemic disease)	168	41.8	168	41.8	
	III (severe systemic disease)	226	56.2	226	56.2	
	IV (threat to life)	5	1.2	5	1.2	
Admission type	emergency	376	93.5	376	93.5	1.0
	registered, planned	26	6.5	26	6.5	
Insurance	statutory	355	88.3	355	88.3	1.0
	private	47	11.7	47	11.7	
Diagnosis	A41 Sepsis	1	0.25	1	0.25	1.0
	C18 Malignant neoplasm of colon	3	0.75	3	0.75	
	E11 Type 2 diabetes mellitus	5	1.2	5	1.2	
	I70 Atherosclerosis	7	1.7	7	1.7	
	K40 Inguinal hernia	10	2.5	10	2.5	
	K56 Paralytic ileus and intestinal obstruction without hernia	23	5.7	23	5.7	
	K57 Diverticular disease of intestine	6	1.5	6	1.5	
	K80 Cholelithiasis	6	1.5	6	1.5	
	L89 Decubitus ulcer and pressure area	1	0.25	1	0.25	
	S00 Superficial injury of head	1	0.25	1	0.25	
	S06 Intracranial injury	80	19.9	80	19.9	
	S22 Fracture of rib(s), sternum and thoracic spine	3	0.75	3	0.75	
	S32 Fracture of lumbar spine and pelvis	9	2.2	9	2.2	
	S42 Fracture of shoulder and upper arm	11	2.7	11	2.7	
	S52 Fracture of forearm	15	3.7	15	3.7	
	S70 Superficial injury of hip and thigh	8	2.0	8	2.0	
	S72 Fracture of femur	203	50.5	203	50.5	
	S82 Fracture of lower leg, including ankle	5	1.2	5	1.2	
	T81 Complications of procedures, not elsewhere classified	4	1.0	4	1.0	
	T84 Complications of internal orthopaedic prosthetic devices, implants and grafts	1	0.25	1	0.25	

SD: Standard Deviation, ASA: American Society of Anesthesiologists classification system.

results remained similar: 7.6 ± 8.8 days in the patients from LTCFs and 9.0 ± 8.0 in those admitted from home.

Admission from LTCFs did not seem to influence the primary outcome measure. Our matched-pair analysis revealed comparable complication rates between the groups: 13 % for patients admitted from LTCFs and 14 % for the home group.

Our analysis showed no statistically significant difference in the overall mortality rate between the groups. The mortality rate for patients admitted from LTCFs was 4.5 %, marginally higher than the 3.7 % for those admitted from home ($p = 0.720$). Our examination of discharge patterns, however, revealed striking differences between the groups. Notably, none of the patients from the LTCF group returned home post-discharge compared to 49.3 % patients from the home group. The most pronounced difference was observed in discharge to nursing homes: 89.3 % from the LTCF group compared to 14.7 % from the home group (Table 3).

Discussion

The aim of this study was to examine the differences in the in-hospital outcomes of patients admitted from LTCFs versus patients admitted from home, with the same age, sex, ASA score, admission type, insurance status, and diagnoses. A major strength of our study is the use of data from the AQC database gathered across Switzerland and the large size of the study population. Our key finding was that despite higher complication and mortality rates among LTCF patients, the matched-pair analysis revealed no significant difference in complication rate and overall mortality between the two groups. Admission from a nursing home was per se not a predictor for a negative outcome. The absence of a significant difference in complication and mortality rates between the two matched groups is a noteworthy finding. Without the matching, we observed a higher complication rate (15 % versus 6.9 %) and a higher mortality rate (5.8 % versus 1.1 %) in patients admitted from LTCFs compared to patients admitted from home.

Overall, these findings may be explained by the increased frailty and comorbidity burden in this population, which are factors influencing both morbidity and mortality [20–22]. Furthermore, these patients may have delayed presentation to the hospital due to various reasons, including late recognition of symptom severity and logistical difficulties in transferring them to the hospital [23,24]. Interestingly, patients admitted from a nursing home did not have a worse outcome, after controlling for important confounders. They even had an advantageous shorter length of stay.

Our study adds to the existing literature by presenting a comprehensive case-control analysis, which clarifies the relationship between pre-admission residence and in-hospital outcomes. These findings

Table 3
Outcome details of matched cases.

Parameter		Group home (n = 402)		Group long-term care facility (n = 402)		p value	
		n	%	n	%		
Length of stay (days)	mean ± SD	8.9		7.5		0.004	
	±	7.9		8.7			
Complications	yes	55	13.7	52	12.9	0.742	
	Discharge	deceased	15	3.7	18	4.5	<0.001
	at home	198	49.3	0	0		
	rehabilitation clinic	65	16.2	4	1.0		
	nursing home	59	14.7	359	89.3		
	old people's home	45	11.2	16	4.0		
	hospital or similar institution	20	5.0	5	1.2		

SD: Standard Deviation.

highlight the importance of enhanced pre-hospital and in-hospital care for patients admitted from LTCFs, including early recognition and management of acute conditions, comprehensive geriatric assessment, and individualized care planning [25].

Complications

In our findings, the LTCF group showed twice as many in-hospital complications as the home group. Although there was no significant difference in the matched-pair analysis, the higher rate of complications is in line with findings from the literature that showed higher susceptibility among nursing home patients to complications like community-acquired pneumonia (CAP) [26]. Prevention of this common complication is an urgent need, as the number of residents in LTCFs will increase considerably within the next few years [27].

The observed complication rate of 7 % in the studied population is noteworthy. Studies suggest that complication rates vary greatly based on factors such as the type of medical procedure, patient's age, and the presence of comorbidities [28,29]. The common complications noted in this study, including pneumonia, urinary retention, urinary tract infection, sepsis, arrhythmias, and ileus, are indeed a cause for concern. These complications are generally associated with higher mortality rates, longer hospital stays, and increased healthcare costs [30–32]. In the context of clinical practice, these findings underscore the importance of diligent pre-operative assessment and post-operative care. Healthcare providers should be vigilant in identifying and managing risk factors for these complications, especially in patients with existing comorbidities.

Furthermore, these findings highlight the need for robust, multidisciplinary approaches to patient care, with collaborations between various specialties playing a pivotal role in enhancing patient outcomes. By implementing these suggestions for clinical practice and research, we can aim to reduce the incidence and impact of complications, ultimately enhancing patient safety and the quality of care in the process.

Mortality

The higher mortality in the LTCF group may be influenced by socioeconomic factors. It is known that mostly poorer older adults live in nursing homes and that those who die in these facilities are mostly women [33]. This may be because women tend to outlive their husbands and have healthier lifestyles [34].

Length of stay

Shorter hospital stays for LTCF patients may be due to several factors. Intensive treatment may quickly resolve acute conditions, enabling earlier discharge with continued care at LTCFs.

The familiar environment of the LTCF may also reduce the chances of acquiring hospital-based infections or experiencing delirium, thereby promoting an earlier discharge once the patient's condition has stabilized [35].

After excluding cases involving deceased patients from our analysis, the outcomes persisted with minimal variance. This observation was consistent across both the entire cohort and the matched pair analysis, with the discrepancies not exceeding a one-day difference in hospital length of stay.

Advanced care plans often recommend avoiding extended hospital stays, potentially influencing quicker patient return to LTCFs. Efficient healthcare system strategies, including prompt coordination between hospitals and LTCFs, speedy diagnostic and treatment procedures, and early discharge planning also contribute to shorter stays. Lastly, systemic pressures to utilize hospital resources optimally could expedite the discharge of medically stable LTCF residents, given limited hospital bed availability and lower care costs at LTCFs [36].

Limitations and future directions

The study's limitations are as follows. As is the case with registry data analyses, all the desired information about the study population was not available. We had information about the in-hospital stay but no indicators for assessing the health status or the care level needed by individual patients. Further, we had no data on the functional status of the patients, the severity of illness upon admission, the quality of care before hospitalization, social support, or the readmission rate. In future, in addition to the characterization of the LTCF group, studies should consider the geographic differences within Switzerland while interpreting our findings. For instance, in eastern Switzerland, more elderly people are admitted to nursing homes, whereas in western Switzerland, the use of home care is more prevalent (Spitex) [37]. Thus, it would be interesting to assess if our results vary regionally within the country. Another aspect that may influence these regional differences within Switzerland is the access to physicians: patients in rural areas are hospitalized more often than those in metropolitan areas [38].

All these aspects may influence the outcomes. While a case-control study can control for known confounders, there may be unknown or unmeasured confounders that could have influenced the results. This is a limitation inherent to all observational studies. In the future, scholars should attempt to validate these findings in multicenter studies and investigate the underlying mechanisms for increased in-hospital mortality and morbidity. There is also a need to explore the effectiveness of targeted interventions aimed at improving the outcomes of these patients. The modest share of (1.9 %) of patients from LTCFs in our study can be attributed to several factors. The quality of LTCF reporting, potentially marked by inaccuracies, is one of them. Additionally, our study's broad scope, encompassing all surgical conditions, may have diluted the LTCF patient representation. The COVID-19 pandemic, by leading to the prioritization of high-acuity admissions, could have further skewed this trend. Geographical considerations and the fact that not all hospitals feature in the AQC register may also have influenced these findings.

Conclusion

This study enriches our understanding of health outcomes for patients admitted to hospitals from both homes and LTCFs. Even though LTCF patients showed higher rates of complications and mortality, our matched-pair analysis did not reveal significant differences in these respects between the two groups. However, we observed pronounced differences in discharge patterns. Given the higher costs associated with hospitalization, the early discharge of LTCF patients compared to home patients reflects the high-quality elderly care provision [39]. While our study offers valuable insights, we advise caution in the interpretation of the results, given the possibility of unmeasured confounding factors and regional disparities in healthcare systems and practices. Future research should strive to decipher the underlying mechanisms that inform these observations, with the ultimate goal of enhancing care for all hospitalized older adults, regardless of their residential circumstances prior to hospitalization.

Key summary points

Aim: The aim of this study is to evaluate whether patients admitted to hospitals from long-term care facilities (LTCFs) experience higher incidences of in-hospital complications, mortality, and a longer length of stay compared to patients admitted from home.

Findings: In our matched-pair analysis no significant differences between the two groups were found, although LTCF patients showed higher rates of complications and mortality.

Message: LTCF patients were discharged earlier from the hospital, which mirrors the high-quality elderly care provision in Switzerland.

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Ethical review committee statement

The data of this study are based on anonymized, de-identified data; our institutional review board waives the necessity of institutional review board approval.

Statement of location where the work was performed

Division of Trauma Surgery, University Hospital Zurich (USZ), University of Zurich (UZH), Raemistrasse 100, 8091 Zurich, Switzerland.

CRedit authorship contribution statement

Claudio Canal: Conceptualization, Data curation, Writing – original draft, Writing – review & editing. **Anne-Sophie Mittlmeier:** Writing – original draft, Writing – review & editing. **Valentin Neuhaus:** Conceptualization, Data curation, Methodology, Writing – review & editing. **Hans-Christoph Pape:** Supervision, Writing – review & editing. **Mathias Schlögl:** Methodology, Supervision, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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