Fever, Hyperglycemia, and Swallowing Management in Stroke Unit and Non–Stroke-Unit European Hospitals: A Quality in Acute Stroke Care (QASC) Europe Substudy

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ABSTRACT

BACKGROUND: Stroke unit care reduces patient morbidity and mortality. The Quality in Acute Stroke Care Europe Study achieved significant large-scale translation of nurse-initiated protocols to manage Fever, hyperglycemia (Sugar), and Swallowing (FeSS) in 64 hospitals across 17 European countries. However, not all hospitals had stroke units. Our study aimed to compare FeSS protocol adherence in stroke unit versus non–stroke-unit hospitals. **METHODS:** An observational study using Quality in Acute Stroke Care Europe Study postimplementation data was undertaken. Hospitals were categorized using 4 evidence-based characteristics for defining a stroke unit, collected from an organizational survey of participating hospitals. Differences in FeSS Protocol adherence between stroke unit and non–stroke-unit hospitals were investigated using mixed-effects logistic regression, adjusting for age, sex, and National Institutes of Health Stroke Scale. **RESULTS:** Of the 56 hospitals from 16 countries providing organizational data, 34 (61%) met all 4 stroke unit characteristics, contributing data for 1825 of 2871 patients (64%) (stroke unit hospitals). Of the remaining 22 hospitals (39%), 17 (77%) met 3 of the 4 stroke unit characteristics (non–stroke-unit hospitals). There were no differences between hospitals with a stroke unit and those without for postimplementation adherence to fever (49% stroke unit vs 57% non–stroke unit; odds ratio [OR], 0.400; 95% confidence interval [CI], 0.087-1.844; $P = .240$), hyperglycemia (50% stroke unit vs 57% non–stroke unit; OR, 0.403; 95% CI, 0.087–1.856; $P = .243$), swallowing (75% stroke unit vs 60% non–stroke unit; OR, 1.702; 95% CI, 0.643–4.502; $P = .284$), or overall FeSS Protocol adherence (36% stroke unit vs 36% non–stroke unit; OR, 0.466; 95% CI, 0.106–2.043; $P = .311$). **CONCLUSION:** Our results demonstrate that the nurse-initiated FeSS Protocols can be implemented by hospitals regardless of stroke unit status. This is noteworthy because hospitals without stroke unit resources that care for acute stroke patients can potentially implement these protocols. Further effort is needed to ensure better adherence to the FeSS Protocols.

Keywords: dysphagia, FeSS, fever, hyperglycemia, implementation, QASC, stroke, stroke unit, swallow

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Stroke is a leading cause of disability and mortality in Europe.[1] In 2017, the incidence of stroke in Europe was 1.12 million with a mortality of 0.46 million and 7.06 million years of life lost due to disability.[1] It results in considerable healthcare and societal costs, over €60 billion annually to the European economy.[2] Stroke survivors may require ongoing assistance with activities of daily living and long-term rehabilitation to regain their independence.[3]

Organized inpatient management in stroke units has been shown to reduce morbidity and mortality after stroke.[4] A stroke unit is defined as a dedicated geographically clearly defined area or ward in a hospital where stroke patients are admitted and cared for by a multidisciplinary team who have specialist knowledge, training, and skills in stroke care, and this care is coordinated through regular (weekly) multidisciplinary meetings.[5,6] Patients managed in stroke units are more likely to survive, be independent, and be living at home 1 year after the stroke.[4,7] Hence, stroke unit care is strongly recommended for stroke patient management in national stroke clinical guidelines globally.[8–10] Despite the compelling evidence and strong recommendation for stroke unit care, only 30% of stroke patients are treated in stroke units across Europe.[11]

The landmark Australian Quality in Acute Stroke Care (QASC) trial showed that facilitated implementation of nurse-initiated protocols to manage Fever, hyperglycemia (Sugar), and Swallowing (FeSS Protocols) in the first 72 hours after stroke resulted in a 16% reduction in 90-day mortality and disability.[12] This effect was sustained with over 20% of patients who received care in the intervention stroke units, more likely to be alive 4 years later.[13] Fever, hyperglycemia, and swallowing difficulty are associated with poor outcomes in stroke patients, and the first 72 hours after the onset of a stroke are crucial for patients' prognosis.[14] Optimal management of these 3 clinical variables is pivotal for favorable stroke outcomes, and the focused care stroke patients receive in a stroke unit has the potential to improve the management of these variables. Evidence from the United States showed that fever and hyperglycemia management is often overlooked with calls for renewed discussions among stroke teams for nurses to assume leadership of monitoring and treatment of these variables.[15] To date, there is little information on how well fever, hyperglycemia, and swallowing are managed in patients in stroke-unit and non–stroke-unit European hospitals.

A recent partnership between the QASC researchers, European Stroke Organisation (ESO), European Acute Networks Striving for Excellence in Stroke (Angels) Initiative, and the global Registry of Stroke Care Quality (RES-Q) achieved large-scale translation of the FeSS Protocols into routine acute stroke care in 64 hospitals across 17 European countries.[16] The QASC Europe Study was a pretest/posttest implementation study demonstrating significant improvements in overall FeSS Protocols adherence, as well as individual fever, hyperglycemia, and swallowing elements of the FeSS Protocols. Given the wide variability in hospital staffing and resources, not all hospitals participating in the QASC Europe Study had stroke units. This substudy aimed to determine whether the FeSS Protocols could be applied equally well in QASC Europe Study hospitals that did not have a stroke unit.

> Protocol adherence was similar in stroke-units (35.7%) and non-stroke-units (35.9%).

Method

A retrospective descriptive observational study using the postimplementation audit data (between January 2019 and April 2021) for the QASC Europe Study was undertaken. Approval for the QASC Europe Study was obtained from the Australian Catholic University Human Research Ethics Committee. Details of the methods and results of the QASC Europe Study have been published.[15] Hospitals with stroke units or stroke services already participating in the European Angels Initiative program were eligible to participate. Patients 18 years or older, with a diagnosis of ischemic stroke or intracerebral hemorrhage, and who presented to the hospital within 48 hours of symptom onset were included. Patients receiving palliative care were excluded. Postimplementation audits for prospectively identified consecutive stroke admissions occurred.

An organizational survey completed by clinicians from each participating hospital was used to assess structural workplace characteristics for the purpose of the QASC Europe Study. The survey comprised 12 questions reporting on bed capacity, types of stroke services available, presence of a stroke expert nurse, stroke unit certification from ESO, and presence of 4 evidence-based characteristics that define a stroke unit: a dedicated geographically clearly defined area or ward in a hospital; a dedicated, multidisciplinary stroke and/or rehabilitation team comprising medical, nursing, and allied health staff; weekly multidisciplinary meetings to coordinate patient care; and regular staff education and training in stroke.[5,6,17]

Patient age, sex, stroke subtype, stroke severity (National Institutes of Health Stroke Scale [NIHSS]), premorbid risk factors, time from onset of symptoms to emergency department arrival, time from onset of symptoms to stroke unit arrival, premorbid and discharge functional status (modified Rankin scale [mRS]), duration of hospital stay, discharge destination, and adherence to the FeSS Protocols were measured. Data were entered into the RES-Q database. The primary outcome measure was a composite outcome of the proportion of patients monitored and treated according to the overall monitoring and treatment elements of the FeSS Protocols in stroke-unit compared with non–stroke-unit hospitals. Secondary outcome measures were adherence to each of the combined monitoring and treatment elements for the individual FeSS Protocols (Supplementary Table 1, http://links.lww.com/JNN/A502).

Data were analyzed in SPSS (version 29). Continuous variables (time from onset of symptoms to emergency department and time from onset of symptoms to stroke unit) were reported as median and interquartile range. Categorical variables (sex, age group, premorbid risk factors, premorbid mRS, stroke type, NIHSS, and ability to walk unassisted on admission) were reported as frequencies and percentages. Hospitals were categorized as stroke-unit or non–stroke-unit hospitals as per organizational survey responses. Hospitals that did not meet all 4 evidence-based characteristics were classified as non–stroke-unit hospitals. Demographic characteristics of patients were compared as 2 independent groups, that is, patients managed in stroke units and patients managed in nonstroke units. The Mann-Whitney *U* test was used to compare the medians for continuous variables because they were not normally distributed, and the χ^2 test was used to compare percentages for categorical variables. Mixed-effects logistic regression was used to compare differences in adherence to the FeSS Protocols between stroke-unit and non–stroke-unit patients. *P* values less than .05 and odds ratio with 95% confidence intervals (CIs) that did not include 1 were considered statistically significant.

Results

A total of 3257 patients from 64 hospitals in 17 European countries were included in the postimplementation audit. Organizational survey data from 56 hospitals in 16 European countries were able to be included in the substudy. Of these, 34 hospitals (61%) met all 4 stroke unit characteristics, contributing data for 1825 patients (64%). Seventeen of the 56 hospitals (30%) met 3 of the 4 stroke unit characteristics, 1 (2%) met 2 characteristics, and 4 (7%) met 1 characteristic. These 22 hospitals (39%), which contributed data for 1046 patients (36%), were categorized as non–stroke-unit hospitals. A total of 13 hospitals (23%) reported ESO stroke unit certification, of which 9 (69%) were categorized as stroke unit hospitals and 4 (31%) as non–stroke-unit hospitals (Supplementary Table 2, http://links.lww.com/JNN/A503).

Similar patient demographic and clinical characteristics were found in stroke-unit and non–stroke-unit hospitals for sex, age, stroke type, NIHSS, and ability to walk on admission. However, relative to patients in the non–stroke-unit hospitals, patients in the stroke unit hospitals had higher proportions of previous strokes (stroke unit vs non–stroke unit, 19% vs 16%; $P = .027$), lower levels of disability before their admission (premorbid mRS ≥ 2; stroke unit vs non–stroke unit, 22% vs 28%; $P < .001$), higher proportions of mild and moderate strokes (stroke unit vs non–stroke unit, 73% vs 58%), and longer median time from onset of symptoms to emergency department arrival (stroke unit vs non–stroke unit, 200 vs 130 minutes; $P < .001$) (Table 1).

FeSS Protocol overall adherence was similar in stroke-unit and non–stroke-unit hospitals (stroke unit vs non–stroke unit, 35.7% vs 35.9%; OR, 0.466; 95% CI, 0.106–2.043; $P = .311$). There were no differences between stroke-unit and non–stroke-unit hospitals for individual adherence to the Fever Protocol (48.7% vs 56.5%; OR, 0.400; 95% CI, 0.087–1.844; $P = .240$), Hyperglycemia (Sugar) Protocol (50.3% vs 57.4%; OR, 0.403; 95% CI, 0.087–1.856; $P = .243$), and Swallowing Protocol (74.5% vs 59.9%; OR, 1.702; 95% CI, 0.643–4.502; $P = .284$) (Table 2).

Discussion

In this secondary analysis of postimplementation data from the multicountry, multicenter QASC Europe Study, we found no difference in overall FeSS Protocol adherence or any of the 3 individual protocol elements between stroke-unit and non–stroke-unit hospitals. Although we expected a higher adherence to the FeSS Protocols in stroke unit hospitals given the association between stroke unit care and improved patient outcomes,[4,7] we have shown that the FeSS Protocols can be applied by hospitals that care for acute stroke patients regardless of their stroke unit status. Our results are noteworthy because it has the potential to raise stroke care standards globally.

Findings from a recent multicenter trial in 9 countries (Australia, United Kingdom, China, Taiwan, India, Sri Lanka, Brazil, Chile, and Colombia) that quantified regional variations in the components of stroke unit care showed considerable variation in the types of care and management patients receive under the umbrella of stroke unit care, within and across different health systems.[18] It was suggested that some of

TABLE 1. Patient Demographics and Clinical Characteristics

		Stroke Unit (N = 1825) n (%)	Non–Stroke Unit (N = 1046) n (%)	*P*
Sex[a]	Female	931 (51.0)	500 (47.8)	.095
	Male	893 (48.9)	546 (52.2)	
Age group,[a] y	<65	516 (28.3)	273 (26.1)	.062
	65 to <75	556 (30.5)	288 (27.5)	
	75 to <85	487 (26.7)	319 (30.5)	
	85+	265 (14.5)	166 (15.9)	
Premorbid risk factors	Previous stroke	348 (19.1)	165 (15.8)	.027
	Diabetes	461 (25.3)	268 (25.6)	.831
	None	1122 (61.5)	668 (63.9)	.205
Premorbid modified Rankin score	0, no symptoms at all	1002 (54.9)	546 (52.2)	.165
	1, no significant disability despite symptoms	216 (11.8)	159 (15.2)	
	2, slight disability	185 (10.1)	108 (10.3)	
	3, moderate disability	191 (10.5)	97 (9.3)	
	4, moderately severe disability	138 (7.6)	84 (8.0)	
	5, severe disability	93 (5.1)	52 (5.0)	
	mRS ≥ 2	408 (22.4)	288 (27.5)	<.001
Stroke type	Ischemic stroke	1627 (89.2)	913 (87.3)	.055
	Intracerebral hemorrhage	176 (9.6)	126 (12.0)	
	Undetermined	22 (1.2)	7 (0.7)	
National Institutes of Health Stroke Scale	0-7 (mild stroke)	826 (45.3)	384 (36.7)	.012
	8-16 (moderate stroke)	505 (27.7)	221 (21.1)	
	17+ (severe stroke)	299 (16.4)	185 (17.7)	
Able to walk unassisted on admission	Yes	813 (44.5)	462 (44.2)	.050
Time from onset of symptoms to emergency department, min	Median (Q1, Q3)	200 (93, 480)	130 (74, 350)	<.001
Time from onset of symptoms to stroke unit, min	Median (Q1, Q3)	360 (170, 812)	380 (190, 990)	.084

P values were from χ^2 test for categorical data and Mann-Whitney *U* test for continuous data.
Numbers may not add up to the total sample size because of missing data.
[a]Missing data × 1 for sex and age.

TABLE 2. FeSS Protocol Implementation in Stroke-Unit and Non–Stroke-Unit Hospitals

	Stroke Unit (N = 1825) n (%)	Non–Stroke Unit (N = 1046) n (%)	OR (95% CI)	*P*
Monitored and treated according to the combined FeSS Protocol[a]	651 (35.7)	375 (35.9)	0.466 (0.106-2.043)	.311
Monitored and treated according to the Fever Protocol[b]	889 (48.7)	591 (56.5)	0.400 (0.087-1.844)	.240
Monitored and treated according to the Hyperglycemic Protocol[c]	918 (50.3)	600 (57.4)	0.403 (0.087-1.856)	.243
Monitored and treated according to the Swallowing Protocol[d]	1359 (74.5)	627 (59.9)	1.702 (0.643-4.502)	.284

Note. CI, confidence interval; FeSS, Fever, hyperglycemia (Sugar), and Swallowing; OR, odds ratio.
[a]Must meet b, c, and d to be deemed as having been monitored and treated according to the combined FeSS protocol.
[b]Must meet all elements to be deemed as having been monitored and treated according to the fever protocol.
[c]Must meet all elements to be deemed as having been monitored and treated according to the hyperglycemic (sugar) protocol.
[d]Must meet all elements to be deemed as having been monitored and treated according to the swallowing protocol.

this variation may be due to differences in definitions, concepts, and approaches to monitoring. To improve access to stroke unit care, many developed countries have therefore reorganized their stroke services in line with national policies and clinical guidelines.[4] Although various service models of stroke unit care exist, the core characteristics of stroke units identified by the Stroke Unit Trialists' Collaboration Cochrane Review are multidisciplinary staffing (medical, nursing, and therapy staff, eg, physiotherapy, occupational therapy, speech therapy, social worker) and coordinated multidisciplinary team care with at least once-per-week team meetings.[4]

It is recognized that, besides the presence of a stroke unit, other contributors such as processes or protocols of care delivery,[12] timeliness of nursing care,[19] and early rehabilitation[20] may also improve stroke patient outcomes. In an attempt to define further other care processes, the ESO developed a suite of 44 quality measures (22 "must": and 22 "non-must"). Not all are evidence based, but they are good practice points. On the basis of these quality measures, stroke unit certification is provided to European hospitals.[6] Of note, the 4 evidence-based characteristics for defining a stroke unit used in our study are also listed as part of the ESO stroke unit quality measures. However, presence of a dedicated geographical area and a multidisciplinary team are designated as "must" measures by the ESO, whereas regular multidisciplinary meetings and staff education are "non-must" measures.[6] Surprisingly, regular multidisciplinary meetings is a "non-must" quality measure and not considered as essential by the ESO for stroke unit certification despite being identified as a core stroke unit characteristic by the Stroke Unit Trialists' Collaboration Cochrane Review. Although the reason for this is unknown, the stroke unit characteristics we used in this study align with those of the Stroke Unit Trialists' Collaboration, which are widely known and accepted.[4,5]

Although 30% of hospitals participating in our study fulfilled 3 of the 4 characteristics, they were categorized as non–stroke-unit hospitals because they did not meet all 4 characteristics. In addition, 4 of the hospitals we categorized as non–stroke units reported ESO stroke unit certification despite only one of these hospitals having the core stroke unit characteristic of regular multidisciplinary meetings (Supplementary Table 2, http://links.lww.com/JNN/A503). This is a likely explanation for our finding of a similar adherence to the FeSS Protocols in European stroke-unit and non–stroke-unit hospitals. However, it is important to note that the overall FeSS Protocol adherence of 36% is suboptimal because all patients should receive care in line with the Protocols. Hence, further effort is needed by hospitals to improve adherence.

Nonetheless, our results demonstrate that the FeSS Protocols potentially can be applied by hospitals irrespective of whether or not they have a certified stroke unit. This is particularly important for hospitals without stroke unit resources because it extends the reach for improving stroke care quality globally especially in low- and middle-income countries, where the highest burden of stroke exists.[21] Although it is not possible to know how generalizable these results are outside Europe, our large sample size of 56 hospitals provides encouraging results.

Interestingly, our results showed that although patients in non–stroke-unit hospitals had more severe strokes compared with patients in stroke unit hospitals, both hospital groups had similar adherence to the FeSS Protocols. The clinical importance of this finding is noteworthy because it highlights the potential for protocols of care delivery, such as the FeSS Protocols, in improving stroke patient outcomes. A previous post hoc analysis of the QASC Europe Study data that examined the hospital presence of a stroke expert nurse (stroke specialist nurse, stroke nurse practitioner, clinical nurse educator, clinical nurse consultant, or advanced practice nurse) on FeSS Protocol adherence found no differences in FeSS Protocol adherence between hospitals with a stroke expert nurse and those without.[22] Because stroke units are staffed with stroke expert nurses,[4,23–25] better protocol adherence would be expected in this setting. Furthermore, there is evidence to support nurses undertaking further stroke specialty certification to improve care for acute stroke patients.[19] However, the results of the post hoc analysis show that the existence of an advanced nursing role did not affect FeSS Protocol adherence. The results indicate that the FeSS Protocols are easily understood by bedside stroke clinicians who work in nondesignated stroke units and translate well into real-time clinical practice internationally. This supports our findings that the protocols can be successfully implemented by both stroke-unit and non–stroke-unit hospitals.

Our study has several strengths. To our knowledge, it is the first to compare adherence to the FeSS Protocols in patients receiving care in European hospitals with stroke units and those in non–stroke-unit hospitals. Whereas the primary study focused on fever, hyperglycemia, and swallowing management across all hospitals, this substudy provided the opportunity to address an important question regarding the implementation of the FeSS Protocols at the stroke unit level and to unpack the details about the level of care that can be provided in non–stroke-unit hospitals. Some limitations were also noted. The study was a secondary analysis of postimplementation data. Eight hospitals did not provide organizational survey data and could therefore not be categorized as stroke-unit or non–stroke-unit hospitals. In addition, only postimplementation data were analyzed, increasing the likelihood for better adherence to the FeSS Protocols as the main trial showed significant improvements in the postimplementation cohort. Although the processes of care in this substudy were similar in both stroke-unit and non–stroke-unit hospitals, patient outcomes might differ and should be examined in future research.

Conclusion

The evidence-based nurse-initiated FeSS Protocols can be successfully implemented by all hospitals regardless of stroke unit status, thereby extending the reach for improving stroke care quality globally. However, further effort is needed to improve European hospitals' adherence to the FeSS Protocols.

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