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Regional variation in acute stroke care organisation

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ABSTRACT

Background: Few studies have assessed regional variation in the organisation of stroke services, particularly health care resourcing, presence of protocols and discharge planning. Our aim was to compare stroke care organisation within middle- (MIC) and high-income country (HIC) hospitals participating in the Head Position in Stroke Trial (HeadPoST).

Methods: HeadPoST is an on-going international multicenter crossover cluster-randomized trial of 'sitting-up' versus 'lying-flat' head positioning in acute stroke. As part of the start-up phase, one stroke care organisation questionnaire was completed at each hospital. The World Bank gross national income per capita criteria were used for classification.

Results: 94 hospitals from 9 countries completed the questionnaire, 51 corresponding to MIC and 43 to HIC. Most participating hospitals had a dedicated stroke care unit/ward, with access to diagnostic services and expert stroke physicians, and offering intravenous thrombolysis. There was no difference for the presence of a dedicated multidisciplinary stroke team, although greater access to a broad spectrum of rehabilitation therapists in HIC compared to MIC hospitals was observed. Significantly more patients arrived within a 4-h window of symptoms onset in HIC hospitals (41 vs. 13%; $P < 0.001$), and a significantly higher proportion of acute ischemic stroke patients received intravenous thrombolysis (10 vs. 5%; $P = 0.002$) compared to MIC hospitals.

Conclusions: Although all hospitals provided advanced care for people with stroke, differences were found in stroke care organisation and treatment. Future multilevel analyses aims to determine the influence of specific organisational factors on patient outcomes.

1. Introduction

Organisation of stroke care is a key factor influencing patient outcomes, having been shown to significantly reduce mortality and disability [1]. Presence of local protocols and pathways, adequate health care resources (including staff), regular quality assessments, and discharge

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planning appear to positively impact care. However, wide variations have been reported in acute stroke care processes, costs and outcomes worldwide [2,3]. In addition, there are fewer stroke units in lower-income countries, where acute care tends to be inconsistent, with large differences in average length of hospital stay between countries [3].

Disparity in stroke care is important as stroke disproportionately affects people in low- and middle-income countries (MIC), compared to high-income countries (HIC) [4]. This has resulted in the World Stroke Organisation assigning the highest priority to the detection of barriers and implementation of evidence-based interventions for stroke care [5]. Unfortunately, gaps in information about stroke organisation care from different sites, and in particular according to country income, have hampered the implementation of specifically designed and focussed interventions.

1.1. Aim

To describe the organisation of care in stroke units from different countries participating in the Head Position in Stroke Trial (HeadPoST), and to compare health care resourcing, presence of protocols and discharge planning by country income.

2. Methods

HeadPoST is an international, cluster-randomized, crossover, open, blinded outcome-assessed clinical trial to determine the effects of lying-flat (0°) compared with sitting-up (≥30°) head positioning in the first 24 h of hospital admission for patients with acute stroke. Methods have been published in detail elsewhere [6]. Hospitals with established acute stroke care programs have started recruitment and are at different stages of the trial. As part of the start-up phase, principal investigators at each hospital were required to complete a previously published Hospital Organisation Questionnaire (HOQ) designed by the study investigators to determine how stroke care is organised [6]. The HOQ has only closed questions on a wide variety of stroke topics, including hospital details, stroke pathways, emergency department characteristics, imaging and clinical resources, acute treatment strategies, stroke care and stroke unit, discharge plans, rehabilitation and follow-up services, continuing education, research and quality improvement. Answers were uploaded into an electronic database, identified only by the study assigned number. The HOQ was designed in English and translated into Chinese.

To be included in HeadPoST, hospitals were required to have an established acute stroke care program within a geographically defined area and a sufficient projected throughput of patients to ensure feasibility of recruitment within a short time frame. Local Ethics and regulatory entities have approved the study in the different countries. Study data were collected and managed using REDCap electronic data capture tools hosted at The George Institute for Global Health [7]. Hospitals were classified as MIC or HIC according to the World Bank gross national income per capita criteria [8].

2.1. Statistical analysis

Chi squared or Fisher tests were used to compare categorical variables, and Mann-Whitney test was used for continuous variables. IBM SPSS Statistics version 21 was used. A two-sided P value <0.05 was considered significant.

3. Results

Ninety-four hospitals completed the HOQ between 26 August 2014 and 1 February 2016. According to 2015 World Bank gross national income per capita criteria [8], hospitals were allocated in the MIC (51 hospitals; India [5], Sri Lanka [4], Brazil [1], Colombia [1], China [40]), or HIC groups (43; Australia [6], Chile [6], United Kingdom [UK, 28], Taiwan [3]).

3.1. Health service capacity for stroke care

Hospital characteristics are depicted in Table 1, with most having a dedicated stroke care unit/ward. MIC hospitals were more likely to be academic, with a higher number of beds, including dedicated stroke beds, and also more likely to be located in a metropolitan area (Table 1). Access to diagnostic and other support services was comparable; with local urgent CT available in 49 [98%] of MIC and 43 [100%] of HIC hospitals, and emergency laboratory facilities in 49 [98%] and 43 [100%] of MIC and HIC hospitals, respectively. Most hospitals had access to on-going rehabilitation at the admitting or another hospital, and offered routine outpatient clinic follow-up review for all stroke patients (Table 2).

3.2. Stroke pathway for intravenous thrombolysis

Compared to MIC hospitals, HIC hospitals had more stroke patients arriving by ambulance and within 4 h of symptom onset; 81% (interquartile range [IQR] 75–90) vs. 21% (IQR 10–48) ($P < 0.001$), and 35% (IQR 25–55) vs. 10% (IQR 6–20) ($P < 0.001$). In addition, HIC hospitals received more frequently a pre-alert from the ambulance service to the Emergency Department (ED) prior to patient arrival (39 [91%] vs. 36 [72%], $P = 0.034$), and have an acute "code stroke" pager system for potential thrombolysis patients with medical staff from the stroke service available in ED (38 [88%] vs. 21 [42%] hospitals, $P < 0.001$). Although there was no significant difference in the proportion of HIC and MIC hospitals offering thrombolysis (Table 1), more acute ischemic stroke (AIS) patients received recombinant tissue plasimogen activator (rtPA) in HIC compared to MIC hospitals (10% [IQR 7–15] vs. 5% [IQR 1–10] ($P = 0.002$), respectively. Interventional neuroradiology and neurosurgery were more likely to be available in MIC hospitals (Table 1).

3.3. Human resources in stroke care

All hospitals had access to physicians with stroke expertise and a dedicated multidisciplinary team. MIC hospitals had a higher total number, as well as range, of medical officers, but this difference is associated with a higher number of dedicated stroke beds in MIC hospitals. No difference was detected in the number of patients to one nurse or health assistant in ED or stroke care unit between MIC and HIC hospitals. However, HIC hospitals offer access to a broader range of rehabilitation therapists compared to MIC. Further details of staffing are provided in Table 2 and Fig. 1.

Table 1
Hospital characteristics by World Bank gross national income per capita.

	MIC	HIC	P value
Academic status	47 (94%)	29 (67%)	0.001
Number of beds	1000 (800–1800)	600 (404–745)	<0.001
Metropolitan location	43 (84%)	26 (61%)	0.011
Intensive care unit	51 (100%)	43 (100%)	NS
Neurosurgery available	45 (90%)	16 (37%)	<0.001
Interventional neuroradiology available	33 (67%)	15 (35%)	0.003
Dedicated stroke ward/unit	42 (84%)	41 (95%)	NS
Number of dedicated stroke beds	51 (10 − 100)	28 (10–38)	0.009
Number of stroke patients admitted annually	740 (400–2148)	576 (400–818)	0.046
Intravenous thrombolysis (rtPA)	46 (92%)	42 (98%)	NS
Stroke database	34 (68%)	40 (93%)	0.004

Data are presented in number and percentage or median and interquartile range (IQR).
MIC: middle-income countries, HIC: high-income countries, rtPA: recombinant tissue plasminogen activator, NS: not significant. Academic means it is a teaching hospital. P value from Chi squared, Fisher or Mann-Whitney test as appropriate.

Table 2
Stroke care organisation by World Bank gross national income per capita.

	MIC	HIC	*P* value
Special pathway, ward or service organisation for stroke care	40 (82%)	41 (95%)	NS
Current ED pathway/checklist for rapid triage and treatment of patients with acute ischemic stroke	48 (94%)	38 (88%)	NS
Clinical pathway/checklist for patients with acute intracerebral hemorrhage	42 (86%)	28 (68%)	0.048
Protocol for administering intravenous rtPA	45 (100%)	41 (100%)	NS
Guidelines for acute treatment of stroke patients in the stroke care unit	44 (94%)	41 (95%)	NS
Local protocols for fever control	45 (88%)	34 (79%)	NS
Local protocols for reducing elevated blood glucose levels	44(86%)	37 (86%)	NS
Local protocols for swallow dysfunction	45 (88%)	41 (95%)	NS
Protocol for referral to the following health professionals			
Physiotherapist	34 (67%)	36 (84%)	NS
Speech pathologist	16 (31%)	39 (91%)	<0.001
Occupational therapist	17 (33%)	36 (84%)	<0.001
Dietician	24 (47%)	37 (86%)	<0.001
Psychologist	22 (43%)	22 (51%)	NS
Psychiatrist	9 (18%)	21 (49%)	0.002
Social worker	6 (12%)	35 (81%)	<0.001
Swallowing screen performed within 24 h for all stroke patients	28 (56%)	34 (79%)	0.027
Formal swallowing assessment performed on referral	17 (36%)	31 (72%)	0.001
Discharge summary sent to the General Practitioner	16 (36%)	41 (95%)	<0.001
Routine outpatient clinic follow-up review for all stroke patients	41 (87%)	37 (86%)	NS
Early supported discharge service with home-based rehabilitation and assessment	29 (60%)	33 (77%)	NS
Access to on-going rehabilitation at the hospital or at another hospital	44 (92%)	41 (95%)	NS
Home nursing service available for stroke patients	11 (23%)	26 (63%)	<0.001
Access to palliative care services	17 (37%)	42 (98%)	<0.001
Nursing staff attend continuing education on stroke management	42 (86%)	39 (91%)	NS
Quality improvement activities in the last 2 years for the stroke team	36 (75%)	40 (93%)	0.007
Dedicated stroke team	42 (82%)	41 (95%)	NS
Onsite specialist physicians responsible for stroke patients	47 (92%)	42 (98%)	NS
Number of patients to one staff member in ED			
Nurse	4.5 (2–8)	4 (3–7)	NS
Health assistant	5 (3 − 10)	6 (4–8)	NS
Number of patients to one staff member in the stroke care unit			
Nurse	6 (4–9)	6 (4–8)	NS
Health assistant	5.5 (2 − 10)	7 (6–8)	NS
Medical staff from the stroke service available in ED	34 (68%)	36 (88%)	0.044
Doctor rostered to attend after hours stroke patients admission	44 (92%)	26 (61%)	<0.001
Multidisciplinary stroke team meetings held at least weekly	24 (48%)	38 (93%)	<0.001
Stroke unit team provide care or advice out of the stroke care unit	36 (78%)	42 (100%)	0.001

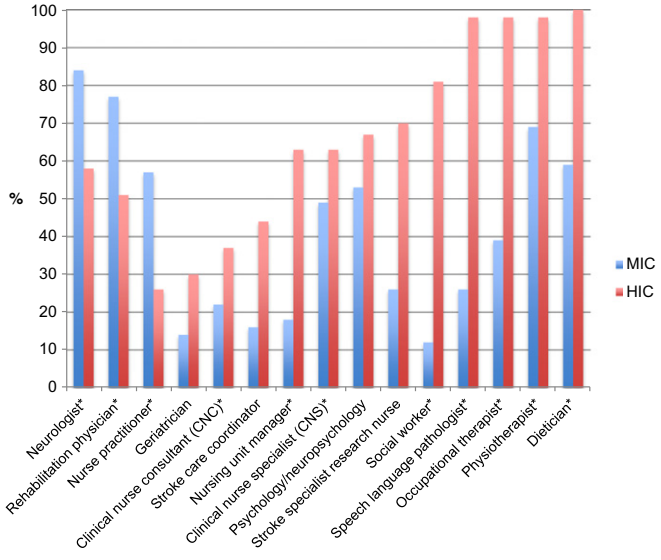
Data are presented in number and percentage or median and interquartile range (IQR).
ED: emergency department, MIC: middle income countries, HIC: high income countries, rtPA: recombinant tissue plasminogen activator, NS: not significant. P value from Chi squared, Fisher or Mann-Whitney test as appropriate.

3.4. Protocols, discharge plans and quality assurance

The availability of a special pathway, or ward for stroke care was non-significantly higher in HIC hospitals (41 [95%] vs. 40 [82%], $P = 0.056$), as were referral protocols to different health professionals more common (Table 2). However, most hospitals had local protocols available for fever control, blood glucose management and swallow assessment, with no significant difference between HIC and MIC hospitals (Table 2). In addition, access to on-going rehabilitation, discharge services with home-based rehabilitation and assessment, and routine outpatient follow-up review was similar between HIC and MIC hospitals, though home nursing service and palliative care were more frequently available in HIC hospitals (Table 2). Continuing stroke management education was available in most hospitals, though quality improvement activity was more frequent in HIC hospitals (Table 2).

4. Discussion

Most HeadPoST-participating hospitals had advanced health service capacity for stroke care following the recently published World Stroke Organisation classification [5], with access to coordinated stroke care, physicians with stroke expertise, advanced diagnostic and interventional services, rehabilitation and discharge programs. We acknowledge, however, that this manuscript relates to selected hospitals participating in a clinical trial, which may not necessarily represent other institutions within and outside these countries, and that the majority of hospitals



* indicates a statistically significant difference, with P value <0.05
MIC: middle-income countries, HIC: high-income countries

Fig. 1. Percentage of hospitals having different health professionals involved in the management of stroke patients, by country income. * indicates a statistically significant difference, with *P* value < 0.05. MIC: middle-income countries, HIC: high-income countries.

were located in China and the UK. Nonetheless, this article provides a description of stroke care in MIC hospitals, which are currently underrepresented in the literature, with most publications referring to hospitals in Europe [2], the United States [9], Canada [10] and Taiwan [11]. This study, therefore, provides an important opportunity to compare and contrast stroke care between MIC and HIC health systems. In particular, the wide array of stroke care in different hospitals from a number of countries allows analyses of the particular characteristics of facilities, patient pathways, staffing, protocols and quality improvement activities.

Though most MIC hospitals have implemented pre-hospital ambulance pathways for the timely arrival of patients, have an emergency call number, and are located in a metropolitan area, our data show that most stroke patients do not use the ambulance service to go to hospital and therefore fail to arrive within the time window for intravenous thrombolysis. Importantly, responses to the HOQ indicate that service organisation in MIC hospitals is available to ensure appropriate door-to-needle time in those patients arriving within a thrombolysis time window. These data stress the need for comprehensive strategies to provide successful pre-hospital stroke care, with networks ensuring rapid access to health care, timely medical evaluation and diagnosis, and tailored treatment. In addition, educational programs and campaigns to raise awareness of stroke symptoms and the importance of immediate consultation can aid in improving the number of patients being evaluated during the reperfusion window, and thus increase the number of rtPA-treated patients in MIC [12,13].

In contrast to thrombolysis management of ischemic stroke, MIC hospitals had more evidence of stroke care focused on intracerebral hemorrhage (ICH) management, including local clinical pathways and on-site neurosurgical availability. This probably reflects the high prevalence of ICH in MIC hospitals which were located in Asia [14], but does confirm the ability of implementing care pathways similar to ischemic stroke. This is important, because the pattern of stroke is rapidly changing in Asia with urbanisation, causing an increase in rates of ischemic stroke, and a need to provide pathways and protocols similar to those reported in western countries [15].

MIC hospitals were predominantly larger with high patient-flow, and this 'volume–outcome relationship' has been shown to be an important predictor of short-term mortality in some [16], but not all [17], stroke studies. However, participating HIC hospitals may have adopted a two-tiered (or 'hub-and-spoke') model of stroke care in which a central 'comprehensive stroke centre' serves a number of smaller hospitals working as 'primary stroke centres' for thrombolysis of AIS patients, using protocols for transfer to larger hospitals for interventional therapies and telemedicine assistance [18]. The HOQ may not have captured the entire range of treatment options available to patients in participating HIC hospitals. There were fewer doctors rostered to attend to stroke patients after hours in HIC hospitals and differences in the staffing available to manage stroke patients between MIC and HIC hospitals. Although geriatricians were involved in stroke management in one third of the HIC hospitals, most of the doctors were neurologists in MIC. This may reflect differences in the skill mix of health professionals, resourcing, socio-demographic and cultural characteristics of populations. Further, there are important differences in the demographic characteristics of stroke patients, with those in Asian countries having a lower mean age at the time of stroke compared with those in western countries [15].

Another difference in stroke care is that MIC hospitals had fewer multidisciplinary stroke care and referral protocols to different health professionals when compared to HIC hospitals. Moreover, nursing care depended mostly on nurse practitioners in MIC hospitals, although HIC hospitals had a wider range of specialized nurses, with more clinical nurse specialists, nurse unit managers and research nurses. Restricted multidisciplinary care may have an adverse impact on stroke outcome, as the presence of occupational therapy or physiotherapy, stroke team assessment and continuing education are key for stroke care, showing an effect that is independent of the severity of the disease [9,10]. Indeed, escalating levels of organised care, measured by the Organised Care Index - a summary score based on hospital availability of occupational therapy or physiotherapy, stroke team assessment of patients, and admission to a stroke unit - were independent predictors of improved stroke survival in Canada [10] and Europe [2]. How these differences in stroke care impact on patient outcome is not known.

In conclusion, differences exist in stroke care organisation within hospitals with advanced health service capacity that have been selected to participate in a large-scale stroke trial. Importantly, these differences exist along the whole stroke care pathway, from pre-hospital, including population awareness of stroke, through acute and rehabilitation hospital care, to long-term community care, including palliative care services. Whilst these differences may reflect variations in funding and/or national health programs between MIC and HIC hospitals, it is important to consider the potential impact on patient outcome, including in the context of the ongoing HeadPoST study. Future multilevel analyses will be required to determine the influence of these organisational factors on patient outcome in different stroke subtypes within MIC and HIC health economies.

Conflicts of interest

TR has received consultancy payments from Bayer, Boehringer Ingelheim, Daiichi Sankyo, and his institution has received grant funding from the National Institute of Health Research, British Heart Foundation, Stroke Association, and the Engineering and Physical Sciences Research Council. PML has received research grant support from Bayer, Boehringer Ingelheim and AstraZeneca and receives research support from CONICYT-FONIS, Clínica Alemana de Santiago and The George Institute for Global Health. He has received speaker honoraria from Bayer. PMV and VVO have received research grant support from Clínica Alemana de Santiago. CSA has received travel reimbursement and honorarium from Takeda China and Boehringer Ingelheim. Other authors have no conflicts of interest to declare.

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