Quality of Ischemic Stroke Care in Emerging Countries

The Argentinian National Stroke Registry (ReNACer)

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Background and Purpose—Limited information is available on stroke management in developing countries. An accurate monitoring of quality of stroke care will become crucial, particularly with the emerging paradigm of pay-for-performance. Our aim was to explore the feasibility of measuring standardized indicators of quality of ischemic stroke care in acute care facilities in Argentina.

Methods—ReNACer is a prospective, multicenter, countrywide, stroke registry comprising 74 academic and nonacademic institutions in Argentina. The registry includes patient-level information on demography, clinical characteristics, diagnostic procedures, treatment, and the selected key performance indicators of quality of ischemic stroke care (access to thrombolysis or aspirin use in the acute setting, admission to designated stroke units, length of stay, risk-adjusted in-hospital pneumonia, risk-adjusted in-hospital mortality, discharge on antithrombotics, and antihypertensive agents).

Results—We included 1991 patients with ischemic stroke from 74 institutions in Argentina between November 2004 and October 2006. Seventy-nine per cent of the patients were prescribed antithrombotic therapy within 48 hours of admission, but only 1% received thrombolytics. No more than 5.7% were admitted to stroke units. In-hospital pneumonia was diagnosed in 14.3% of the patients and was higher in nonacademic facilities (16.4% versus 11.4%, \( P < 0.02 \)). The overall adjusted in-hospital mortality was 9.1%, also higher in nonacademic hospitals (10.6% versus 7.1%, \( P < 0.008 \)). At discharge, antithrombotics were prescribed in 90.2% and antihypertensive agents in 63.6% of the patients.

Conclusions—In ReNACer, there was a limited access to stroke units and thrombolytics, and a relatively high incidence of in-hospital pneumonia. Differences in stroke care were observed between academic and nonacademic institutions. There is an urgent need to develop national stroke programs in Argentina. (Stroke. 2008;39:3036-3041.)

Key Words: stroke ■ quality of care ■ health policy ■ stroke outcome ■ health services research ■ thrombolytic therapy ■ health indicators ■ antithrombotics ■ hypertension ■ mortality

Stroke is a major cause of death and disability worldwide. During 2005, 87% of stroke deaths occurred in low and middle-income countries. Based on projections from the World Health Organization (WHO), the overall stroke mortality will accelerate in low and middle-income countries in the near future.¹

Over the last decades, several strategies have been implemented to reduce stroke mortality and to improve the quality of stroke care. Nevertheless, limited information is available on quality of stroke care in emerging countries, and particularly in South America.

Recognized geographic variations in culture, stroke subtypes, or risk factors in South American countries may influence mortality and overall outcome.² Most South American studies involving stroke populations are based on single hospital data and do not provide information regarding quality of care.³ ⁴ Knowledge of quality of stroke care is of critical importance to establish short-term prognosis and select better therapeutic goals. Whereas in the near future stroke prevalence will steadily increase and direct medical costs will continue to rise,⁵ it is likely that hospitals’ financial support will be based on performance. Therefore, a sustained and accurate monitoring of quality of stroke care will become crucial.

We conducted a multicenter prospective study to evaluate indicators of quality of stroke care in the Argentinian Na-
tional Stroke Registry (ReNAcEr), a countrywide hospital-based stroke registry across Argentina.

To our knowledge, this project would constitute the first attempt to measure standardized indicators of quality of stroke care in an emerging country from South America.

**Methods**

**Study Design and Data Source: The Argentinian National Stroke Registry (ReNAcEr)**

ReNAcEr is a prospective, multicenter, countrywide, cooperative, hospital-based stroke registry that includes rural and urban hospitals of different facility types: low, medium, and high complexity, community, academic, and private. The registry was established in June 2004 as an initiative of the Stroke Working Group of the Argentinian Neurological Society and the Argentinian National Ministry of Public Health. To minimize center and investigator variability, the Executive Committee developed a guide delineating standardized definitions for each variable. During 2004, we undertook a 3-month pilot study in 3 hospitals located in Buenos Aires to assess feasibility. After this initial study, the Executive Committee organized workshops at each Region involved in the registry where investigators were invited to participate in a thorough discussion of the guide.

All consecutive patients older than 18 years admitted for an acute stroke to the participating institutions were included in the registry. We defined stroke according to the WHO criteria.8 For the present analysis, we excluded patients with hemorrhagic strokes (n=416), subarachnoid hemorrhages (n=103), transient ischemic attacks (TIAs), and unknown stroke subtype (n=74). We ruled out hemorrhage by CT or MRI.

We assessed stroke severity on the basis of the number of neurological deficits as previously reported by other authors.2 The neurological deficits included in the score were: (1) motor deficit, (2) sensory deficit, (3) presence of cortical signs such as aphasia, hemianopia, or neglect, (4) dysarthria, (5) ataxia, and (6) involvement of cranial nerves. We selected this score because not all neurologists were certified or familiar with the administration of the National Institutes of Health Stroke Scale (NIHSS). In addition, the use of the NIHSS would have been a barrier for centers not specialized in stroke, thus limiting the inclusion of these institutions and the generalizability of our results.

We defined designated stroke unit as an organized unit, in a specific location within the hospital, with physicians, nurses, and administrative professionals assigned to that unit and trained in the management of cerebrovascular disease. The stroke unit should also have algorithms for that purpose.

**Argentinian Health Care System**

Argentina is an emerging country. According to the 2001 National Census, Argentina’s surface area is 2 791 810 km² with a population of 36 260 130. Its health insurance system comprises the workers’ trade union organizations or “obras sociales” (39%), government-funded social insurance for part of the retired population (PAMI) (8%), and the private health insurers and providers (8%). The uninsured (45%) have access to public hospitals funded by the Government.

**Data Collection**

Once accredited with the Executive Committee, the data were collected on real-time during hospitalization using a secure web-based system from 74 institutions (6.2% of the total of health care facilities in the country) from 20 of 23 (91%) provinces across Argentina. As the identity of the patients was kept completely anonymous, no specific informed consent was required. The data were secured using a password-protected centrally computerized system.

The study protocol was approved by the Ministry of Public Health. After completing the recruitment period the website was closed to assure confidentiality. We conducted a data quality study including 10% of randomly selected records to evaluate completeness of registration, misreporting, and miscoding issues. The diagnoses in the database matched the diagnoses in the charts in 99% of the stroke cases. The agreement of the coding of data collected for the day of admission was 97%, and for death was greater than 99%. Nonmedical and socio-demographic data elements in this study had agreement rates ranging from 96% to 100%. For the purpose of this quality study, we used a modified questionnaire as reported by other authors.8

**Quality of Ischemic Stroke Care Indicators**

According to criteria proposed by the Canadian Stroke Network9 and the American Heart Association/American College of Cardiologists Quality of Care and Outcomes Research in CVD and Stroke Working Groups,10 we selected 8 key performance indicators that can be used for surveillance and quality improvement, are widely accepted, easy to measure, and available to the ReNAcEr registry.

Table 1 describes the 8 key performance indicators, including different domains (acute treatment of ischemic stroke, organization, and delivery of stroke evaluation and care, stroke complications and outcome, and secondary stroke prevention at discharge).

We applied the methodology proposed by the Agency for Healthcare Research and Quality (AHRQ) to calculate the in-hospital mortality rate.11

**Data Analysis and Statistics**

We used χ² tests to compare categorical variables, and Student t tests for continuous variables. We compared baseline characteristics and quality of stroke care indicators among academic and nonacademic hospitals. Statistical analysis was performed using commercially available STATA software (version 7.0, StatCorp LP). All tests were 2-tailed, and probability values <0.05 were considered significant.

In developing the model for in-hospital mortality, a statistical significance level of P<0.2 on univariate analysis was used as a screening cutoff. Factors achieving this level of significance and those with biological importance were then included in a multivariable analysis for mortality at discharge. Only variables achieving statistical significance of P<0.05 were left in the final multivariable model. The association between covariates and in-hospital mortality was expressed as the odds ratio and 95% CI. Hosmer-Lemeshow goodness-of-fit statistics was used to assess the calibration of the models.

**Results**

During the 24-month study period (November 2004 to October 2006), 1911 patients with acute ischemic stroke were admitted to the 74 participating institutions in ReNAcEr.

The baseline characteristics of the patients included in the analysis are summarized in Table 2. The mean age was 69.4±13 years, 55.5% were males. Patients admitted to nonacademic hospitals were older (72.7±12 versus 66.8±13 years, P<0.001), less likely to be unemployed at the time of the qualifying stroke (54.4% versus 73.5%, P<0.001), and more likely to be heavy drinkers (11.5% versus 6.6%, P<0.001) than those admitted to academic hospitals. Nonacademic hospitals had a lower proportion of patients with medical insurance (53.0 versus 87.2, P<0.001).

Overall, 897 patients (45%) were recruited in 11 academic hospitals (15%). Academic institutions were more likely to have a hospital-based neurology residency program (72.7% versus 11.1%, P<0.001).
Table 3 shows selected indicators of in-hospital care by facility type. Only 1.05% of patients received thrombolytic therapy and 78.9% were treated with aspirin during the first 48 hours after the acute ischemic stroke, with nonsignificant differences between academic and nonacademic hospitals. Only 5.7% of patients were admitted to designated stroke units. Admission to stroke units was significantly higher in academic centers (8.5% versus 3.2%, \( P < 0.001 \)).

The mean length of stay (LOS) was 8.1 days (range 3 to 9 days). Academic facilities had a shorter median LOS (6.3 versus 9.5 days, \( P < 0.001 \)).

Table 1 shows the definitions and domains for selected indicators of quality of stroke care. Overall, 14.3% of patients were diagnosed with in-hospital pneumonia. After adjustment for stroke severity, age, and sex, pneumonia was higher in nonacademic hospitals (15.5% versus 9.6%, OR 1.65, CI 95% 1.12 to 2.41, \( P < 0.01 \)).

The adjusted in-hospital mortality rate was 9.1%, higher in nonacademic centers (10.6% versus 7.1%, \( P < 0.01 \)). Table 4 shows the multiple logistic regression analysis for in-hospital mortality.

Among stroke survivors, 87.7% were discharged home. When analyzing indicators in the secondary prevention domain, 90.2% of the patients were discharged on antithrombotics and 63.6% on antihypertensive agents.

Table 2 shows baseline characteristics in academic and nonacademic institutions. Demographic characteristics, stroke severity, premorbid cardiovascular risk factors, and medical insurance were compared between academic and nonacademic hospitals.
In this large prospective multicenter study of hospitalized patients with ischemic stroke, we explored the feasibility of measuring indicators of quality of stroke care and outcome. We analyzed 8 key performance indicators comprising 4 different domains: acute treatment of ischemic stroke, organization and delivery of stroke evaluation and care, stroke complications and outcome, and secondary stroke prevention at discharge.

We found limited use of thrombolysis, limited initiation of aspirin within 48 hours, few admissions to stroke units, and deficient discharge on antihypertensive agents. In addition, in-hospital pneumonia, LOS and adjusted in-hospital mortality were higher among nonacademic facilities.

In comparison to stroke registries from industrialized countries, the mean age of our cohort is low. Previous studies have shown a lower mean age for stroke in Argentina and other emerging countries. Although the underlying mechanisms are not yet identified, the poor control of vascular risk factors could explain, at least in part, the observed differences.

**Acute Treatment of Ischemic Stroke Domain**

The uncommon use of thrombolytic therapy could be explained, at least partially, by costs and limited access to specialized care. Our results do not differ from those described for some U.S. populations (1.7%), but are lower than others found in more experienced U.S. (3% to 8.5%) and Canadian (8.9%) centers. In agreement with previous studies, we found a low use of aspirin in the acute ischemic stroke setting, with no significant differences between academic and nonacademic centers. The low use of aspirin in the first 48 hours after stroke could be explained by contraindications or lack of adherence to the guidelines.

Unfortunately, the health care system in Argentina provides limited incentives to health care providers and hospitals to offer specialized care for stroke patients. This is aggravated by the fact that some health maintenance organizations (HMOs) do not cover/reimburse for thrombolytic therapy.

**Organization and Delivery of Stroke Evaluation and Care Domain**

The low proportion of patients (5.7%) admitted to stroke units in comparison to other institutions (19% to 62%) reflects a lower access to specialized care as reported in emerging countries. Overall, the median LOS was similar to other studies. Interestingly, LOS was lower in academic institutions, perhaps associated with more availability of resources and organized stroke care.

**Stroke Complications and Outcome Domain**

In terms of medical complications, we found a higher frequency of in-hospital pneumonia than other authors. The in-hospital mortality rate in our cohort (9.1%) was higher than reported in other authors. The higher proportion of in-hospital pneumonias, and the higher risk-adjusted mortality may reflect that poorer outcomes are associated with lower access to specialized care.

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**Table 3. Quality of Stroke Care Indicators**

<table>
<thead>
<tr>
<th>Domains &amp; Indicators</th>
<th>Overall</th>
<th>Academic</th>
<th>Nonacademic</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Acute treatment of ischemic stroke</td>
<td>n=1991</td>
<td>n=868</td>
<td>n=1123</td>
<td></td>
</tr>
<tr>
<td>1. Thrombolytic therapy, No. (%)</td>
<td>21 (1.05)</td>
<td>10 (1.15)</td>
<td>11 (0.98)</td>
<td>0.88</td>
</tr>
<tr>
<td>2. Aspirin use in the acute setting, No. (%)</td>
<td>1571 (78.9)</td>
<td>673 (77.5)</td>
<td>898 (80.0)</td>
<td>0.19</td>
</tr>
<tr>
<td>B. Organization and delivery of stroke evaluation and care</td>
<td>n=1991</td>
<td>n=868</td>
<td>n=1123</td>
<td></td>
</tr>
<tr>
<td>3. Admission to designated stroke units, No. (%)</td>
<td>113 (5.7)</td>
<td>74 (8.5)</td>
<td>36 (3.2)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>4. Length of stay (days), median (interquartile range 25%, 75%), d</td>
<td>5 (3–9)</td>
<td>4 (3–7)</td>
<td>6 (4–11)</td>
<td>NA</td>
</tr>
<tr>
<td>C. Stroke complications and outcome</td>
<td>n=1991</td>
<td>n=868</td>
<td>n=1123</td>
<td></td>
</tr>
<tr>
<td>5. Risk-adjusted in-hospital pneumonia, % (95%CI)*</td>
<td>13.1 (11.2–15.3)</td>
<td>9.6 (7.3–12.6)</td>
<td>15.5 (12.8–18.5)</td>
<td>0.003</td>
</tr>
<tr>
<td>6. Risk-adjusted in-hospital mortality, % (95%CI)*</td>
<td>7.6 (6.4–9.1)</td>
<td>5.5 (4.1–7.3)</td>
<td>9.9 (8.2–12.0)</td>
<td>0.0004</td>
</tr>
<tr>
<td>D. Secondary prevention (only surviving patients are considered)</td>
<td>n=1810</td>
<td>n=806</td>
<td>n=1004</td>
<td></td>
</tr>
<tr>
<td>7. Antithrombotics at discharge, No. (%)</td>
<td>1632 (90.2)</td>
<td>712 (88.3)</td>
<td>920 (91.6)</td>
<td>0.02</td>
</tr>
<tr>
<td>8. Antihypertensive agents at discharge, No. (%)</td>
<td>1152 (63.6)</td>
<td>443 (55.0)</td>
<td>709 (70.6)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

*The analysis for in-hospital pneumonia corresponds to the second recruitment period, which included 1148 patients (483 from academic centers and 665 from nonacademic centers).

**Table 4. Variables Associated With In-Hospital Mortality**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>OR (CI 95%)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, years</td>
<td>0.019</td>
<td>1.02 (1.00–1.03)</td>
<td>0.01</td>
</tr>
<tr>
<td>Sex, male</td>
<td>0.545</td>
<td>1.06 (0.76–1.66)</td>
<td>0.75</td>
</tr>
<tr>
<td>Glucose on admission &gt; 130 mg/dL</td>
<td>0.887</td>
<td>2.43 (1.75–3.36)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Type of hospital, academic</td>
<td>-0.638</td>
<td>0.53 (0.98–0.75)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>History of TIA or stroke</td>
<td>0.330</td>
<td>1.39 (0.98–1.97)</td>
<td>0.06</td>
</tr>
<tr>
<td>History of atrial fibrillation</td>
<td>0.498</td>
<td>1.65 (1.13–2.39)</td>
<td>0.01</td>
</tr>
<tr>
<td>Stroke severity, No. of neurological deficits</td>
<td>0.224</td>
<td>1.25 (1.05–1.49)</td>
<td>0.01</td>
</tr>
</tbody>
</table>

C Statistics: 5.09, P=0.75.

In-hospital mortality was adjusted for health coverage, vascular risk factors, alcohol intake, left ventricular hypertrophy, and thrombolytic treatment.
Secondary Prevention Domain
In agreement with other studies, we found a relatively high use of antithrombotics at discharge.27,28,29 However, the indication of antihypertensive drugs at discharge was strikingly lower than that reported in the UK National Sentinel Stroke Audit for 2006.16

In Argentina, there is a low availability of acute inpatient rehabilitation and long-term care facilities, wide and diverse admission criteria, and high costs attributable to limited rehabilitation coverage by the HMOs. For example, we found that 88% of patients were discharged home. This suggests a high proportion of home discharge for stroke victims with moderate to severe deficit rather than a higher rate of independency at discharge.

Limitations and Strengths
Our study has some limitations and strengths that deserve comment. First, we have no information on the processes of in-hospital care or specific time for the initiation of rehabilitation after admission. This may be a contributing factor to explain why patients admitted to nonacademic hospitals were more likely to be discharged on antithrombotics and antihypertensive agents. Second, we have no information of stroke care after discharge. Third, as the participation in ReNACer was voluntary, we cannot rule out the possibility of selection bias. Finally, as there is no information available about the number of stroke patients admitted to Argentinian hospitals, we were not able to estimate what percentage of the stroke patients in Argentina was included in the study.

Despite these limitations, ReNACer is a prospective, multicenter, and comprehensive registry designed for the surveillance of cerebrovascular disease in Argentina, representing the first step in the understanding of stroke care in emerging countries.

Organized stroke care has been proven to reduce stroke morbidity and mortality.30,31 Our findings call the attention of stakeholders and policymakers to develop strategies to improve quality of stroke care (development of stroke units and centers for short and long-term rehabilitation, discharge planning, and home-care programs). South American countries have an urgent need for collaboration among partners in stroke research including scientific societies, healthcare providers, and state health agencies.

A cooperative effort should be focused on the implementation of national and regional stroke programs, the creation of stroke units that meet the specified criteria proposed by the 107 ReNACer Investigators.

ReNACer Investigators

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Disclosures
None.

References
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