Patient-Level and Hospital-Level Determinants of the Quality of Acute Stroke Care
A Multilevel Modeling Approach

Mathew J. Reeves, PhD; Julia Gargano, PhD; Kimberly S. Maier, PhD; Joseph P. Broderick, MD; Michael Frankel, MD; Kenneth A. LaBresh, MD; Charles J. Moomaw, PhD; Lee Schwamm, MD

Background and Purpose—Quality of care may be influenced by patient and hospital factors. Our goal was to use multilevel modeling to identify patient-level and hospital-level determinants of the quality of acute stroke care in a stroke registry.

Methods—During 2001 to 2002, data were collected for 4897 ischemic stroke and TIA admissions at 96 hospitals from 4 prototypes of the Paul Coverdell National Acute Stroke Registry. Duration of data collection varied between prototypes (range, 2–6 months). Compliance with 8 performance measures (recombinant tissue plasminogen activator treatment, antithrombotics <24 hours, deep venous thrombosis prophylaxis, lipid testing, dysphagia screening, discharge antithrombotics, discharge anticoagulants, smoking cessation) was summarized in a composite opportunity score defined as the proportion of all needed care given. Multilevel linear regression analyses with hospital specified as a random effect were conducted.

Results—The average hospital composite score was 0.627. Hospitals accounted for a significant amount of variability (intraclass correlation = 0.18). Bed size was the only significant hospital-level variable; the mean composite score was 11% lower in small hospitals (<145 beds) compared with large hospitals (≥500 beds). Significant patient-level variables included age, race, ambulatory status documentation, and neurologist involvement. However, these factors explained <2.0% of the variability in care at the patient level.

Conclusions—Multilevel modeling of registry data can help identify the relative importance of hospital-level and patient-level factors. Hospital-level factors accounted for 18% of total variation in the quality of care. Although the majority of variability in care occurred at the patient level, the model was able to explain only a small proportion. (Stroke. 2010;41: 2924-2931.)

Key Words: health care ■ multilevel analysis ■ quality ■ registries

The goal of the Paul Coverdell National Acute Stroke Registry is to track the delivery of care to hospitalized acute stroke patients and to guide quality improvement.1 Previous analyses have focused on patient-level determinants of care;1 however, quality of care is also determined by hospital-level and other system-level factors.2 Data collected from hospital-based quality-of-care registries are inherently hierarchical; patients and physicians are nested within hospitals, and hospitals may be nested within larger health systems. This multilevel data structure has implications regarding the most appropriate statistical analyses; for example, methods should account for hospital clustering because patients within a hospital do not represent independent observations.3 Failure to account for the multilevel nature of registry data has been shown to result in an inflated number of statistically significant associations and errors in identifying hospital-level determinants of care.4 The latter may be especially important given that interventions to improve quality often involve manipulation of hospital-level factors.

Multilevel or hierarchical modeling is an analytic technique designed for complex nested data structures.5,6 It is commonly used in educational and social research7–9 and is increasingly being used in health services research.10,11 Multilevel modeling has several advantages for the analysis of hospital-based registry data, including the ability to partition sources of variation between levels (ie, patient-level vs hospital-level), to model the interaction between variables at different levels and to provide more precise estimates of hospital-specific effects, especially when faced with small sample sizes.3,4,6
Our primary objective was to identify patient-level and hospital-level variables associated with the quality of acute stroke care. To address this objective, we used multilevel analysis applied to data from a large prototype stroke registry.

Specific questions of interest included: (1) How much of the variation in the quality of care is attributable to hospital-level factors?; (2) What are the patient-level and hospital-level determinants of quality?; and (3) Are there interactions between patient-level and hospital-level determinants?

**Materials and Methods**

**Registry Design**

Detailed information on the design of the 4 state registry prototypes (Georgia, Massachusetts, Michigan, Ohio) has been published previously. Briefly, each registry developed its own sampling design to obtain a representative sample of hospitals using a combination of sampling with certainty and stratified sampling (with strata defined by hospital size or location). Overall, 98 hospitals were included: 34 from Georgia, 12 from Massachusetts, 16 from Michigan, and 36 from Ohio.

**Acute Stroke Case Ascertainment and Case Definition**

Acute stroke admissions were identified through either a prospective or a retrospective approach. In Massachusetts and Michigan, admissions were identified prospectively based on presenting clinical signs and symptoms. The Georgia and Ohio eligible cases were identified retrospectively based on stroke discharge codes. All admissions had to present to the hospital with signs and symptoms consistent with acute stroke. This analysis was restricted to cases of ischemic stroke, TIA, or ischemic stroke of uncertain duration. Cases of TIA were included only if there were stroke signs and symptoms on presentation (and therefore were potentially eligible for thrombolysis intervention). The ischemic stroke of uncertain duration definition was only used at the 2 sites using prospective methods (Michigan, Massachusetts) when the duration of clinical signs (ie, <24 hours or >24 hours) was not documented.

**Data Collection**

Registry information was collected between October 2001 and November 2002. The exact duration of care ascertainment varied between sites (2 months for Ohio, 3 months for Georgia and Massachusetts, and 6 months for Michigan). All consecutive acute stroke admissions that occurred during these time periods were included. Human subject approval was obtained from each hospital’s Institutional Review Board before starting data collection. All sites collected the same set of core Paul Coverdell National Acute Stroke Registry data elements using either retrospective chart abstraction (Georgia, Ohio) or, at the 2 prospective sites (Massachusetts, Michigan), a combination of concurrent data collection and chart abstraction. Findings from audits designed to assess case ascertainment and data reliability have been published. Information on the hospital’s capacity to provide acute stroke care was collected using a survey that included items identified by the Brain Attack Coalition. The 12-item survey was completed by a representative of the hospital’s stroke service and included information on availability of an acute stroke team, written treatment guidelines, intravenous thrombolysis (intravenous recombinant tissue plasminogen activator) treatment, stroke neurologists, imaging capabilities, in-hospital rehabilitation services, stroke case manager/specialist, and previous involvement in stroke quality-improvement or databanks. Information was also collected on bed size, annual stroke admissions, urban vs nonurban location, and teaching status.

**Quality of Care Definitions**

The following 8 performance measures selected by the Paul Coverdell National Acute Stroke Registry were used as quality indica-
modeled relative to the number the subject was eligible for) and an arcsine-root transformation model, which is a variance-stabilizing transformation designed to “normalize” the outcome variable.

Results

The hospital-level characteristics are shown in Table 1. The distribution of bed size varied by state, with Georgia having more small hospitals (<145 beds) and Massachusetts having more large hospitals (>500 beds). The majority of hospitals reported having access to written treatment guidelines, acute stroke teams, and neurologists. Patient-level characteristics are shown in Table 2. The mean age was 69.7 years. The racial distribution varied across the prototypes, with Georgia having the highest proportion of blacks (37%) and Massachusetts having the lowest proportion (9%).

The overall patient-level mean composite score was 0.68 (SD = 0.12), indicating that, on average, patients received 68% of the measures they were eligible for. At the hospital level, the mean composite score was 0.63 and varied from 0.57 (Georgia) to 0.70 (Massachusetts). The mean hospital scores were also approximately normally distributed (Figure 1). The compliance data for the 8 performance measures are shown in Table 3. Overall, compliance was lowest for recombinant tissue plasminogen activator treatment (27%), lipid profile checked (41%), and smoking cessation counseling (26%), and it was highest for discharge antithrombotics (99%).

Multilevel Analysis

In a 3-level unconditional means model that included both state and hospital as random effects, the hospital term was statistically significant (P < 0.0001), whereas the state term was not (P = 0.14) and therefore was eliminated from further consideration. The intraclass correlation (P) from a 2-level unconditional means model (including only hospital as a random effect) was 0.18 (ie, 0.00743/0.04072). These data indicate that there was only a moderate degree of clustering within hospital and that, after taking into account hospital-level random effects, considerable unexplained variability in composite scores remains.

Results of the final multilevel model are shown in Table 4. Bed size was the only hospital-level variable that was significantly associated with composite score (P < 0.001). Compared to the largest hospitals (>500 beds), the proportion of care opportunities fulfilled by the smallest hospitals (<145 beds) was 11% lower (P < 0.0001). Age had a significant curvilinear relationship with composite score. A plot of the mean composite scores by 10-year age intervals illustrates that the mean composite care scores increased up until approximately age 60 and then declined with increasing age (Figure 2). The composite score was 4.8% lower (P < 0.001) among patients whose ambulatory status was documented compared to those whose ambulatory status was not. Neurologist involvement in the care of patients was a significant determinant of quality; compared to patients who did not have a neurologist involved, the proportion of care opportunities fulfilled was 4.9% higher (P < 0.0001) in those who did.

None of the patient-level variables had statistically significant random effects. The random effect for hospital remained significant in the final multilevel model, indicating that after accounting for patient characteristics and hospital characteristics there was still considerable unexplained variability in

### Table 1. Hospital Characteristics Among 96 Hospitals From 4 Prototypes of the Paul Coverdell National Acute Stroke Registry

<table>
<thead>
<tr>
<th>N of hospitals</th>
<th>N (%)</th>
<th>GA, N (%)</th>
<th>MA, N (%)</th>
<th>MI, N (%)</th>
<th>OH, N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>27–145 beds</td>
<td>96 (100)</td>
<td>34 (35)</td>
<td>11 (10)</td>
<td>15 (16)</td>
<td>36 (38)</td>
</tr>
<tr>
<td>146–263 beds</td>
<td>96 (100)</td>
<td>34 (35)</td>
<td>11 (10)</td>
<td>15 (16)</td>
<td>36 (38)</td>
</tr>
<tr>
<td>264–499 beds</td>
<td>96 (100)</td>
<td>34 (35)</td>
<td>11 (10)</td>
<td>15 (16)</td>
<td>36 (38)</td>
</tr>
<tr>
<td>500–970 beds</td>
<td>96 (100)</td>
<td>34 (35)</td>
<td>11 (10)</td>
<td>15 (16)</td>
<td>36 (38)</td>
</tr>
</tbody>
</table>

**Bed size**

- 27–145 beds: 96 (100) cases
- 146–263 beds: 96 (100) cases
- 264–499 beds: 96 (100) cases
- 500–970 beds: 96 (100) cases

**Results**

- The distribution of bed size varied by state, with Georgia having more small hospitals (<145 beds) and Massachusetts having more large hospitals (>500 beds).
- The majority of hospitals reported having access to written treatment guidelines, acute stroke teams, and neurologists.
- Patient-level characteristics are shown in Table 2. The mean age was 69.7 years.
- The racial distribution varied across the prototypes, with Georgia having the highest proportion of blacks (37%) and Massachusetts having the lowest proportion (9%).

**Multilevel Analysis**

- In a 3-level unconditional means model that included both state and hospital as random effects, the hospital term was statistically significant (P < 0.0001), whereas the state term was not (P = 0.14) and therefore was eliminated from further consideration.
- Bed size was the only hospital-level variable that was significantly associated with composite score (P < 0.001). Compared to the largest hospitals (>500 beds), the proportion of care opportunities fulfilled by the smallest hospitals (<145 beds) was 11% lower (P < 0.0001).
- Age had a significant curvilinear relationship with composite score. A plot of the mean composite scores by 10-year age intervals illustrates that the mean composite care scores increased up until approximately age 60 and then declined with increasing age (Figure 2).
- The composite score was 4.8% lower (P < 0.001) among patients whose ambulatory status was documented compared to those whose ambulatory status was not documented.
- Neurologist involvement in the care of patients was a significant determinant of quality; compared to patients who did not have a neurologist involved, the proportion of care opportunities fulfilled was 4.9% higher (P < 0.0001) in those who did.
hospital composite scores. Compared to the unconditional means model, the variance associated with the hospital-level composite scores was reduced by 30% in the final model (ie, $0.00743 - 0.0052/0.00743$), almost all of which was attributable to the addition of bed size. In contrast to the findings at the hospital level, the variance associated with the patient-level composite scores was reduced by only 1.8% (ie, $0.04072 - 0.040/0.0472$) by the inclusion of the patient-level variables in the final model. The correlation between the observed composite scores and the model’s predictive scores was $0.232$ ($P<0.001$), indicating that the final model had at least moderate predictive power.

With respect to the sensitivity analyses, after excluding 17 hospitals with $<10$ observations (n=76 subjects), the model results were essentially identical. Similarly, after excluding the 1182 TIA cases, the model coefficients were similar, although their statistical significances were attenuated given the smaller sample size. The magnitude and statistical significance of the model coefficients were also similar in the Poisson and arcsine-root transformation models (data not shown), indicating that our conclusions were robust when alternative statistical approaches were used.

### Discussion

In this multilevel analysis of the quality of stroke care in 4 prototype stroke registries, we found that only approximately two-thirds of interventions that patients were eligible for were documented as having been provided. We found that mean composite scores varied substantially across hospitals, and much of this variation remained even after significant hospital-level and patient-level factors were identified. Bed size was the only hospital-level variable that was a significant determinant of quality of care. Hospital size has been shown to be an important predictor of quality of care for many conditions, including stroke. The lower quality of care in small hospitals is probably a reflection of more limited resources, such as physician and staff expertise and specialty services. Bed size, which is strongly correlated with stroke volume, has been shown to be an important predictor of
short-term mortality in some, although not all, stroke studies. Our finding that smaller hospitals provide lower quality of care provides evidence to support the hypothesis that part of the widely reported “volume–outcome relationship” is attributable to the delivery of poorer care in smaller hospitals. Hospital size is also positively correlated with several other hospital characteristics important to stroke care, including teaching status, presence of stroke units or stroke teams, quality-improvement infrastructure, stroke pathways, and standing orders. Although many of these variables were associated with quality of care in unadjusted analyses, we did not find any of them to be significant determinants independent of bed size. The lack of benefit of standing orders is contrary to some,1,2 but not all,2 previous reports. It is possible that the lack of significant findings associated with the Brain Attack Coalition items might be because more detailed information is required to understand the particular context and application of these factors within each hospital. Although previous studies have found the Brain Attack Coalition items to be highly correlated and to have limited variability between hospitals, we did not find this to be the case. Most of the characteristics were present in approximately 60% to 80% of hospitals, which probably reflects the fact that the prototypes included a broader range of hospitals. Overall, our results suggest that further work is required to identify the organizational, structural, and process measures that could explain the lower-quality care observed in smaller hospitals.

In this analysis, compared to patients in their early 60s, both younger and older patients had lower quality of care. The finding that older age is associated with lower quality of stroke care is not uncommon; however, we are not aware of previous studies showing that younger patients also have lower-quality care. The reasons for this are unknown, although we speculate that it might be because younger patients have fewer risk factors and comorbidities, or that their risk of stroke recurrence is falsely underestimated by hospitals and physicians. We found that the involvement of a neurologist was associated with higher-quality care. There have been several previous reports evaluating the impact of neurologists on the quality and efficiency of stroke care. A study of stroke outcomes in academic medical centers found that in-hospital mortality was lower in those centers that had a vascular neurologist. A study of Medicare recipients found

### Table 3. Overall Compliance With Individual Performance Indicators Among 4897 Acute Ischemic Stroke or TIA Admissions From 4 Prototype Registries

<table>
<thead>
<tr>
<th>Performance Indicator</th>
<th>Total % (N Eligible)</th>
<th>GA, % (N)</th>
<th>MA, % (N)</th>
<th>MI, % (N)</th>
<th>OH</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV-tPA treatment*</td>
<td>27 (362)</td>
<td>16 (89)</td>
<td>63 (57)</td>
<td>24 (123)</td>
<td>22 (93)</td>
</tr>
<tr>
<td>Antithrombotics &lt;24 hours†</td>
<td>88 (4897)</td>
<td>87 (1041)</td>
<td>88 (642)</td>
<td>91 (1942)</td>
<td>86 (1272)</td>
</tr>
<tr>
<td>DVT prophylaxis &lt;48 hours‡</td>
<td>73 (2391)</td>
<td>56 (605)</td>
<td>97 (376)</td>
<td>76 (619)</td>
<td>70 (591)</td>
</tr>
<tr>
<td>Dysphagia screening§</td>
<td>50 (3715)</td>
<td>42 (800)</td>
<td>69 (498)</td>
<td>48 (1443)</td>
<td>48 (974)</td>
</tr>
<tr>
<td>Lipid profile checked¶</td>
<td>41 (4897)</td>
<td>34 (1041)</td>
<td>55 (642)</td>
<td>45 (1942)</td>
<td>34 (1272)</td>
</tr>
<tr>
<td>Discharged on antithrombotics¶</td>
<td>99 (4483)</td>
<td>99 (912)</td>
<td>98 (621)</td>
<td>99 (1800)</td>
<td>99 (1150)</td>
</tr>
<tr>
<td>Discharged on anticoagulants**</td>
<td>73 (534)</td>
<td>74 (124)</td>
<td>88 (88)</td>
<td>66 (173)</td>
<td>73 (149)</td>
</tr>
<tr>
<td>Smoking cessation††‡‡</td>
<td>26 (1143)</td>
<td>22 (287)</td>
<td>32 (123)</td>
<td>29 (467)</td>
<td>22 (266)</td>
</tr>
</tbody>
</table>

DVT indicates deep venous thrombosis; GA, Georgia; IV-tPA, intravenous tissue plasminogen activator; MA, Massachusetts; MI, Michigan; OH, Ohio.

*Model equation: \( Y_0 = \gamma_0 + \gamma_1(27–145 \text{ beds}) + \gamma_2(146–263 \text{ beds}) + \gamma_3(264–499 \text{ beds}) + \gamma_4(40\text{ not documented}) + \gamma_5(\text{neurologist}) + u_{ij} + \epsilon_i \).
†P generated from Wald statistics.
‡Overall test for fixed effect of bed size, \( P<0.001 \).
§Dysphagia screening during hospitalization (IS only).
¶Lipid profile (LDL-C) checked during hospitalization.
**Discharged on anticoagulation if atrial fibrillation present among those with no contraindications.
††Discharged on antithrombotics medication among those with no contraindications.
‡‡Discharged on anticoagulation if atrial fibrillation present among those with no contraindications.

### Table 4. Final Multilevel Linear Regression Model of Composite Care (%) Showing Fixed-Effect Hospital-Level, Patient-Level, and Random-Effect Variables*

<table>
<thead>
<tr>
<th>Subject</th>
<th>Estimate</th>
<th>SE</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed-effect hospital-level variables</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bed size‡</td>
<td>-0.113</td>
<td>0.027</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>27–145, ( \gamma_{01} )</td>
<td>-0.046</td>
<td>0.027</td>
<td>0.09</td>
</tr>
<tr>
<td>146–263, ( \gamma_{02} )</td>
<td>-0.031</td>
<td>0.023</td>
<td>0.18</td>
</tr>
<tr>
<td>264–499, ( \gamma_{03} )</td>
<td>-0.023</td>
<td>0.008</td>
<td>0.008</td>
</tr>
<tr>
<td>500–970</td>
<td>-0.048</td>
<td>0.014</td>
<td>0.0004</td>
</tr>
<tr>
<td>Fixed-effect patient-level variables</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept, ( \gamma_{00} )</td>
<td>0.6236</td>
<td>0.023</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Age (yr), ( \gamma_{10} )</td>
<td>-0.00064</td>
<td>0.00024</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Age² (yr), ( \gamma_{20} )</td>
<td>-0.00006</td>
<td>0.00001</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Black (vs white/other), ( \gamma_{30} )</td>
<td>-0.023</td>
<td>0.008</td>
<td>0.008</td>
</tr>
<tr>
<td>Ambulatory status not documented (vs documented), ( \gamma_{40} )</td>
<td>-0.048</td>
<td>0.014</td>
<td>0.0004</td>
</tr>
<tr>
<td>Neurologist involved in care, ( \gamma_{50} )</td>
<td>0.049</td>
<td>0.008</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Random-effect variables</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospital, ( \text{var}(u_{ij}, \gamma_{00}) )</td>
<td>0.0052</td>
<td>0.0010</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>( \text{Var} (\epsilon_i) ), ( \sigma^2 )</td>
<td>0.040</td>
<td>0.0008</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

*Model equation: \( Y_0 = \gamma_0 + \gamma_1(27–145 \text{ beds}) + \gamma_2(146–263 \text{ beds}) + \gamma_3(264–499 \text{ beds}) + \gamma_4(40\text{ not documented}) + \gamma_5(\text{neurologist}) + u_{ij} + \epsilon_i \).
†P generated from Wald statistics.
that compared to other specialists, neurologists provided better but more expensive care to hospitalized stroke patients—neurologists ordered more MRI scans and were more likely to prescribe warfarin and to discharge patients to inpatient rehabilitation, but their patients had lower mortality 90 days after discharge.\textsuperscript{25} Similar findings of increased testing but better outcomes for stroke patients treated by neurologists were also found in a Veterans’ Administration study.\textsuperscript{26}

A major rationale for using the multilevel approach in the assessment of health care quality is the fact that many policy decisions affecting the delivery of hospital-based care require an understanding of how hospital-level factors influence care and how they interact with patient-level variables. In studies that include a large number of hospitals, only multilevel modeling has the ability to determine if factors operating at the patient level are modified by group or contextual factors operating at the hospital level.\textsuperscript{5,6} Other advantages of the multilevel approach include the ability to simultaneously examine the relative contributions of individual-level and group-level variables on the outcomes of interest and to account for the nonindependence of observations (ie, clustering) within groups.\textsuperscript{6} To date, many previous analyses of stroke quality of care data have focused on patient-level factors using the generalized estimating equation (GEE) approach to account for clustering within hospitals while either ignoring or including hospital-level characteristics as fixed effects.\textsuperscript{18,23,27} The GEE model provides a different interpretation from the multilevel model; the GEE model averages across random effects, thereby providing a marginal or population average estimate, whereas the multilevel model provides estimates that are conditional on the group-level random effects.\textsuperscript{5,6} Random-effect models also make an assumption that the group-level units (ie, hospitals) represent a random sample of a larger underlying population to which the model results can be applied.\textsuperscript{5} Other drawbacks of the GEE approach to modeling stroke care data have focused on patient-level factors using an approach to partition the variance components. \textsuperscript{28} In this analysis, it is easier to determine if significant cross-level interaction effects are present between patient-level and hospital-level variables (none was significant in this analysis), or to quantify the magnitude of the hospital-level variation that remains in the final multilevel model.

By partitioning the variance components, the multilevel approach illustrates the relative contributions of hospital-level and patient-level factors to the variation in quality of care. In this analysis, we found that 18\% of the total variance occurred at the hospital level and that almost one-third of this was explained by bed size. The final model found that the majority of variability in quality of care occurred at the patient level (ie, 82\%), but that the patient-level variables in the model (ie, age, race, documentation of ambulatory status, and neurologist) only accounted for a tiny fraction of this (ie, 1.8\%). These findings illustrate that there remains a large amount of unexplained variability in quality of care, the origins of which should be the focus of future studies.

There are several potential limitations associated with the data used in this report. First, although all 4 prototypes shared some common design features, their sampling designs were different.\textsuperscript{1} Although variability in the size and demographic make-up of the states justified an adaptable design, the representativeness of these prototype designs remains unknown. Second, as previously mentioned, information on the origins of which should be the focus of future studies.
limitations (as reviewed by Peterson et al\textsuperscript{16}), and our understanding of how such measures relate to patient-oriented outcomes is limited but represents an important area of future research.\textsuperscript{28} Limitations associated with the collection of hospital-level variables have already been mentioned.

Conclusion

In summary, this study has shown the value of using a multilevel approach for the analysis of hospital-based stroke registry data when the focus is on understanding the relative contributions of patient-level and hospital-level factors. Although the majority of variance in quality of care occurred at the patient level, the model was only able to explain a small proportion of this. Involvement of a neurologist and data documentation were the only potentially modifiable patient-level factors that predicted quality of care. Hospital-level variability accounted for a minority of the total variation in care (18%), but bed size was found to explain almost one-third of this variation. Future analyses of stroke registries should aim to include a larger number of hospitals and stroke admissions, to use more consistent sampling designs, and to include more detailed information on both hospital-level and patient-level variables to explain a greater proportion of the variability in care.

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Disclosures

None.

References


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急性卒中护理质量中患者层面与医院层面决定因素的多元模型分析

Patient-Level and Hospital-Level Determinants of the Quality of Acute Stroke Care
A Multilevel Modeling Approach

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背景与目的：治疗质量可能受到患者及医院两个层面因素的影响。我们的目的是使用多层面模型分析法以确定在卒中登记中急性卒中护理质量上患者层面及医院层面的决定因素。

方法：数据包括了在2001至2002年间，来自于保罗卡文戴尔国家急性卒中登记的四个样本中的96家医院4897个缺血性卒中和短暂性脑缺血发作（TIA）的住院病例资料。资料收集持续的时间在不同来源的样本中有所不同（2-6个月之间）。

从符合八项处理措施（包括：重组组织型纤溶酶原激活剂溶栓治疗、抗血栓形成治疗<24小时、预防深静脉血栓形成、血脂检测、吞咽困难筛查、抗凝药物的使用以及戒烟）中总结出一个综合机会分数，即需要治疗而又实际给予了治疗的患者比例。针对特定的医院，作为一个随机效应来完成多元线性回归分析。

结果：医院综合机会分数平均为0.627。医院变量子占据了变异性的显著额度（组内相关性=0.18），床位数是唯一的具有显著性差异的医院层面的变量，与大医院（>500床位）相比，小医院（<145床位）的平均综合机会分数得分低11%。患者层面具有显著性差异的变量包括年龄、种族、行走状态记录以及神经科医生的参与。然而，这些因素只能解释<2.0%的患者层面的护理差异性。

结论：登记数据的多元模型资料有助于确定医院层面及患者层面因素的相对重要性。医院层面的因素占护理质量总变异的18%。尽管大部分的护理质量差异性发生在患者层面，但是该模型能够解释的也只有一小部分。

关键词：卫生保健, 多水平分析, 质量, 登记

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