The aim of the clinical pathway is to establish a standardized healthcare plan for a specific disease in a specific patient cohort. To date, clinical pathways have been implemented for a great variety of diseases to improve the treatment effectiveness and to reduce the cost. Various clinical pathways on stroke management have been explored to enhance the interdisciplinary coordination, reduce the length of hospital stay, and facilitate the patients’ rehabilitation.

Clinical Challenges
Approximately 1.6 million patients died of stroke every year in China, which hugely strains the financial means of patients and the government. Therefore, the National Health and Family Planning Commission of China (formerly the Ministry of Health) commissioned a panel of physician experts to produce a draft of stroke clinical pathway and tested in a limited scale for 1 year. After the revision based on the feedbacks, the stroke clinical pathway entered a nationwide evaluation period from 2009 to 2013. Individual healthcare institutions were allowed to fine tune recommended protocols if necessary. The aim of this stroke clinical pathway study was to find a strategy to reduce the cost for healthcare without jeopardizing the quality of treatments by streamlining the stroke management.

In this study, we separately investigated the impact of clinical pathways on transient ischemic attack (TIA) and intracerebral hemorrhage (ICH) to offer a discriminating insight into the role of clinical pathways in managing different subtypes of patients with stroke.

Description of Solutions
TIA Study
A total of 426 patients diagnosed of TIA (International Classification of Diseases, Tenth Revision [ICD-10]: G54.0 and ICD-10: G45.1) at 5 participating hospitals in Beijing, China, between March 2010 and October 2010 were enrolled. This population was randomized into 2 groups: a conventional group (control; n=213) and a clinical pathway group (CP group; n=213). The clinical pathway is summarized in Table 1. A physical examination was performed per the standard of care in China.

ICH Study
A total of 332 patients diagnosed of CH (ICD-10: I61) at 5 participating hospitals in Beijing, China, between March 2010 and October 2010 were enrolled. This population was randomized into 2 groups: a conventional group (control; n=166) and a CP group (n=166). The clinical pathway is summarized in Table 2. ICH patients were enrolled and retained in the clinical pathway scheme, even after surgery, unless he or she was diagnosed of other diseases, the treatments of which would interfere with the implementation of ICH clinical pathway. A physical examination was performed per the standard of care in China.

Evaluation Criteria
Factors in the criteria included the average length of hospital stay, costs (hospitalization and drugs), incidence of stroke within 90 days (TIA study only), rates of infection and mortality (ICH study only), National Institute of Health Stroke Scale (ICH study only) and Barthel Index (ICH study only). Student t test and \( \chi^2 \) analysis were run using SPSS (IBM, Armonk, NY) where appropriate (\( \alpha=0.05 \)). Results were presented as mean±SE.

Results of Pilot Testing
TIA Clinical Pathway
Neither the \( \chi^2 \) analysis of the patients’ sex nor the Student t test of the patients’ age showed a marked difference between the control and CP groups in the TIA patient population (Table 3). The control group reported an average age of 58.79±13.28 (64.4% men), whereas the CP group 60.24±10.77 (65.8% men; Table 3). A Student t test showed that the average length
of hospital stay decreased to 9.93±4.31 days from 13.19±4.73 days because of the implementation of clinical pathways (Table 3). Accordingly, the cost associated with hospital stay demonstrated a significant drop to $1507.72±757.85 from $1923.56±1066.82 from $2214.72±694.59, which compromised the quality of treatments for TIA patients.

### Table 1. Summary of TIA Clinical Pathway

<table>
<thead>
<tr>
<th>Time, d</th>
<th>Preparatory Items</th>
<th>Clinical Cares</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Same as day 2</td>
<td></td>
</tr>
<tr>
<td>4–6</td>
<td>Same as day 2</td>
<td></td>
</tr>
<tr>
<td>5–7</td>
<td>Discharge with prescription drug</td>
<td></td>
</tr>
</tbody>
</table>

APTT indicates activated partial thromboplastin time; ENA, extractable nuclear antigens; PT/INR, prothrombin time/international normalized ration; and TIA, transient ischemic attack.

*These items were required to be completed on indicated time point in the clinical pathway group, whereas, in the control group, the completion was subject to the availability and was frequently delayed.

†Class I care: eligibility: (1) Patients with TIA under stable conditions; (2) patients who need extended in-bed rest (eg, paralyzed patients); and (3) patients under unstable or unpredictable conditions. Clinical cares: (1) check the patients hourly, including consciousness, pupils, headache, vomit, body motor control, etc; (2) monitor life indicators; (3) ensure the administration of prescribed drugs; (4) provide basic cares, including oral care and preventive measures for fall out of bed, etc; (5) provide patient education on stroke; and (6) for paralyzed patients, bathing and assisted food intake are offered and bed sheets are replaced daily.

### Table 2. Summary of Intracerebral Hemorrhage Clinical Pathway

<table>
<thead>
<tr>
<th>Time, d</th>
<th>Preparatory Items</th>
<th>Clinical Cares</th>
</tr>
</thead>
<tbody>
<tr>
<td>7–13</td>
<td>1. Prepare to discharge&lt;br&gt;2. Make appointments for future examinations&lt;br&gt;3. Note treatment plans in the medical chart if the patient is not ready for discharge</td>
<td>1. Routine care for stroke&lt;br&gt;2. Class II or III care&lt;br&gt;3. Diet (low fat and salt)&lt;br&gt;4. In-bed rest&lt;br&gt;5. Previous drug prescriptions&lt;br&gt;6. DSA, CTA, and MRA if necessary</td>
</tr>
<tr>
<td>8–14</td>
<td>Discharge</td>
<td></td>
</tr>
</tbody>
</table>

Some patients underwent emergency surgery on day 1 but not on day 2 or 3. CT indicates computed tomography; CTA, computed tomographic angiography; DSA, digital subtraction angiography; MRA, magnetic resonance angiography; NIHSS, National Institute of Health Stroke Scale.

*These items were required to be completed on indicated time point in the clinical pathway group, whereas, in the control group, the completion depended on the availability and was frequently delayed.

### ICH Clinical Pathway

The average ages of patients in the control group and CP group were 66.32±8.95 (60.6% men) and 66.74±8.57 (62.9% men), respectively, without significant difference (Table 4). We found that the average length of hospital stay reduced to 17.93±6.35 days from 21.18±6.50 days after the implementation of the clinical pathway. Consequently, the hospitalization cost decreased to $1923.56±1066.82 from $2214.72±694.59,
Table 3. Statistics of Transient Ischemic Attack Patients

<table>
<thead>
<tr>
<th></th>
<th>Control Group (n=213)</th>
<th>CP Group (n=213)</th>
<th>PValue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average age</td>
<td>58.7±13.28</td>
<td>60.2±10.77</td>
<td>0.21</td>
</tr>
<tr>
<td>Men, %</td>
<td>64.4</td>
<td>65.8</td>
<td>0.84</td>
</tr>
<tr>
<td>Hospital stay, d</td>
<td>13.19±4.73</td>
<td>9.93±3.41</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Hospitalization ($)</td>
<td>1734.58±845.79</td>
<td>1507.72±757.85</td>
<td>0.02</td>
</tr>
<tr>
<td>Drugs ($)</td>
<td>734.01±362.25</td>
<td>629.81±373.71</td>
<td>0.04</td>
</tr>
<tr>
<td>Incidence of stroke within 90 days (incidence %)</td>
<td>28 (13.14)</td>
<td>35 (16.43)</td>
<td>0.16</td>
</tr>
</tbody>
</table>

CP indicates clinical pathway.

Table 4. Statistics of Intracerebral Hemorrhage Patients

<table>
<thead>
<tr>
<th></th>
<th>Control Group (n=166)</th>
<th>CP Group (n=166)</th>
<th>PValue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average age</td>
<td>66.32±8.95</td>
<td>66.74±8.57</td>
<td>0.68</td>
</tr>
<tr>
<td>Men, %</td>
<td>60.6</td>
<td>62.9</td>
<td>0.68</td>
</tr>
<tr>
<td>Hospital stay, d</td>
<td>21.18±6.50</td>
<td>17.93±6.35</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Hospitalization ($)</td>
<td>2214.72±694.59</td>
<td>1923.56±1066.82</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Drugs ($)</td>
<td>1293.50±386.23</td>
<td>1066.82±335.07</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>NIHSS (admission)</td>
<td>7.99±3.66</td>
<td>7.78±3.67</td>
<td>0.48</td>
</tr>
<tr>
<td>NIHSS (14 days)</td>
<td>5.04±3.12</td>
<td>4.15±2.53</td>
<td>0.10</td>
</tr>
<tr>
<td>Mortality, %</td>
<td>2.4</td>
<td>3.0</td>
<td>0.72</td>
</tr>
<tr>
<td>Infection</td>
<td>18.98</td>
<td>11.20</td>
<td>0.07</td>
</tr>
</tbody>
</table>

CP indicates clinical pathway, and NIHSS, National Institute of Health Stroke Scale.

Table 5. Barthel Index of Intracerebral Hemorrhage Patients

<table>
<thead>
<tr>
<th>Scale</th>
<th>At Admission</th>
<th>CP Group (n=166)</th>
<th>PValue</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>4</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>75–95</td>
<td>59</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>50–70</td>
<td>87</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>25–45</td>
<td>35</td>
<td>23</td>
<td></td>
</tr>
<tr>
<td>0–20</td>
<td>31</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>Death</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

CP indicates clinical pathway.

Conclusions and Future Work

Stroke management is a highly interdisciplinary expertise involving knowledge and staff from various departments, thus frequently have poor coordination and inefficient treatments. Consequently, physicians are prompted to develop clinical pathways to streamline the management of patients with stroke, avoid unnecessary delays, and improve the quality of treatment and rehabilitations. A side-by-side comparison between the control and CP groups confirmed that each clinical pathway achieved its goal of significantly decreasing the length of hospital stay and thus overall healthcare costs. Meanwhile, no sacrifice of treatment quality was observed. These benefits are particularly pronounced for populous countries, such as China, India, etc.

However, we also faced some challenges during the study. For example, in China, patients prefer to receive healthcare for stroke at specialty hospitals. Unfortunately, only a handful of these specialty hospitals are available in Beijing, the population of which exceeds 20 million. The hugely strained demand-and-supply relationship translated into increased working hours of healthcare providers and additional capital investment for new equipment. The fact that the resources of healthcare institutions vary significantly from metropolitan cities to rural counties in China has prompted the National Health and Family Planning Commission of China to blueprint different versions of clinical pathways. These fine-tuned clinical pathways are currently being evaluated.

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Disclosures

None.

References


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