Simple Text-Messaging Intervention Is Associated With Improved Door-to-Needle Times for Acute Ischemic Stroke

Molly M. Burnett, MD; Lara Zimmermann, MD; Zlatan Coralic, PharmD; Tina Quon, RN, MSN, CEN, BC; William Whetstone, MD; Anthony S. Kim, MD, MAS

Background and Purpose—Timely administration of intravenous tissue-type plasminogen activator (IV tPA) is associated with improved outcomes for acute ischemic stroke; yet, developing processes to consistently provide prompt treatment remains a challenge. We developed and evaluated a simple quality improvement intervention designed to improve door-to-needle (DTN) times for resident-led Code Stroke teams at an academic medical center.

Methods—we evaluated a simple text-messaging based intervention with real-time feedback to improve DTN times for intravenous tissue-type plasminogen activator. We used the rank-sum test and linear regression to evaluate for a change in DTN times that was temporally associated with the rollout of the intervention.

Results—A total of 202 patients received intravenous tissue-type plasminogen activator; 94 preintervention and 108 postintervention. The median DTN time was significantly lower in the postintervention period (56 minutes [interquartile range 44–71] versus 82 minutes [IQR 68–103], P<0.0001) and a significantly higher proportion of patients were treated within 60 minutes (61% versus 16%, P<0.001).

Conclusions—A simple real-time text-messaging intervention was associated with a significant improvements in DTN times for acute ischemic stroke. (Stroke. 2014;45:3714-3716.)

Key Words: door-to-treatment time ■ quality improvement ■ stroke ■ thrombolytic therapy

Thrombolysis for acute ischemic stroke is most effective when administered soon after symptom onset, and this efficacy declines with time.1–4 Therefore, improving door-to-needle (DTN) times for intravenous tissue-type plasminogen activator (IV tPA) has been a major goal for ongoing quality improvement efforts.

Current guidelines recommend administering IV tPA within 60 minutes of arrival to the emergency department,3 and recent reports have demonstrated that median DTN times of 20 minutes are achievable.6 The American Heart Association’s Target: Stroke initiative has highlighted this focus on DTN time and has been associated with improvements in this process measure at a national level,7 although there continue to be opportunities for improvement.8

At our academic medical center, we found that components of the Code Stroke response such as door-to-computed tomography scan or door-to-laboratory times often individually met performance goals. However, we were concerned that the frequent turnover of residents and fellows every few weeks contributed to a shorter institutional memory for best practices and a diffusion of accountability for the overall DTN performance. Therefore, we developed, implemented, and evaluated a simple text-messaging–based intervention to provide real-time feedback to improve DTN times.

Methods
We developed and implemented a quality improvement intervention to improve DTN times with 3 components:

Real-time feedback: For each Code Stroke activation, the team leader was required to report whether IV tPA was administered and the DTN time to the entire Code Stroke team in real-time via a group text page.

Process for improvement: Any cases with DTN time >60 minutes were formally reviewed within 24 to 72 hours to identify and address any systemic barriers to timely IV tPA administration.

Sharing performance data: A DTN dashboard was distributed to the team on a biweekly basis. This included midpoint feedback for on-service residents, as well as data on the prior performance-to-date for incoming residents before the start of their clinical rotation.

To evaluate the impact of the intervention, we compiled longitudinal data on consecutive adults treated with IV tPA for acute ischemic stroke that presented to the emergency department at our tertiary care center from January 2008 to April 2011. This analysis period encompassed the experience for ≥3 years before and 3 years after the intervention was implemented in April 2011.

Code Stroke responses are activated by group text page for suspects within 12 hours of symptom onset. Teams are led by a rotating neurology resident and include fellows and attendings; emergency department nurses, residents, pharmacists, and attendings; neuroradiologists; and radiology and laboratory technicians. Eligibility...
characteristics for IV tPA were based on 2007 and 2009 American Heart Association guidelines.\textsuperscript{2,9}

We used descriptive statistics and Fisher exact test to evaluate univariate and bivariate associations. We evaluated for a secular trend in DTN times during the preintervention period by visual inspection, as well as with linear regression. We used the rank-sum test to evaluate changes in median DTN times and linear regression to evaluate for changes in the slope or intercept of the linear trend associated with the intervention or potential co-interventions (an ED pharmacist service was initiated 14 months before the intervention, and an electronic medical record system with computerized physician order entry went live and the requirement for an INR result in patients without a known history of anticoagulant use was dropped 14 months after the intervention.)

**Results**

A total of 94 patients were treated in the preintervention period and 108 patients were treated in the postintervention period (Table). There was no significant linear trend for DTN times during the preintervention period (slope=-0.17 minutes/mo, 95% CI -0.66 to 0.31, \(P=0.47\)).

The median DTN time was significantly lower in the postintervention period compared with the preintervention period (56 minutes [IQR 44–71] versus 82 minutes [IQR 68–103], rank-sum \(P<0.001\) and a significantly higher proportion of patients were treated within 60 minutes (63\% versus 16\%, \(P<0.001\); Figure). Based on the linear trend, we observed a 14.9-minute improvement in DTN time (95\% CI 0.56–29.3, \(P=0.04\)) that coincided with the rollout of the intervention but not with the potential cointerventions listed above (data not shown).

**Table.** Characteristics of Patients With Acute Ischemic Stroke Treated With IV tPA Before and After Implementation of a Quality Improvement Intervention to Improve Door-to-Needle Times

<table>
<thead>
<tr>
<th></th>
<th>Preintervention n=94</th>
<th>Postintervention n=108</th>
<th>(P) Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age, mean (SD)</strong></td>
<td>73.2 (15.2)</td>
<td>73.6 (15.6)</td>
<td>0.83</td>
</tr>
<tr>
<td><strong>Female sex, n (%)</strong></td>
<td>48 (51.1)</td>
<td>58 (53.7)</td>
<td>0.78</td>
</tr>
<tr>
<td><strong>Initial NIHSS, median (IQR)</strong></td>
<td>10 (4–15)</td>
<td>10 (4–17)</td>
<td>0.74</td>
</tr>
<tr>
<td><strong>Stroke subtype, n (%)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Large vessel, anterior circulation</td>
<td>63 (67)</td>
<td>65 (60)</td>
<td>0.38</td>
</tr>
<tr>
<td>Large vessel, posterior circulation</td>
<td>6 (6)</td>
<td>10 (9)</td>
<td>0.60</td>
</tr>
<tr>
<td>Small vessel</td>
<td>4 (4)</td>
<td>12 (11)</td>
<td>0.12</td>
</tr>
<tr>
<td>Multifocal</td>
<td>3 (3)</td>
<td>9 (8)</td>
<td>0.15</td>
</tr>
<tr>
<td>Watershed</td>
<td>1 (1)</td>
<td>0 (0)</td>
<td>0.47</td>
</tr>
<tr>
<td>Mimic or undetermined</td>
<td>17 (18)</td>
<td>11 (10)</td>
<td>0.15</td>
</tr>
<tr>
<td>Diabetes mellitus, n (%)</td>
<td>21 (22)</td>
<td>24 (22)</td>
<td>0.99</td>
</tr>
<tr>
<td>Hypertension, n (%)</td>
<td>73 (78)</td>
<td>90 (83)</td>
<td>0.25</td>
</tr>
<tr>
<td>Dyslipidemia, n (%)</td>
<td>40 (43)</td>
<td>56 (52)</td>
<td>0.47</td>
</tr>
<tr>
<td>Atrial fibrillation, n (%)</td>
<td>39 (41)</td>
<td>46 (43)</td>
<td>0.86</td>
</tr>
<tr>
<td>CAD, n (%)</td>
<td>21 (22)</td>
<td>21 (19)</td>
<td>0.83</td>
</tr>
<tr>
<td>CHF, n (%)</td>
<td>17 (18)</td>
<td>17 (16)</td>
<td>0.99</td>
</tr>
<tr>
<td>Smoking, n (%)</td>
<td>20 (21)</td>
<td>12 (11)</td>
<td>0.16</td>
</tr>
<tr>
<td>Prior stroke/TIA, n (%)</td>
<td>31 (33)</td>
<td>28 (26)</td>
<td>0.70</td>
</tr>
</tbody>
</table>

\(\text{CAD}\) indicates coronary artery disease; \(\text{CHF}\), congestive heart failure; IV, intravenous; NIHSS, National Institute of Health Stroke Scale; \(\text{TIA}\), transient ischemic attack; and \(\text{tPA}\), tissue-type plasminogen activator.

There were no significant differences in the incidence of symptomatic intracranial hemorrhage (4% pre and post; \(P=0.99\)), stroke mimics (10% pre versus 8% post; \(P=0.81\)), and in-hospital death (13% pre versus 6% post; \(P=0.15\)).

**Discussion**

A simple text-messaging–based quality improvement intervention that provided real-time DTN time feedback was temporally associated with a significant improvement in DTN times at our academic medical center.

Our intervention was designed to focus the team on a specific performance goal and to provide timely feedback on performance against that goal but did not require a large investment of resources or staff time, or changes in existing protocols since we left it to team leaders to define how the goal was to be achieved.

Quality improvement efforts that rely on retrospective review can often provide feedback only weeks or months later. In practice settings where staff rotate frequently, this feedback can arrive too late to change clinical practice. In contrast, a real-time reporting mechanism allows for a tighter feedback loop while the clinical details of a particular case are still fresh in the minds of team members. It may also serve to increase accountability for DTN performance—an especially relevant issue at centers where staff turnover can contribute to a diffusion of accountability.

Although the performance improvements we observed were robust and temporally associated with our intervention, these data reflect the experience at a single center and we cannot exclude the possibility that cointerventions or unmeasured changes contributed to the observed improvements. Furthermore, although the particular components of the intervention that may be most responsible for improvements are unknown and further improvements will require additional structural changes to our infrastructure and protocols, our simple intervention could be readily implemented at other centers and its impact has the potential to be generalizable to other practice settings.
Disclosures
Dr Kim receives support from the National Institutes of Health (the National Institute of Neurological Disorders and Stroke and the National Center for Advancing Translational Sciences). The other authors have no disclosures to report.

References
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