

Improving Door-to-Needle Times in Acute Ischemic Stroke: Principal Results from the Target: Stroke Initiative

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Background

- The benefits of intravenous tPA in acute ischemic stroke are highly time-dependent.
- Because of the importance of rapid treatment, AHA/ASA guidelines recommend a door-to-needle (DTN) time of ≤ 60 minutes.
- Yet prior studies suggested fewer than 30% of intravenous tPA treated acute ischemic stroke patients in the United States were meeting this goal.
- To address this shortfall, Target: Stroke, a national initiative organized by the AHA/ASA, was launched in January 2010 to increase the proportion of stroke patients with DTN times ≤ 60 minutes (initial goal of $\geq 50\%$).

Target: Stroke

- Target: Stroke was initiated by the AHA/ASA together with other partner organizations as a collaborative national initiative comprising a multidisciplinary group of clinicians and broad alliance of hospitals.
- The primary goal of Target: Stroke was for GWTG-Stroke participating hospitals in aggregate to treat at least 50% of acute ischemic stroke patients with tPA within 60 minutes or less of hospital arrival.
- An expert working group performed a systematic review of the published data on improving DTN times and identified 10 key evidence-based strategies associated with timely stroke reperfusion that could be most rapidly, feasibly, and cost effectively adopted by participating hospitals.
- Comprehensive implementation manual, clinical decision support tools, education, sharing of best practices, performance feedback, and national recognition opportunities.

Target: Stroke 10 Key Best Practice Strategies

1. Hospital pre-notification by Emergency Medical Services
2. Rapid triage protocol and stroke team notification
3. Single call/paging activation system for entire stroke team
4. Use of a stroke toolkit containing clinical decision support, stroke-specific order sets, guidelines, hospital-specific algorithms, critical pathways, NIH Stroke Scale and other stroke tools
5. Rapid acquisition and interpretation of brain imaging
6. Rapid Laboratory Testing (including point-of-care testing) if indicated
7. Pre-mixing tPA medication ahead of time for high likelihood candidates
8. Rapid access to intravenous tPA in the ED/brain imaging area
9. Team-based approach
10. Rapid data feedback to stroke team on each patient's DTN time and other performance data

Customizable Implementation Tools

- Patient time-trackers
- Guideline based algorithms
- tPA checklist
- Standardized order sets
- Dosing charts
- Clinical pathways
- Evidence-based protocols
- EMS tools
- Patient educational materials
- Other tools

Target: Stroke tools: www.targetstroke.org
 Clinical tools library: heart.org/strokeclinicaltools.

PATIENT TIME TRACKER

TARGET: STROKE

ACUTE ISCHEMIC STROKE TREATMENT GOAL:
DTN TIME WITHIN 60 MINUTES

Last Known Well: _____ Date: _____ Time: _____
 Weight: _____ (kg) Total Dose: _____ (mg) Bolus: _____ (mg)

| | Clock Time | Time Intervals |
|------------------------------------|-------------------------|----------------|
| Pre-Arrival notification: | Date: _____ Time: _____ | _____ (min) |
| Arrival (ED Registration): | Date: _____ Time: _____ | 0 (min) |
| Acute Stroke Team Notification: | Time: _____ | _____ (min) |
| Acute Stroke Team Bedside: | Time: _____ | _____ (min) |
| CT/MRI Time (Scout Film Acquired): | Time: _____ | _____ (min) |
| IV rt-PA Order* Time: | Time: _____ | _____ (min) |
| IV rt-PA Time Given: | Time: _____ | _____ (min) |

Door to TPA time (goal ≤ 60 minutes): _____ minutes
 Door to CT/MRI time (goal ≤ 25 minutes): _____ minutes
 Door to Stroke Team Notification (goal ≤ 15 minutes): _____ minutes

* If IV rt-PA not given, select reason(s) for non-treatment. (See Get With The Guidelines coding instructions for definitions.)

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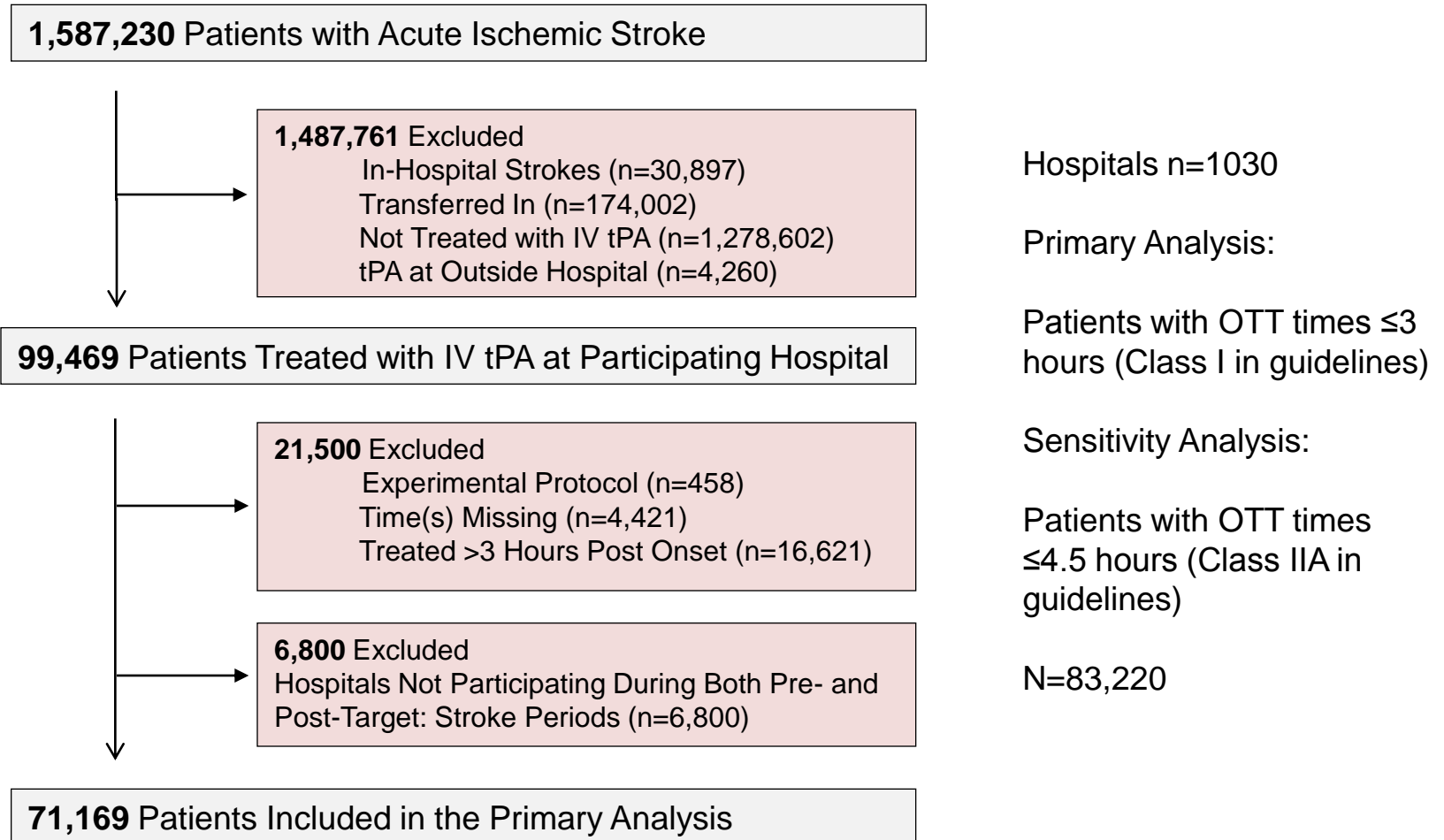
Objectives

- To evaluate the principle results of the Target: Stroke by analyzing the temporal trends in DTN times and proportion of patients with DTN times ≤ 60 minutes before and after initiation of the Target: Stroke program among GWTG-Stroke participating hospitals.
- To evaluate whether potential improvements in DTN times were associated with improvements in clinical outcomes including in-hospital mortality, discharge destination, ambulatory status, symptomatic intracranial hemorrhage ≤ 36 hours after tPA, and overall tPA complications.

Methods

- This study included 71,169 stroke patients treated with tPA (27,319 pre-intervention, 43,850 post-intervention) from 1,030 GWTG-Stroke participating hospitals during the pre- and post-Target: Stroke periods.
- Quarterly rates of DTN times ≤ 60 minutes and clinical outcomes pre-Target: Stroke (2003-2009) were compared to post-Target Stroke (2010-2013).
- Adjustment for patient and hospital characteristics. To account for within-hospital clustering, generalized estimating equations were used. To compare the temporal change in rates of DTN times piecewise (segmented) logistic regression analyses were performed.
- Clinical outcomes assessed: in-hospital mortality, discharge destination, ambulatory status, symptomatic intracranial hemorrhage ≤ 36 hours after tPA, and overall tPA complications.

Selection of the Study Population



Demographics and Clinical Characteristics Pre- and Post-Target: Stroke

| Characteristics | Total (N=71,169) | Pre-Target: Stroke (N=27,319) | Post-Target: Stroke (N=43,850) | Standardized Difference |
|---|---------------------|-------------------------------------|--------------------------------------|----------------------------|
| Demographics | | | | |
| Age (median, 25 th , 75 th) | 72 (60-82) | 72 (60-82) | 72 (60-83) | 3.70 |
| Sex (% , women) | 50.1 | 49.4 | 50.5 | 2.25 |
| Race/Ethnicity (%) | | | | |
| White | 72.8 | 75.1 | 71.4 | 8.43 |
| Black | 13.8 | 12.6 | 14.5 | 5.80 |
| Hispanic | 6.6 | 5.7 | 7.3 | 6.51 |
| Arrival and Admission | | | | |
| Patient Arrival Mode (% , EMS) | 80.4 | 84.6 | 77.7 | 17.8 |
| Arrival on Hours (% , yes) | 47.4 | 47.4 | 47.4 | 0.10 |
| Onset-to-Arrival Time | 51 (36-72) | 50 (35-70) | 52 (36-73) | 4.74 |
| Medical History | | | | |
| Atrial Fibrillation/Flutter (%) | 22.8 | 22.6 | 22.9 | 0.69 |
| Previous Stroke/TIA (%) | 23.7 | 22.5 | 24.5 | 4.79 |
| CAD/Prior MI (%) | 25.7 | 26.9 | 24.9 | 4.48 |
| Diabetes Mellitus (%) | 24.6 | 22.9 | 25.6 | 6.28 |
| PVD (%) | 3.5 | 3.4 | 3.5 | 0.87 |
| Hypertension (%) | 72.4 | 71.2 | 73.1 | 4.24 |
| Smoking (%) | 17.8 | 18.7 | 17.3 | 3.71 |
| Evaluation | | | | |
| NIH Stroke Scale (median, 25 th , 75 th) | 11 (6-18) | 12 (7-18) | 11 (6-18) | 12.9 |
| Length of Stay (days) | 5 (3-8) | 5 (3-8) | 5 (3-7) | 11.2 |

Hospital Characteristics Pre- and Post-Target: Stroke

| Characteristics | Total (N=71,169) | Pre-Target: Stroke (N=27,319) | Post-Target: Stroke (N=43,850) | Standardized Difference |
|--|---------------------|----------------------------------|--------------------------------------|----------------------------|
| Annual Volume of Ischemic Stroke Admissions (median, 25 th , 75 th) | 233 (163-339) | 240 (165-347) | 230 (161-337) | 2.50 |
| Annual Volume of IV tPA (median, 25 th , 75 th) | 19.5 (11.6-29.6) | 19.2 (11.6-29.3) | 19.7 (11.7-29.6) | 1.15 |
| Number of Beds (median, 25 th , 75 th) | 403 (283-595) | 404 (283-601) | 401 (280-588) | 2.51 |
| Region (%) | | | | |
| West | 21.5 | 21.2 | 21.7 | 1.23 |
| South | 33.9 | 32.3 | 34.8 | 5.27 |
| Midwest | 17.3 | 17.3 | 17.3 | 0.17 |
| Northeast | 27.3 | 29.2 | 26.2 | 6.83 |
| Teaching Hospital (%) | 65.2 | 65.5 | 65.0 | 0.94 |
| Rural Location (%) | 2.2 | 2.2 | 2.2 | 0.15 |
| Certified Primary Stroke Center (%) | 57.3 | 58.3 | 56.7 | 3.12 |

A standardized difference greater than 10 is typically considered meaningful.

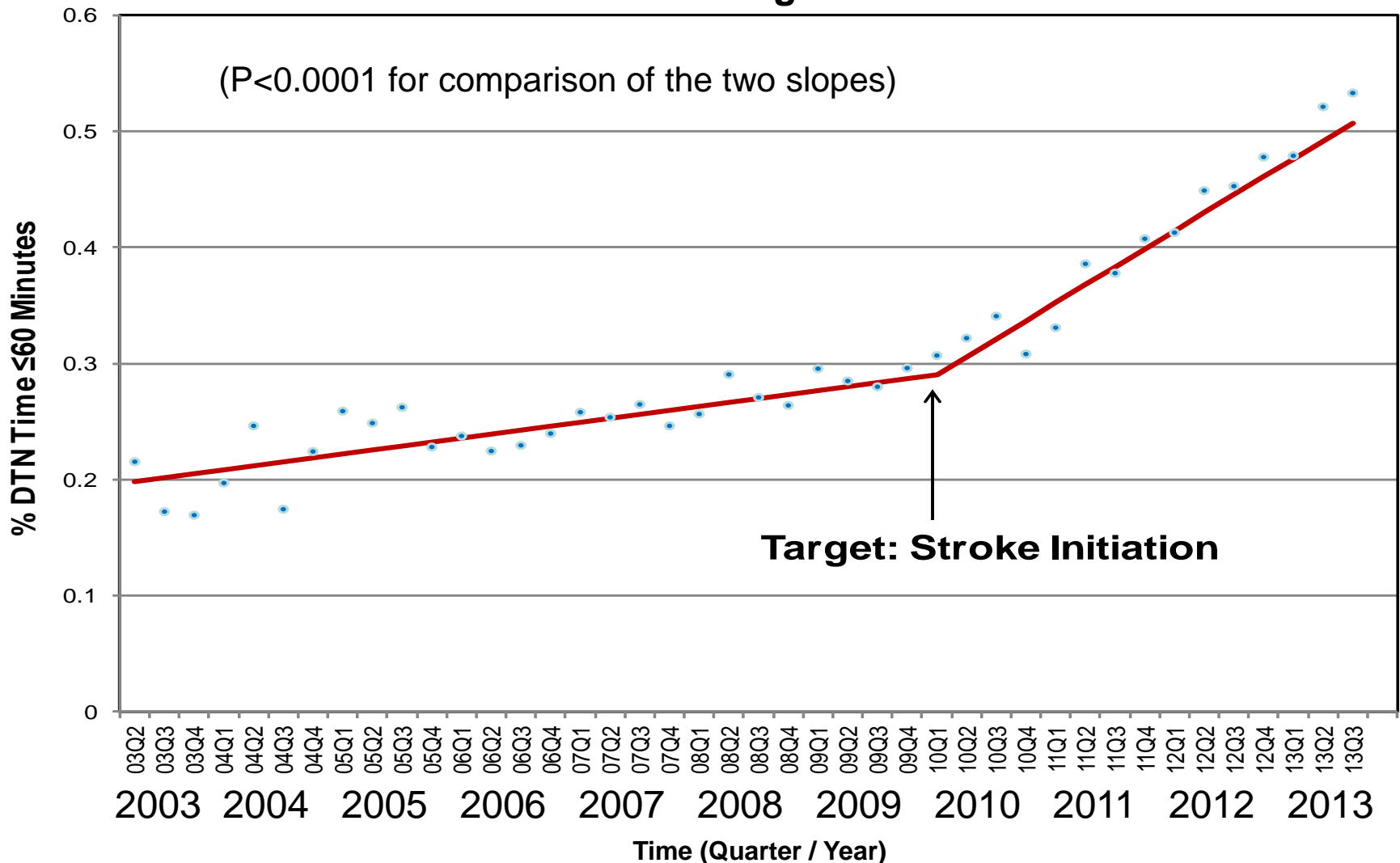
Results: Impact on DTN Times

The percentage of patients with DTN times ≤ 60 minutes increased from 29.6% immediately prior to the start of Target: Stroke in Quarter 4 of 2009) to 53.3% in Quarter 3 of 2013 ($P < 0.0001$).

The median DTN time was 74 minutes in Quarter 4 of 2009 immediately prior to initiation of Target: Stroke and declined to 59 minutes by Quarter 3 of 2013 (absolute difference 15 minutes, $P < 0.0001$).

In 2009, prior to initiation of Target: Stroke, 15.6% of hospitals had DTN times ≤ 60 minutes in 50% or more of tPA treated stroke patients whereas in 2013, this benchmark was being met by 46.7% of participating hospitals ($P < 0.0001$).

Time Trend in the Proportion of Patients with DTN Times within 60 Minutes Pre- and Post-Target: Stroke



Unadjusted and Adjusted Piecewise GEE Analyses for the Proportion of Patients with DTN Times within 60 Minutes Post- vs Pre-Target: Stroke

| | | Unadjusted | | | Adjusted* | | |
|----------------------|--|------------|------------|---------|-----------|-----------|---------|
| Outcome | Variable | OR | 95% CI | P-value | OR | 95% CI | P-value |
| DTN time ≤60 Minutes | Pre-Target: Stroke (per 4 quarters calendar time) | 1.08 | 1.05-1.12 | <0.0001 | 1.09 | 1.06-1.13 | <0.0001 |
| | Post-Target: Stroke (per 4 quarters calendar time) | 1.32 | 1.28- 1.35 | <0.0001 | 1.35 | 1.31-1.38 | <0.0001 |
| | Post vs. Pre-Target: Stroke (per 4 quarters calendar time) | 1.22 | 1.16-1.28 | <0.0001 | 1.23 | 1.17-1.29 | <0.0001 |
| | Post vs. Pre-Target: Stroke (cumulative difference) | 1.98 | 1.84-2.12 | <0.0001 | 2.09 | 1.95-2.25 | <0.0001 |

*Adjusted for patient characteristics including age, sex, race, medical history of atrial fibrillation, prosthetic heart valve, previous stroke/transient ischemic attack, coronary heart disease or prior myocardial infarction, carotid stenosis, peripheral vascular disease, hypertension, dyslipidemia, and current smoking, stroke severity (NIHSS), arrival time during regular work hours, arrival mode, onset-to-arrival time; hospital characteristics of hospital size, region, teaching status, certified primary stroke center, annual volume of tPA, and annual stroke discharge.

Results: Impact on DTN Times

The annual rate of increase in the proportion of patients with DTN time ≤ 60 minutes was 1.36% per year pre-Target: Stroke with notable acceleration to 6.20% per year after implementation of Target: Stroke ($P < 0.0001$).

The program goal of DTN times ≤ 60 minutes in at least 50% of patients was achieved in < 4 years rather than the expected 15 or more years if the pre-Target: Stroke intervention slope of increase in the proportion of patients with DTN times ≤ 60 minutes had persisted.

The improvement in DTN times post-Target: Stroke were observed among clinically relevant subgroups of patients including men and women, patients older and younger than the median age of 72, white, black, and Hispanic patients, and patients with greater and lesser stroke severity (NIHSS above and below the median of 11).

Results: Clinical Outcomes Pre- and Post-Target: Stroke

| Outcome | Pre-Target: Stroke (n=27,319) | Post-Target: Stroke (n=43,850) | Difference Pre and Post | P Value |
|-------------------------------------|-------------------------------------|--------------------------------------|----------------------------|---------|
| In-Hospital Mortality | 9.93% | 8.25% | -1.68% | <0.0001 |
| Discharge Home | 37.6% | 42.7% | +5.1% | <0.0001 |
| Ambulatory Status Independent | 42.2% | 45.4% | +3.2% | <0.0001 |
| Symptomatic ICH | 5.68% | 4.68% | -1.00% | <0.0001 |
| Any tPA Complications | 6.68% | 5.50% | -1.18% | <0.0001 |

Outcomes Pre- and Post-Target: Stroke- GEE Analyses

| Outcome | Unadjusted Odds Ratios (95% CI) | P Value | Adjusted Odds Ratios (95% CI)* | P Value* |
|-------------------------------|---------------------------------|---------|--------------------------------|----------|
| In-Hospital Mortality | 0.81 (0.77-0.86) | <0.0001 | 0.89 (0.83-0.94) | 0.0002 |
| Discharge Home | 1.23 (1.18-1.27) | <0.0001 | 1.14 (1.09-1.19) | <0.0001 |
| Ambulatory Status Independent | 1.14 (1.09-1.20) | <0.0001 | 1.03 (0.97-1.10) | 0.3091 |
| Symptomatic ICH | 0.81 (0.75-0.88) | <0.0001 | 0.83 (0.76-0.91) | <0.0001 |
| Any tPA Complications | 0.80 (0.75-0.87) | <0.0001 | 0.83 (0.77-0.90) | <0.0001 |

*Adjusted for patient characteristics including age, sex, race, medical history of atrial fibrillation, prosthetic heart valve, previous stroke/transient ischemic attack, coronary heart disease or prior myocardial infarction, carotid stenosis, peripheral vascular disease, hypertension, dyslipidemia, and current smoking, stroke severity (NIHSS), arrival time during regular work hours, arrival mode, onset-to-arrival time; hospital characteristics of hospital size, region, teaching status, certified primary stroke center, annual volume of tPA, and annual stroke discharge.

Results: Sensitivity Analyses

- Similar findings were obtained in sensitivity analyses including all intravenous tPA treated patients with onset-to-treatment times within 4.5 hours (n=83,220).
- There was a marked improvement in the proportion of patients with DTN times ≤ 60 minutes after initiation of Target: Stroke with a significant slope change starting in January 2010.
- This improvement in DTN times was accompanied by lower in-hospital mortality, symptomatic intracranial hemorrhage, and overall tPA complications with more patients able to be discharged to home.
- These findings remained highly statistically significant after adjusting for patient and hospital characteristics.

Limitations

- Participation in GWTG-Stroke/Target: Stroke was voluntary and these hospitals likely have greater interest in stroke quality improvement.
- Target: Stroke did not have a concurrent control group of hospitals and it is possible that the improvements in DTN times may have been influenced by other factors. However, efforts in place in the 2003-2009 timeframe were observed to have little impact on DTN times.
- Possibility for there to be residual measured and unmeasured confounders related to the improvements in DTN times and clinical outcomes.
- Data collected as part of GWTG-Stroke including DTN times are dependent on the accuracy and completeness of abstraction from the medical record.

Conclusions

- The timeliness of tPA administration improved substantially in GWTG-Stroke hospitals after initiation of the multidimensional AHA/ASA Target: Stroke quality initiative.
- The proportion of patients with DTN times ≤ 60 minutes increased from 29.6% to 53.3%. There was also a more than 4-fold increase in the annual rate of improvement in patients with DTN time ≤ 60 minutes.
- This improvement was accompanied by lower in-hospital mortality, symptomatic intracranial hemorrhage, and overall tPA complications with more patients able to be discharged to home.
- The results of this study suggest a favorable impact of applying performance improvement techniques of identifying best practices, clinical decision support, guideline-driven care improvement tools, educational outreach, collaborative support, performance profiling, feedback, and recognition.

Conclusions

- While there have been concerns that attempting to achieve shorter DTN times may lead to rushed assessments, inappropriate patient selection, dosing errors, and greater likelihood of complications, our findings suggest that more rapid reperfusion therapy in acute ischemic stroke is not only feasible, but can be achieved with actual reductions in complications and improved outcomes.
- These findings further reinforce the importance and substantial clinical benefits of more rapid administration of intravenous tPA.

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- DCRI



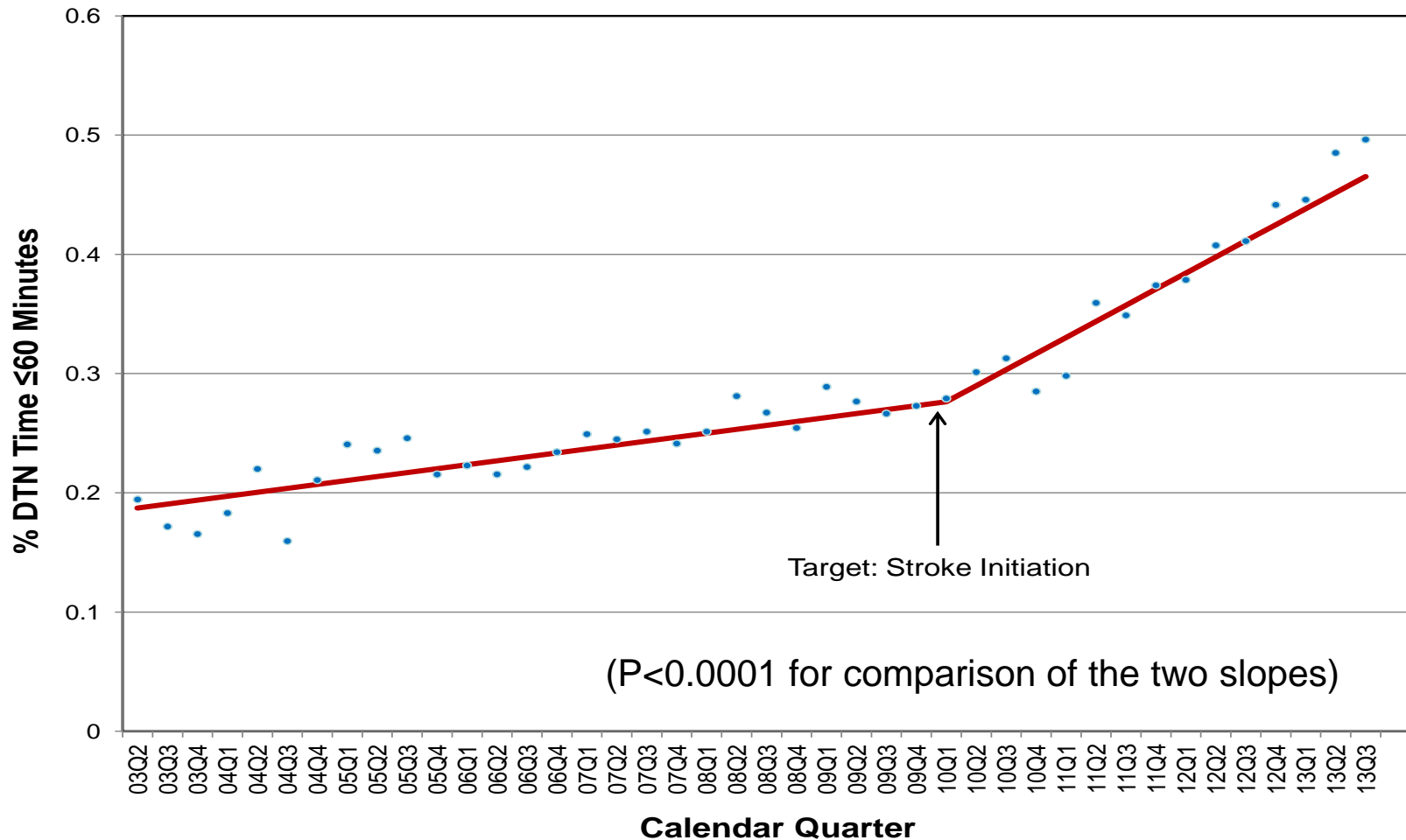
strokeassociation.org/targetstroke



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Back-up Slides

Time Trend in the Proportion of Patients with DTN Times within 60 Minutes Pre- and Post-Target: Stroke in Patients with OTT Time within 4.5 Hours



Clinical Outcomes Pre- and Post-Target: Stroke in Patients in Patients with Onset to Treatment Time within 4.5 Hours

| Outcome | Pre-Target: Stroke (n=29,986) | Post-Target: Stroke (n=53,234) | P Value | Unadjusted Odds Ratios (95% CI) | P Value | Adjusted Odds Ratios (95% CI)* | P Value* |
|-------------------------------|----------------------------------|-----------------------------------|---------|------------------------------------|---------|-----------------------------------|----------|
| In-Hospital Mortality | 9.95% | 8.08% | <0.0001 | 0.79 (0.75-0.84) | <0.0001 | 0.90 (0.84-0.95) | 0.0004 |
| Discharge Home | 37.6% | 43.3% | <0.0001 | 1.25 (1.20-1.29) | <0.0001 | 1.13 (1.08-1.17) | <0.0001 |
| Ambulatory Status Independent | 42.2% | 45.9% | <0.0001 | 1.16 (1.10-1.22) | <0.0001 | 1.02 (0.96-1.09) | 0.4538 |
| Symptomatic ICH | 5.74% | 4.74% | <0.0001 | 0.81 (0.75-0.88) | <0.0001 | 0.84 (0.78-0.92) | <0.0001 |
| Any tPA Complications | 6.75% | 5.54% | <0.0001 | 0.80 (0.75-0.86) | <0.0001 | 0.84 (0.78-0.91) | <0.0001 |

*Adjusted for patient characteristics including age, sex, race, medical history of atrial fibrillation, prosthetic heart valve, previous stroke/transient ischemic attack, coronary heart disease or prior myocardial infarction, carotid stenosis, peripheral vascular disease, hypertension, dyslipidemia, and current smoking, stroke severity (NIHSS), arrival time during regular work hours, arrival mode, onset-to-arrival time; hospital characteristics of hospital size, region, teaching status, certified primary stroke center, annual volume of tPA, and annual stroke discharge.

Association of DTN Time ≤ 60 Minutes with in-Hospital Clinical Outcomes in GWTG-Stroke

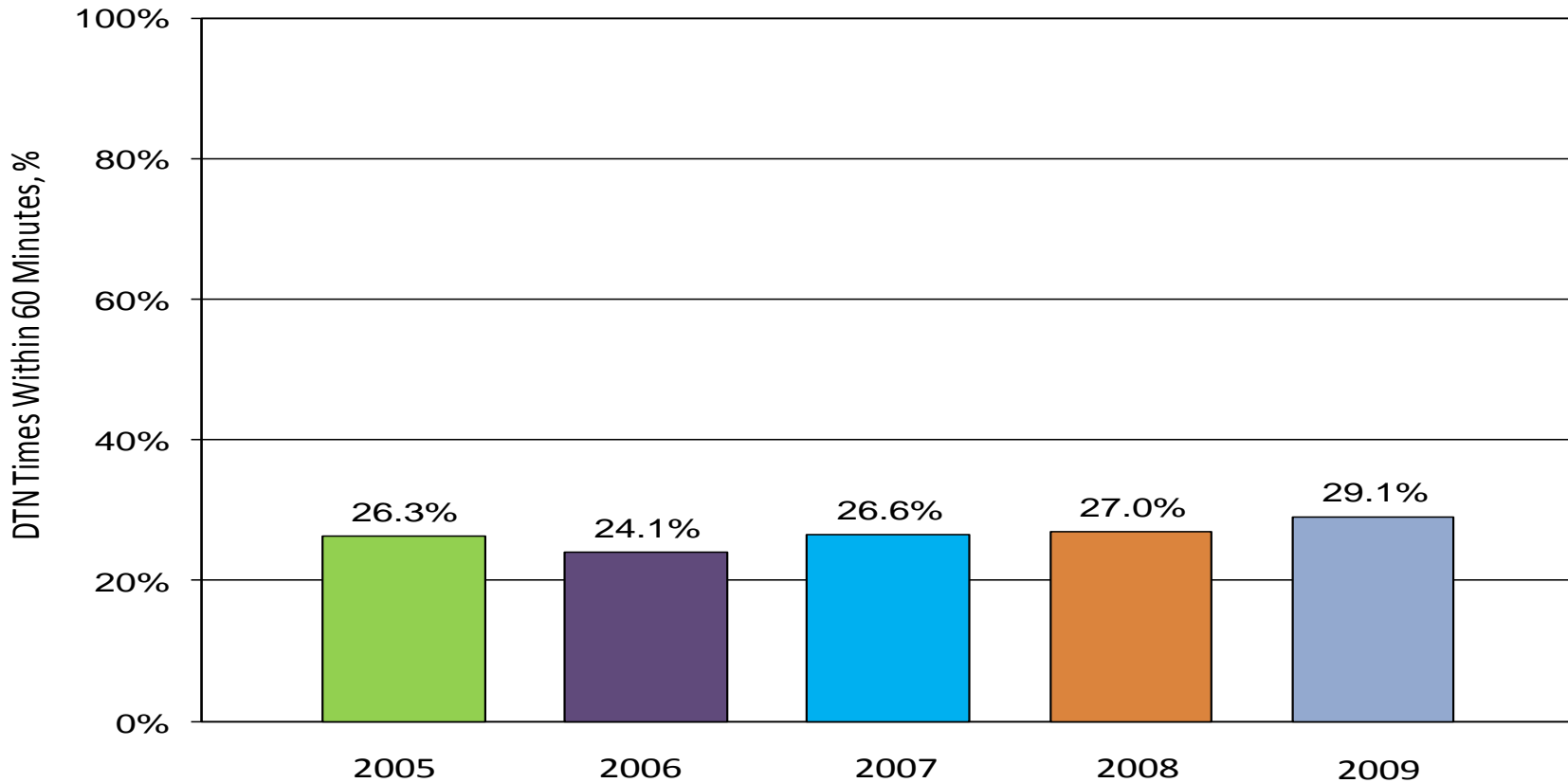
25,504 acute ischemic stroke patients treated with tPA within 3 hrs of symptom onset at 1082 hospital sites.

After adjustment, DTN ≤ 60 minutes was associated with 22% lower odds of in-hospital mortality, adjusted OR, 0.78; 95% CI, 0.69 to 0.90; P=0.0003

Lower rates of sICH and any tPA complications

* Variables included in multivariable GEE models were age, sex, race, prior medical history of AF, stroke/TIA, CHD/MI, carotid stenosis, diabetes, PVD, hypertension, dyslipidemia, smoking, NIHSS (continuous), arrival mode (EMS vs other), arrival time on hours, hospital characteristics of geographic region, academic, PSC, bed size, annual number of strokes, annual number of tPA patients.

Temporal Trends in the Proportion of Patients with DTN Times ≤ 60 Minutes 2005-2009



Hospital Variation in the Proportion of Ischemic Stroke Patients with DTN Times ≤ 60 Minutes

