Population-based study of home-time by stroke type and correlation with modified Rankin score

Amy Y.X. Yu, MD, MSc
Edwin Rogers, MA
Meng Wang, MSc
Tolulope T. Sajobi, PhD
Shelagh B. Coutts, MD,
MSc
Bijoy K. Menon, MD,
MSc
Michael D. Hill, MD,
MSc
Eric E. Smith, MD, MPH

Correspondence to
Dr. Yu:
amy.yu@ucalgary.ca

ABSTRACT

Objective: To describe home-time, stratified by stroke type, in a complete population and to determine its correlation with modified Rankin Scale (mRS) scores.

Methods: We used linked administrative data to derive home-time in all patients admitted for a cerebrovascular event in Alberta, Canada, between 2012 and 2016. Home-time is the number of days spent outside a health institution in the first 90 days after index hospitalization. We used negative binomial regression, adjusted for age, sex, Charlson comorbidity index, and hospital location, to determine the association between home-time and stroke type. In 552 patients enrolled in 4 acute ischemic stroke clinical trials, we used multivariable ordinal logistic regression analysis to determine the association between home-time and mRS score at 90 days.

Results: Among 15,644 patients ($n = 10,428$ with ischemic stroke, $n = 1,415$ with intracerebral hemorrhage, $n = 760$ with subarachnoid hemorrhage, $n = 3,041$ with TIA), patients with TIA have the longest home-time, almost triple the number of days at home compared to patients with intracerebral hemorrhage (incidence rate ratio 2.85, 95% confidence interval [CI] 2.58–3.15). Among clinical trial ischemic stroke patients, longer home-time was associated with a lower mRS score at 90 days (adjusted common odds ratio 1.04, 95% CI 1.04–1.05).

Conclusions: We showed that home-time is an objective and graded indicator that is correlated with disability after stroke. It is obtainable from administrative data, applicable to different stroke types, and a valuable outcome indicator in population-based health services research.

Neurology® 2017;89:1970–1976

GLOSSARY

CI = confidence interval; **ESCAPE** = Endovascular Treatment for Small Core and Anterior Circulation Proximal Occlusion With Emphasis on Minimizing CT to Recanalization Times; **GAIN** = Glycine Antagonist in Neuroprotection; **ICD-10-CA** = International Classification of Diseases, 10th Canadian Revisions; **INTERSeCT** = Identifying New Approaches to Optimize Thrombus Characterization for Predicting Early Recanalization and Reperfusion With IV tPA Using Serial CT Angiography; **IRR** = incidence rate ratio; **MRS** = modified Rankin Scale; **NIHSS** = NIH Stroke Scale; **PROvelT** = Precise and Rapid Assessment of Collaterals Using Multiphase CTA in the Triage of Patients With Acute Ischemic Stroke for Intra-arterial Therapy; **SAINT I** = Stroke-Acute Ischemic NXY Treatment I; **TEMPO-1** = TNK-tPA Evaluation for Minor Ischemic Stroke With Proven Occlusion.

Functional recovery is an important poststroke outcome. The modified Rankin Scale (mRS), the most commonly used stroke outcome measure in clinical studies,¹ is subject to rater bias and variations in interrater reliability² and requires prospective data collection, making it vulnerable to selection and attrition bias. Home-time, broadly defined as the total number of days living independently in the community in the initial 90 days after stroke, has been proposed as an alternative metric that correlates well with global disability after stroke.^{3–5} Returning to home is valued by patients after stroke⁶ and other medical conditions.⁷ Home-time is graded and objective, easily interpretable, and intuitively associated with decreased direct health care costs.^{3,8}

A key advantage of home-time is that it is obtainable from routinely collected administrative data.⁸ It is therefore applicable to population-based health services research in which active collection of individual outcomes may not be feasible. A recent study of US Medicare beneficiaries ≥ 65 years of age showed that home-time after ischemic stroke, calculated from

Supplemental data
at Neurology.org

From the Department of Clinical Neurosciences (A.Y.X.Y., M.W., T.T.S., S.B.C., B.K.M., M.D.H., E.E.S.), Department of Community Health Sciences (A.Y.X.Y., T.T.S., S.B.C., B.K.M., M.D.H., E.E.S.), Department of Radiology (S.B.C., B.K.M., M.D.H., E.E.S.), and Hotchkiss Brain Institute (T.T.S., S.B.C., B.K.M., M.D.H., E.E.S.), University of Calgary; and Alberta Health Services (E.R.), Calgary, Canada.

Go to Neurology.org for full disclosures. Funding information and disclosures deemed relevant by the authors, if any, are provided at the end of the article.

administrative data, was highly correlated with prospectively collected mRS scores.⁸ Home-time is less understood in younger patients, and it has not been studied in other stroke types, including TIAs and hemorrhagic strokes. Moreover, because administrative data are influenced by country- or jurisdiction-specific health systems and clinical practices, it is valuable to study the variations of this new outcome metric in different populations.

We aimed to describe home-time after stroke, stratified by stroke type, in a complete Canadian population and to assess the correlation between administrative data-based home-time and prospectively collected mRS score at 90 days using data from Canadian ischemic stroke clinical trials. We hypothesized that home-time has strong content validity compared with the mRS score.

METHODS **Definition and calculation of home-time after stroke.** We developed an administrative data algorithm to calculate home-time for all patients admitted to hospital for a stroke or TIA in Alberta, Canada. The algorithm applied 2 methods to calculate the 90-day home-time. In the first method, home-time return to home was defined as the number of nights spent in a private residence, whether it was the patient's own home or that of a relative, with or without home care services, within 90 days of the index admission to acute care hospital. Time spent home was inferred when nights were not recorded as being spent in some form of care. The second method, home-time return to baseline, recognized that patients who experience cerebrovascular events may already be living in a care setting at the time of stroke onset. For example, a stroke patient who was living in supportive living before the stroke may recover enough function to return to the same level of care after stroke. This type of outcome is important to capture because a return to the pre-morbid living situation is valued by the patient and cost-saving to the health system. Therefore, home-time return to baseline was defined as the number of nights the patients spent in their pre-stroke living situation, without an increase in level of care, within 90 days of the index admission to acute care hospital for stroke. Baseline home status was determined from administrative data and was assigned on the basis of any use of continuing care facilities in the 2-week period before stroke admission. If a patient was not recorded as receiving some form of care, the baseline living situation was inferred to be the private home. By definition, in both methods, patients who died in hospital after the index stroke have a home-time of zero days.

Administrative data sources and linkage. Data sources used to determine home-time include the inpatient Discharge Abstract Database (acute care hospitals),⁹ the National Ambulatory Care Reporting System (emergency department),¹⁰ the National Rehabilitation System (rehabilitation facilities),¹¹ and the Provincial Continuing Care Information System (supportive living and long-term care facilities).¹² All residents of Alberta, Canada, have access to the publicly funded and universally available health care system. The Alberta Health Care Insurance Plan provides medical coverage to most (>99%) Alberta residents except for the

members of the military, federal inmates, individuals who opt out of the Alberta Health Care Insurance Plan, and the Royal Canadian Mounted Police. The administrative health databases were linked deterministically by use of the unique personal health number.

Population data. Alberta residents with a valid health care number admitted to an acute care hospital with ischemic stroke, intracerebral hemorrhage, subarachnoid hemorrhage, or TIA between April 1, 2012, and March 31, 2016, were identified. Patients <20 years of age and those with record of leaving against medical advice or failing to return after an out-of-hospital pass were excluded. We used ICD-10-CA codes G45.x except G45.4 to identify TIA; H34.1, I63.x except I63.6, and I64.x for ischemic strokes; I61.x for intracranial hemorrhage; and I60.x for subarachnoid hemorrhage.¹³ Only the most responsible diagnosis was used, implying that stroke accounted for the highest resource use during the admission.

Clinical trials data. We compared the administrative data-derived 90-day home-time with the prospectively collected 90-day mRS score in a cohort of ischemic stroke patients enrolled in 4 clinical trials: Endovascular Treatment for Small Core and Anterior Circulation Proximal Occlusion With Emphasis on Minimizing CT to Recanalization Times (ESCAPE; NCT01778335), TNK-tPA Evaluation for Minor Ischemic Stroke With Proven Occlusion (TEMPO-1; NCT01654445), Precise and Rapid Assessment of Collaterals Using Multiphase CTA in the Triage of Patients With Acute Ischemic Stroke for Intra-arterial Therapy (PROVE-IT; NCT02184936), and Identifying New Approaches to Optimize Thrombus Characterization for Predicting Early Recanalization and Reperfusion With IV tPA Using Serial CT Angiography (INTERRSeCT).^{14–16} All 4 trials enrolled acute ischemic stroke patients within 12 hours of stroke onset. Extracted data included age, sex, baseline NIH Stroke Scale (NIHSS), date of enrollment, and 90-day mRS score. Only residents of Alberta were included.

Standard protocol approvals, registrations, and patient consents. All 4 clinical trials were sponsored by the University of Calgary and received approval from the institutional review board for research using human participants. Written informed consent was obtained from patients enrolled in ESCAPE, TEMPO-1, and INTERRSeCT, and waiver of consent was approved for enrollment in PROVE-IT. The current study received approval from the University of Calgary institutional review board for research, and a waiver of consent was granted (REB16-0873).

Statistical methods. Patient characteristics in both data sources were described with proportions for categorical variables and medians with 25th and 75th percentiles. The distributions of home-time by stroke type were presented with violin plots and histograms. The correlation between the 2 methods of home-time calculation (return to baseline vs return to home) was assessed with the Spearman rank correlation. Because of the nonnormal bucket-shaped distribution of home-time, we used the Kruskal-Wallis test to compare the median home-time across the different stroke types in administrative data sources. We used negative binomial regression to assess the association between home-time and stroke type controlling for age, sex, Charlson comorbidity index, and initial presentation to a rural hospital. The incidence rate ratio (IRR) and 95% confidence interval (CI) were used to estimate the effects of each predictor on home-time. IRR is the ratio of the number of days at home among patients exposed to covariates of interest over the number of days at home among those unexposed. We used the acute ischemic stroke clinical trials

Table 1 Baseline characteristics by stroke type

	Ischemic stroke (n = 10,428)	Intracerebral hemorrhage (n = 1,415)	Subarachnoid hemorrhage (n = 760)	TIA (n = 3,041)
Median age (quartile 1, 3), y	74 (63, 83)	73 (61, 82)	58 (50, 69)	75 (63, 84)
Male sex, n (%)	5,614 (53.8)	720 (50.9)	316 (41.6)	1,587 (52.2)
Charlson comorbidity index >2, n (%)	2,647 (25.4)	331 (23.4)	76 (10.0)	410 (13.5)
Premorbid home in rural municipality, n (%)	5,066 (48.6)	591 (41.8)	379 (49.9)	1,935 (63.7)
Premorbid home status noninstitutionalized, n (%)	9,465 (90.7)	1,268 (89.6)	741 (97.5)	2,756 (90.6)
Presenting hospital in rural municipality, n (%)	2,982 (28.6)	238 (16.8)	67 (8.8)	1,527 (50.2)
Any transfer during care, n (%)	1,084 (10.4)	206 (14.6)	108 (14.2)	117 (3.9)

data to evaluate the association between home-time and mRS score at 90 days using the Spearman rank correlation. Ordinal logistic regression was used to assess the association between home-time and mRS score with and without adjustment for age, sex, baseline NIHSS score, and Charlson comorbidity index. Odds ratio and 95% CI were used to assess the effect of each predictor of mRS score. The assumptions of proportionality for ordinal logistic regression were assessed with the score test, and model fit was assessed with the C statistic. All analyses were conducted with SAS 9.4 (SAS Institute Inc, Cary, NC), and some analyses and all figures were completed with STATA 14.0 (STATA Corp, College Station, TX).

RESULTS Home-time after stroke in the population.

We included 15,644 patients, including 10,428 (66.7%) patients admitted to the hospital with an ischemic stroke, 1,415 (9.1%) patients with intracerebral hemorrhage, 760 (4.9%) patients with subarachnoid hemorrhage, and 3,041 (19.4%) patients with TIA. The median (quartile 1, 3) age was 74 (61, 83) years, and 52.7% were male. Table 1 presents the baseline characteristics by stroke type. There were 1,423 (9.1%) patients living in an assisted living or long-term care institution at baseline, and 4,814 (30.8%) patients presented to a rural hospital.

Patients with TIA had the highest home-time and the smallest range in the number of nights spent at home. Three of 4 patients with TIA spent at least 82 nights at home or at their baseline residence in the first 90 days after the index admission to hospital. Patients with intracerebral hemorrhage had the least amount of home-time, with half the patients not returning to home or baseline residence in the first 90 days. Table 2 describes the unadjusted median home-time, patient location, and mortality at 90 days by stroke type. Figure 1 illustrates the distribution of unadjusted 90-day home-time return to baseline by stroke type using violin plots (figure e-1 at Neurology.org shows the corresponding histograms). The 2 methods of home-time calculations (return to baseline and return to home) were highly correlated for all stroke types: Spearman rank correlation ρ was 0.94 for ischemic stroke, 0.95 for intracerebral hemorrhage, 0.99 for subarachnoid hemorrhage, and 0.92 for TIA ($p < 0.0001$ for all stroke types). The unadjusted median home-times were different among stroke types ($p = 0.0001$).

After adjustment for baseline characteristics, compared to patients with intracerebral hemorrhage,

Table 2 Outcomes by stroke type at 90 days

	Ischemic stroke (n = 10,428)	Intracerebral hemorrhage (n = 1,415)	Subarachnoid hemorrhage (n = 760)	TIA (n = 3,041)
Home-time return to baseline, median (quartile 1, 3), d	71 (0, 85)	0 (0, 74)	67 (0, 81)	87 (82, 88)
Home-time return to home, median (quartile 1, 3), d	65 (0, 85)	0 (0, 71)	66 (0, 80.5)	87 (79, 88)
90-d location, n (%)				
Home	6,474 (62.1)	579 (40.9)	472 (62.1)	2,525 (83.0)
Acute care	617 (5.9)	110 (7.8)	53 (7.0)	103 (3.4)
Subacute care	53 (0.5)	6 (0.4)	2 (0.3)	4 (0.1)
Rehabilitation	611 (5.9)	93 (6.6)	31 (4.1)	26 (0.9)
Supportive living	444 (4.3)	42 (3.0)	4 (0.5)	245 (8.1)
Long-term care	592 (5.7)	106 (7.5)	16 (2.1)	66 (2.2)
Death, n (%)	1,637 (15.7)	479 (33.9)	182 (24.0)	72 (2.4)

Figure 1 Violin plots of 90-day home-time return to baseline by stroke type

Violin plots illustrate the probability density distributions of home-time for each stroke type. Medians are marked by a white horizontal bar; values between the first and third quartiles are marked by the thick black bar; and nonoutlier values are marked by the thinner black line. Median home-time (quartile 1, 3): ischemic stroke 71 (0, 85) days, intracerebral hemorrhage 0 (0, 74) days, subarachnoid hemorrhage 67 (0, 81) days, and TIA 87 (82, 88) days.

those admitted with ischemic strokes spent close to double the number of days at home in the first 90 days after stroke (IRR 1.82, 95% CI 1.67–1.98, table 3). Patients with TIA and subarachnoid hemorrhage also experienced longer home-time compared to those with intracerebral hemorrhage (IRR 2.85, 95% CI 2.58–3.15 and IRR 1.25, 95% CI 1.09–1.43, respectively). Patients who were younger, male, or with fewer comorbidities experienced longer home-time, but presentation to a rural hospital did not show a significant association with home-time (table 3).

Home-time after ischemic stroke in clinical trials. Of the 552 unique patients participating in clinical trials during the period of administrative data collection (2012–2016), there were 42 (7.6%) patients enrolled

in TEMPO-1, 97 (17.6%) patients in ESCAPE, and 413 (74.8%) patients in the acute imaging trials (INTERSeCT $n = 181$ and PROVE-IT $n = 232$). In total, there were 313 (56.7%) male patients; 384 (69.6%) were ≥ 65 years of age; median (quartile 1, 3) age was 72 (62, 80) years; and median baseline NIHSS score was 11 (5, 18). Only 6 (1.1%) patients were in an institutionalized setting at baseline; the rest were assumed to be at home.

At 90 days, 368 (66.7%) patients were back at home, 36 (6.5%) were in acute care, 59 (10.7%) were in a rehabilitation facility, and 65 (11.8%) patients died. There were few patients in subacute care ($n = 4$), supportive living ($n = 1$), and long-term care ($n = 19$). The median (quartile 1, 3) prospectively collected 90-day mRS score was 2 (1, 4), and the median 90-day home-time was 59 (0, 85) days. In univariable analysis, longer 90-day home-time was associated with lower mRS scores (Spearman rank correlation $\rho = -0.73$, $p < 0.0001$). Figure 2 illustrates this association using boxplots. Among patients ≥ 65 years of age, median, interquartile range, and range of home-time by mRS score were similar: 0 ($n = 67$, 86 [82, 87] days), 1 ($n = 80$, 82 [60.5, 87] days), 2 ($n = 54$, 55 [37, 82] days), 3 ($n = 51$, 30 [0, 75] days), 4 ($n = 49$, 0 [0, 1] days), 5 ($n = 12$, 1 [0, 22.5] days), and 6 ($n = 71$, 0 [0, 1] days) (figure e-2).

Ordinal logistic regression analysis revealed that longer home-time was associated with a lower 90-day mRS score, even after adjustment for baseline characteristics, including age, sex, NIHSS, and Charlson comorbidity index (common odds ratio 1.04 per additional home-time day, 95% CI 1.04, 1.05, $p <$

Table 3 Multivariable analysis of clinical variables and 90-day home-time (IRR [95% CI])

	Home-time (return to baseline)	Home-time (return to home)
Stroke type		
Intracerebral hemorrhage	Referent	Referent
Ischemic stroke	1.82 (1.67–1.98)	1.87 (1.69–2.05)
TIA	2.85 (2.58–3.15)	2.91 (2.61–3.25)
Subarachnoid hemorrhage	1.25 (1.09–1.43)	1.27 (1.09–1.48)
Age (per year)	0.99 (0.98–0.99)	0.98 (0.98–0.98)
Male sex	1.12 (1.06–1.17)	1.19 (1.13–1.26)
Charlson comorbidity index	0.88 (0.86–0.89)	0.86 (0.85–0.88)
Rural hospital presentation	1.01 (0.95–1.05)	0.96 (0.90–1.02)

Abbreviations: CI = confidence interval; IRR = incidence rate ratio.

Figure 2 Boxplot of 90-day home-time return to baseline and prospectively collected mRS score from clinical trials of acute ischemic stroke patients

Median home-time (quartiles 1, 3) by mRS score: 0 (n = 118, 86 [83, 88] days), 1 (n = 119, 83 [60, 87] days), 2 (n = 91, 56 [34, 82] days), 3 (n = 69, 22 [0, 73] days), 4 (n = 64, 0 [0, 1] days), 5 (n = 16, 0.5 [0, 22.5] days), and 6 (n = 75, 0 [0, 0] days). mRS = modified Rankin Scale.

0.0001, table e-1). Home-time was a good predictor of disability at 90 days as measured by the mRS score (C statistic 0.800 in the univariable model). In the multivariable model, the C statistic was only slightly better, 0.826, indicating that home-time highly predicts the 90-day mRS score and that adjusting for baseline age, sex, NIHSS, and Charlson comorbidity index adds little additional discriminative value.

DISCUSSION We show that home-time is a feasible and valid measure of outcome after stroke. Home-time is obtainable in a complete population with administrative data, which makes it a pertinent health services research outcome in population-based analyses because passive data collection has relative resistance to attrition bias compared to active prospective data collection. Consistent with our understanding of the nature and severity of the spectrum and types of cerebrovascular diseases, our analyses of a cohort of stroke patients from a complete population revealed that patients with TIA had the highest home-time (i.e., best outcomes), whereas patients with hemorrhagic stroke had the lowest. After baseline age, sex, and comorbidities were accounted for, ischemic stroke patients spent close to double the amount of time at home in the first 90 days compared to patients with intracerebral hemorrhage, and those diagnosed with a TIA experienced close to triple the amount of time at home. Among 552 patients enrolled in acute ischemic stroke clinical trials, we confirmed the content validity of home-time with the strong association between home-time and prospectively

collected mRS score at 90 days.^{3,8} Home-time strongly predicts mRS score, even after adjustment for baseline age, sex, stroke severity, and comorbidities.

The correlation between mRS score and home-time has previously been reported by the authors of 2 international neuroprotection randomized controlled trials, the Glycine Antagonist in Neuroprotection (GAIN)³ and the Stroke-Acute Ischemic NXY Treatment I (SAINT I) trials.¹⁷ In these 2 studies, functional outcome scores were prospectively collected, and home-time was reconstructed by calculating the number of noninstitutionalized days from admission and discharge records and patient interviews. Approximately 1,700 patients were enrolled in multiple centers internationally in each of the GAIN and SAINT I trials, and both studies showed statistically significant differences in home-time between the country of enrollment, suggesting that home-time should be validated with country-specific data. Fonarow et al.⁸ published the first study to use routinely collected administrative data in 815 US Medicare beneficiaries to show that home-time is highly correlated with 90-day mRS score and has good discrimination for functional independence; however, that study was restricted to survivors to hospital discharge who provided consent to participate in a prospective study. Another study of Medicare beneficiaries showed that home-time was associated with older age, more severe stroke, black race, and female sex.¹⁸ Studies using US Medicare data are not representative of the entire adult stroke population because they are necessarily restricted to persons >65 years of age.

Our findings add to the understanding of home-time. Using Canadian administrative data, we provided population-representative distributions of home-time in adults for different stroke types. We used 2 different calculations for home-time to discriminate patients who return home and those who return to their baseline living situation. This distinction is important because it is valued by the patient and their caregivers and informs health economic analyses. In addition, we found that for a given mRS score, home-time is shorter in the Canadian population than the US Medicare population.⁸ Taking the example of an outcome of mRS score of 3 at 90 days, this corresponded to a median (quartile 1, 3) home-time of 75 (59, 85) days in the US study, while it corresponded to a median home-time of 22 (0, 73) days with the use of Canadian data. In the subgroup of Canadian patients ≥ 65 years of age, an mRS score of 3 corresponded to a median home-time of 30 (0, 75) days. This observation is likely due to differences in practices regarding discharge and length of stay, access to inpatient vs home rehabilitation services, availability of other social and community support

for independent living, or differences in baseline characteristics for patients with the same 90-day mRS score. Regardless of the cause, administrative data are variable between jurisdictions,¹⁹ and these observations demonstrate the necessity of calibrating the relationship between home-time and 90-day mRS score in each health care system in which it is used as a metric.

We show that women have less home-time compared to men, even after adjustment for age, comorbidities, and stroke type. Sex has previously been reported to be a predictor of home-time in 1 study¹⁸ but has not been confirmed by others.^{8,17} This observation is nevertheless consistent with prior studies suggesting that women experience greater disability and poorer quality of life after stroke compared to men.^{20,21} The explanation is likely multifactorial, including premorbid health, access to social support, stroke severity, and differences in acute stroke treatment.^{21,22} In addition to sex, home-time is influenced by age and burden of comorbidities, suggesting that it discriminates graded outcomes, a desired property in outcome metrics. The degree of influence of age, sex, stroke severity, and comorbidities on the association between home-time and prospectively collected mRS score is small, suggesting that the home-time construct inherently accounts for these factors.

Administrative data calculation of home-time has some limitations. It does not consider the level of assistance required by patients who are inferred to be home. Return to home may be contingent on social support or private funds, which is neither accounted for by home-time nor obtainable in administrative data. Finally, in the population data analysis part of our study, as with most complete-population studies, baseline stroke severity cannot be ascertained. The high correlation between home-time and mRS score was determined with ischemic stroke patients enrolled in clinical trials and needs confirmation with future population-based analyses. The relationship between home-time and mRS score in other stroke types could not be determined in our study and requires dedicated studies.

Our results suggest that home-time is a graded and objective metric that can be used to track patient outcomes and health care use, making it a valuable stroke outcome measure for health services research, evaluation of health policies, or future clinical trials using a pragmatic design such as registry-based randomized controlled trials.

AUTHOR CONTRIBUTIONS

A.Y.X. Yu contributed to the drafting and revision of the manuscript, study concept and design, interpretation of data. E. Rogers contributed to revision of the manuscript, study concept and design, acquisition and interpretation of data. M. Wang and T.T. Sajobi contributed to the revision of the manuscript, analysis and interpretation of data, and

statistical analysis. S.B. Coutts and B.K. Menon contributed to the revision of the manuscript, acquisition and interpretation of data. M.D. Hill contributed to the revision of the manuscript, study concept and design, and acquisition and interpretation of data. E.E. Smith contributed to revision of the manuscript, study concept and design, interpretation of data, and overall study supervision.

STUDY FUNDING

The ESCAPE trial was funded by a consortium that included grants to the University of Calgary from Medtronic (Covidien LLC at the time), Alberta Innovates, Heart & Stroke Foundation of Canada, Canadian Institutes for Health Research (Canadian Stroke Prevention Intervention Network), Alberta Health Services, and University of Calgary (Hotchkiss Brain Institute, Department of Clinical Neuroscience, Calgary Stroke Program). TEMPO-1 study was funded by the Heart & Stroke Foundation of Alberta and Nunavut and Alberta Innovates, and study drug was donated by Hoffman Le Roche.

DISCLOSURE

A.Y.X. Yu, E. Rogers, M. Wang, and T.T. Sajobi report no disclosures relevant to the manuscript. S.B. Coutts was principal investigator of the TEMPO-1 study, funded by the Heart and Stroke Foundation of Alberta and Nunavut and Alberta Innovates: Health Solutions, and study drug was donated by Hoffman Le Roche. B.K. Menon reports no disclosures relevant to the manuscript. M.D. Hill was principal investigator of the ESCAPE trial, funded by Medtronic (Covidien LLC at the time), Alberta Innovates, Heart & Stroke Foundation of Canada, University of Calgary, Canadian Institutes for Health Research, and Alberta Health Services. E.E. Smith reports no disclosures relevant to the manuscript. Go to Neurology.org for full disclosures.

Received April 18, 2017. Accepted in final form August 22, 2017.

REFERENCES

1. Quinn TJ, Dawson J, Walters MR, Lees KR. Functional outcome measures in contemporary stroke trials. *Int J Stroke* 2009;4:200–205.
2. Wilson JT, Hareendran A, Grant M, et al. Improving the assessment of outcomes in stroke: use of a structured interview to assign grades on the modified Rankin Scale. *Stroke* 2002;33:2243–2246.
3. Quinn TJ, Dawson J, Lees JS, et al. Time spent at home poststroke: “home-time” a meaningful and robust outcome measure for stroke trials. *Stroke* 2008;39:231–233.
4. Campbell BC, Mitchell PJ, Kleinig TJ, et al. Endovascular therapy for ischemic stroke with perfusion-imaging selection. *N Engl J Med* 2015;372:1009–1018.
5. Mishra NK, Shuaib A, Lyden P, et al. Home time is extended in patients with ischemic stroke who receive thrombolytic therapy: a validation study of home time as an outcome measure. *Stroke* 2011;42:1046–1050.
6. Xian Y, O'Brien EC, Fonarow GC, et al. Patient-centered research into outcomes stroke patients prefer and effectiveness research: implementing the patient-driven research paradigm to aid decision making in stroke care. *Am Heart J* 2015;170:36–45, 45.e1–45.e11.
7. Groff AC, Colla CH, Lee TH. Days spent at home: a patient-centered goal and outcome. *N Engl J Med* 2016;375:1610–1612.
8. Fonarow GC, Liang L, Thomas L, et al. Assessment of home-time after acute ischemic stroke in Medicare beneficiaries. *Stroke* 2016;47:836–842.
9. Canadian Institute for Health Information. Discharge Abstract Database (DAD) Metadata [online]. Available at: <https://www.cihi.ca/en/types-of-care/hospital-care/acute-care/dad-metadata>. Accessed February 6, 2017.

10. Canadian Institute for Health Information. National Ambulatory Care Reporting System (NACRS) Metadata [online]. Available at: <https://www.cihi.ca/en/types-of-care/hospital-care/emergency-and-ambulatory-care/nacrs-metadata>. Accessed February 6, 2017.
11. Canadian Institute for Health Information. National Rehabilitation Reporting System (NRS) Metadata [online]. Available at: <https://www.cihi.ca/en/types-of-care/hospital-care/rehabilitation/national-rehabilitation-reporting-system-nrs-metadata>. Accessed February 6, 2017.
12. Alberta Health. Alberta's Continuing Care System [online]. Available at: <http://www.health.alberta.ca/services/continuing-care-system.html>. Accessed February 6, 2017.
13. Kokotailo RA, Hill MD. Coding of stroke and stroke risk factors using International Classification of Diseases, Revisions 9 and 10. *Stroke* 2005;36:1776–1781.
14. Goyal M, Demchuk AM, Menon BK, et al. Randomized assessment of rapid endovascular treatment of ischemic stroke. *N Engl J Med* 2015;372:1019–1030.
15. Coutts SB, Dubuc V, Mandzia J, et al. Tenecteplase-tissue-type plasminogen activator evaluation for minor ischemic stroke with proven occlusion. *Stroke* 2015;46:769–774.
16. Menon BK, d'Esteirre CD, Qazi EM, et al. Multiphase CT angiography: a new tool for the imaging triage of patients with acute ischemic stroke. *Radiology* 2015; 275:510–520.
17. Mishra NK, Lyden P, Grotta JC, Lees KR, Collaborators V. Thrombolysis is associated with consistent functional improvement across baseline stroke severity: a comparison of outcomes in patients from the Virtual International Stroke Trials Archive (VISTA). *Stroke* 2010;41:2612–2617.
18. O'Brien EC, Xian Y, Xu H, et al. Hospital variation in home-time after acute ischemic stroke: insights from the PROSPER study (Patient-Centered Research Into Outcomes Stroke Patients Prefer and Effectiveness Research). *Stroke* 2016;47:2627–2633.
19. Yu AY, Holodinsky JK, Zerna C, et al. Use and utility of administrative health data for stroke research and surveillance. *Stroke* 2016;47:1946–1952.
20. Bushnell CD, Reeves MJ, Zhao X, et al. Sex differences in quality of life after ischemic stroke. *Neurology* 2014;82: 922–931.
21. Lisabeth LD, Reeves MJ, Baek J, et al. Factors influencing sex differences in poststroke functional outcome. *Stroke* 2015;46:860–863.
22. Shobha N, Sylaja PN, Kapral MK, Fang J, Hill MD. Differences in stroke outcome based on sex. *Neurology* 2010;74:767–771.

This Week's *Neurology*® Podcast

This variant alters protein function, but is it pathogenic? (see the August 2017 issue of *Neurology*® *Genetics*)

This podcast begins and closes with Dr. Robert Gross, Editor-in-Chief, briefly discussing highlighted articles from the November 7, 2017, issue of *Neurology*. In the first segment, Dr. Michelle Mauermann talks with Dr. Massimo Pandolfo about his recent *Neurology: Genetics* editorial, entitled “This variant alters protein function, but is it pathogenic?” In the second part of the podcast, Dr. Nicole Chiota focuses her interview with Dr. Steven Messe on recent PFO/stroke updates.

Disclosures can be found at Neurology.org.

At Neurology.org, click on “RSS” in the Neurology Podcast box to listen to the most recent podcast and subscribe to the RSS feed.

No CME will be offered this week: Interviews based on articles from *Neurology*® *Clinical Practice*, *Neurology: Genetics*, and *Neurology*® *Neuroimmunology & Neuroinflammation* are excluded from the CME program.