ORIGINAL RESEARCH

Optimizing the Economic Impact of rtPA Use in a Stroke Belt State: The Case of South Carolina

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Background: Stroke is the fourth leading cause of death in the United States, and its incidence is especially high in South Carolina. Recombinant tissue plasminogen activator (rtPA) has been given to patients with acute ischemic stroke since 1996 and has shown overall improved outcomes relative to patients who are not treated with rtPA.

Objective: A 1998 study by Fagan and colleagues reported the economic impact of the use of rtPA. The purpose of this current article is to present an updated economic analysis of the impact of rtPA.

Methods: In the current analysis, an updated estimate of the economic and health benefits of treatment with rtPA in South Carolina was provided using estimates of cost, incidence, and course of treatment from several data sources. The Markov model in the 1998 study was used as a guide in this current study; we sought to replicate the methodology, while providing updated economic figures and applying it to the state of South Carolina. We estimated the costs per 1000 patients who are eligible for treatment with rtPA compared with 1000 untreated patients, as well as routine medical practice and outcomes of quality-adjusted life-years (QALYs) and economic costs based on whether a patient was treated with rtPA or not. We calculated the number of stroke cases that would be treated with rtPA if the rate were to increase from 3% to 20%, using the most recent number of strokes in South Carolina and prorating for 5 years to estimate the total expected cost-savings with increased rtPA use.

Results: The results indicate that the use of rtPA in South Carolina accounts for a cost-savings of $3454 per treated patient over a 6-year period. The model estimates an increase of 0.425 QALYs (or 5.1 quality-adjusted months) of survival per patient treated with rtPA. Over the lifetime of a treated patient, the estimated cost-savings are $4084, with an accrued health benefit of 0.692 QALYs (or 8.3 quality-adjusted months). For every 100 patients treated with rtPA, there is a gain of 69.17 QALYs and of $408,419 over the lifetime of 100 treated patients with acute ischemic stroke. We calculated that the cost-savings gained by increasing the rtPA treatment rate in a state with a high incidence of stroke from the current 3% rate to an achievable 20% rate over a 5-year period would be $16,615,723.

Conclusions: This new analysis demonstrates a significant savings associated with the use of rtPA for patients with stroke and provides great support for the increased systematic use of rtPA in the state of South Carolina for patients with acute ischemic stroke. For every additional 100 patients who are treated with rtPA in South Carolina, a robust savings supports the wider economic benefit that would be gained with an increased use of rtPA.

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Stroke remains a leading cause of disability and is the fourth leading cause of death in the United States.[1,2] Approximately 780,000 strokes occur in the United States annually; in 2004, stroke accounted for 1 of every 16 deaths.[3] The burden of stroke is especially high in South Carolina, which is central within the so-called

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KEY POINTS

- Stroke is a leading cause of disability and death in the United States and is most prevalent in the so-called Stroke Belt.
- Recombinant tissue plasminogen activator (rtPA) has been shown to improve outcomes in patients with stroke, but currently less than 5% of patients with acute ischemic stroke receive rtPA.
- Using data for patients with stroke in South Carolina, this study analyzes the economic and health benefits of treating acute ischemic stroke with rtPA.
- The results show a cost-savings of $3454 and an increase of 0.425 quality-adjusted life-years per treated patient over a 6-year period.
- By increasing the rtPA treatment rate in South Carolina from the current 3% to an achievable rate of 20% over 5 years, the potential increased cost-savings would be $16,615,723.
- Each percentage increase of rtPA use is associated with an estimated increased cost-savings of nearly $1 million.
- For these outcomes to be fully realized, systems and policies must be in place to allow for the timely care of patients with acute ischemic stroke.

Stroke Belt.[4-7] The Stroke Belt is an 11-state region in the southeastern United States that has been characterized as having a particularly high incidence of stroke.

Recombinant tissue plasminogen activator (rtPA) has been approved by the US Food and Drug Administration (FDA) for the treatment of stroke.[8] There have been few analyses on the economic impact of rtPA[9-13]; however, no study has focused on 1 single state. Stroke is a costly disease to the US healthcare system and to patients, and it can have a significant impact on a patient's quality of life.

The direct costs of stroke treatment include initial hospitalization and treatment, rehabilitation, nursing home care, physician care, home healthcare, rehabilitation, drugs, and medical equipment.[9] The indirect costs include reduced or loss of productivity as a result of disability or mortality from stroke.[9] In 2008, the American Heart Association estimated the total direct and indirect costs of stroke at $65.5 billion and the mean lifetime cost at $140,048 per patient.[3] Others have projected that this cost would reach $2.2 trillion between 2005 and 2050, suggesting that the economic impact on the healthcare system remains significant.[10]

Much of these high costs are the result of the need for skilled nursing and rehabilitation care after a stroke. Previous research has suggested that these costs may be reduced through increased treatment with rtPA, which was approved by the FDA in 1996 for patients with acute ischemic stroke, and has been shown to significantly reduce disability.[11-13]

Fagan and colleagues analyzed the use of rtPA in 1000 hypothetical patients using a Markov model[14]; this present analysis is an update of that earlier study. Such an update is needed, because of the time that has passed since the last analysis, the updated costs of rtPA, and the changes in routine care and clinical outcomes for patients with acute ischemic stroke. Furthermore, we examined the specified estimates of the use of rtPA in a very specific statewide basis in a state of high stroke incidence and mortality, South Carolina, which is the buckle of the Stroke Belt. Although recent analyses have shown that hospitalization costs for patients with acute ischemic stroke who are treated with rtPA are higher than diagnosis-related group reimbursement from Medicare, there may be long-term cost-savings associated with the use of rtPA.[15]

The purpose of this new study is to examine the potential cost-savings of treating patients with acute ischemic stroke with rtPA in South Carolina. To provide an updated and state-specific prediction of the health and economic outcomes of the use of rtPA for this patient population, a Markov model was used, which was similar to previous research.[11,14] In the model used in the study by Fagan and colleagues, healthcare provided for patients with acute ischemic stroke was assumed to be consistent with routine medical practice for 2 groups: one group that received rtPA and a placebo group that did not receive rtPA.[14] That analysis estimated cost-savings of $600,000 in the first year of care and an increase in quality-adjusted life-years (QALYs) of 751 per 1000 patients by using one-way sensitivity analysis of assumptions and a Monte Carlo multiway sensitivity analysis for validation.[14] Similarly, a Markov model estimated the costs of each component of treatment and the quality-adjusted survival expected based on patient age, the distribution of health outcomes at the time of hospital discharge, and on the likelihood of having a recurring stroke for patients over a 5-year period.[14]

The current study provides an updated economic analysis to a single Stroke Belt state, South Carolina, from a societal perspective. In addition to estimating the economic impact of the use of rtPA for patients with stroke, we also sought to measure the impact of increased rtPA use on a patient's quality of life.

Methods

Markov Model by Fagan and Colleagues

The Markov model by Fagan and colleagues was used

as a guide in this present study, and we sought to replicate the methodology, while providing updated economic figures and applying it to the state of South Carolina. Fagan's original study developed a Markov model to measure the potential benefit of the use of rtPA in patients with acute ischemic stroke against the cost of the drug, increased time in the intensive care unit, and the risk of intracerebral hemorrhage. Fagan and colleagues then estimated the costs per 1000 patients who are eligible for treatment with rtPA compared with 1000 untreated patients. The model assumed routine medical practice and considered outcomes of QALYs and economic costs.[14] The model had 7 poststroke disability states based on the modified Rankin scale (mRS), and all patients were assumed to be age 67 years at the time of stroke.[14]

Fagan and colleagues used a sensitivity analysis to address the concern that patients in the National Institute of Neurological Disorders and Stroke (NINDS) trial were healthier than patients in the general population. Applying a societal perspective, Fagan and colleagues used previous data to make assumptions of economic cost, patient value and preference, and epidemiologic factors. The data sources included a local survey, NINDS data, and related literature. The model examined patient states at 10 days, 3 months, 6 months, and 1 year.[14]

The Updated Model

In building the model in the current analysis, NINDS data from previous research in the study by Fagan and colleagues were used to verify the structure of our model and to assess its predictive validity in replicating their results. We used an approach similar to that used by Fagan and colleagues, in which patients could move between 7 poststroke states based on the mRS: no symptoms (mRS 0), no significant disability (mRS 1), minimal disability (mRS 2), moderate disability (mRS 3), moderate-to-severe disability (mRS 4), severe disability (mRS 5), and death (mRS 6). The health outcomes were measured using QALYs, and the economic outcomes were based on the estimated cost to treat a patient based on whether that patient received rtPA.

The model held most of the previous assumptions, including the rate of recurrent stroke (0.052), the rate of symptomatic hemorrhage after treatment with rtPA (6.45%), the inclusion of a charge for a 2-hour visit to a specialist during the initial evaluation, patients being discharged to a nursing home and remaining there until death, and patients who did not receive rtPA having subsequent strokes. Other assumptions included patients being discharged from rehabilitation and going to a nursing home, and all patients were aged 67 years (the reported mean age of patients in the NINDS rtPA stroke trial) at the time of the stroke.

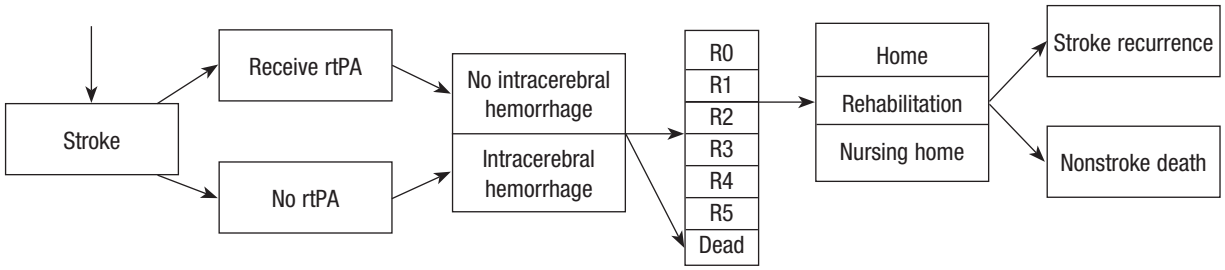
Table 1 The Model's Assumptions

Variables	rtPA	Placebo	Source
rtPA cost, $	2750	—	Hospital billing
Consult physician cost, $	467	—	Hospital billing
ICU cost, $	1206	—	Hospital billing
Intracranial hemorrhage rate, %	0.0645	0.01	NINDS
Died in hospital, %	0.074	0.101	NINDS
Discharged home, %	0.46	0.36	NINDS
Rehabilitation to nursing home, %	0.18	0.18	NINDS
Death multiplier	1.65	1.65	NINDS
Annual restroke, %	0.052	0.052	NINDS
Recurrent stroke death, %	0.18	0.18	NINDS
Hospital days, N	10.9	12.4	NINDS
Daily hospital cost, $	2984	2984	HCUP
Rehabilitation days, N	20	20	NINDS
Daily rehabilitation cost, $	1652	1652	HCUP
Home health days, N	10	10	NINDS
Daily home health cost, $	349	349	HCUP
ICH added cost, $	7002	7002	HCUP
Annual nursing home cost, $	62,218	62,218	HCUP
Subsequent stroke cost, $	64,096	64,096	HCUP
Utilities R0	0.9	0.9	Fagan model
Utilities R1	0.8	0.8	Fagan model
Utilities R2	0.46	0.46	Fagan model
Utilities R3	0.34	0.34	Fagan model
Utilities R4	0.3	0.3	Fagan model
Utilities R5	0.01	0.01	Reflective of national policy

HCUP indicates Healthcare Cost and Utilization Project; ICH, intracerebral hemorrhage; ICU, intensive care unit; NINDS, National Institute of Neurological Disorders and Stroke; rtPA, recombinant tissue plasminogen activator.

Sources: South Carolina Universal Billing 92 Form discharge data; HCUP nationwide inpatient sample 2010. www.hcup-us.ahrq.gov/db/nation/nis/nisdbdocumentation.jsp; 2009 and 2010 HCUP state inpatient data for South Carolina, State Inpatient Databases. www.hcup-us.ahrq.gov/db/state/siddbdocumentation.jsp; NINDS. Clinical research tool kit. www.ninds.nih.gov/research/clinical_research/toolkit/common_data_elements.htm.

Figure Illustration of Patient Movement in the Model



NOTE: Patients enter the model when they are seen in the hospital for stroke and receive or do not receive rtPA. Then, they experience or do not experience an intracerebral hemorrhage and either enter into varying states of disability, based on Rankin score (R0-R5), or die. On discharge from the hospital, and based on the patient's state of disability, the patient is then discharged home, to rehabilitation, or to a nursing home, and subsequently has a stroke recurrence or a nonstroke death in varying time intervals.
rtPA indicates recombinant tissue plasminogen activator.

Several assumptions in our study were updated. First, the mRS of 5 was assigned to a utility of 0.01 instead of –0.02, because this is consistent with euthanasia, which is illegal in the United States. Other utility values remained the same as the previous model in the Fagan and colleagues study. First, a score of 1.0 was used for perfect health (with mRS of 1-4 corresponding to scores of 0.80, 0.46, 0.34, and 0.30, respectively). Second, a Centers for Disease Control and Prevention–specific death rate was used instead of an actuarial death rate for the patients with stroke.[16] Third, a 9-month follow-up period was added to the model to account for a patient's movement between outcome states at another designated time interval. Fourth, the cost of rtPA was updated based on average hospital billing in South Carolina ($2750 for 100 mg), and hospitalization rates were provided by the Uniform Billing form (UB-92) discharge data.

Finally, unlike previous models, for our model we first considered only 6 years poststroke, to be able to predict the short-term quality of life and economic outcomes. The lifetime costs predicted by the same model and a sensitivity analysis of the lifetime model were also considered. The sensitivity analysis was conducted using Crystal Ball software (Oracle; Redwood Shores, CA). The assumptions of our model are provided in **Table 1**, and the stages of the model are shown in the **Figure**.

The following variables were included based on NINDS trials: (1) patients treated with rtPA experienced an intracerebral hemorrhage rate of 0.0645% compared with a rate of 0.010% in the group that received a placebo, (2) 46% of patients treated with rtPA were discharged home compared with 36% of those who received a placebo, and (3) the average number of inpatient hospital days for patients treated with rtPA was 10.9 compared with 12.4 days for patients who received a placebo.

Updated cost information using Healthcare Cost and Utilization Project (HCUP) data from South Carolina and Maryland was included to account for the cost of patients with acute ischemic stroke who were treated with rtPA and patients who did not receive rtPA. Although the focus of the analysis was on South Carolina, we also examined HCUP data from Maryland to ensure that the cost was nationally representative, and then applied the cost to South Carolina–specific incidence.

South Carolina Medicare data from 1996 to 1997 and 2004 to 2005 were used to calculate the frequency of time in the sequence of care for patients in each of the health states and treatment types. Data from these 2 different decades were used to ensure that the included estimates are reflective of the episodes of care in South Carolina. A transition matrix is provided in the **Appendix** (page 162).

The use of these data sets allowed for the estimation of the impact of rtPA use for a specific population, to inform policymakers and payer groups of the potential budget and impact on health benefits of increasing access to rtPA treatment. The HCUP data were inflated using the medical care Consumer Price Index for 2011 from the US Bureau of Labor and Statistics.[17] Future costs and QALYs were discounted by 3%, which was consistent with requirements of economic analyses exceeding a 1-year time horizon.

After calculating the cost and quality-of-life gains that are associated with rtPA use for individual patients, we estimated (based on our model) outcomes for

Table 2 Short-Term Cost-Savings with rtPA Treatment

Outputs	rtPA	Placebo
Intracerebral hemorrhage events, N	6.45	1.00
Total QALYs, N	225.16	179.85
Total cost, $	8,872,933	9,225,364
Additional intracerebral hemorrhage events, N	5.45	
QALYs gained, N	45.31	
Cost-Savings, $	352,430	
Discounted outcomes[a]		
Total discounted QALYs, N	210.97	168.59
Total discounted cost, $	8,651,313	8,996,752
QALYs gained, N	42.38	
Cost-savings, $	345,438	
Per patient		
Quality-adjusted months gained, N	5.1	
Cost-savings, $	3454	

[a]Discounts were made using the US Bureau of Labor Statistics. Consumer Price Index, Medical Care. Series ID, CUUR0000SAM2; not seasonally adjusted; area, US city average; item, medical care services; base period, 1982-1984 = 100. www.data.bls.gov/.

QALYs indicates quality-adjusted life-years; rtPA, recombinant tissue plasminogen activator.

an achievable rate (ie, 20%) of rtPA use. Specifically, we calculated the number of stroke cases that would be treated with rtPA if the rate were to increase from 3% to 20%, using the most recent number of strokes in South Carolina and prorating this number for 5 years to estimate the total cost-savings that are expected for increased rtPA use in the state.

The number of strokes in South Carolina was provided by the UB-92 hospital discharge data, and the rate of ideal use was estimated to increase from 3% to 20% for the years 2012 to 2016. In 2009, the most recent year available, 9299 cases of acute ischemic stroke were reported in South Carolina for patients aged >45 years. This number was used as a baseline estimate for the number of strokes in 2012, with small increases of strokes estimated annually, based on recent trends in South Carolina, according to the UB-04 data. Patients aged <45 years were not included in this study, because these strokes are often associated with conditions such as sickle-cell disease or with cocaine use.

Table 3 Lifetime Cost-Savings with rtPA Treatment

Outputs	rtPA	Placebo
Intracerebral hemorrhage events, N	6.45	1
Total QALYs, N	392.02	310.8
Total cost, $	11,778,377	12,215,019
Additional intracerebral hemorrhage events, N	5.45	
QALYs gained, N	81.22	
Cost-savings, $	436,642	
Discounted outcomes		
Total discounted QALYs, N	335.7	266.54
Total discounted cost, $	10,806,268	11,214,687
QALYs gained, N	69.17	
Cost-savings, $	408,419	
Per patient		
Quality-adjusted months gained, N	8.3	
Cost-savings, $	4084	

QALYs indicates quality-adjusted life-years; rtPA, recombinant tissue plasminogen activator.

Table 4 Statewide Cost-Savings of Increased rtPA Use in South Carolina

Patients receiving rtPA, %	Cost-savings
3	$2,498,166,586
20	$2,514,782,309

rtPA indicates recombinant tissue plasminogen activator.

Results

Based on our model, the use of rtPA to treat 100 patients with acute ischemic stroke was estimated to result in an increased QALYs of 225.[16] Our analysis predicted cost-savings for South Carolina of $352,430 for 100 patients over a 6-year period. At an individual patient level, this amounted to 5.1 quality-adjusted months gained per patient and a cost-savings of $3454 per patient (**Table 2**).

Consistent with previously published studies, our model also examined the lifetime costs associated with rtPA treatment. The estimated overall lifetime cost-savings for 100 patients was $408,419, with 69.17 QALYs gained. These estimates indicate a $4084 cost-savings per patient over a lifetime of treatment with rtPA, and 8.3 quality-adjusted months gained per patient over a life-

Table 5 Sensitivity Analysis of Lifetime Model

	Months gained, N	Cost-savings (increase), $	Months gained, N	Cost-savings (increase), $
Base model	8.3	4084		
	Increase	**Increase**	**Decrease**	**Decrease**
Double or halve intracranial hemorrhage rate	8.3	3703	8.3	4275
Died in hospital: up 20%, down 20%	8.3	4087	8.3	4084
Died at home: up 20%, down 20%	8.3	6278	8.3	1891
Rehabilitation at nursing home: up 20%, down 20%	8.3	4747	8.3	3421
Death multiplier: up 20%, down 20%	7.6	3930	9.2	4279
Annual restroke: up 20%, down 20%	8.2	3861	8.4	4312
Recurring stroke death: up 20%, down 20%	8.2	4065	8.4	4104
Hospital days: up 20%, down 20%	8.3	–2421	8.3	10,589
Hospital cost: up 20%, down 20%	8.3	4979	8.3	3189
Rehabilitation days: up 20%, down 20%	8.3	4582	8.3	3586
Rehabilitation cost: up 20%, down 20%	8.3	4582	8.3	3586
Home health days: up 20%, down 20%	8.3	4013	8.3	4156
Home health cost: up 20%, down 20%	8.3	4013	8.3	4156
Intracerebral hemorrhage added cost: up 20%, down 20%	8.3	4008	8.3	4161
Annual nursing home cost: up 20%, down 20%	8.3	4747	8.3	3421
Subsequent stroke cost: up 20%, down 20%	8.3	3878	8.3	4291
QALY weights: up 10%, down 10%	9.1	4084	7.5	4084

QALY indicates quality-adjusted life-year.

time of treatment with rtPA. The results of the model for a lifetime savings are presented in **Table 3** and are similar to the findings of Fagan and colleagues.

Given the magnitude and frequency of stroke in South Carolina, if the rate of rtPA treatment would increase from 3% of all strokes to 20% of all strokes, the estimated total cost-savings for South Carolina would increase by $16,615,723, to $2,514,782,309 (**Table 4**). The cost-savings for treating 3% of patients with stroke with rtPA between 2012 and 2016 would be $2,531,398,032. This indicates an increased cost-savings of nearly $1 million for each percentage increase of rtPA use.

The sensitivity analysis of the lifetime model was conducted using the Crystal Ball software and is presented in **Table 5**. Examining the sensitivity of a 20% change in either direction for each factor in the model (except for intracerebral hemorrhage rate, which was halved and doubled) and the QALYs weight estimated a change of 10%. The QALYs gained ranged from 0.625 years to 0.767 years (7.5 months-9.2 months) per patient. A doubling of the intracerebral hemorrhage rate decreased the cost-savings to $3703, whereas a halving of the intracerebral hemorrhage rate increased the cost-savings to $4275. A 20% change in the hospital costs led to a per-patient cost-savings from $3189 to $4979.

Discussion

In 1998, Fagan and colleagues used a Markov model to predict the economic and health outcomes of acute ischemic stroke based on the use of rtPA versus placebo on a national level.[14] That analysis predicted significant economic savings throughout a patient's lifetime with the use of rtPA, along with an increase in QALYs.[14] This current analysis was repeated for South Carolina, using updated economic estimates for cost and outcomes, revealing similar cost-savings as seen in the previous study.

As part of the Stroke Belt, South Carolina has a high rate of stroke, strokes in young people, and stroke mortality.[4-7,18] In fact, previous research has shown that Stroke Belt residents are more likely to die from stroke

while in their home county, and that visitors to the area are more likely to die from stroke while visiting there than in their own region, but Stroke Belt residents are less likely to die from stroke while away from the region.[5] The reasons for this are unclear and complex, but the economic case for increased access to treatment with rtPA is neither unclear nor complex. The findings of the current analysis show that the patient outcomes and cost benefits of increased rtPA utilization are real, even when estimated only over a 6-year period; however, to be fully realized, systems and policies must be in place to allow for the timely care of acute ischemic stroke.

Because South Carolina has a higher rate of mortality from stroke in young people aged <70 years than in other areas, the findings of this model are important to the state. The care and treatment of younger patients with stroke have been shown to be more expensive than that for patients with stroke overall, providing additional potential cost-savings opportunities through the use of rtPA.[18] The savings predicted by our model will save money for the US healthcare system overall, particularly for public and private insurance payers. Although rtPA was the first FDA-approved treatment for acute ischemic stroke, the use of rtPA has not become widespread, in part because it must be administered within 3 hours of the onset of stroke symptoms.[19-21] In fact, Capampangan and colleagues report that more than a decade after its FDA approval, fewer than 5% of patients with acute ischemic stroke receive rtPA.[22]

As Fagan and colleagues pointed out, rtPA is a relatively expensive drug,[14] which has continued to increase in price since their 1998 analysis. Yet, treatment with rtPA has been shown to improve the short- and long-term health outcomes of patients with acute ischemic stroke. Although the decision to treat a patient with rtPA should be based solely on clinical eligibility, the financial case should be considered in designing stroke systems of care and statewide policies to optimize treatment opportunities with rtPA.

When comparing the early cost-savings with the lifetime cost-savings of treatment with rtPA for patients with acute ischemic stroke, the marginal savings decrease over time. Although the lifetime cost-savings ($4084) for patients treated with rtPA may seem only slightly greater than the savings over the first 6 years ($3454), the quality-adjusted months (8.3 lifetime vs 5.1, respectively) should be considered. Our analysis suggests that much of the cost-savings of the use of rtPA occur in the early years after treatment. This is likely a function of the aging process, with individuals being more likely to suffer from other expensive medical conditions as their age increases.

Limitations

Our study has several limitations. First, we examined only a single state, which may limit the generalizability of our findings.

Second, differences in clinical practice and the NINDS study in the area of intracerebral hemorrhage and entry-patient severity have been noted, and the QALY assumptions applied to each state may not fit the modeled population.

Third, although the data are the most recent available, they do not represent the current year. In addition, advances in stroke treatment could be developed and could improve patients' quality of life in future years, thus complicating the study.

Furthermore, because we have conservatively estimated our model and have built it based on a previously validated model, we believe that we may be underestimating the benefits. Finally, although a recent study reported that rtPA may be effective up to 4.5 hours after treatment, we only considered treatment within 3 hours, to be conservative.[15]

Conclusions

When looking at a short-term period of time after hospitalization, the treatment of acute ischemic stroke with rtPA is a cost-saving approach that provides increased quality of life for patients. However, challenges to such a treatment exist. Providers and administrators should be aware of the challenges of timely treatment of acute ischemic stroke, and they should work with policymakers to improve the systems of care to allow patients appropriate access to high-quality care. Funding sources, such as Medicare, Medicaid, and private insurers, will also want to offer reasonable motivation and reimbursement for treatment with rtPA to be given to appropriate patients, considering that the costs for treatment during hospitalization may be higher than current payments for providers.[19]

The patient outcomes and cost benefits with the use of rtPA described in this article are real, even when estimated only over a 6-year period. However, for these benefits to be fully realized, systems and policies must be in place to allow for the timely care of patients with acute ischemic stroke. ■

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Continued

Appendix

A. Transition Matrix for a 67-Year-Old Patient with Stroke Receiving rtPA

	Ran 0	Ran 1	Ran 2	Ran 3	Ran 4	Ran 5	Died of stroke	Summary
Start								
Hospital	15.8	16.8	8.4	9.4	21.9	20.3	7.4	100.00
Mos 3	18.4	24.0	7.4	12.9	13.6	6.2	17.5	100.00
Mos 6	19.5	22.4	8.2	13.9	9.9	4.6	21.5	100.00
Mos 9	20.0	22.2	8.0	13.4	8.3	4.6	23.5	100.00
Mos 12	20.5	22.1	7.7	13.1	6.4	4.7	25.5	100.00

B. Transition Matrix for a 67-Year-Old Comparison Group Patient

	Ran 0	Ran 1	Ran 2	Ran 3	Ran 4	Ran 5	Died of stroke	Summary
Start								
Hospital	7.5	10.1	9.5	9.4	28.3	25.1	10.1	100.00
Mos 3	10.8	16.3	11.7	14.3	19.5	6.5	20.9	100.00
Mos 6	10.9	18.5	10.5	16.5	13.9	5.9	23.8	100.00
Mos 9	10.9	17.8	11.4	14.7	12.8	5.8	26.6	100.00
Mos 12	10.9	17.0	12.2	12.9	11.6	5.8	29.6	100.00

Mos indicates months; Ran, ranking scale; rtPA, recombinant tissue plasminogen activator.

Author Disclosure Statement

Dr Adams is on the Speaker's Bureau for Genentech and is a stockholder of REACH Health, Inc. Dr Kazley, Dr K Simpson, Dr A Simpson, and Dr Jauch have reported no conflicts of interest.

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STAKEHOLDER PERSPECTIVE

Stroking This South Carolina Model: Will It Play in Peoria?

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A phrase once uttered by US Supreme Court Associate Justice Louis D. Brandeis can often be heard within the realm of political science. In opining on one case, Brandeis described each of the states as the "laboratories of democracy."[1] In doing so, he stated, "it is one of the happy accidents of the federal system that a single courageous state may, if its citizens choose, serve as a laboratory, and try novel social and economic experiments without risk to the rest of the country."[1] Within the political arena, Brandeis' comment has spawned much discussion; outside of the political arena, it has served as an analogy for looking at how a positive result obtained in one state should be expanded to others.

POLICYMAKERS: And so it is with the article by Kazley and colleagues appearing in this issue of the journal. In their study, Kazley and colleagues use the methodology of the 1998 study by Fagan and colleagues, which looked at the economic impact of the potential widespread use of recombinant tissue plasminogen activator, and applies updated cost figures to a key state residing within the so-called 11-state Stroke Belt, South Carolina. Their results reiterate several encouraging findings from the study by Fagan and colleagues, including cost-savings and improved quality of life. In fact, Kazley and colleagues acknowledge that "the savings predicted by our model will save money for the US healthcare system overall," assuming that appropriate systems of care are in place.

However, as noted by the Centers for Disease Control and Prevention, several medical consequences of lifestyle, including diabetes, hypertension, hypercholesterolemia, overweight, and obesity, are key risk factors for stroke.[2] Translating the Joseph Juran model for the "cost of poor quality" to our example, the cost of preventing a stroke (by addressing stroke risk factors) will always be less than the cost of "appraising" a stroke (also known as a "rule-out stroke" workup).[3] Both of those will still cost less than addressing "an internal failure" (defined as treating a stroke acutely) or the yet more expensive "external failure" (defined as treating the rehabilitation needs of the sequelae of stroke or, worse yet, the lost productivity of a stroke death). It should not, then, be a surprise to anyone that public health policy focuses more on prevention and early identification of strokes and, given the promotion and coverage of preventive health services through the Affordable Care Act, will continue to do so for the foreseeable future.

PAYERS/PROVIDERS: That being said, we are still aware of the need for treating acute ischemic stroke early and effectively, and the study by Kazley and colleagues provides some key points that health plans and providers must address. First, given that many of the country's largest payers are involved in providing services to older adults through Medicare Advantage plans, the fact that the results noted in the study were geared toward a population aged ≥67 years should not be discounted. If health plans can serve as an impetus for providers to arrange for appropriate systems of care, then health plans should, in the short-term, experience decreased costs for their members' care and an improved member experience through decreased member morbidity (as defined by improved quality-adjusted life-years).

More important, as accountable care organizations accept both responsibility and risk for the populations they serve, providers will further drive the development of the appropriate, and necessary, systems of care to treat stroke as well as its underlying risk factors. Such changes yield the longer-term results that Kazley and colleagues allude to in their analysis. Should these happen, will we actually see such results in South Carolina or, beyond its borders, in other states comprising the Stroke Belt? Maybe. Or, to paraphrase another US Supreme Court Associate Justice, Potter Stewart, we'll know it when we see it. ■

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