What Is the Evidence for State Laws to Enhance In-hospital and Post-hospital Stroke Care?

A Policy Evidence Assessment Report

National Center for Chronic Disease Prevention and Health Promotion
Division for Heart Disease and Stroke Prevention

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The Big Picture

Background

Stroke is a leading cause of death and serious disability in the United States.[1] State and regional **stroke systems of care** coordinate and promote timely patient access to the full range of activities and services associated with stroke prevention, treatment, and rehabilitation.[2]

Policy is a tool that could be used to improve stroke systems of care. **Policy** can be defined as a law, regulation, procedure, administrative action, incentive, or voluntary practice of governments and other institutions.[3] Multiple states have enacted laws aimed at improving the care provided to stroke patients before, during, and after their stay at the hospital.[4] In May 2017, the Centers for Disease Control and Prevention (CDC) Division for Heart Disease and Stroke Prevention (DHDSP) assessed the best available evidence for seven different policy interventions to improve **pre-hospital** stroke care, addressed in state law.[5] Between May and August 2018, DHDSP assessed the best available evidence for nine additional policy interventions to improve acute-care **in-hospital** and **post-hospital** stroke care.

About This Report

This report assesses the strength and quality of the best available evidence for eight policy interventions to improve hospital stroke care and one policy intervention related to post-hospital stroke care.[a] Each of these policy interventions a) is recommended by experts on stroke systems of care and b) was addressed in at least one state's law in effect as of May 31, 2018.[b] In this assessment, best available evidence included research and evaluation studies, as well as subject matter expert and practitioner recommendations, drawn from the published and grey literature. For more on the methods, see the Appendix.

Results of this assessment offer decision makers real-world, evidence-informed options for supporting stroke systems of care. The figure on the next page prioritizes the nine hospital/post-hospital stroke policy interventions addressed in state law by evidence level ("best," "promising quality," "promising impact," or "emerging"). **As of May 31, 2018, there were four policy interventions impacting in-hospital/post-hospital stroke care that were found to have "best" evidence and five found to have "emerging" or "promising" evidence (Figure)**.

Emergency medicine: The diagnosis and treatment of unforeseen illness or injury that may be practiced in a variety of settings, including hospital-based and freestanding emergency departments, urgent care clinics, observation medicine units, emergency medical response vehicles, and disaster sites, or through telemedicine.

Pre-hospital stroke care: This includes all emergency medical care provided to the stroke patient prior to the handoff of the patient from EMS providers to staff at the acute care facility.

In-hospital stroke care: This includes all care provided to the stroke patient at an acute care facility by hospital staff and their consulting specialists before a patient is discharged.

Post-hospital stroke care: This includes all long-term, rehabilitative care received by the stroke patient after they have been discharged from the acute care facility.

a. Post-hospital stroke laws and post-hospital stroke policy interventions are still developing. This assessment identified one post-hospital stroke policy intervention addressed in both evidence and laws. Future assessments may examine more policy interventions impacting the post-hospital stage as these policy interventions emerge.

b. Policy interventions related to primordial prevention, public and provider education on stroke, and telehealth for stroke rehabilitation services (including interstate licensure compacts for physicians) were not included in this assessment, because there are already high-quality evidence and law assessments for these topics. Health insurance coverage of stroke rehabilitation services was considered a dynamic, cross-cutting contextual factor affecting the implementation of the stroke policy interventions included in this assessment. Increased development of policy interventions to improve stroke rehabilitation is still needed.

State laws that address the policy interventions with **"best"** evidence that are expected to have the greatest potential for a positive health and associated economic impact were related to:

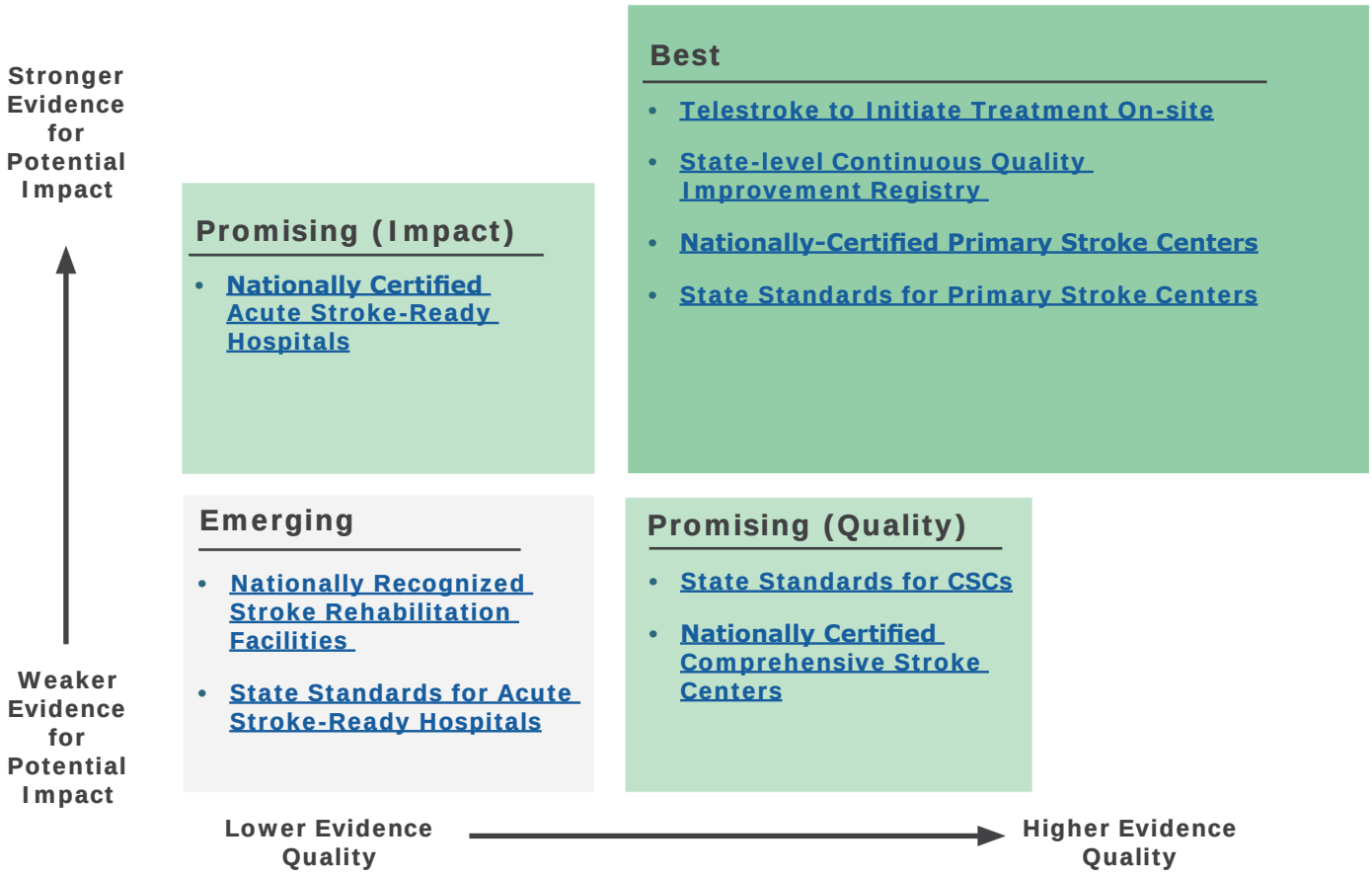
- Telestroke to Initiate Treatment On-site
- State-level Continuous Quality Improvement Registry
- Nationally Certified Primary Stroke Centers (PSCs)
- State Standards for Primary Stroke Centers

The following state laws that address the policy interventions with **"promising"** or **"emerging"** evidence could also have positive impacts, but the quantity and quality of the evidence for public health impact is limited at this time:

- State Standards for Comprehensive Stroke Centers (CSCs)
- Nationally Certified Comprehensive Stroke Centers (CSCs)
- Nationally Certified Acute Stroke-Ready Hospitals (ASRHs)
- Nationally Recognized Stroke Rehabilitation Facilities
- State Standards for Acute Stroke-Ready Hospitals

Researchers and evaluators could help build stronger evidence for these "promising" and "emerging" policy interventions. See the Appendix for a more detailed description of scoring and how the evidence for the policy interventions in this assessment could be strengthened.

Figure. Nine policy interventions impacting in-hospital/post-hospital stroke care addressed in existing state law as of May 31, 2018
Use the links in this figure to navigate to an evidence summary for each policy intervention.



In-depth Results

In this assessment, policy interventions addressing **Stroke Telemedicine** had the most robust evidence base in terms of evidence for potential public health impact and quality. Additionally, while both the **Nationally Certified PSCs** and **State Standards for PSCs** policy interventions had evidence bases that scored "best," based on many high-quality studies finding positive outcomes, it is worth noting that there were also multiple studies of PSCs finding mixed or no outcomes, including suboptimal allocation.[c]

The evidence base for **Nationally Certified CSCs** scored "promising evidence quality," with several published recommendations from experts and one study comparing outcomes at nationally and state-certified CSCs with outcomes at certified PSCs; the CSCs in this study exceeded PSCs in timely acute reperfusion therapy for emergency department admissions, whereas PSCs had lower risk-adjusted in-hospital mortality.[6] The policy intervention of **State Standards for CSCs** also scored "promising evidence quality" with several other supportive items of evidence, including a study finding CSCs meeting state standards were linked with increased access to appropriate stroke treatment and improved stroke recognition in New Jersey.[7]

ASRHs, along with stroke telemedicine, are meant to help fill gaps in stroke care, particularly in rural areas.[8, 9] The evidence base for **Nationally Certified ASRHs** scored "promising evidence for potential public health impact" in this assessment, based primarily on one study finding improved stroke recognition and increased access to appropriate stroke treatment and expert care at a hospital serving a rural community in North Carolina while seeking Joint Commission certification as an ASRH.[10]

The evidence base for **Nationally Recognized Stroke Rehabilitation Facilities** scored "emerging," with several recommendations from experts. The evidence base for **State Standards for ASRHs** also scored "emerging," with one indirect link with health improvements suggested.[11] Despite the current limitations in the evidence for the "emerging" policy interventions in this assessment, input from subject matter experts suggests continued innovation and testing in these areas.

How to Use This Report

State decision makers and public health organizations may consider presenting this report, along with facts about stroke rates and existing stroke policies and programs, to state stroke task forces and collaboratives, state and local public health agencies, health care providers and payers, and others interested in improving stroke outcomes.

State decision makers may consider planning for a state stroke policy that addresses multiple evidence-informed policy interventions to improve stroke care. State and local health agencies and their partners, state legislators, and task forces can help drive stroke policy development. State health departments often play a major role in implementing state stroke policies.[12]

Stroke researchers may consider reviewing this report for evidence gaps to be addressed in future studies. This assessment identified several research gaps, including the following:

- What are the core components of CSCs, PSCs, and ASRHs?
- How do stroke systems of care impact the health of populations experiencing stroke disparities?
- What is the value added of establishing a state-level CQI registry for stroke?
- To what extent has telestroke filled the gap for stroke care in rural areas?
- Does regionalization of stroke systems help to optimize outcomes?
- What other state-level policy interventions facilitate access to the right level of post-hospital care for every stroke patient and follow-up data collection?

c. See the *Evidence base* section of each evidence summary for a full list of the studies with mixed or no outcomes.

Evidence Summaries

The next section provides evidence summaries of eight policy interventions impacting in-hospital stroke care and one policy intervention within post-hospital stroke care included in this assessment. These summaries could help state decision makers and public health organizations determine which policy interventions may be useful in their state. The links in the figure on the previous page can be used to navigate to the evidence summary for each policy intervention.

How to use an evidence summary. Evidence summaries describe the evidence used to score a policy intervention's evidence base on potential public health impact and quality. Each evidence summary includes a full reference and evidence list and provides a list of the positive outcomes observed in intervention studies, as well as the specific states in which these outcomes were found. When there were no studies of a policy intervention, the rationale for the policy intervention, as described by experts and practitioners, is provided. See the Appendix for more on the method used to develop evidence summaries.

Additionally, each evidence summary includes a brief description of a state law that closely aligns with the policy intervention and may be listed among the states where the intervention achieved positive health outcomes. However, it is important to note that these states may not explicitly authorize the policy intervention through state statutes and regulations. These states may have authorized implementation of the policy intervention at the state, regional, and/or local levels under broader legal authorities and local laws and through state-level programs.

As a first step, state decision makers and public health organizations may consider researching the health status of their state's population. CDC offers many state health facts on its website, including those about stroke. Next, state decision makers and public health organizations may consider using the evidence summaries in this report to identify policy interventions impacting in-hospital/post-hospital stroke care that may help improve stroke systems of care in their state setting.

References

1. Centers for Disease Control and Prevention. Stroke facts. https://www.cdc.gov/stroke/facts.htm.
2. Schwamm LH, Pancioli A, Acker JE, et al. Recommendations for the establishment of stroke systems of care. Recommendations from the American Stroke Association's Task Force on the Development of Stroke Systems. Stroke. 2005;36(3):690-703.
3. Centers for Disease Control and Prevention. Definition of policy. https://www.cdc.gov/policy/analysis/process/definition.html.
4. Uchino K, Man S, Schold JD, Katzan IL. Stroke legislation impacts distribution of certified stroke centers in the United States. Stroke. 2015;46(7):1903-1908.
5. Centers for Disease Control and Prevention, Division for Heart Disease and Stroke Prevention. The evidence for pre-hospital emergency medical service systems policy interventions addressed in existing state laws. Atlanta, GA: Centers for Disease Control and Prevention; 2017.
6. Man S, Zhao X, Uchino K, et al. Comparison of acute ischemic stroke care and outcomes between comprehensive stroke centers and primary stroke centers in the United States. Circulation. 2018;11:e004512.
7. McKinney JS, Deng Y, Kasner SE, Kostis JB; Myocardial Infarction Data Acquisition System Study Group. Comprehensive stroke centers overcome the weekend versus weekday gap in stroke treatment and mortality. Stroke. 2011;42(9):2403-2409.
8. Alberts MJ, Wechsler LR, Jensen ME, et al. Formation and function of acute stroke-ready hospitals within a stroke system of care: Recommendations from the Brain Attack Coalition. Stroke. 2013;44(12):3382-3393.
9. Schwamm LH, Audebert HJ, Amarenco P, et al. Recommendations for the implementation of telemedicine within stroke systems of care: A policy statement from the American Heart Association. Stroke. 2009;40(7):2635-2660.
10. Slivinski A, Jones R, Whitehead H, Hooper V. Improving access to stroke care in the rural setting: The journey to acute stroke-ready designation. Journal of Emergency Nursing. 2017;43(1):24-32.
11. Thurman RJ, Jauch EC, Panagos PD, Reynolds MR, Mocco J. Four evolving strategies in the emergent treatment of acute ischemic stroke. Emergency Medicine Practice. 2012;14(7):1-26; quiz 26-27.
12. Centers for Disease Control and Prevention. A summary of Primary Stroke Center policy in the United States. Atlanta: U.S. Department of Health and Human Services; 2011.

Evidence Summaries

Telestroke to Initiate Treatment On-site

Evidence Level: **BEST**

Telemedicine involves the use of technology to provide health care, monitor health status, and share health information remotely. Telestroke involves using telemedicine to evaluate patients and initiate treatment for acute stroke care and provide access to acute stroke specialists in medically underserved, rural, and geographically remote areas.

Example of state law addressing this type of intervention

An Arizona statute requires all insurance contracts provided to subscribers by certain "hospital service corporations" and "medical service corporations" issued, delivered, or renewed on or after January 1, 2018, to provide coverage for stroke telemedicine services "if the health care service would be covered were it provided through in-person consultation…to a subscriber receiving the service in Arizona." "Telemedicine" is defined as the "interactive use of audio, video or other electronic media for…diagnosis, consultation or treatment…beyond the sole use of an audio-only telephone, a video-only system, a facsimile machine, instant messages or electronic mail." 2018 ARIZ. REV. STAT. §§ 20-841.09 & 20-822 (2018).

Evidence for Potential Public Health Impact:

Effectiveness: ●●●●
Equity & Reach: ●●●●
Efficiency: ●●●●
Transferability: ●●●●

Weaker=●○○○ ◄► ●●●●=Stronger

For more on the scoring and summary methods see the Appendix

TOTAL: ●●●●●●●●●●●●●●●●

Weak | Moderate | Strong | **Very Strong**

SCORE: VERY STRONG

Evidence Quality:

Evidence Types: ●●●○
Sources: ●●●●
Evidence from Research: ●○○○
Evidence from Translation & Practice: ●●●●

Lower=●●●● ◄► ●●●●=Higher

For more on the scoring and summary methods see the Appendix

TOTAL: ●●●●●●●●●●●●○○○○

Low | Moderate | **High** | Very High

SCORE: HIGH

Health-related outcomes	Telestroke was linked with improved neurological outcomes,[1, 8-10] mortality rates,[2, 8-10] stroke recognition,[2, 6, 9, 11, 57, 58] and access to care,[12-14] as well as increased access to appropriate stroke treatment.[2, 3, 10, 11, 13-22, 57] Stroke systems of care that included telestroke were also linked with improved mortality rates[59] and increased access to appropriate stroke care.[23-25, 59, 60]
Population(s) impacted	Most studies reporting positive health-related outcomes examined the general population.[1-3, 6, 8-9, 11-12, 14-25, 57-60] Two studies examined rural populations.[10, 13]
Economic highlights	Telestroke was linked with shorter hospital stays,[8] cost savings,[58] and cost-effectiveness.[2, 57, 58, 10]
States where interventions achieved positive health-related outcomes	Studies of local stroke systems of care including telestroke were set in Arizona,[3, 6] California,[22] Delaware,[18] Georgia,[19] Illinois,[11] Louisiana,[21] Montana,[17] Massachusetts,[24] Michigan,[9] New Jersey,[18] North Carolina,[10, 16] Pennsylvania,[18] South Carolina,[19, 20] and Texas.[12] Regional studies were set in Massachusetts,[8] Maine,[8] New Hampshire,[8] Alaska,[23] Idaho,[23] Montana,[23] Oregon,[23] and Washington.[23] There were also 10 national studies.[1, 2, 13-15, 25, 57-60]

Evidence base

Research-based studies

1. Demaerschalk BM, Bobrow BJ, Raman R, et al. Computed tomography interpretation in a telestroke network: agreement between spoke radiologist, hub vascular neurologist, and hub neuroradiologist. Stroke. 2012;43(11):3095-3097.
2. Demaerschalk BM, Raman R, Ernstrom K, Meyer BC. Efficacy of telemedicine for stroke: pooled analysis of the Stroke Team Remote Evaluation Using a Digital Observation Camera (STRokE DOC) and STRokE DOC Arizona telestroke trials. Telemedicine Journal and e-Health. 2012;18(3): 230-237.[a]

Practice-based studies

3. Pervez MA, Silva G, Masrur S, et al. Remote supervision of IV-tPA for acute ischemic stroke by telemedicine or telephone before transfer to a regional stroke center is feasible and safe. Stroke. 2010;41(1):e18-24.
4. Majersik JJ, Meurer WJ, Frederiksen SA, et al. Observational study of telephone consults by stroke experts supporting community tissue plasminogen activator delivery. Academic Emergency Medicine. 2012;19(9):E1027-1034.
5. Tegeler CH, Suwatcharangkoon S, Bradbury E. Telestroke to improve acute stroke care in North Carolina. North Carolina Medical Journal. 2012;73(6):481-484.
6. Cutting S, Conners JJ, Lee VH, Song S, Prabhakaran S. Telestroke in an urban setting. Telemedicine Journal and e-Health. 2014;20(9):855-857.
7. Wu TC, Lyerly MJ, Albright KC, et al. Impact of telemedicine on access to acute stroke care in the state of Texas. Annals of Clinical & Translational Neurology. 2014;1(1):27-33.
8. Kulcsar M, Gilchrist S, George MG. Improving stroke outcomes in rural areas through telestroke programs: An examination of barriers, facilitators, and state policies. Telemedicine Journal and e-Health. 2013;20(1):3-10.[b]
9. Silva GS, Farrell S, Shandra E, Viswanathan A, Schwamm LH. The status of telestroke in the United States. A survey of currently active stroke telemedicine programs. Stroke. 2012;43(8):2078-2085.[c]
10. Demaerschalk BM, Hwang HM, Leung G. Cost analysis review of stroke centers, telestroke, and rt-PA. American Journal of Managed Care. 2010;16(7):537-544.[d]
11. Goldstein LB. Statewide hospital-based stroke services in North Carolina: Changes over 10 years. Stroke. 2010;41(4):778-783.
12. Okon NJ, Fogle CC, McNamara MJ, et al. Statewide efforts to narrow the rural-urban gap in acute stroke care. American Journal of Preventive Medicine. 2010;39(4):329-333.
13. Chalouhi N, Dressler JA, Kunkel ES, et al. Intravenous tissue plasminogen activator administration in community hospitals facilitated by telestroke service. Neurosurgery. 2013;73(4):667-671; discussion 671-672.[e]
14. Switzer JA, Singh R, Mathiassen L, Waller JL, Adams RJ, Hess DC. Telestroke: Variations in intravenous thrombolysis by spoke hospitals. Journal of Stroke & Cerebrovascular Diseases. 2015;24(4):739-744.
15. Al Kasab S, Harvey JB, Debenham E, Jones DJ, Turner N, Holmstedt CA. Door-to-needle time over telestroke: A Comprehensive Stroke Center experience. Telemedicine Journal and e-Health. 2018;24(2):111-115.
16. Commiskey P, Afshinnik A, Cothren E, et al. Description of a novel telemedicine-enabled comprehensive system of care: drip and ship plus drip and keep within a system of stroke care delivery. Journal of Telemedicine and Telecare. 2017;23(3):428-436.
17. Shkirkova K, Akam EY, Huang J, et al. Feasibility and utility of an integrated medical imaging and informatics smartphone system for management of acute stroke. International Journal of Stroke. 2017;12(9):953-960.
18. Shultis W, Graff R, Chamie C, et al. Striking rural-urban disparities observed in acute stroke care capacity and services in the Pacific Northwest: Implications and recommendations. Stroke. 2010;41(10):2278-2282.
19. Rost NS, Smith EE, Pervez MA, Mello P, Dreyer P, Schwamm LH. Predictors of increased intravenous tissue plasminogen activator use among hospitals participating in the Massachusetts Primary Stroke Service Program. Circulation: Cardiovascular Quality & Outcomes. 2012;5(3):314-320.
20. Rubin MN, Demaerschalk BM, Schwamm LH, Wechsler LR. Telestroke. In: Tsao JW, Demaerschalk BM, eds. Teleneurology in practice: A comprehensive clinical guide. New York, NY: Springer Science + Business Media; 2015:47-57.
21. Smith EE, Dreyer P, Prvu-Bettger J, et al. Stroke center designation can be achieved by small hospitals: The Massachusetts experience. Critical Pathways in Cardiology. 2008;7(3):173-177.
22. Adams RJ, Debenham E, Chalela J, et al. REACH MUSC: A telemedicine facilitated network for stroke: Initial operational experience. Frontiers in Neurology. 2012;3:33.[f]
23. Albright KC, Boehme AK, Mullen MT, et al. The effect of telemedicine on access to acute stroke care in Texas: The story of age inequalities. Stroke Research and Treatment. 2015;2015:813493.[g]
24. Amorim E, Shih MM, Koehler SA, et al. Impact of telemedicine implementation in thrombolytic use for acute ischemic stroke: The University of Pittsburgh Medical Center telestroke network experience. Journal of Stroke & Cerebrovascular Diseases. 2013;22(4):527-531.[h]
25. Budhram SC. An economic evaluation comparing stroke telemedicine to conventional stroke medicine. Dissertation Abstracts International Section A: Humanities and Social Sciences. 2012;73(3-A):815.
26. Demaerschalk B, Switzer JA, Xie J, Fan L, Villa KF, Wu EQ. Cost utility of hub-and-spoke telestroke networks from societal perspective. American Journal of Managed Care. 2013;19(12):976-985.
27. Fearon P, Quinn TJ. Making the call: Is telestroke cost effective? Expert Review of Pharmacoeconomics and Outcomes Research. 2012;12(1):15-18.
28. Greenberg K, Maxwell CR, Moore KD, et al. Improved door-to-needle times and neurologic outcomes when IV tissue plasminogen activator is administered by emergency physicians with advanced neuroscience training. American Journal of Emergency Medicine. 2015;33(2):234-237.[i]
29. Guzauskas GF, Boudreau DM, Villa KF, Levine SR, Veenstra DL. The cost-effectiveness of primary stroke centers for acute stroke care. Stroke. 2012;43(6):1617-1623.
30. Heffner DL, Thirumala PD, Pokharna P, Chang YF, Wechsler L. Outcomes of spoke-retained telestroke patients versus hub-treated patients after intravenous thrombolysis: Telestroke patient outcomes after thrombolysis. [Erratum appears in Stroke. 2016;47(1):e19; PMID: 26712954]. Stroke. 2015;46(11):3161-3167.[j]
31. Hoegerl C, Goldstein FJ, Sartorius J. Implementation of a stroke alert protocol in the emergency department: A pilot study. Journal of the American Osteopathic Association. 2011;111(1):21-27.
32. Kazley AS, Wilkerson RC, Jauch E, Adams RJ. Access to expert stroke care with telemedicine: REACH MUSC. Frontiers in Neurology. 2012;3:44.

Telestroke to Initiate Treatment On-site (cont.)

33. LaMonte MP, Bahouth MN, Magder LS, et al. A regional system of stroke care provides thrombolytic outcomes comparable with the NINDS stroke trial. Annals of Emergency Medicine. 2009;54(3):319-327.[k]
34. Lazaridis C, DeSantis SM, Jauch EC, Adams RJ. Telestroke in South Carolina. Journal of Stroke & Cerebrovascular Diseases. 2013;22(7):946-950.[l]
35. Martin-Schild S, Morales MM, Khaja AM, et al. Is the drip-and-ship approach to delivering thrombolysis for acute ischemic stroke safe? Journal of Emergency Medicine. 2011;41(2):135-141.[m]
36. Meyer BC, Raman R, Ernstrom K, et al. Assessment of long-term outcomes for the STRokE DOC telemedicine trial (STRokE DOC-LTO). Journal of Stroke & Cerebrovascular Diseases. 2012;21(4):259-264.[n]
37. Miley ML, Demaerschalk BM, Olmstead NL, et al. The state of emergency stroke resources and care in rural Arizona: A platform for telemedicine. Telemedicine and e-Health. 2009;15(7):691-699.
38. O'Carroll CB, Hentz JG, Aguilar MI, Demaerschalk BM. Robotic telepresence versus standardly supervised stroke alert team assessments. Telemedicine Journal and e-Health. 2015;21(3):151-156.[o]
39. O'Toole LJ, Jr., Slade CP, Brewer GA, Gase LN. Barriers and facilitators to implementing primary stroke center policy in the United States: Results from 4 case study states. American Journal of Public Health. 2011;101(3):561-566.
40. Samson M, Trivedi T, Heidari K. Telestroke centers as an option for addressing geographical disparities in access to stroke care in South Carolina, 2013. Preventing Chronic Disease. 2015;12:E227.[p]
41. Slade CP, O'Toole LJ, Jr., Rho E. State primary stroke center policies in the United States: Rural health issues. Telemedicine Journal and e-Health. 2012;18(3):225-229.
42. Switzer JA, Demaerschalk BM, Xie J, Fan L, Villa KF, Wu EQ. Cost-effectiveness of hub-and-spoke telestroke networks for the management of acute ischemic stroke from the hospitals' perspectives. Circulation: Cardiovascular Quality and Outcomes. 2013;6(1):18-26.
43. Switzer JA, Hall C, Gross H, et al. A web-based telestroke system facilitates rapid treatment of acute ischemic stroke patients in rural emergency departments. Journal of Emergency Medicine. 2009;36(1):12-18.[q]
44. Uchino K, Massaro L, Jovin TG, Hammer MD, Wechsler LR. Protocol adherence and safety of intravenous thrombolysis after telephone consultation with a stroke center. Journal of Stroke & Cerebrovascular Diseases. 2010;19(6):417-423.[r]
45. Wolff C, Boehme AK, Albright KC, et al. Sex disparities in access to acute stroke care: can telemedicine mitigate this effect? Journal of Health Disparities Research and Practice. 2016;9(1).
46. Zaidi SF, Jumma MA, Urra XN, et al. Telestroke-guided intravenous tissue-type plasminogen activator treatment achieves a similar clinical outcome as thrombolysis at a comprehensive stroke center. Stroke. 2011;42(11):3291-3293.[s]

a. Mixed outcome—improved stroke recognition and increased access to appropriate stroke care but noted longer times for consultations, declines in neurological outcomes, and higher rates of mortality.
b. Mixed outcome—heavy upfront costs, but overall telemedicine was cost-effective.
c. Mixed outcome—Medicare reimbursement is possible, but issues remain, particularly if IV rt-PA is administered through the drip-and-ship model.
d. Mixed outcome—more patients received appropriate stroke care, but consultations were not occurring, because there was no two-way interaction video in place.
e. Mixed outcome—telestroke is a possible explanation for the increase in patients remaining at spoke facilities, but various factors that may impact the decision to transfer patients were not controlled for.
f. Mixed outcome—improved neurological outcomes but longer door-to-needle times.
g. Mixed outcome—younger populations fared well, but the elderly had less access to care.
h. Mixed outcome—patients had increased access to appropriate care but noted more incorrect treatment decisions occurring and a higher percentage of in-hospital mortality.
i. Mixed outcome—improved neurological outcomes but longer mean door-to-needle times, and fewer patients had door-to-needle within 60 minutes.
j. Negative outcomes—majority of negative outcomes from patients were treated with the drip-and-stay model compared to drip-and-ship, as well as increased odds of a length of stay despite lower risk of intubation and fever.
k. Mixed outcome—improved access to treatment; however, patients who received tPA at a remote ED by teleconsultation were more likely to have experienced a symptomatic intracranial hemorrhage (sICH) than those who received tPA after face-to-face consultations.
l. Mixed outcome—improved neurological outcomes but longer door-to-computed tomography and consult-to-tPA times.
m. Mixed outcome—improved neurological outcomes but longer onset-to-treatment and arrival-to-treatment times.
n. Mixed outcome—higher mortality rates at 6 and 12 months, a lower percentage of patients with positive functional scores at 6 months, a higher percentage of patients with positive functional scores at 12 months, and a lower percentage of patients with recurrent stroke at 6 and 12 months.
o. Mixed outcome—improved neurological outcomes and mortality rates but longer times between stroke alert activation and initiation of intravenous thrombolytic treatment; increase in the length of hospital stay.
p. Mixed outcome—telestroke increased access to care and reduced geographical disparities; however, the shortage of specialized stroke treatment facilities in South Carolina is impeding these benefits.
q. Mixed outcome—increased access to treatment but noted higher rates of sICH.
r. Mixed outcome—increased access to treatment and lower rates of asymptomatic ICH but also reported longer onset-to-hospital and transfer duration times, higher rates of sICH and in-hospital mortality, and a higher rate of protocol deviations.
s. Mixed outcome—improved neurological outcomes but higher rates of mortality.

Telestroke to Initiate Treatment On-site (cont.)

Narratives and Commentaries

47. Schwamm LH, Holloway RG, Amarenco P, et al. A review of the evidence for the use of telemedicine within stroke systems of care: A scientific statement from the American Heart Association/American Stroke Association. Stroke. 2009;40(7):2616-2634.
48. Wechsler LR, Demaerschalk BM, Schwamm LH, et al. Telemedicine quality and outcomes in stroke: A scientific statement for healthcare professionals from the American Heart Association/American Stroke Association. Stroke. 2017;48(1):e3-e25.
49. Demaerschalk BM, Miley ML, Kiernan T-EJ, et al. Stroke telemedicine. Mayo Clinic Proceedings. 2009;84(1):53-64.
50. Alberts MJ, Latchaw RE, Jagoda A, et al. Revised and updated recommendations for the establishment of primary stroke centers: A summary statement from the brain attack coalition. Stroke. 2011;42(9):2651-2665.
51. Lackland DT, Roccella EJ, Deutsch AF, et al. Factors influencing the decline in stroke mortality: A statement from the American Heart Association/American Stroke Association. Stroke. 2014;45(1):315-353.
52. Dumitrascu OM, Demaerschalk BM. Telestroke. Current Cardiology Reports. 2017;19(9):85.
53. Demaerschalk BM. Telemedicine or telephone consultation in patients with acute stroke. Current Neurology and Neuroscience Reports. 2011;11(1):42-51.
54. Reynolds MR, Panagos PD, Zipfel GJ, Lee J-M, Derdeyn CP. Elements of a stroke center. Techniques in Vascular and Interventional Radiology. 2012;15(1):5-9.
55. Gorelick PB. Primary and Comprehensive Stroke Centers: History, value, and certification criteria. Journal of Stroke. 2013;15(2):78-89.
56. Alberts MJ, Latchaw RE, Selman WR, et al. Recommendations for comprehensive stroke centers: A consensus statement from the Brain Attack Coalition. Stroke. 2005;36(7):1597-1616.
57. Alberts MJ, Wechsler LR, Jensen ME, et al. Formation and function of acute stroke-ready hospitals within a stroke system of care: Recommendations from the Brain Attack Coalition. Stroke. 2013;44(12):3382-3393.
58. Ali SF, Singhal AB, Viswanathan A, Rost NS, Schwamm LH. Characteristics and outcomes among patients transferred to a regional comprehensive stroke center for tertiary care. Stroke. 2013;44(11):3148-3153.[t]
59. Amarenco P. "Telethrombolysis": Stroke consultation by telemedicine. The Lancet Neurology. 2008;7(9):763-765.
60. Callison RC, Leira EC. Strategies to improve acute stroke care of patients in rural and other geographically dispersed areas. Current Treatment Options in Neurology. 2008;10(6):450-454.
61. de Havenon A, Sultan-Qurraie A, Hannon P, Tirschwell D. Development of regional stroke programs. Current Neurology and Neuroscience Reports. 2015;15(5):544.
62. Demaerschalk BM. Remote evaluation of the patient with acute stroke. CONTINUUM: Lifelong Learning in Neurology. 2017;23(1, Cerebrovascular Disease):259-267.
63. DeSousa KG, Haussen DC, Yavagal DR. Strategies for streamlining emergency stroke care. Current Neurology and Neuroscience Reports. 2014;14(11):497.
64. Gropen T, Magdon-Ismail Z, Day D, Melluzzo S, Schwamm LH; NECC Advisory Group. Regional implementation of the Stroke Systems of Care Model: Recommendations of the Northeast Cerebrovascular Consortium. Stroke. 2009;40(5):1793-1802.
65. Higashida R, Alberts MJ, Alexander DN, et al. Interactions within stroke systems of care: A policy statement from the American Heart Association/American Stroke Association. Stroke. 2013;44(10):2961-2984.
66. Jauch EC, Holmstedt C, Nolte J. Techniques for improving efficiency in the emergency department for patients with acute ischemic stroke. Annals of the New York Academy of Sciences. 2012;1268:57-62.
67. Jauch EC, Saver JL, Adams HP, Jr., et al. Guidelines for the early management of patients with acute ischemic stroke: A guideline for healthcare professionals from the American Heart Association/American Stroke Association. Stroke. 2013;44(3):870-947.
68. Klein KE, Rasmussen PA, Winners SL, Frontera JA. Teleneurocritical care and telestroke. Critical Care Clinics. 2015;31(2):197-224.
69. North Carolina Department of Health and Human Services, Division of Public Health. Association of State and Territorial Health Officials (ASTHO): Stroke system of care plan for North Carolina. Raleigh, NC: North Carolina Department of Health and Human Services; 2010:1-43.
70. Park S, Schwamm LH. Organizing regional stroke systems of care. Current Opinion in Neurology. 2008;21(1):43-55.
71. Rubin MN, Demaerschalk BM. The use of telemedicine in the management of acute stroke. Neurosurgical Focus. 2014;36(1):E4.
72. Saler M, Switzer JA, Hess DC. Use of telemedicine and helicopter transport to improve stroke care in remote locations. Current Treatment Options in Cardiovascular Medicine. 2011;13(3):215-224.
73. Schwamm LH, Audebert HJ, Amarenco P, et al. Recommendations for the implementation of telemedicine within stroke systems of care: A policy statement from the American Heart Association. Stroke. 2009;40(7):2635-2660.
74. Schwamm LH, Chumbler N, Brown E, et al. Recommendations for the implementation of telehealth in cardiovascular and stroke care: A policy statement from the American Heart Association. Circulation. 2017;135(7):e24-e44.
75. Silva GS, Schwamm LH. Review of stroke center effectiveness and other Get With the Guidelines data. Current Atherosclerosis Reports. 2013;15(9):350.
76. Silva GS, Schwamm LH. Use of telemedicine and other strategies to increase the number of patients that may be treated with intravenous thrombolysis. Current Neurology and Neuroscience Reports. 2012;12(1):10-16.
77. Thurman RJ, Jauch EC, Panagos PD, Reynolds MR, Mocco J. Four evolving strategies in the emergent treatment of acute ischemic stroke. Emergency Medicine Practice. 2012;14(7):1-26; quiz 26-27.

t. Mixed outcome—mixed results for in-hospital mortality rates, range of last known well to intravenous tPA administration, and discharge disposition; an increase in the length of hospital stay.

State-level Continuous Quality Improvement Registry

Evidence Level: **BEST**

*A statewide continuous quality improvement (CQI) program, process, and/or plan is needed to ensure that stroke care delivery across the state applies to evidence-based national standards and best practices. As part of CQI, a state-level stroke database, data system, or registry helps to track nationally recognized consensus stroke care metrics.**

**Nationally recognized consensus stroke metrics are provided by the following entities: American Heart Association, Paul Coverdell National Acute Stroke Program, National Committee for Quality Assurance, and Public Health Issues Management.*

Example of state law addressing this type of intervention

All hospitals designated at any level (CSC, PSC, Remote Treatment Stroke Center, or other authorized level) by the Georgia Department of Public Health (DPH) as a stroke center must participate in the Georgia Coverdell Acute Stroke Registry and submit a minimum set of data elements to the Registry as required. DPH may suspend or revoke designation of non-compliant hospitals. Ga Comp. R. & Regs. 511-9-2-04 (2018).

Evidence for Potential Public Health Impact:

Effectiveness: ●●●●
Equity & Reach: ●●●○
Efficiency: ●●○○
Transferability: ●●●●

Weaker=●○○○ ◄► ●●●●=Stronger

For more on the scoring and summary methods see the Appendix

TOTAL: ●●●●●●●●●●●●○○○

Weak | Moderate | Strong | **Very Strong**

SCORE: VERY STRONG

Evidence Quality:

Evidence Types: ●●●○
Sources: ●●●●
Evidence from Research: ●○○○
Evidence from Translation & Practice: ●●●●

Lower=●○○○ ◄► ●●●●=Higher

For more on the scoring and summary methods see the Appendix

TOTAL: ●●●●●●●●○○○○○○○

Low | Moderate | **High** | Very High

SCORE: HIGH

Health-related outcomes	State-level CQI registries were linked with increased access to appropriate stroke treatment,[1, 6, 7] lower rates of mortality,[8] and improved neurological outcomes.[2] Stroke systems of care that included state-level CQI registries were also linked to improved neurological outcomes.[3]
Population(s) impacted	Studies reporting positive health-related outcomes examined the general population.[1-3, 6-8] One study examined a rural population.[9]
Economic highlights	*No economic outcomes January 1, 2007, to May 31, 2018*
States where interventions achieved positive health-related outcomes	Studies of local stroke systems of care including state-level CQI registries were set in Arizona,[1] California,[1] Florida,[1] Georgia,[1, 8, 9] Illinois,[3] Kansas,[3] Massachusetts,[1, 7] Michigan,[1] North Carolina,[9] Ohio,[1] Pennsylvania,[1] and South Carolina.[9] There were three national studies.[2, 4, 6]

Evidence base

Research-based studies

1. LaBresh KA, Reeves MJ, Frankel MR, Albright D, Schwamm LH. Hospital treatment of patients with ischemic stroke or transient ischemic attack using the "Get With the Guidelines" program. Archives of Internal Medicine. 2008;168(4):411-417.
2. Fonarow GC, Zhao X, Smith EE, et al. Door-to-needle times for tissue plasminogen activator administration and clinical outcomes in acute ischemic stroke before and after a quality improvement initiative. JAMA. 2014;311(16):1632-1640.
3. Prabhakaran S, Lee J, O'Neill K. Regional learning collaboratives produce rapid and sustainable improvements in stroke thrombolysis times. Circulation: Cardiovascular Quality & Outcomes. 2016;9(5):585-592.
4. Schwamm L, Fonarow GC, Reeves MJ, et al. Get With the Guidelines-Stroke is associated with sustained improvement in care for patients hospitalized with acute stroke or transient ischemic attack. Circulation. 2009;119(1):107-115.
5. Sauser K, Burke JF, Levine DA, Scott PA, Meurer WJ. Time to brain imaging in acute stroke is improving: Secondary analysis of the INSTINCT trial. Stroke. 2014;45(1):287-289.

Practice-based studies

6. Lewis WR, Fonarow GC, Grau-Sepulveda MV, et al. Improvement in use of anticoagulation therapy in patients with ischemic stroke: Results from Get With the Guidelines-Stroke. American Heart Journal. 2011;162(4):692-699.e692.
7. Rost NS, Smith EE, Pervez MA, Mello P, Dreyer P, Schwamm LH. Predictors of increased intravenous tissue plasminogen activator use among hospitals participating in the Massachusetts Primary Stroke Service Program. Circulation: Cardiovascular Quality & Outcomes. 2012;5(3):314-320.
8. Ido MS, Frankel MR, Okosun IS, Rothenberg RB. Quality of Care and Its Impact on One-Year Mortality: The Georgia Coverdell Acute Stroke Registry. American Journal of Medical Quality. 2017;33(1):86-92.
9. Khan JA, Casper M, Asimos AW, et al. Geographic and sociodemographic disparities in drive times to Joint Commission-certified primary stroke centers in North Carolina, South Carolina, and Georgia. Preventing Chronic Disease. 2011;8(4):A79.
10. Ciliberti-Vargas MA, Gardener H, Wang K, et al. Stroke hospital characteristics in the Florida-Puerto Rico Collaboration to Reduce Stroke Disparities Study. Southern Medical Journal. 2017;110(7):466-474.
11. Kim JT, Fonarow GC, Smith EE, et al. Treatment with tissue plasminogen activator in the golden hour and the shape of the 4.5-hour time-benefit curve in the national United States Get With the Guidelines-Stroke population. Circulation. 2017;135(2):128-139.
12. O'Toole LJ, Jr., Slade CP, Brewer GA, Gase LN. Barriers and facilitators to implementing primary stroke center policy in the United States: Results from 4 case study states. American Journal of Public Health. 2011;101(3):561-566.
13. Pervez MA, Silva G, Masrur S, et al. Remote supervision of IV-tPA for acute ischemic stroke by telemedicine or telephone before transfer to a regional stroke center is feasible and safe. Stroke. 2010;41(1):e18-24.
14. Shultis W, Graff R, Chamie C, et al. Striking rural-urban disparities observed in acute stroke care capacity and services in the Pacific Northwest: Implications and recommendations. Stroke. 2010;41(10):2278-2282.
15. Smith EE, Dreyer P, Prvu-Bettger J, et al. Stroke center designation can be achieved by small hospitals: The Massachusetts experience. Critical Pathways in Cardiology. 2008;7(3):173-177.
16. Xian Y, Holloway RG, Chan PS, et al. Association between stroke center hospitalization for acute ischemic stroke and mortality. JAMA. 2011;305(4):373-380.[a]

Narratives and commentaries

17. Amin A, Dressler DD, Likosky DJ, et al. Systems approach to standardization of care in the secondary prevention of noncardioembolic ischemic stroke. Journal of Hospital Medicine. 2008;3(Suppl4):S29-S35.
18. Clark ML, Gropen T. Advances in the Stroke System of Care. Current treatment options in cardiovascular medicine. 2015;17(1).
19. Dowla N, Chan L. Improving quality in stroke rehabilitation. Topics in Stroke Rehabilitation. 2010;17(4):230-238.
20. El-Ghanem M, Al-Mufti F, Thulasi V, Singh IP, Gandhi C. Expanding the treatment window for ischemic stroke through the application of novel system-based technology. Neurosurgical Focus. 2017;42(4):E7.
21. George MG, Matters MD, Xie J, McGruder HF, Valderrama AL. The role of public health in promoting quality improvement in care for stroke and heart disease. Preventing Chronic Disease. 2008;5(2):A62.
22. Gropen T, Magdon-Ismail Z, Day D, Melluzzo S, Schwamm LH; NECC Advisory Group. Regional implementation of the Stroke Systems of Care Model: Recommendations of the Northeast Cerebrovascular Consortium. Stroke. 2009;40(5):1793-1802.
23. Higashida R, Alberts MJ, Alexander DN, et al. Interactions within stroke systems of care: A policy statement from the American Heart Association/American Stroke Association. Stroke. 2013;44(10):2961-2984.
24. Jauch EC, Saver JL, Adams HP, Jr., et al. Guidelines for the early management of patients with acute ischemic stroke: A guideline for healthcare professionals from the American Heart Association/American Stroke Association. Stroke. 2013;44(3):870-947.
25. Levine SR, Adamowicz D, Johnston KC. Primary stroke center certification. CONTINUUM: Lifelong Learning in Neurology. 2008;14(6):98-116.
26. Lu-Emerson C, Likosky D, Amin A, Tirschwell D. Management of ischemic stroke: Part 2. The inpatient stay. Journal of Hospital Medicine. 2010;5(2):88-93.
27. Park S, Schwamm LH. Organizing regional stroke systems of care. Current Opinion in Neurology. 2008;21(1):43-55.
28. Reeves MJ, Parker C, Fonarow GC, Smith EE, Schwamm LH. Development of stroke performance measures: Definitions, methods, and current measures. Stroke. 2010;41(7):1573-1578.
29. Reynolds MR, Panagos PD, Zipfel GJ, Lee JM, Derdeyn CP. Elements of a stroke center. Techniques in Vascular and Interventional Radiology. 2012;15(1):5-9.
30. Rokos IC, Schwamm LH, Konig M, et al. Variable impact of state legislative advocacy on registry participation and regional systems of care implementation. A policy statement from the American Heart Association. Circulation. 2013;128(16):1799-1809.[b]
31. Schwamm L, Fayad P, Acker JE, 3rd, et al. Translating evidence into practice: A decade of efforts by the American Heart Association/American Stroke Association to reduce death and disability due to stroke. A presidential advisory from the American Heart Association/American Stroke Association. Stroke. 2010;41(5):1051-1065.
32. Silva GS, Schwamm LH. Review of stroke center effectiveness and other Get With the Guidelines data. Current Atherosclerosis Reports. 2013;15(9):350.
33. Thurman RJ, Jauch EC, Panagos PD, Reynolds MR, Mocco J. Four evolving strategies in the emergent treatment of acute ischemic stroke. Emergency Medicine Practice. 2012;14(7):1-26; quiz 26-27.

a. Mixed outcome—mortality benefit was related to stroke center designation rather than to overall quality improvement efforts at designated stroke centers.
b. Mixed outcome—in a case study, one of the state health departments determined that operation of a stroke registry was cost-prohibitive.

Nationally Certified Primary Stroke Centers

Evidence Level: **BEST**

PSCs certified by nationally recognized accrediting bodies must have infrastructure and demonstrated ability to stabilize and treat acute stroke patients, including timely provision of intravenous thrombolytic therapy utilizing alteplase, neuroimaging capabilities, and the management of intracranial pressure.*[41]

*Nationally recognized accrediting bodies for PSCs include The Joint Commission/AHA/ASA, Center for Improvement in Healthcare Quality, Det Norske Veritas, and Healthcare Facilities Accreditation Program. State standards for PSCs are addressed in a separate policy intervention.

Example of state law addressing this type of intervention

The Illinois Department of Public Health is authorized to designate hospitals as Primary Stroke Centers with proof of certification from a Department-approved, nationally recognized certifying body using "current nationally recognized, evidence-based stroke guidelines." 210 Ill. Comp. Stat. § 50/3.116 & 210 Ill. Comp. Stat. § 50/3.117 (2018). See also rules: 77 Ill. Adm. Code 515.5020 to 77 Ill. Adm. Code 515.5040 (2018).

Evidence for Potential Public Health Impact:

Effectiveness: ●●●●
Equity & Reach: ●●○○
Efficiency: ●●○○
Transferability: ●●●●

Weaker=●●●● ◄► ●●●●=Stronger

For more on the scoring and summary methods see the Appendix

TOTAL: ●●●●●●●●●●●○○○○

Weak | Moderate | **Strong** | Very Strong

SCORE: STRONG

Evidence Quality:

Evidence Types: ●●●○
Sources: ●●●●
Evidence from Research: ○○○○
Evidence from Translation & Practice: ●●●●

Lower=●●●● ◄► ●●●●=Higher

For more on the scoring and summary methods see the Appendix

TOTAL: ●●●●●●●●●●○○○○○

Low | Moderate | **High** | Very High

SCORE: HIGH

Health-related outcomes	PSCs certified by nationally recognized accrediting bodies were linked with improved neurological outcomes,[3] decreased morbidity,[3-4, 8] increased access to appropriate stroke treatment,[3, 5, 7-9, 15, 18, 22, 26, 28, 30, 32, 34, 39, 43, 48, 53] and improved mortality rates.[8, 20-21, 23, 47, 53] Stroke systems of care that included PSCs certified by nationally recognized accrediting bodies were linked with increased access to appropriate stroke treatment.[6]
Population(s) impacted	Studies reporting positive health-related outcomes examined the general population.[3-4, 7-9, 15, 20-23, 26, 28, 30, 34, 39, 43, 47-48, 53] One study examined a rural population.[32]
Economic highlights	In one study, PSCs certified by The Joint Commission were linked with shorter hospital stays.[29]
States where interventions achieved positive health-related outcomes	Studies of local stroke systems of care were set in Alaska,[33] California,[1] the District of Columbia,[6] Georgia,[17, 36-37, 39] Illinois,[28] Idaho,[33] Michigan,[5, 29, 31] Montana,[33] New Jersey,[44] New York,[13] North Carolina,[11, 15, 17, 30] Oregon,[33] Pennsylvania,[14] South Carolina,[17, 37] and Washington.[33] There were no national studies.[7, 9, 19, 22-23, 26, 32, 46, 53]

Evidence Base

Practice-based studies

1. Ballard DW, Reed ME, Huang J, Kramer BJ, Hsu J, Chettipally U. Does primary stroke center certification change ED diagnosis, utilization, and disposition of patients with acute stroke? American Journal of Emergency Medicine. 2012;30(7):1152-1162.[a]
2. Bekelis K, Marth NJ, Wong K, Zhou W, Birkmeyer JD, Skinner J. Primary Stroke Center hospitalization for elderly patients with stroke: Implications for case fatality and travel times. JAMA Internal Medicine. 2016;176(9):1361-1368.[b]
3. Bershad EM, Rao CP, Vuong KD, et al. Multidisciplinary protocol for rapid head computed tomography turnaround time in acute stroke patients. Journal of Stroke & Cerebrovascular Diseases. 2015;24(6):1256-1261.
4. Bettger JP, Thomas L, Liang L, et al. Hospital variation in functional recovery after stroke. Circulation: Cardiovascular Quality & Outcomes. 2017;10(1).
5. Bhattacharya P, Mada F, Salowich-Palm L, et al. Are racial disparities in stroke care still prevalent in certified stroke centers? Journal of Stroke & Cerebrovascular Diseases. 2013;22(4):383-388.
6. Boden-Albala B, Edwards DF, St. Clair S, et al. Methodology for a community-based stroke preparedness intervention: The Acute Stroke Program of Interventions Addressing Racial and Ethnic Disparities Study. Stroke. 2014;45(7):2047-2052.
7. Boehme AK, Carr BG, Kasner SE, et al. Sex differences in rt-PA utilization at hospitals treating stroke: The National Inpatient Sample. Frontiers in Neurology. 2017;8:500.
8. Chaudhry SA, Afzal MR, Chaudhry BZ, et al. Rates of adverse events and outcomes among stroke patients admitted to Primary Stroke Centers. Journal of Stroke & Cerebrovascular Diseases. 2016;25(8):1960-1965.[c]
9. Fonarow GC, Liang L, Smith EE, et al. Comparison of performance achievement award recognition with Primary Stroke Center certification for acute ischemic stroke care. Journal of the American Heart Association. 2013;2(5).
10. Fonarow GC, Smith EE, Reeves MJ, et al. Hospital-level variation in mortality and rehospitalization for Medicare beneficiaries with acute ischemic stroke. Stroke. 2011;42(1):159-166.[d]
11. Goldstein LB. Statewide hospital-based stroke services in North Carolina: Changes over 10 years. Stroke. 2010;41(4):778-783.[e]
12. Gonzales S, Mullen MT, Skolarus L, Thibault DP, Udoeyo U, Willis AW. Progressive rural-urban disparity in acute stroke care. Neurology. 2017;88(5):441-448.
13. Guzauskas GF, Boudreau DM, Villa KF, Levine SR, Veenstra DL. The cost-effectiveness of primary stroke centers for acute stroke care. Stroke. 2012;43(6):1617-1623.
14. Heffner DL, Thirumala PD, Pokharna P, Chang YF, Wechsler L. Outcomes of spoke-retained telestroke patients versus hub-treated patients after intravenous thrombolysis: Telestroke patient outcomes after thrombolysis. [Erratum appears in Stroke. 2016 Jan;47(1):e19; PMID: 26712954]. Stroke. 2015;46(11):3161-3167.[f]
15. Johnson AM, Goldstein LB, Bennett P, O'Brien EC, Rosamond WD; Registry of the North Carolina Stroke Care Collaborative. Compliance with acute stroke care quality measures in hospitals with and without Primary Stroke Center certification: The North Carolina Stroke Care Collaborative. Journal of the American Heart Association. 2014;3(2).
16. Khan AA, Chaudhry SA, Hassan AE, et al. Potential synergy between advanced primary stroke centers and level I or II trauma centers in the United States. American Journal of Emergency Medicine. 2012;30(8):1535-1539.
17. Khan JA, Casper M, Asimos AW, et al. Geographic and sociodemographic disparities in drive times to Joint Commission-certified primary stroke centers in North Carolina, South Carolina, and Georgia. Preventing Chronic Disease. 2011;8(4):A79.
18. Lewis WR, Fonarow GC, Grau-Sepulveda MV, et al. Improvement in use of anticoagulation therapy in patients with ischemic stroke: Results from Get With the Guidelines-Stroke. American Heart Journal. 2011;162(4):692-699.e692.
19. Lichtman JH, Allen NB, Wang Y, Watanabe E, Jones SB, Goldstein LB. Stroke patient outcomes in U.S. hospitals before the start of the Joint Commission Primary Stroke Center certification program. Stroke. 2009;40(11):3574-3579.[g]
20. Lichtman JH, Jones SB, Leifheit-Limson EC, Wang Y, Goldstein LB. 30-day mortality and readmission after hemorrhagic stroke among Medicare beneficiaries in Joint Commission primary stroke center-certified and -noncertified hospitals. Stroke. 2011;42(12):3387-3391.[h]
21. Lichtman JH, Jones SB, Wang Y, Watanabe E, Leifheit-Limson E, Goldstein LB. Outcomes after ischemic stroke for hospitals with and without Joint Commission-certified primary stroke centers. Neurology. 2011;76(23):1976-1982.[i]
22. Man S, Cox M, Patel P, et al. Differences in acute ischemic stroke quality of care and outcomes by Primary Stroke Center certification organization. Stroke. 2017;48(2):412-419.
23. Man S, Schold JD, Uchino K. Impact of stroke center certification on mortality after ischemic stroke: The Medicare cohort from 2009 to 2013. Stroke. 2017;48(9):2527-2533.
24. Man S, Zhao X, Uchino K, et al. Comparison of acute ischemic stroke care and outcomes between comprehensive stroke centers and primary stroke centers in the United States. Circulation. 2018;11:e004512.[j]
25. Mullen MT, Judd S, Howard VJ, et al. Disparities in evaluation at certified primary stroke centers: Reasons for geographic and racial differences in stroke. Stroke. 2013;44(7):1930-1935.[k]
26. Mullen MT, Kasner SE, Kallan MJ, Kleindorfer DO, Albright KC, Carr BG. Joint Commission Primary Stroke Centers utilize more rt-PA in the Nationwide Inpatient Sample. Journal of the American Heart Association: Cardiovascular and Cerebrovascular Disease. 2013;2(2):e000071.
27. Mullen MT, Wiebe DJ, Bowman A, et al. Disparities in accessibility of certified primary stroke centers. Stroke. 2014;45(11):3381-3388.
28. Prabhakaran S, McNulty M, O'Neill K, Ouyang B. Intravenous thrombolysis for stroke increases over time at primary stroke centers. Stroke. 2012;43(3):875-877.
29. Rajamani K, Millis S, Watson S, et al. Thrombolysis for acute ischemic stroke in Joint Commission-certified and -noncertified hospitals in Michigan. Journal of Stroke & Cerebrovascular Diseases. 2013;22(1):49-54.[l]
30. Rose KM, Rosamond WD, Huston SL, Murphy CV, Tegeler CH. Predictors of time from hospital arrival to initial brain-imaging among suspected stroke patients: The North Carolina Collaborative Stroke Registry. Stroke. 2008;39(12):3262-3267.
31. Sauser K, Levine DA, Nickles AV, Reeves MJ. Hospital variation in thrombolysis times among patients with acute ischemic stroke: The contributions of door-to-imaging time and imaging-to-needle time. JAMA Neurology. 2014;71(9):1155-1161.[m]
32. Seabury S, Bognar K, Xu Y, Huber C, Commerford SR, Tayama D. Regional disparities in the quality of stroke care. American Journal of Emergency Medicine. 2017;35(9):1234-1239.
33. Shultis W, Graff R, Chamie C, et al. Striking rural-urban disparities observed in acute stroke care capacity and services in the Pacific Northwest: Implications and recommendations. Stroke. 2010;41(10):2278-2282.
34. Skolarus LE, Meurer WJ, Shanmugasundaram K, Adelman EE, Scott PA, Burke JF. Marked regional variation in acute stroke treatment among Medicare beneficiaries. Stroke. 2015;46(7):1890-1896.
35. Song S, Saver J. Growth of regional acute stroke systems of care in the United States in the first decade of the 21st century. Stroke. 2012;43(7):1975-1978.[n]
36. Switzer JA, Akinwuntan A, Waller J, Nichols FT, Hess DC, Bruno A. Impact of primary stroke center certification on location of acute ischemic stroke care in Georgia. Stroke. 2012;43(5):1415-1417.[o]

37. Switzer JA, Singh R, Mathiassen L, Waller JL, Adams RJ, Hess DC. Telestroke: Variations in intravenous thrombolysis by spoke hospitals. Journal of Stroke & Cerebrovascular Diseases. 2015;24(4):739-744.[p]
38. Uchino K, Man S, Schold JD, Katzan IL. Stroke legislation impacts distribution of certified stroke centers in the United States. Stroke. 2015;46(7):1903-1908.
39. Zimmermann S, Spiva L, Foster K. What does it take to become a primary stroke center? Journal of Neuroscience Nursing. 2011;43(5):280-281.

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40. Alberts MJ. Do primary stroke centers occur randomly? Stroke. 2014;45(12):3499-3500.
41. Alberts MJ, Latchaw RE, Jagoda A, et al. Revised and updated recommendations for the establishment of primary stroke centers: A summary statement from the Brain Attack Coalition. Stroke. 2011;42(9):2651-2665.
42. Chaudhry FS, Schneck MJ, Warady J, et al. Primary stroke center concept: Strengths and limitations. Frontiers in Neurology. 2012;3:1-4.
43. de Havenon A, Sultan-Qurraie A, Hannon P, Tirschwell D. Development of regional stroke programs. Current Neurology and Neuroscience Reports. 2015;15(5):544.
44. Dumont AS, Jabbour PM. Comprehensive stroke centers: Eliminating an apparent disparity in stroke care on weekends versus weekdays? Stroke. 2011;42(9):2380-2382.[q]
45. Fonarow GC, Gregory T, Driskill M, et al. Hospital certification for optimizing cardiovascular disease and stroke quality of care and outcomes. Circulation. 2010;122(23):2459-2469.
46. Gorelick PB. Primary and Comprehensive Stroke Centers: History, value, and certification criteria. Journal of Stroke. 2013;15(2):78-89.
47. Higashida R, Alberts MJ, Alexander DN, et al. Interactions within stroke systems of care: A policy statement from the American Heart Association/American Stroke Association. Stroke. 2013;44(10):2961-2984.
48. Jauch EC, Saver JL, Adams HP, Jr., et al. Guidelines for the early management of patients with acute ischemic stroke: A guideline for healthcare professionals from the American Heart Association/American Stroke Association. Stroke. 2013;44(3):870-947.
49. Lackland DT, Roccella EJ, Deutsch AF, et al. Factors influencing the decline in stroke mortality: A statement from the American Heart Association/American Stroke Association. Stroke. 2014;45(1):315-353.
50. Levine SR, Adamowicz D, Johnston KC. Primary stroke center certification. CONTINUUM: Lifelong Learning in Neurology. 2008;14(6):98-116.
51. Millin MG, Gullett T, Daya MR. EMS management of acute stroke—Out-of-hospital treatment and stroke system development (Resource document to NAEMSP position statement). Prehospital Emergency Care: Official Journal of the National Association of EMS Physicians and the National Association of State EMS Directors. 2007;11(3):318-325.
52. Reynolds MR, Panagos PD, Zipfel GJ, Lee JM, Derdeyn CP. Elements of a stroke center. Techniques in Vascular and Interventional Radiology. 2012;15(1):5-9.
53. Saler M, Switzer JA, Hess DC. Use of telemedicine and helicopter transport to improve stroke care in remote locations. Current Treatment Options in Cardiovascular Medicine. 2011;13(3):215-224.
54. Schwamm LH. When in Rome, do like the Romans: Certifying stroke centers with the Rod of Aesculapius or the medical caduceus of Hermes? Journal of the American Heart Association. 2013;2(2):e000120.
55. Silva GS, Schwamm LH. Review of stroke center effectiveness and other Get With the Guidelines data. Current Atherosclerosis Reports. 2013;15(9):350.
56. Thurman RJ, Jauch EC, Panagos PD, Reynolds MR, Mocco J. Four evolving strategies in the emergent treatment of acute ischemic stroke. Emergency Medicine Practice. 2012;14(7):1-26; quiz 26-27.

a. Mixed outcome—PSC certification was associated with significant changes in ED admission and radiographic utilization patterns, without measurable improvements in survival.
b. Mixed outcome—receiving treatment in PSCs was associated with a 30-day survival benefit for patients traveling less than 90 minutes, but traveling at least 90 minutes offset any benefit of PSC care.
c. Mixed outcome—total length of stay was slightly lower, but total in-hospital charges were significantly higher in certified PSCs.
d. No outcome—being a designated PSC and higher stroke patient volume were not significantly associated with better clinical outcome rates or lesser variations in outcomes at the hospital level.
e. Mixed outcome—although the proportions of hospitals using care maps and having tissue plasminogen activator (tPA) protocols, having prewritten stroke orders, and having a stroke team increased during a period of rapid PSC certification expansion, the rural–urban disparity in tPA use worsened because of increasing concentration of PSCs in urban areas.
f. No outcome—in-hospital mortality, complication rates, stroke severity, onset-to-needle time, and length of stay did not change significantly after PSC certification.
g. Mixed outcome—PSC-certified hospitals had better outcomes than non-certified hospitals before the certification program began.
h. No outcome—no difference in 30-day risk-adjusted readmission rates for patients with hemorrhagic stroke based on PSC certification status.
i. No outcome—readmission rates were similar between hospitals with PSC certification and those without certification.
j. Mixed outcome—certified CSCs exceeded certified PSCs in timely acute reperfusion therapy for emergency department admissions, whereas PSCs had lower risk-adjusted in-hospital mortality.
k. Mixed outcome—the association between PSC certification and rt-PA use was stronger in rural PSCs, but the study included a small number of hospitals and discharges in rural centers.
l. Mixed outcome—rates of thrombolysis administration for acute stroke patients in the study were low in both PSC-certified and noncertified hospitals, although a greater number of the eligible patients received thrombolysis in the certified centers.
m. No outcome—PSC designation was not a significant predictor of timely tPA use.
n. Mixed outcome—additional efforts are needed to extend regional stroke systems of care to the rest of the U.S.
o. No outcome—the impact of PSC certification on where patients were discharged was small and inconsistent.
p. No outcome—PSC certification did not significantly increase tPA use.
q. Mixed outcome—although the adjusted odds of intravenous tissue plasminogen activator administration were higher at PSCs compared to nonstroke centers, adjusted 90-day mortality was greater during weekend admissions to PSCs.

State Standards for Primary Stroke Centers

Evidence Level: **BEST**

A state can designate a facility as a Primary Stroke Center (PSC) or the equivalent when the facility meets specific standards set by the state. Currently, the following states use their own standards to designate some or all PSCs: Alabama, Florida, Massachusetts, Missouri, New Jersey, Oklahoma, and Texas.*

**PSCs certified by nationally recognized accrediting bodies are addressed in a separate policy intervention.*

Example of state law addressing this type of intervention

As of April 2017, a Massachusetts regulation allows hospitals to apply to the Department of Public Health for designation as a Primary Stroke Service (PSS) provider to provide emergency diagnostic and therapeutic services to acute stroke patients through a multidisciplinary team approach, available 24 hours per day, 7 days per week. Additional PSS criteria and standards include hospital-based emergency department and EMS staff education in acute stroke prevention, diagnosis, and treatment; hospital stroke CQI and submission of stroke data to the Department of Public Health; and EMS pre-hospital stroke notification. 105 Mass. Code Regs. §§130.1400 through 130.1413 (2018).

Evidence for Potential Public Health Impact:

Effectiveness: ●●●○
Equity & Reach: ●●●●
Efficiency: ●●○○
Transferability: ●●●○

Weaker=●○○○ ◄► ●●●●=Stronger

For more on the scoring and summary methods see the Appendix

TOTAL: ●●●●●●●●●●●○○○○

Weak | Moderate | **Strong** | Very Strong

SCORE: STRONG

Evidence Quality:

Evidence Types: ●●●○
Sources: ●●●●
Evidence from Research: ○○○○
Evidence from Translation & Practice: ●●●○

Lower=●○○○ ◄► ●●●●=Higher

For more on the scoring and summary methods see the Appendix

TOTAL: ●●●●●●●●●○○○○○○

Low | Moderate | **High** | Very High

SCORE: HIGH

Health-related outcomes	PSCs meeting state standards were linked with increased access to appropriate stroke treatment[1-3] and reduced mortality.[2-3] Stroke systems including PSCs meeting state standards were linked with increased access to appropriate stroke treatment[4-5] and improved clinical outcomes.[13]
Population(s) impacted	Studies reporting positive health-related outcomes examined the general population.[1-5, 13]
Economic highlights	*No economic outcomes January 1, 2007, to May 31, 2018*
States where interventions achieved positive health-related outcomes	Studies of PSCs meeting state standards were set in New York,[2-3] New Jersey,[1] and Massachusetts.[4] There were two national studies.[5, 13]

Evidence Base

Practice-based studies

1. McKinney JS, Deng Y, Kasner SE, Kostis JB; Myocardial Infarction Data Acquisition System Study Group. Comprehensive stroke centers overcome the weekend versus weekday gap in stroke treatment and mortality. Stroke. 2011;42(9):2403-2409.
2. Xian Y. Do healthcare process and outcomes differ for acute ischemic stroke patients admitted to designated stroke centers? Dissertation Abstracts International: Section B: The Sciences and Engineering. 2011;71(12-B):7391.
3. Xian Y, Holloway RG, Chan PS, et al. Association between stroke center hospitalization for acute ischemic stroke and mortality. JAMA. 2011;305(4):373-380.
4. Rost NS, Smith EE, Pervez MA, Mello P, Dreyer P, Schwamm LH. Predictors of increased intravenous tissue plasminogen activator use among hospitals participating in the Massachusetts Primary Stroke Service Program. Circulation: Cardiovascular Quality & Outcomes. 2012;5(3):314-320.
5. Uchino K, Man S, Schold JD, Katzan IL. Stroke legislation impacts distribution of certified stroke centers in the United States. Stroke. 2015;46(7):1903-1908.
6. Lichtman JH, Allen NB, Wang Y, Watanabe E, Jones SB, Goldstein LB. Stroke patient outcomes in U.S. hospitals before the start of the Joint Commission Primary Stroke Center certification program. Stroke. 2009;40(11):3574-3579.
7. Man S, Cox M, Patel P, et al. Differences in acute ischemic stroke quality of care and outcomes by Primary Stroke Center certification organization. Stroke. 2017;48(2):412-419.[a]
8. Man S, Zhao X, Uchino K, et al. Comparison of acute ischemic stroke care and outcomes between comprehensive stroke centers and primary stroke centers in the United States. Circulation. 2018;11:e004512.[b]
9. O'Toole LJ, Jr., Slade CP, Brewer GA, Gase LN. Barriers and facilitators to implementing primary stroke center policy in the United States: Results from 4 case study states. American Journal of Public Health. 2011;101(3):561-566.
10. Panezai S, Gezmu T, Kirmani J, et al. Compliance with Joint Commission measures in state-designated stroke centers. Journal of Hospital Medicine. 2014;9(2):88-93.[c]
11. Slade CP, O'Toole LJ, Jr., Rho E. State primary stroke center policies in the United States: Rural health issues. Telemedicine Journal and e-Health. 2012;18(3):225-229.[d]
12. Smith EE, Dreyer P, Prvu-Bettger J, et al. Stroke center designation can be achieved by small hospitals: The Massachusetts experience. Critical Pathways in Cardiology: A Journal of Evidence-Based Medicine. 2008;7(3):173-177.

Narratives and commentaries

13. Schwamm L, Fayad P, Acker JE, et al. Translating evidence into practice: A decade of efforts by the American Heart Association/American Stroke Association to reduce death and disability due to stroke: A presidential advisory from the American Heart Association/American Stroke Association. Stroke 2010;41(5):1051-1065.
14. Alberts MJ, Latchaw RE, Jagoda A, et al. Revised and updated recommendations for the establishment of primary stroke centers: A summary statement from the brain attack coalition. Stroke. 2011;42(9):2651-2665.
15. George MG, Matters MD, Xie J, McGruder HF, Valderrama AL. The role of public health in promoting quality improvement in care for stroke and heart disease. Preventing Chronic Disease. 2008;5(2):A62.
16. Gropen T, Magdon-Ismail Z, Day D, Melluzzo S, Schwamm LH; NECC Advisory Group. Regional implementation of the Stroke Systems of Care Model: Recommendations of the Northeast Cerebrovascular Consortium. Stroke. 2009;40(5):1793-1802.
17. Higashida R, Alberts MJ, Alexander DN, et al. Interactions within stroke systems of care: A policy statement from the American Heart Association/American Stroke Association. Stroke. 2013;44(10):2961-2984.
18. Jauch EC, Saver JL, Adams HP, Jr., et al. Guidelines for the early management of patients with acute ischemic stroke: A guideline for healthcare professionals from the American Heart Association/American Stroke Association. Stroke. 2013;44(3):870-947.
19. Massachusetts Department of Public Health. Association of State and Territorial Health Officials (ASTHO): Massachusetts Stroke Systems Plan. Boston, MA: Massachusetts Department of Public Health;2011:1-19.
20. Rokos IC, Schwamm LH, Konig M, et al. Variable impact of state legislative advocacy on registry participation and regional systems of care implementation. A policy statement from the American Heart Association. Circulation. 2013;128(16):1799-1809.
21. Schwamm LH. When in Rome, do like the Romans: Certifying stroke centers with the Rod of Aesculapius or the medical caduceus of Hermes? Journal of the American Heart Association. 2013;2(2):e000120.

a. Mixed outcome—while state PSCs overall showed lower performance on many measures, when analyzed by individual states, certain state PSCs did have performance that matched or exceeded that of other certifying bodies.
b. Mixed outcome—certified CSCs exceeded certified PSCs in timely acute reperfusion therapy for emergency department admissions, whereas PSCs had lower risk-adjusted in-hospital mortality.
c. Mixed outcome—in New Jersey, state CSCs were more likely to adhere better to JC core performance measures than state PSCs. Median door-to-thrombolytic drug times were also significantly lower at the state CSCs.
d. No outcome—rural hospitals included in the study were unlikely to have state PSC designation and likely to lack stroke resources.

State Standards for Comprehensive Stroke Centers

Evidence Level: **PROMISING EVIDENCE QUALITY**

A state can designate a facility as a Comprehensive Stroke Center (CSC) or the equivalent when the facility meets specific standards set by the state. Currently, the following states use their own standards to designate some or all CSCs in the state: Florida, Massachusetts, Missouri, New Jersey, and Texas.*

**CSCs certified by nationally recognized accrediting bodies are addressed in a separate policy intervention. This assessment only included studies in which the impact of CSCs could be differentiated from the impact of PSCs.*

Example of state law addressing this type of intervention

Since 2004, hospitals in New Jersey must apply to the Commissioner of Health and Senior Services for designation as a Primary or Comprehensive Stroke Center. Designated CSCs are required to meet the minimum PSC criteria set forth in statute and regulation as well as additional statutory and regulatory CSC criteria and standards. N.J. Rev. Stat. §§ 26:2H-12.27 to 26:2H–12.32 (2018); N.J. Admin. Code §§ 8:43G–7A.1 to 8:43G–7A.10 (2018).

Evidence for Potential Public Health Impact:

Effectiveness: ●●●●
Equity & Reach: ●●○○
Efficiency: ○○○○
Transferability: ●●○○

Weaker=●○○○ ◄► ●●●●=Stronger

For more on the scoring and summary methods see the Appendix

TOTAL: ●●●●●●●●○○○○○○○○

Weak | **Moderate** | Strong | Very Strong

SCORE: MODERATE

Evidence Quality:

Evidence Types: ●●●○
Sources: ●●●●
Evidence from Research: ○○○○
Evidence from Translation & Practice: ●●○○

Lower=●○○○ ◄► ●●●●=Higher

For more on the scoring and summary methods see the Appendix

TOTAL: ●●●●●●●●○○○○○○○○

Low | Moderate | **High** | Very High

SCORE: HIGH

Health-related outcomes	CSCs meeting state standards were linked with increased access to appropriate stroke treatment and improved stroke recognition.[3]
Population(s) impacted	The one study reporting positive health-related outcomes examined the general population.[3]
Economic highlights	*No economic outcomes from January 1, 2007, to May 31, 2018*
States where interventions achieved positive health-related outcomes	The study of CSCs meeting state standards was set in New Jersey.[2]

Evidence Base

Research-based studies

No research-based studies January 1, 2007, to May 31, 2018

Practice-based studies

1. Panezai S, Gezmu T, Kirmani J, et al. Compliance with Joint Commission measures in state-designated stroke centers. Journal of Hospital Medicine. 2014;9(2):88-93.
2. Man S, Zhao X, Uchino K, et al. Comparison of acute ischemic stroke care and outcomes between comprehensive stroke centers and primary stroke centers in the United States. Circulation. 2018;11:e004512.[a]
3. McKinney JS, Deng Y, Kasner SE, Kostis JB; Myocardial Infarction Data Acquisition System Study Group. Comprehensive stroke centers overcome the weekend versus weekday gap in stroke treatment and mortality. Stroke. 2011;42(9):2403-2409.

Narratives and commentaries

4. Jauch EC, Saver JL, Adams HP, Jr., et al. Guidelines for the early management of patients with acute ischemic stroke: A guideline for healthcare professionals from the American Heart Association/American Stroke Association. Stroke. 2013;44(3):870-947.
5. Janjua N, Qureshi AI, Zaidat OO. Systemization of advanced stroke care: The dollars and sense of comprehensive stroke centers. Journal of Neuro-Interventional Surgery. 2014;6(3):162-165.

a. Mixed outcome—certified CSCs exceeded certified PSCs in timely acute reperfusion therapy for emergency department admissions, whereas PSCs had lower risk-adjusted in-hospital mortality.

Nationally Certified Comprehensive Stroke Centers

Evidence Level: **PROMISING EVIDENCE QUALITY**

Nationally certified Comprehensive Stroke Centers (CSCs) provide highly specialized stroke care for patients who require more complex medical and surgical interventions.[1] They also serve as a top-tier resource center for other facilities within the stroke system of care.[2]*

**Nationally recognized accrediting bodies for CSCs include The Joint Commission, the Center for Improvement in Healthcare Quality, Det Norske Veritas, and Healthcare Facilities Accreditation Program. State standards for CSCs are addressed in a separate policy intervention. This assessment only included studies in which the impact of CSCs could be differentiated from the impact of PSCs.*

Example of state law addressing this type of intervention

As of August 30, 2016, the Delaware Department of Health and Social Services is required to designate an in-state acute health care facility, as well as out-of-state facilities upon request, as a Comprehensive Stroke Center if the facility is certified by either The Joint Commission (i.e., Advanced Certification for Comprehensive Stroke Centers) or another nationally recognized accrediting organization with an equivalent certification. Del. Code Ann. tit. 16 § 1019 (2018).

Evidence for Potential Public Health Impact:

Effectiveness: ●●○○
Equity & Reach: ●●○○
Efficiency: ●○○○
Transferability: ●●○○

Weaker=●●●● ◄► ●●●●=Stronger

For more on the scoring and summary methods see the Appendix

TOTAL: ●●●●●●●○○○○○○○○○

Weak | **Moderate** | Strong | Very Strong

SCORE: MODERATE

Evidence Quality:

Evidence Types: ●●○○
Sources: ●●●●
Evidence from Research: ○○○○
Evidence from Translation & Practice: ●●●○

Lower=●●●● ◄► ●●●●=Higher

For more on the scoring and summary methods see the Appendix

TOTAL: ●●●●●●●●●○○○○○○○

Low | Moderate | **High** | Very High

SCORE: HIGH

Rationale for health-related outcomes	The American Heart Association and other stroke care experts and practitioners[4-7] recommend certification of CSCs based on national standards and integration of nationally certified CSCs into stroke systems of care to improve health outcomes.
Population(s) impacted	*No health-related outcomes from January 1, 2007, to May 31, 2018*
Economic highlights	*No economic outcomes from January 1, 2007, to May 31, 2018*
States where interventions achieved positive health-related outcomes	*No health-related outcomes January 1, 2007, to May 31, 2018*

Evidence Base

Practice-based studies

1. Kilbourn KJ, Killory BD, Fortunato G, et al. Clinical characteristics and outcomes of patients with intracerebral hemorrhage after interhospital transfer to a designated stroke center. Connecticut Medicine. 2015;79(6):335-341.[a]
2. Man S, Zhao X, Uchino K, et al. Comparison of acute ischemic stroke care and outcomes between comprehensive stroke centers and primary stroke centers in the United States. Circulation. 2018;11:e004512.[b]

Narratives and commentaries

3. Alberts MJ, Latchaw RE, Selman WR, et al. Recommendations for comprehensive stroke centers: A consensus statement from the Brain Attack Coalition. Stroke. 2005;36(7):1597-1616.
4. Leifer D, Bravata DM, Connors JJ, 3rd, et al. Metrics for measuring quality of care in Comprehensive Stroke Centers: Detailed follow-up to Brain Attack Coalition comprehensive stroke center recommendations: A statement for healthcare professionals from the American Heart Association/American Stroke Association. [Erratum appears in Stroke. 2011;42(4):e369]. Stroke. 2011;42(3):849-877.
5. Jauch EC, Saver JL, Adams HP, Jr., et al. Guidelines for the early management of patients with acute ischemic stroke: A guideline for healthcare professionals from the American Heart Association/American Stroke Association. Stroke. 2013;44(3):870-947.
6. Janjua N, Katzan I, Badruddin A, Nguyen TN, Abou-Chebl A, Zaidat OO. Endovascular comprehensive stroke center designation parameters. Neurology. 2012;79(13 Suppl 1):S239-242.
7. Silva GS, Schwamm LH. Review of stroke center effectiveness and other Get With the Guidelines data. Current Atherosclerosis Reports. 2013;15(9):350.
8. Derdeyn CP, Panagos PD. Stroke center certification: Where are we in 2010? Journal of NeuroInterventional Surgery. 2010;2:41-43.
9. DeSousa KG, Haussen DC, Yavagal DR. Strategies for streamlining emergency stroke care. Current Neurology and Neuroscience Reports. 2014;14(11):497.
10. Gropen T, Magdon-Ismail Z, Day D, Melluzzo S, Schwamm LH; NECC Advisory Group. Regional implementation of the stroke systems of care model: Recommendations of the Northeast Cerebrovascular Consortium. Stroke. 2009;40(5):1793-1802.
11. Higashida R, Alberts MJ, Alexander DN, et al. Interactions within stroke systems of care: A policy statement from the American Heart Association/American Stroke Association. Stroke. 2013;44(10):2961-2984.
12. Janjua N, Katzan I, Badruddin A, Nguyen TN, Abou-Chebl A, Zaidat OO. Endovascular comprehensive stroke center designation parameters. Neurology. 2012;79(13 Suppl 1):S239-242.
13. Janjua N, Qureshi AI, Zaidat OO. Systemization of advanced stroke care: The dollars and sense of comprehensive stroke centers. Journal of NeuroInterventional Surgery. 2014;6(3):162-165.
14. Mokin M, Snyder KV, Siddiqui AH, Levy EI, Hopkins LN. Recent endovascular stroke trials and their impact on stroke systems of care. Journal of the American College of Cardiology. 2016;67(22):2645-2655.
15. Park S, Schwamm LH. Organizing regional stroke systems of care. Current Opinion in Neurology. 2008;21(1):43-55.
16. Reynolds MR, Panagos PD, Zipfel GJ, Lee JM, Derdeyn CP. Elements of a stroke center. Techniques in Vascular and Interventional Radiology. 2012;15(1):5-9.

a. Mixed outcome—the benefit of transfer to a CSC remains unclear, as younger, healthier patients were most likely to be transferred.
b. Mixed outcome—certified CSCs exceeded certified PSCs in timely acute reperfusion therapy for emergency department admissions, whereas PSCs had lower risk-adjusted in-hospital mortality.

Nationally Certified Acute Stroke-Ready Hospitals

Evidence Level: **PROMISING EVIDENCE FOR POTENTIAL PUBLIC HEALTH IMPACT**[a]

Acute Stroke-Ready Hospital (ASRH) is a relatively new certification for facilities from nationally recognized accrediting bodies. ASRHs are intended to expand evidence-based stroke care to patients who are otherwise unable to access a Primary Stroke Center—for example, patients who live in rural areas.*

**As of May 31, 2018, the only nationally recognized accrediting body for ASRHs is The Joint Commission. State standards for ASRHs are addressed in a separate policy intervention.*

Example of state law addressing this type of intervention

The North Carolina Department of Health and Human Services is required to designate a hospital as a certified "Designated Stroke Center" if the hospital is certified by JC, AHA, ASA, HFAP, DNV, or another nationally accrediting body "that requires conformance to best practices for stroke care" as a PSC, CSC, or ASRH. 10A N.C. Admin. Code 14L .0201 (2018).

Evidence for Potential Public Health Impact:

Effectiveness: ●●●●
Equity & Reach: ●●●●
Efficiency: ○○○○
Transferability: ●●○○

Weaker=●○○○ ◄► ●●●●=Stronger

For more on the scoring and summary methods see the Appendix

TOTAL: ●●●●●●●●●○○○○○○

Weak | Moderate | **Strong** | Very Strong

SCORE: STRONG

Evidence Quality:

Evidence Types: ●●○○
Sources: ●●●○
Evidence from Research: ○○○○
Evidence from Translation & Practice: ●○○○

Lower=●○○○ ◄► ●●●●=Higher

For more on the scoring and summary methods see the Appendix

TOTAL: ●●●●●●○○○○○○○○○

Low | **Moderate** | High | Very High

SCORE: MODERATE

Health-related outcomes	One study found improved recognition and increased access to appropriate stroke treatment and expert care at a hospital seeking Joint Commission certification as an ASRH.[1]
Population(s) impacted	The study reporting positive health-related outcomes examined a rural population.[1]
Economic highlights	*No economic outcomes January 1, 2007, to May 31, 2018*
States where interventions achieved positive health-related outcomes	The study reporting positive health-related outcomes was set in a local stroke system of care in North Carolina.[1]

a. The evidence base for nationally certified ASRHs scored "promising evidence for potential public health impact," because while it only had three items of evidence supporting it, one item of evidence was a non-experimental study finding improved access to appropriate stroke treatment in an ASRH that was located in a rural community.

Evidence Base

Research-based studies

No research-based studies January 1, 2007, to May 31, 2018

Practice-based studies

1. Slivinski A, Jones R, Whitehead H, Hooper V. Improving access to stroke care in the rural setting: The journey to acute stroke-ready designation. Journal of Emergency Nursing. 2017;43(1):24-32.

Narratives and commentaries

2. Alberts MJ, Wechsler LR, Jensen ME, et al. Formation and function of acute stroke-ready hospitals within a stroke system of care: Recommendations from the Brain Attack Coalition. Stroke. 2013;44(12):3382-3393.
3. DeSousa KG, Haussen DC, Yavagal DR. Strategies for streamlining emergency stroke care. Current Neurology and Neuroscience Reports. 2014;14(11):497.

Nationally Recognized Stroke Rehabilitation Facilities

Evidence Level: **EMERGING**

National standards and certification for stroke rehabilitation facilities could assure quality and a commitment to continuous improvement of post-hospital stroke care and services.*

**Entities providing rehabilitation facility certification/recognition based on national standards currently include The Joint Commission and the Commission on Accreditation of Rehabilitation Facilities (CARF).*

Example of state law addressing this type of intervention

A Florida regulation requires Comprehensive Stroke Centers to ensure that patients meeting acute care rehabilitation admission criteria are transferred to a CARF- or JC-accredited acute rehabilitation facility. Fla. Admin. Code r. 59A-3.246(4) (2018).

Evidence for Potential Public Health Impact:

Effectiveness: ●●○○
Equity & Reach: ○○○○
Efficiency: ●●○○
Transferability: ○○○○

Weaker=●●●● ◄► ●●●●=Stronger

For more on the scoring and summary methods see the Appendix

TOTAL: ●●●●○○○○○○○○○○○○

Weak | Moderate | Strong | Very Strong

SCORE: WEAK

Evidence Quality:

Evidence Types: ●○○○
Sources: ●●●●
Evidence from Research: ○○○○
Evidence from Translation & Practice: ●●○○

Lower=●●●● ◄► ●●●●=Higher

For more on the scoring and summary methods see the Appendix

TOTAL: ●●●●●●●○○○○○○○○○

Low | Moderate | High | Very High

SCORE: MODERATE

Rationale for health-related outcomes

The American Heart Association and other subject matter experts and practitioners recommend national standards and/or CARF certification for stroke rehabilitation facilities.[1-3] The North Carolina Division for Public Health recommends performance measures and standards to improve post-hospital recovery from stroke.[4]

Population(s) impacted

No health-related outcomes January 1, 2007, to May 31, 2018

Economic highlights

No economic outcomes January 1, 2007, to May 31, 2018

States where interventions achieved positive health-related outcomes

No health-related outcomes January 1, 2007, to May 31, 2018

Evidence Base

Narratives and commentaries

1. Miller EL, Murray L, Richards L, et al. Comprehensive overview of nursing and interdisciplinary rehabilitation care of the stroke patient. A scientific statement from the American Heart Association. Journal of the American Heart Association. 2010;41(10):2402-2448.
2. Nathenson PA, Nathenson SL, Divito KS. Implementing the new CARF wellness standards. Journal of Stroke & Cerebrovascular Diseases. 2014;23(5):1118-1130.
3. Peterson-Burch F, Reuter-Rice K, Barr TL. Rethinking recovery: Incorporating holistic nursing perspectives in post-stroke care. Holistic Nursing Practice. 2017;31(1):3-6.
4. North Carolina Department of Health and Human Services, Division of Public Health. Association of State and Territorial Health Officials (ASTHO): Stroke system of care plan for North Carolina. Raleigh, NC: North Carolina Department of Health and Human Services; 2010:1-43.

State Standards for Acute Stroke-Ready Hospitals

Evidence Level: **EMERGING**

A state can designate a facility as an Acute Stroke-Ready Hospital (ASRH) or the equivalent when the facility meets specific standards set by the state. Currently, the following states use their own standards to designate some or all ASRHs in the state: Alabama, Florida, Georgia, Illinois, Minnesota, Missouri, Oklahoma, and Texas.*

**ASRHs certified by nationally recognized accrediting bodies are addressed in a separate policy intervention.*

Example of state law addressing this type of intervention

In 2016, Georgia required the establishment of at least three levels of stroke centers to serve acute stroke patients. The three levels of stroke centers include Comprehensive Stroke Centers for complex specialized care, Primary Stroke Centers, and Remote Treatment Stroke Centers (RTSCs) for rural and underserved areas. Georgia requires CSCs and PSCs to be certified by a "national health care accreditation body" recognized by the Department of Public Health (DPH) and requires Remote Treatment Stroke Centers to be certified and designated by DPH either through certification by a "national health care accreditation body" as an acute stroke-ready hospital or through a process developed by DPH. Ga. Code Ann. § 31-11-113 (2018). Hospitals seeking RTSC designation through the DPH process "will be evaluated on the standards and clinical practice guidelines established by the American Heart Association and American Stroke Association and must utilize current and acceptable telemedicine protocols relative to acute stroke treatment." Ga. Comp. R. & Regs. 511-9-2-.04 (2018).

Evidence for Potential Public Health Impact:

Effectiveness: ●○○○
Equity & Reach: ○○○○
Efficiency: ○○○○
Transferability: ○○○○

Weaker=•••• ◄► ••••=Stronger

For more on the scoring and summary methods see the Appendix

TOTAL: ●○○○○○○○○○○○○○○○

Weak | Moderate | Strong | Very Strong

SCORE: WEAK

Evidence Quality:

Evidence Types: ●○○○
Sources: ●●●○
Evidence from Research: ○○○○
Evidence from Translation & Practice: ●○○○

Lower=•••• ◄► ••••=Higher

For more on the scoring and summary methods see the Appendix

TOTAL: ●●●●●○○○○○○○○○○○

Low | Moderate | High | Very High

SCORE: MODERATE

Rationale for health-related outcomes	State standards for designating facilities as ASRHs or the equivalent are still in development.[1-3] Formal recommendations and outcome studies are needed.
Population(s) impacted	*No health-related outcomes January 1, 2007, to May 31, 2018*
Economic highlights	*No economic outcomes January 1, 2007, to May 31, 2018*
States where interventions achieved positive health-related outcomes	*No health-related outcomes January 1, 2007, to May 31, 2018*

Evidence Base

Narratives and commentaries

1. DeSousa KG, Haussen DC, Yavagal DR. Strategies for streamlining emergency stroke care. Current Neurology and Neuroscience Reports. 2014;14(11):497.
2. Owens S. States increasingly pass legislation to promote stratifying levels of stroke care, but challenges remain. Neurology Today. 2016;16(17):16-22.
3. Thurman RJ, Jauch EC, Panagos PD, Reynolds MR, Mocco J. Four evolving strategies in the emergent treatment of acute ischemic stroke. Emergency Medicine Practice. 2012;14(7):1-26; quiz 26-27.

Appendix—Methods

Background

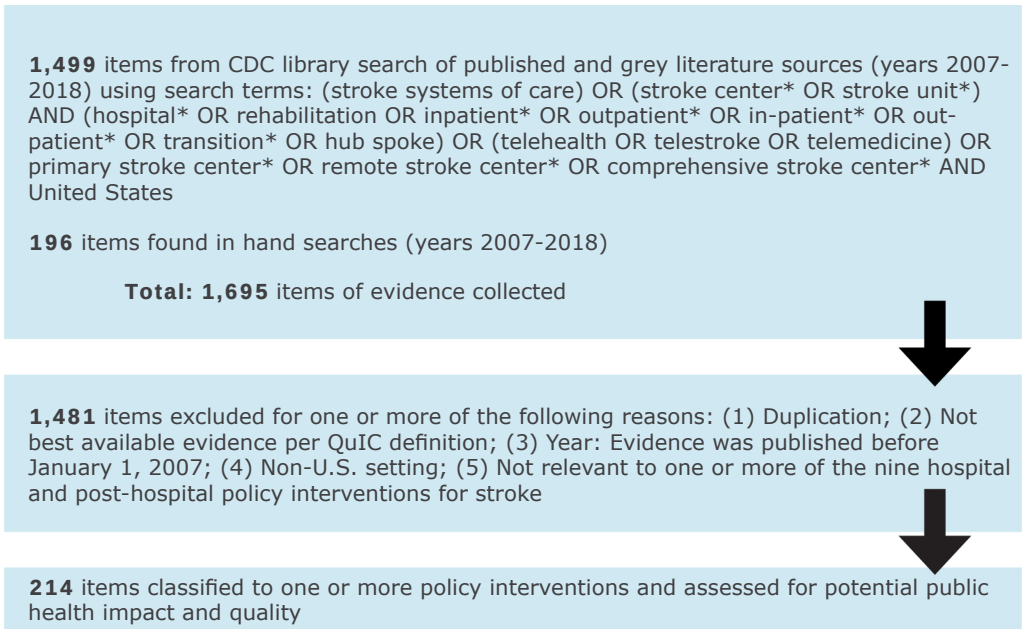
Public decision makers need to know which policies are feasible and most likely to achieve the desired impact. **Early evidence assessment** involves compiling and appraising all relevant, available evidence. This report uses an early evidence assessment approach called the Quality and Impact of Component Evidence Assessment, or QuIC. For more on the QuIC method, contact CDC DHDSP.

In a QuIC assessment, "best available evidence" refers to the written evidence base relevant to assessing the potential public health impact of a policy intervention reflected in state law, when there are no direct experimental studies assessing the law's impact. A QuIC evidence base includes empirical and non-empirical analyses of public health policies, programs, activities, and using data or expert opinion that directly and/or indirectly link interventions of interest with actual or expected outcomes. Best available evidence can be found in journal articles, editorials, commentaries, and perspectives; policy briefs, statements, recommendations, and guidelines; evaluation and technical reports; conference papers; and white papers.

CDC DHDSP selected eight policy interventions within in-hospital stroke care and one intervention in post-hospital care stroke for this evidence assessment by comparing published recommendations by The Joint Commission, the Brain Attack Coalition, the American Heart Association (AHA), and the American Stroke Association (ASA) to the content of enacted state law. The nine policy interventions common to both published expert recommendations and existing state law were refined based on input from a group of four individuals with expertise in stroke systems of care.

Evidence Collection and Classification

The following search was completed in May 31, 2018, for best available evidence published between January 1, 2007, and May 31, 2018. A few additional important items of evidence published after May 31, 2018, were also included during the course of the assessment. Ten CDC policy staff classified the in-hospital/post-hospital stroke evidence base to the nine policy interventions. The evidence base is composed of 214 items of evidence that were relevant to assessing one or more of the nine policy interventions. These include 56 published recommendations from subject matter experts and practitioners as well as 92 practice-based studies that either included the policy interventions of interest or recommended the policy interventions based on study findings. There are only three research-based studies in the evidence base.



Coding and Scoring

To refine the codebook, the team abstracted and coded a sample of evidence for each policy intervention for potential public health impact and discussed coding issues as a group. Each item of evidence assigned to each policy intervention was then independently coded by two of the 10 coders.[a] Coding pairs reconciled coding discrepancies through discussion to reach consensus on every code.[b]

For each policy intervention, reconciled coding results were used to complete the QuIC Evidence Assessment Tool (page 9). One QuIC Tool was completed for each of the nine policy interventions; nine tools were completed in total. To calculate the **evidence for potential impact level** and the **evidence quality level** for each policy intervention, the four criteria scores for impact and the four criteria scores for quality from the QuIC Tool were each assigned a numeric score for the highest level reached (0-4 points), and then criteria scores were summed across impact and quality.

The numeric evidence for potential impact score and quality score were each converted into ordinal evidence levels.[c] Then each policy intervention's **evidence for potential impact level** and **evidence quality level** were used to categorize policy interventions as **"best," "promising (quality)," "promising (impact)," or "emerging"** (Table).

Table. Method for categorizing overall evidence level using evidence for potential impact and quality levels

Evidence for Potential Public Health Impact Level	Evidence Quality Level	Evidence Level
Strong or Very Strong	High or Very High	**Best**
Weak or Moderate	High or Very High	**Promising Evidence Quality**
Strong or Very Strong	Low or Moderate	**Promising Evidence for Potential Public Health Impact**
Weak or Moderate	Low or Moderate	**Emerging**

Evidence Summaries

Each pair of coders jointly developed an evidence summary for their policy intervention. This was done by summarizing the abstracted positive health-related outcomes observed; the populations and settings in which the positive health-related outcomes were observed; and any relevant economic outcomes. More general categories of outcomes, populations, and settings were created for the purposes of reporting; for example, if a study found increased alteplase administration, this was reported as "increased access to appropriate stroke treatment." The list of specific outcomes and populations from this assessment could be useful to those evaluating stroke systems of care—please contact DHDSP for this list. Additionally, see page 10 for more information on how an evidence summary was developed.

Brief examples of state law in effect as of May 31, 2018, were chosen based on alignment with policy interventions. These examples were included in the evidence summaries as appropriate. A full inventory and description of stroke-related laws across the 50 states and D.C. will be provided in a separate DHDSP State Law Fact Sheet.

a. Contact CDC DHDSP for the QuIC Evidence Assessment Handbook.
b. This method has been shown to achieve Very Good to Excellent inter-rater agreement within three previous QuIC assessments: a) Centers for Disease Control and Prevention, Division for Heart Disease and Stroke Prevention. What Could Be Addressed in an Evidence-Informed State Workplace Health Promotion Law? Atlanta, GA: Centers for Disease Control and Prevention; 2017. b) Centers for Disease Control and Prevention, Division for Heart Disease and Stroke Prevention. What Evidence Supports State Laws to Establish Community Health Worker Scope of Practice and Certification? Atlanta, GA: Centers for Disease Control and Prevention; 2017. c) Centers for Disease Control and Prevention. Division for Heart Disease and Stroke Prevention. What Evidence Supports State Laws to Enhance Public Access Defibrillation? Atlanta, GA: Centers for Disease Control and Prevention; 2017.
c. The evidence for potential impact level was determined using the following conversion: 1-4 points = weak; 5-8 points = moderate; 9-12 points = strong; 13-16 points = very strong. The evidence quality level was determined using the following conversion: 1-4 points = low; 5-8 points = moderate; 9-12 points = high; 13-16 points = very high. For example, if the Effectiveness criterion scored "very strong" and the Equity and Reach criterion scored "very strong" and the Efficiency criterion scored "strong" and the Transferability criterion scored "strong," then 4 + 4 + 3 + 3 = 14 = "very strong" evidence for potential impact.

Recommendations

Across the policy interventions in this assessment, there was very little empirical evidence examining economic outcomes such as cost-effectiveness. While several studies in the evidence base examined the effectiveness of a few of the policy interventions in rural populations and settings, there is a lack of evidence of outcomes for other populations and communities known to experience disparities in stroke care.[d]

Across the policy interventions assessed here, more rigorous research-based and practice-based studies are needed. Specifically, high-quality systematic and narrative reviews are needed to synthesize and interpret studies that found mixed outcomes in the telestroke and nationally certified PSC policy interventions.

d. Cruz-Flores S, Rabinstein A, Biller J, et al.; American Heart Association Stroke Council, Council on Cardiovascular and Stroke Nursing, Council on Epidemiology and Prevention, and Council on Quality of Care and Outcomes Research. Racial-ethnic disparities in stroke care: The American experience: A statement for healthcare professionals from the American Heart Association/American Stroke Association. Stroke. 2011: published online before print May 26, 2011, doi:10.1161/STR.0b013e3182213e24.

QuIC Evidence Assessment Tool

Section 1. Evidence for Potential Public Health Impact

Criterion and what it measures	Weak Evidence ●○○○	Moderate Evidence ●●○○	Strong Evidence ●●●○	Very Strong Evidence ●●●●
Effectiveness *Does it work, i.e., improve outcomes relevant to health?*	Indirect evidence for a positive expected outcome relevant to health	Direct evidence for a positive expected outcome relevant to health	Indirect evidence of mostly positive actual outcomes relevant to health	Direct evidence of mostly positive actual outcomes relevant to health
Equity and Reach *Does it work for target population(s)?*	Indirect evidence for a positive expected outcome relevant to equity and reach	Direct evidence for a positive expected outcome relevant to equity and reach	Indirect evidence of mostly positive actual outcomes relevant to equity and reach	Direct evidence of mostly positive actual outcomes relevant to equity and reach
Efficiency *Is it a good use of resources?*	Indirect evidence for a positive expected outcome relevant to efficiency	Direct evidence for a positive expected outcome relevant to efficiency	Indirect evidence of mostly positive actual outcomes relevant to efficiency	Direct evidence of mostly positive actual outcomes relevant to efficiency
Transferability *Does it work across diverse settings?*	Indirect evidence for a positive expected outcome relevant to health in two or more regions of the United States	Direct evidence for a positive expected outcome relevant to health in two or more regions of the United States	Indirect evidence of mostly positive actual outcomes relevant to health in two or more regions of the United States	Direct evidence of mostly positive actual outcomes relevant to health in two or more regions of the United States

Note: If none of its requirements are met, a criterion is assigned a score of 0 points. ••••

Section 2. Evidence Quality

Criterion and what it measures	Low Quality ●○○○	Moderate Quality ●●○○	High Quality ●●●○	Very High Quality ●●●●
Evidence Types *What is the most rigorous design?*	*A narrative review or commentary suggests a positive outcome*	*A non-experimental study suggests a positive outcome*	*An experimental or quasi-experiment suggests a positive outcome*	*A systematic review suggests a positive outcome*
Sources *What is the most credible source?*	*A peer-reviewed journal or conference publication without conflict-of-interest disclosure suggests a positive outcome*	*A systematic review suggests a positive outcome*	*A peer-reviewed journal or conference publication with conflict of interest disclosure suggests a positive outcome*	*A publication by a public health authority suggests a positive outcome*
Evidence from Research *Relevance to controlled settings*	*A small amount of evidence from research suggests positive outcomes*	*A moderate amount of evidence from research suggests positive outcomes*	*A large amount of evidence from research suggests positive outcomes*	*A very large amount of evidence from research suggests positive outcomes*
Evidence from Translation and Practice *Relevance to real world*	*A small amount of evidence from translation and practice suggests positive outcomes*	*A moderate amount of evidence from translation and practice suggests positive outcomes*	*A large amount of evidence from translation and practice suggests positive outcomes*	*A very large amount of evidence from translation and practice suggests positive outcomes*

Note: If none of its requirements are met, a criterion is assigned a score of 0 points. ••••

Evidence Summary Template

Policy Intervention

Evidence Level: *This field provides the evidence level of policy interventions impacting in-hospital or post-hospital stroke care, which is meant to help inform its priority during decision making: BEST, PROMISING (QUALITY), PROMISING (IMPACT), or EMERGING.*

This section describes this policy intervention in detail, often providing supportive references.

Example of state law addressing this type of intervention

This box briefly describes an example of a provision of state law addressing the policy intervention.

Evidence for Potential Public Health Impact:

Effectiveness: ○○○○
Equity & Reach: ○○○○
Efficiency: ○○○○
Transferability: ○○○○

Weaker=●●●● ◄► ●●●●=Stronger

For more on how evidence for potential impact was assessed, see the Appendix

TOTAL: ○○○○○○○○○○○○○○○○

Weak | Moderate | Strong | Very Strong

SCORE: **Weak, Moderate, Strong, or Very Strong**

Evidence Quality:

Evidence Type: ○○○○
Source: ○○○○
Evidence from Research: ○○○○
Evidence from Translation & Practice: ○○○○

Lower=●●●● ◄► ●●●●=Higher

For more on how evidence quality was assessed, see the Appendix

TOTAL: ○○○○○○○○○○○○○○○○

Low | Moderate | High | Very High

SCORE: **Low, Moderate, High, or Very High**

Reported health-related outcomes	If there are studies analyzing health-related outcomes in the evidence base, this field provides the positive outcomes found and whether they were for this policy intervention and/or for a stroke system including this policy intervention (among others). Non-positive outcomes are footnoted in the "Evidence base" list below. If there were no studies observing positive outcomes, this field provides expert recommendations for the policy intervention (i.e., the rationale for positive health-related outcomes). While studies projecting positive outcomes contribute to scoring evidence for impact, they are not listed in this table.
Groups studied	If positive health-related outcomes were found, this field provides the groups who were studied and/or cites the studies looking at general populations.
Economic highlights	If there are studies analyzing economic outcomes—such as cost-effectiveness, return on investment, or quality of life—positive findings are provided in this field. Otherwise, absence of economic outcomes is noted.
Settings	This field provides the states in which the studies finding positive health-related outcomes were set and/or lists the national studies.

Evidence Base

Here you will find the references supporting the description of the policy intervention.

Systematic reviews
Here you will find the studies for this policy intervention that are explicitly described as using "systematic review." Systematic review is a design and method, often applied in public health research, for summarizing outcomes, populations, and settings across a group of high-quality studies of the same intervention.

Research-based studies
Here you will find the studies including this policy intervention that took place in a research context, in which researchers were able to allocate subjects into the intervention and the control groups.

Practice-based studies
Here you will find the studies of this policy intervention that took place under real-world circumstances. In these studies, evaluators were not able to allocate subjects into the intervention and the control groups.

Narratives and commentaries
Here you will find the evidence that provides recommendations for this policy intervention from subject matter experts and practitioners.

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Authors

This document was conceptualized and authored by: Colleen Barbero, PhD, MPPA; Aunima Bhuiya, BSc; Sharada Shantharam, MPH; Lauren Taylor, MPH; Erika Fulmer, MHA; Farah M. Chowdhury, MD, MPH; Kaitlin Graff, MSW, MPH; Stephanie Bernard, PhD; and Siobhan Gilchrist, JD, MPH.

Contributors

The following individuals contributed subject matter expertise, identified tools and resources, advised on the assessment, and reviewed the document: Sallyann Coleman-King, MD, MPH; Erika Odom, PhD, MS; Mary G. George, MD, MSPH; Kim Kelley, MSW; Mary Whittington, RN; Colby Tiner, MA; Joel Stein, MD; Mallika Mahalingham, MPH; Andrew Kunka, JD.