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Executive Report

Closing the Racial and Ethnic Disparity Gap in Stroke Care

Review of Programmatic Interventions, Best Practices and Recommendations

Authors: Shelly Ikeme, Pharm.D, MPH[1], Waleed Brinjikji, M.D.[2], Gold Uzochukwu, MBBS[3], Precious Stanley-Unuane, MS[1], William Humphries, M.D., MPH[4]

Affiliations: [1]CERENOVUS, Johnson & Johnson, Irvine, CA (S.I and P.S.U), [2]Department of Radiology, Mayo Clinic, Rochester, MN (W.B.)., [3]Canebu Consulting LLC, Raleigh, NC (G.U.), [4]WellStar Health System, Marietta, GA (W.H)

Corresponding Author:

William Humphries M.D., MPH, FAANS
Email: William.Humphries@wellstar.org

WellStar Health System, Division of Neurosurgery,
793 Sawyer Rd, Marietta, GA 30062

Abstract

We previously reported a systematic literature review in the STROKE journal that identified racial and ethnic disparities in the 'access to stroke care' pathway. Our review showed that disparities of care exist along the continuum of stroke care; from EMS utilization to patient referral and evaluation to treatment utilization and outcomes.

Racial disparities continue to be a pressing concern in healthcare, highlighting the urgent need for equitable access, treatment, and outcomes for all individuals regardless of their racial or ethnic background. In this review, we provide a compendium of current hospital-level programs, best practices, and recommendations to address disparities in stroke care.

We also highlight global and regional programs established to guide stroke care centers to improve overall outcomes regardless of race and ethnicity. As minority health disparities in the stroke care continuum are often identified in the context of other acute illnesses, our work acknowledges structural interventions and lessons from non-stroke acute care settings that may be applied to stroke care.

Finally, we acknowledge and review several potential challenges to implementing and adopting these recommendations and offer a hospital-oriented disparity maturity model/tool to help guide hospital system leaders who are looking to start implementing strategies to address disparities of care.

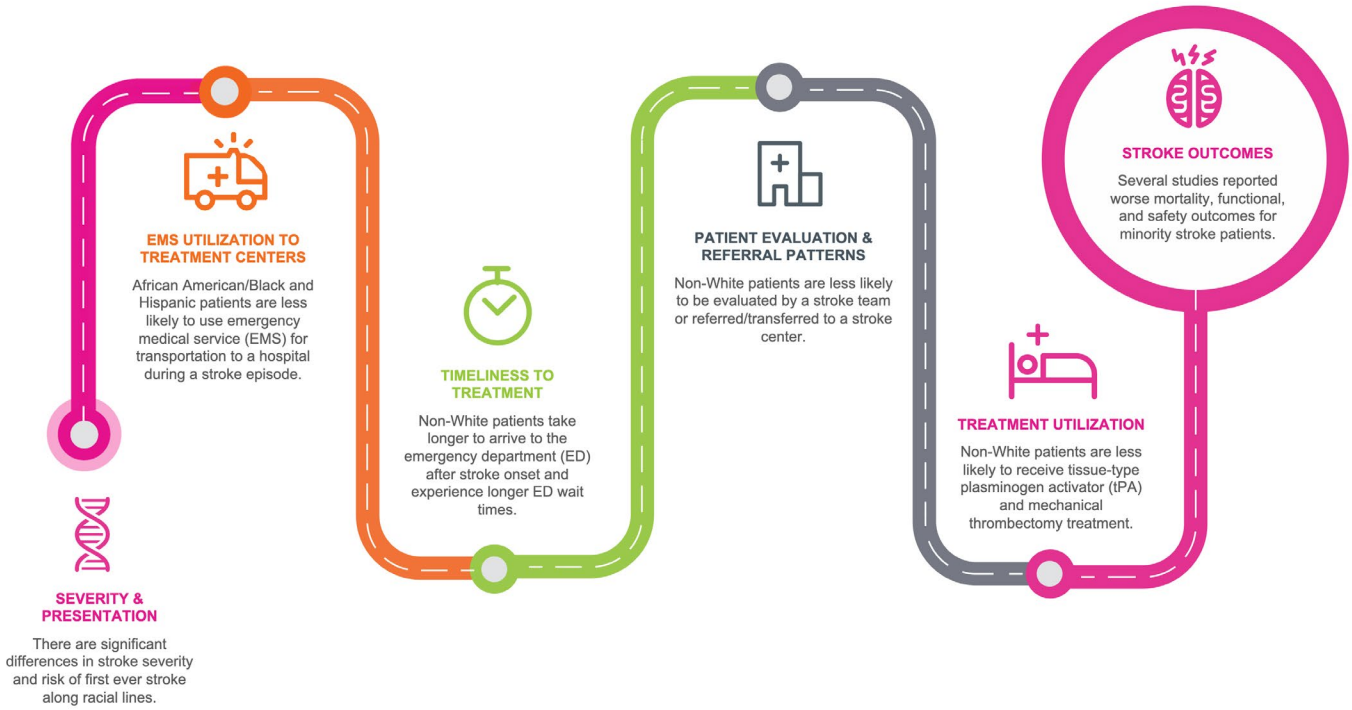
Introduction

Stroke outcomes have improved over time as new treatments and best practices are developed.[1] However, the rate of stroke mortality and complications have not decreased to the same extent in every population.[2] We previously reported a systematic literature review that identified racial disparities in key points along the continuum of stroke care, from onset of stroke symptoms to treatment.[3]

Our systematic review identified racial and ethnic disparities in stroke outcomes attributable to multiple points along the continuum of stroke care: stroke severity and presentation, emergency medical services (EMS) utilization for transportation to treatment centers, timeliness to treatment, patient evaluation and referral patterns, and treatment utilization (Figure 1).[3]

While patient-level factors likely contribute to the identified disparities, many of the disparities may be partially attributed to provider and system level factors. Thus, resources are needed to guide healthcare providers and healthcare systems in reducing the disparities that exist in stroke treatment and outcomes.

Recent publications by the American Heart Association (AHA) summarized strategies aimed at reducing disparities in stroke care.[2,4,5] In this review, we build on this work by providing an updated overview of current programs, best practices, and recommendations for hospitals and related healthcare systems to address these disparities. We also provide a recommended framework for healthcare providers to minimize disparities in stroke care.



*Compared to White patients; mortality, functional and safety outcomes differed across racial groups, although the direction of effect varied (i.e. higher or lower rates relative to reference) for some outcomes.

Figure 1. Racial and ethnic disparities occur at multiple points along the continuum of stroke care.

Current practices to address disparities in stroke

Several established programs[6-13] and best practices[8,9,13-19] are available that have been shown to reduce racial and ethnic disparities in stroke care.

In addition, many studies investigating racial and ethnic disparities in stroke care offer recommendations for changes in practice based on their findings.

Recommendations to improve quality of care include: improving stroke readiness in healthcare facilities, training of personnel, proper documentation of patient symptoms and outcomes, and improving acute care infrastructure.[5,21-23,25] These are summarized in Figure 2.

EMERGENCY MEDICAL SERVICES UTILIZATION

PATIENT EDUCATION

F.A.S.T. Signs

Minority populations often lack knowledge of stroke symptoms and as a result are less likely to utilize emergency medical services to seek treatment for a stroke.[25,26] Improving stroke symptom recognition has been shown to reduce racial disparities in time to treatment.[27,28] Patient education on stroke signs and preparedness, including in-hospital interactive groups, have been shown to increase detection of stroke cases and decrease hospital arrival times.[14]

The F.A.S.T. Signs program created by the American Stroke Association (ASA) offers literature and online resources to promote recognition of the early signs of stroke.[6] Studies have shown that F.A.S.T. public awareness campaigns can increase patients seeking emergency medical care for stroke symptoms, including a significant increase in overall emergency admissions (505, 95% CI = 75 to 935), patients admitted via accident and emergency (451, 95% CI = 26 to 875), thrombolysis activity per month after phase three (3, 95% CI = 1 to 4),[29] and mean daily EMS calls for suspected stroke (increased by 28%, $p<0.001$), particularly less than five hours of onset (increased by 61%, $p<0.001$).[30]

Stroke Belt Consortium

Regional efforts to provide educational resources exist as well, including the Stroke Belt Consortium (SBC).[7,31] Formed in 1994, the SBC emerged in response to the alarming high incidence of stroke and mortality in the southeastern United States, known as the "Stroke Belt."

The SBC has generated a range of impactful strategies and initiatives to enhance stroke prevention and treatment, including improved techniques for educating healthcare professionals, the creation of a mass media campaign for widespread public education, the implementation of stroke risk factor screenings for college students, and the innovative use of fast-food restaurants and sporting events as platforms for promoting stroke awareness.[7] This type of organized effort may produce cost-effective programs and initiatives, particularly for large-scale educational efforts, that will enhance the prevention and treatment of stroke patients. If successful in the Stroke Belt, similar organizations can be formed in other regions of the nation to address specific issues related to stroke prevention, education, and treatment.[7]

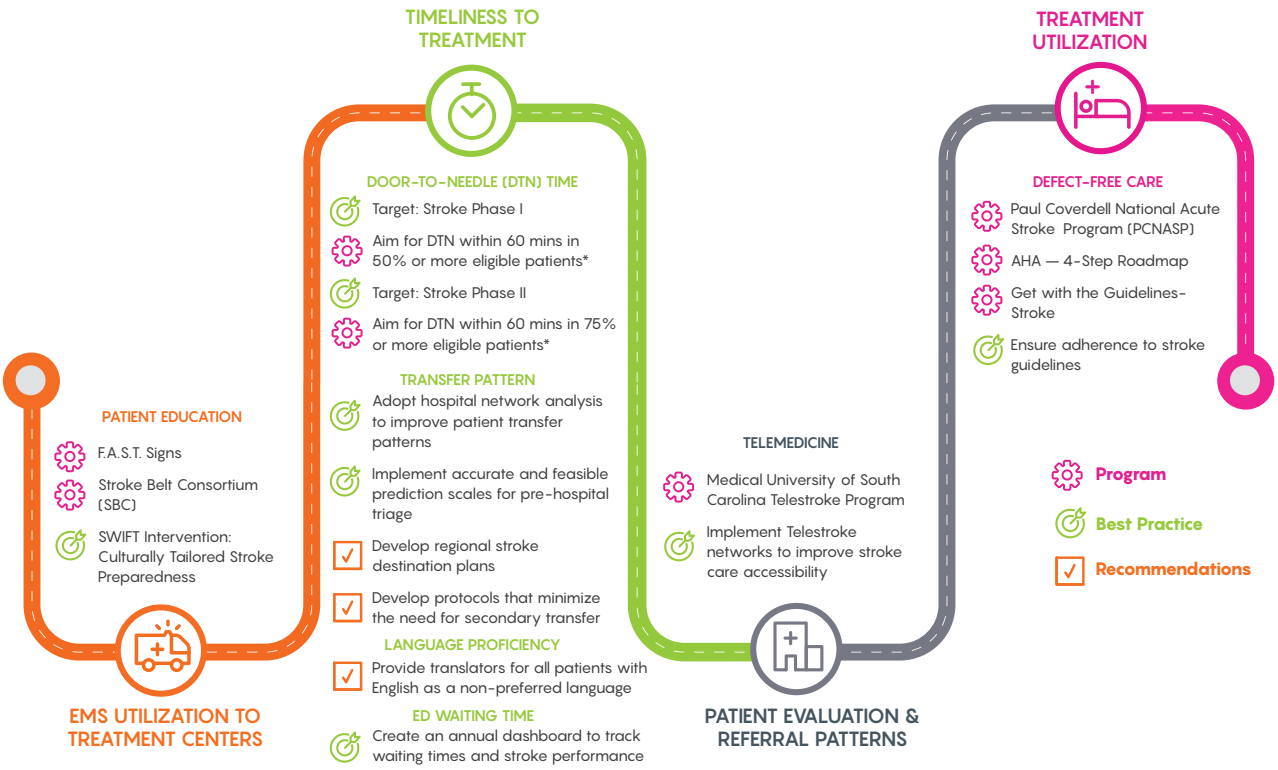


Figure 2. Programs, best practices, and recommendations to address racial and ethnic disparities in acute stroke care

SWIFT Intervention

The Stroke Warning Information and Faster Treatment (SWIFT) study sought to enhance early emergency department (ED) arrival times for recurrent strokes among a diverse multi-ethnic cohort of stroke and transient ischemic attack (TIA) survivors.[14] Through a randomized controlled trial (RCT), the study compared the impact of an interactive intervention (II) (two in-hospital educational sessions and health literate culturally tailored materials) versus using enhanced educational (EE) materials only on stroke knowledge, preparedness capacity, and arrival times within the critical 3-hour treatment window.[14]

Over a 5-year period involving 1193 participants (592 EE, 601 II), both intervention groups exhibited a significant increase in the proportion arriving at the ED under 3 hours, surpassing national trends with an unprecedented 40% to 50%.

Notably, the study identified a substantial increase in arrival times among Hispanics and a positive trend among Black patients, indicating a potential reduction in race-ethnic disparities in ED arrival times.[14] The findings underscore the effectiveness of clear, simple, and preparedness-focused messages, emphasizing the critical role of continued education for stroke survivors in diverse communities.[14] The SWIFT study is recognized as one of the first interventions demonstrating the capacity to decrease race-ethnic disparities in stroke arrival times, offering valuable insights for stroke preparedness interventions.

TIMELINESS TO TREATMENT

REDUCING DOOR-TO-NEEDLE TIME

On average, Black and Hispanic patients use EMS for stroke care transportation less frequently than White patients.[3,32] EMS use for stroke care is associated with shorter transportation times, more urgent medical evaluation, and faster door-to-needle (DTN) times.[33-35]

Studies have found that reducing DTN time reduces disparities in acute stroke care, including improvements in in-hospital mortality, intracranial

*Target Stroke https://www.heart.org/en/professional/quality-improvement/target-stroke/learn-more-about-target-stroke[8]

hemorrhage, and discharge to home.[36] The current gold standard recommendations to reduce door-to-needle time were created by the AHA/ASA.

Target: Stroke Phase I

This initiative, called Target: Stroke, provides a framework for healthcare systems to follow in order to reduce DTN.[8,37]

It offers ten key strategies including EMS pre-notification, activating the stroke team with a single call, rapid acquisition and interpretation of brain imaging, use of specific protocols and tools, premixing tissue plasminogen activator (tPA), a team-based approach, and rapid data feedback.[38] The primary goal of Target: Stroke Phase I is for at least 50% of acute ischemic stroke (AIS) patients to achieve a DTN time of 60 minutes or less. In its first phase, hospitals participating in Target: Stroke Phase I decreased median DTN times by 10 minutes and increased the number of patients treated within 60 minutes from 29.6% to 53.3%, with a corresponding improvement in patient outcomes.[36]

Target: Stroke Phase II

Target: Stroke Phase II advocates for 12 key best practice strategies for reducing DTN time and builds upon the successes of its predecessor (Target: Stroke Phase I), aiming to further reduce DTN times for eligible tPA-treated patients.[9] Target: Stroke Phase II establishes a more ambitious goal of achieving DTN times within 60 minutes in 75 percent or more for AIS patients receiving intravenous (IV) tPA. Meeting this benchmark will allow patients to undergo IV tPA treatment, which is a highly effective time-sensitive treatment in combating stroke.[12]

A large urban academic comprehensive stroke center analyzed DTN time, door-to-CT time, and CT-to-tPA time pre and post implementation of Target: Phase II. They found significant improvements in median DTN time (59 to 29 minutes), door-to-CT time (17 to 16 minutes), and CT-to-tPA time (43 to 13 minutes).[30] Information about the program, including best practice recommendations, clinical tools, and educational resources, can be found online at www.heart.org.[8]

OPTIMIZING TRANSFER PATTERNS

Adopt Hospital Network Analysis

Disparities in transfer and referral patterns persist, with minorities less likely to be transferred to stroke centers than non-minorities.[40-43] To reduce onset to needle times, the Tama-Registry of Acute Endovascular Thrombectomy (TREAT) in Japan found that patients should be expeditiously diverted to centers with stroke treatment capabilities.[20]

To optimize patient transport patterns, hospital network analysis using network science may be used to track data for all stroke patients who are transferred to specialized stroke centers.[15] Hospital networks can also create mathematical models incorporating real-time data to aid in choosing the most effective routing for patients with suspected stroke.[16]

Using network science, researchers at Massachusetts General Hospital developed pre-hospital routing algorithms for patients with suspected stroke due to large vessel occlusions (LVO). They then built a mathematical model to give a real-time, location-based optimal EMS routing location based on local resources, transport times, and patient characteristics. After 1000 simulations, the most frequently occurring optimal strategy was the final recommendation. Results showed that under many scenarios, the recommendations for direct transfer to the endovascular thrombectomy (EVT) site increased with increasing stroke severity and geographic proximity.[16]

Implement Accurate and Feasible Prediction Scales

Stroke prediction scales can assist emergency services paramedics in initiating an acute stroke code and aid in determining the correct transport decision to minimize time to treatment.[44,45]

Several prediction scales exist with different strengths and feasibilities.[44,46,47] Wang et al. report the successful implementation of a hospital

selection protocol based on pre-hospital stroke scale assessment, real-time transport time, and historical hospital time-to-treatment metrics to shorten time-to-treatment for stroke patients.[17] They found that using the proposed protocol for triage reduces the time from onset to receiving definitive treatment by nearly 11 minutes.[17]

Developing networks with accredited acute stroke-ready hospitals, primary stroke centers, thrombectomy-capable stroke centers, and comprehensive stroke centers allows the development of functional stroke destination plans in more isolated regions.[5]

Develop Protocols that Minimize the Need for Secondary Transfer

A retrospective analysis of data from the Tama-Registry of Acute endovascular Thrombectomy (TREAT) compared two paradigm of transportation; direct transfer to an endovascular thrombectomy-capable center (ECC) versus secondary transfer from a non-ECC. The results demonstrated that stroke patients who were transferred directly to an ECC had significantly shorter distance from onset to ECC, shorter onset to needle (OTN) time, and shorter onset to reperfusion (OTR) time compared to patients transferred from non-ECC. These results can be used to create a regional medical policy for the management of acute ischemic stroke.[20]

IMPROVE LANGUAGE PROFICIENCY

Provide Translators for Patients with English as a Non-Preferred Language

Language proficiency may be a determinant of time-to-treatment for stroke patients, with those with limited English proficiency having longer times to treatment in some contexts.[21,22] Clear communication between a patient or caregiver and healthcare providers can assist with quick diagnosis and consent for treatment.

Language proficiency is therefore an area of interest in determining how quickly patients receive care and improving time-to-treatment metrics. Rezania et al. found that in Australia, patients with English as a secondary language had a significantly longer onset to needle time (188 min vs. 173 min, $p = 0.04$) and stayed significantly longer in the stroke unit (six vs. four days, $p = 0.02$).[22]

However and conversely, in the US, Anderson et al. found that patients who preferred English language compared to Spanish and other languages had a significant lower rate of favorable outcomes which became insignificant after controlling for age and NIHSS.[21] Together, these studies suggest that establishing interpreters for all patients with a different preferred language may decrease time to treatment and increase favorable stroke outcomes. However, not all studies noted a difference in outcomes based on preferred language.[21,48] Regional variations in common languages may change the effect of preferred language on stroke outcomes.

For example, in California, where Spanish is spoken more commonly than most other areas of the US, Anderson et al. found that patients who preferred Spanish had no significant difference in favorable outcomes, and in fact had a significantly lower mortality rate compared to English-speaking patients.[21] Similarly, Zachrison et al. found no difference between English-speaking and non-English speaking patients and suggested that the availability of stroke education programs in multiple languages may have improved communication abilities.[48] Thus more studies are needed to determine how language-based interventions may be implemented to maximize impact on clinical outcomes, and the best practices may vary by region.

REDUCING EMERGENCY DEPARTMENT WAITING TIMES

Create Annual Dashboards to Track Waiting Times and Stroke Performance

The National Hospital Ambulatory Medical Care Survey was used to evaluate 2.1 million stroke-related emergency room visits from 1997-2000 and 2003-2005 for patients with ischemic or hemorrhagic stroke. The study found that Black

individuals had a longer waiting time compared to Hispanics and White people.[49]

Measuring and tracking hospital performance and providing benchmarks regarding stroke disparities is an important step in making providers aware of where improvement is needed.[13] Creating annual hospital dashboards so hospitals and providers can see the stroke performance for Black, Hispanic, and White individuals has been shown to be an effective method to reduce disparities in onset-to- needle time.[13]

To address stroke disparities, the Florida Stroke Registry adapted Get with the Guidelines-Stroke (GWTG) program focused on performance metrics to create hospital performance dashboards. The conceptual model was based on collating data across multiple sources, using the data to track how hospitals were performing, benchmarked to regional, state and national metrics, and identifying disparities.[13] While their intervention did not explore other determinants of health, their intervention did influence state policy; based on their data, the state of Florida now requires all stroke centers in the state to participate in the Florida Stroke Registry, and they receive annual appropriations from the Department of Health.[13]

Thus, we recommend that hospitals create and use these dashboards in order to track and improve onset-to-needle time in individuals of different race and ethnicity.

PATIENT EVALUATION AND REFERRAL PATTERNS

TELEMEDICINE

Racial disparities in stroke care are well-documented, with minorities less likely to be referred to stroke centers or receive appropriate evaluation and treatment.[50]

Levine and Gorman proposed the development of telemedical outreach for acute stroke evaluation and management, which they termed "telestroke."[51] In 2019, an estimated 96% of the United States (US) population had access to either a stroke center or a hospital with telestroke capacity, compared to 64% with access to a comprehensive or thrombectomy capable stroke center.[52]

The practice of telestroke has been found to 1). have a high interrater agreement with a bedside assessment of the National Institutes of Health Stroke Scale (NIHSS) score, 2). enhance correct thrombolysis decision making as compared with telephone-only consultation, 3). to reduce disparities, and 4). to be cost-effective.[53,54]

Medical University of South Carolina Telestroke Program

The Medical University of South Carolina (MUSC) telestroke program is a strategic initiative designed to address the challenges of delivering timely and specialized stroke care across various geographic regions.[10] Physicians at MUSC Health partnered with Georgetown Memorial Hospital and Hampton Regional Medical Center to change EMS workflows and incorporate telemedicine techniques, which resulted in significantly shortening of the time between patients stroke symptom onset and treatment from 38 to 20 minutes.[55] Through the MUSC telestroke program, the new telestroke workflow involved three-way communication between the stroke specialist, the EMT, the patient and the receiving hospital nurse and emergency medicine physician.[55] Performing the consult and examination on the way to the hospital allowed emergency room doctors and nurses to be more prepared for their incoming stroke patient.[55]

Implement Telestroke Networks to Improve Access to Stroke Care

In 2022, Barragan-Prieto et al. showed that implementation of a telestroke network in Andalusia, Spain significantly improved acute stroke care accessibility.[18] After the 5 months process of implementing a centralized telestroke network, there was a significant jump in the number of inhabitants who had access to specialized stroke care in less than 30 min (59.72% to 93.5%) bridging the access gap in

acute stroke care in rural hospitals.[51] Furthermore, Reddy et al. found no racial, ethnic, or sex disparities within patients treated in a tele-stroke network.[56] Because of the success of telestroke in reducing disparities in acute stroke care, we recommend that hospitals aim to become part of this network.

TREATMENT UTILIZATION

DEFECT-FREE CARE

Disparities in the utilization of stroke treatment including tPA and mechanical thrombectomy (MT) have been demonstrated in many studies, highlighting the pressing need for equitable care delivery.[3,57-62]

Our previous systematic review found that White patients were more likely to receive tPA than Asian, Hispanic, and Native American patients, and that Black patients were twice as likely to refuse tPA as White patients.[3] Achieving defect-free care, or the consistent adherence to guideline-based recommendations, is crucial to bridging these disparities.

Get with the Guidelines- Stroke

Consistent implementation of existing guideline-based recommendations may decrease disparities in the administration of stroke interventions across patients of different racial and ethnic groups, including both underuse and overuse of medical therapies, such as tPA and antithrombotics, and the use of MT.[3,58,63,64]

For example, Schwamm et al. found that following GWTG improved the quality of care in Black, Hispanic, and White stroke patients.[19] Notably, Black patients exhibited lower odds of receiving certain evidence-based stroke interventions compared to White patients, even after adjusting for patient and hospital characteristics.[19] The analysis underscores the need for consistent adherence to evidence-based stroke guidelines, particularly for Black patients who face a modestly reduced likelihood of receiving guideline-recommended care. Hospitals must prioritize consistent implementation of existing stroke guideline recommendations, such as the GWTG stroke program from the AHA,[65] to decrease racial disparities in stroke interventions, ensure equitable treatment for eligible patient groups, and improve stroke care outcomes.

Paul Coverdell National Acute Stroke Program

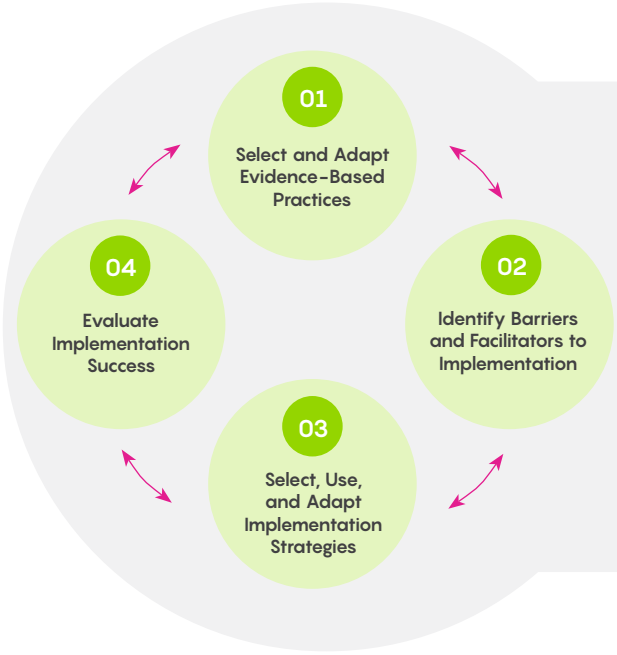
Targeted quality improvement programs have resulted in improvements among all stroke patients and have been shown to help reduce disparities in care.[66] The Paul Coverdell National Acute Stroke Program (PCNASP) uses ten performance measures implemented based on a patient's stroke type.[11] These included IV Alteplase given when indicated, venous thromboembolism prophylaxis (VTE), antithrombotic therapy within 48 hours, dysphagia screening, patients discharged on statin medication, patients discharged on antithrombotic therapy, anticoagulation for atrial fibrillation, stroke education, smoking cessation/advice/counseling, and patients were assessed for or received rehabilitation.

AHA- 4-Step Roadmap

The AHA provides a 4-step roadmap and checklist with critical equity considerations to 1.) select and adapt evidence-based practices, 2.) identify barriers and facilitators to implementation, 3.) select, use and adapt implementation strategies, and 4.) evaluate implementation success (Figure 3).[4]

Hospitals should consider implementing targeted quality improvement programs such as the PCNASP to improve care for all stroke patients and reduce disparities, while following the roadmap provided by the AHA to ensure equity considerations are addressed throughout the selection, implementation, and evaluation of evidence-based practices to address equity considerations.

ROADMAP FOR LEVERAGING IMPLEMENTATION SCIENCE TO ACHIEVE CARDIOVASCULAR HEALTH EQUITY



CRITICAL CONSIDERATIONS FOR EVERY STEP

Involve key stakeholders, including from historically marginalized populations, by drawing from stakeholder engagement, community-based participatory research and learning health system models

Apply equity-informed implementation science theories, models, and frameworks

Incorporate social or structural determinants of cardiovascular health equity

Review level, quality, and generalizatility of evidence (eg, systemic reviews, validated measures, randomized controlled trials) specific to cardiovascular disease disparities

Consider adaptation (including cultural adaptation) in identifying and addressing barriers and priorities of historically marginalized populations

Figure 3. The 4-step roadmap for selecting evidence-based practices to address equity considerations. Reprinted with permission. Circulation.2022;146:e260-e278. ©2022 American Heart Association, Inc.

Lessons from non-stroke acute care settings

Minority health disparities in the stroke care continuum are often found in the context of other acute illnesses, and findings and recommendations from these contexts may be applicable to stroke care. In fact, Brown et al. recommended that structural interventions to address minority health disparities be done with a disease-agnostic approach in order to tackle common risk factors.[4]

MYOCARDIAL INFARCTION

Evidence from a countywide policy intervention to improve care for a related acute cardiovascular condition, acute myocardial infarction (MI), has findings relevant to stroke.[68] One study described an EMS-led program of coordinated and standardized EMS and hospital-based systems of care, which focused on education to improve recognition of MI by EMS and continued monitoring and review of patient care metrics, including time to treatment. The program successfully reduced time from 911 contact to reperfusion, improved the quality of ST-segment— elevation MI care, and reduced racial and ethnic disparities in care.[68]

Furthermore, Trent et al. provided evidence-based guidelines for mitigating disparities in emergency medicine, including a protocol to reduce door-to-balloon time for acute ST-elevation MI.[69]

This protocol involves the following:

1. Pre-hospital activation of the catheterization laboratory: This ensures that the catheterization laboratory is notified as soon as possible after the patient arrives at the hospital, so that they can be prepared to receive the patient and begin treatment.
2. Rapid assessment and triage: This ensures that the patient is quickly assessed and triaged, so that they can be taken to the catheterization laboratory as soon as possible.

Because time is of the essence in the treatment and management of both acute stroke and MI, the recommendations aimed at reducing disparities in MI care may be applied to acute stroke care.

EMERGENCY MEDICINE

Khidir et al. provided guidance on establishing quality measures to address racial and ethnic disparities and summarized existing emergency medicine quality measures that can be adapted to address racial and ethnic disparities:[70]

1. Timely access to care tracks the percentage of patients who receive care within a specified time frame after arrival at the ED.
2. Appropriate use of diagnostic tests tracks the percentage of patients who receive the appropriate diagnostic tests for their condition.
3. Appropriate use of medications tracks the percentage of patients who receive the appropriate medications for their condition.
4. Appropriate discharge planning tracks the percentage of patients who have a plan for follow-up care after discharge from the ED.

These measures can be adapted to address racial and ethnic disparities by stratifying the data by race and ethnicity. This will allow health care

providers to identify disparities in access to care, care delivery, and transitions of care and target interventions that address these disparities.

In addition to these existing measures, Khidir et al. proposed a framework for developing new quality measures that focus on disparities in access to emergency care, care delivery, and transitions of care.[70] This framework includes the following elements:

1. Measures should be specific, measurable, achievable, relevant, and time-bound.
2. Measures should be developed in collaboration with stakeholders from diverse racial and ethnic groups.
3. Measures should be aligned with national priorities for reducing health disparities.

This emergency medicine quality measure framework can be adopted to identify and track racial and ethnic disparities in stroke care.

PERIPHERAL ARTERY DISEASE

Strategies to address racial and ethnic disparities in treatment and outcomes of peripheral artery disease (PAD) are still in development.[71] Coy et al. demonstrated that barbershop-based screening and education led to increased awareness of PAD and increased support for other systemic changes to improve health in the community.[72] They suggest the use of existing culturally-appropriate institutions and community organizations to support education and build community trust. These recommendations can also be applied to stroke education and parallel the recommendations for engagement with community partners when forming stroke care networks.

ACUTE CORONARY SYNDROME

Few initiatives to date have been implemented to address racial disparities in the treatment of acute coronary syndrome (ACS). One initiative is the Coalition to Reduce Racial and Ethnic Disparities in Cardiovascular Disease (CVD) Outcomes (CREDO) alliance, launched by the American College of Cardiology (ACC).[73] The ACC through the CREDO initiative aims to improve physician awareness of racial disparities in cardiovascular disease care, conduct patient education, and provide evidence-based resources and tools to combat CVD care disparities.[73]

Since its inception, CREDO has launched several educational activities and evidence-based tools, including a major performance improvement and education initiative, Keeping PACE (Patient Centred ACS Care Education). Keeping PACE is a performance improvement continuing medical education program that permits GWTG hospitals to examine various in-hospital and discharge performance measures.[72] Keeping PACE also offers clinicians an opportunity to target education and quality improvement (QI) tools to gaps in specific ACS performance metrics. By combining provider and patient education with data-driven QI tools, Keeping PACE effectively promotes health equity.

Practices to improve overall outcomes in stroke

Many programs have been established to guide care centers in improving stroke outcomes regardless of patient race or ethnicity. These global and regional programs aim to decrease mortality and increase positive outcomes after stroke, potentially reducing the long-term impact of racial and ethnic disparities in stroke care. These are summarized in Table 1 and Figure 4.

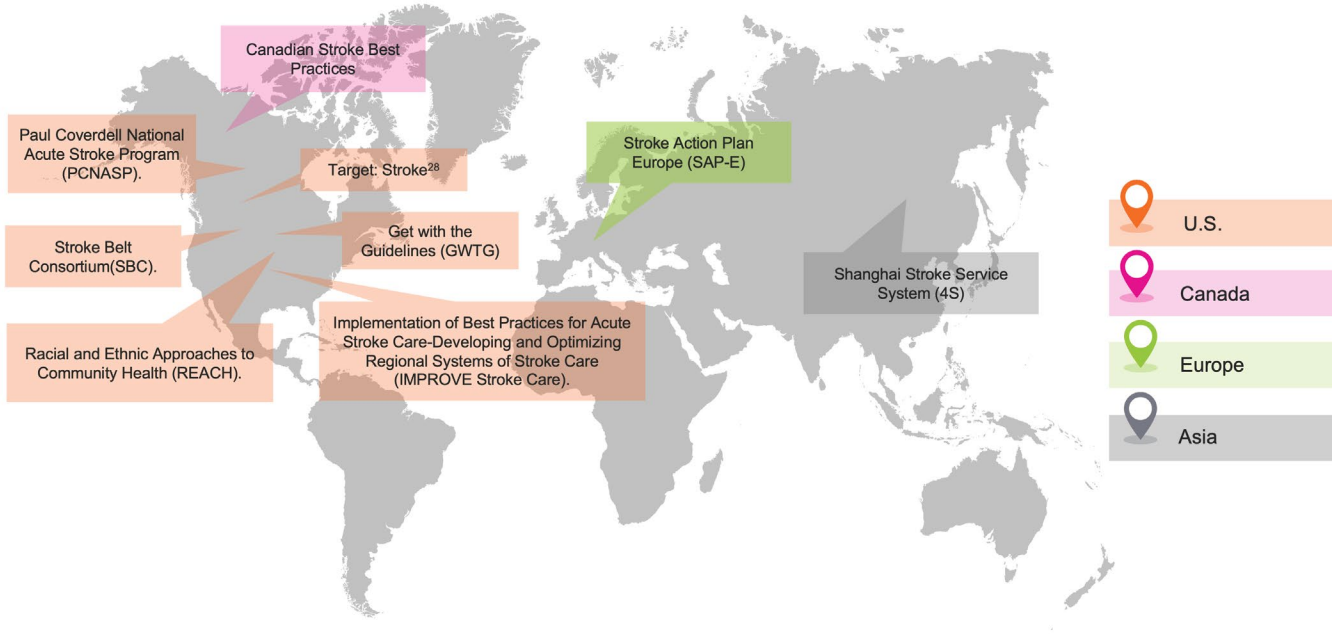
EXISTING PROGRAMS TO IMPROVE OVERALL STROKE OUTCOMES: COUNTRY-LEVEL EFFORT.

The Target: Stroke Guidelines developed by the AHA/ASA are currently the gold standard for stroke treatment.[8,25]

The Target: Stroke guidelines focuses primarily on the following areas:

1. Rapid diagnosis
2. Appropriate use of endovascular therapy
3. Comprehensive post-stroke care
4. Timely treatment with IV thrombolysis

The primary goal of the Target: Stroke guidelines is to reduce DTN times for patients who are eligible to receive tPA. The target DTN time for tPA is 60 minutes or less in 50% (Target: Phase I) and 75% (Target: Phase II) of eligible patients. The implementation of the Target: Stroke guidelines may vary in different care settings. Information about the program, including clinical tools and resources, can be found online at https://www.heart.org/en/professional/quality-improvement/target-stroke.



The country/region of the above existing programs is based on the location of the sponsoring organization

Figure 4. Review existing programs to improve overall stroke outcomes: country and regional efforts

Get with the Guidelines-Stroke is an in-hospital based quality improvement program aimed at improving stroke care and reducing care disparities by promoting consistent adherence to the latest scientific treatment guidelines.[65] The program is based on the AHA/ASA's Stroke Guidelines and focuses on improving the following seven areas of care:

1. Assessment and triage: Identifying patients who are at risk for stroke and ensuring that they receive timely assessment and treatment.
2. Thrombolysis: Administering tPA to eligible patients as quickly as possible.
3. Endovascular therapy: Using mechanical clot removal devices or other endovascular procedures to treat patients with AIS.
4. Blood pressure management: Maintaining blood pressure in a safe range after stroke.
5. Anticoagulation: Using medications to prevent blood clots from forming after stroke.
6. Rehabilitation: Providing patients with the rehabilitation services they need to recover from stroke.
7. Prevention: Educating patients about stroke prevention and helping them make lifestyle changes to reduce their risk of stroke.

Clinical tools and resources for implementing the GWTG stroke program can be found online at https://www.heart.org/en/professional/quality-improvement/get-with-the-guidelines/get-with-the-guidelines-stroke. Adhering to these guidelines has been shown to improve outcomes for all racial groups, and thus may potentially be leveraged to reduce disparities.[19]

Canadian Stroke Best Practices from the Heart and Stroke Foundation provides evidence-based resources for professionals, patients, and caregivers to prevent strokes and improve stroke outcomes. These include updated recommendations and guidelines that highlight key elements involved in the initial assessment, stabilization, and treatment of stroke.[75,76] The guidelines recommend that patients with acute stroke be treated as quickly as possible with clot-busting medications, such as tPA, if they are eligible. While the program is based in Canada, the recommendations and guidelines are available for use internationally and accessible online at https://journals.sagepub.com/doi/10.1111/ijs.12551.

The Racial and Ethnic Approaches to Community Health (REACH) is a national program administered by the Centers of Disease Control and Prevention (CDC) that provides resources, mainly in the form of grants, for recipients to plan and execute programs to address health, racial or ethnic health disparities.[77] REACH recipients may include state and local health departments, tribes, universities, or community-based organizations. The REACH program emphasizes the development of local, culturally-informed programs to address health disparities.

EXISTING PROGRAMS TO IMPROVE OVERALL STROKE OUTCOMES: REGIONAL-LEVEL EFFORT

Several regional efforts have been made to improve acute stroke care and outcomes. Because determinants of health often vary significantly by region, regional efforts to improve stroke care and reduce disparities are often highly effective.[44] Developing a cohesive, aligned regional or state stroke system of care requires identifying and engaging all potential stakeholders to ensure that the concerns of various groups are considered and addressed before the program is fully implemented.

The Implementation of Best Practices for Acute Stroke Care-Developing and Optimizing Regional Systems of Stroke Care (IMPROVE Stroke Care) project is designed to implement existing guidelines and systematically improve the acute stroke system of care in the southeastern US.[78] The goal of the IMPROVE Stroke program is to develop a regional integrated stroke care system that identifies, classifies, and treats AIS patients more

rapidly and effectively with reperfusion therapy. The IMPROVE Stroke Care project focuses on the following areas:

1. Public awareness: Increasing public awareness of the signs and symptoms of stroke and the importance of calling 911 immediately if someone is having a stroke.
2. EMS: Improving EMS response times and ensuring that patients with AIS receive the appropriate care as soon as possible.
3. Hospitals: Improving the care of patients with AIS in hospitals, including ensuring that patients are treated with tPA as quickly as possible.
4. Regional systems: Developing regional systems of stroke care that ensure that patients with AIS receive the best possible care, regardless of where they live.

Information about the IMPROVE Stroke Care project can be found online at https://www.sciencedirect.com/science/article/abs/pii/S0002870320300181.

The Paul Coverdell National Acute Stroke Program (PCNASP) is led by the CDC and funds state health departments in the US to collect, measure, and track data to improve the quality of care for stroke patients.[11] PCNASP supports coordinated stroke systems of care and recommends monitoring patient care and quality improvement from the time of stroke, through EMS transport to the hospital, during in-hospital care, and through their discharge from the hospital to outpatient care.[11] Information about PCNASP can be found online at https://www.cdc.gov/dhdsp/programs/stroke_registry.htm.

The Stroke Belt Consortium is made up of a group of cross-sector organizations in the southeastern US that have formed a network to address the region's high level of stroke incidence and stroke-related mortality.[7] The consortium includes hospitals, other healthcare providers, government, non-profit organizations, and members of the community. Their activities include conducting research, providing education, implementing community-based interventions, and creating and sharing region-specific best practices to address stroke risk factors and disparities.[7] Information about the Stroke Belt Consortium can be found online at https://pubmed.ncbi.nlm.nih.gov/17894966/.

The Shanghai Stroke Service System (4S) aims to improve quality of stroke care by addressing regional disparities through process improvement.[78] The 4S registry uses a web-based database that automatically extracts data from structured electronic medical records.[78] Site-specific education and training programs are then designed and administered according to findings from the data. Information about 4S can be found online at https://journals.sagepub.com/doi/abs/10.1177/1747493018765492.

The Stroke Action Plan for Europe (SAP-E) is a pan-European project led by the European Stroke Organization (ESO) and Stroke Alliance for Europe (SAFE) aimed to set targets and action plan for the implementation of evidence-based preventive best practices and stroke services until 2030.[80] Overall, 30 targets and 72 research priorities were identified with four overarching targets for 2030,[81] these include:

1. to reduce the absolute number of strokes in Europe by 10%
2. to treat 90% or more of all patients with stroke in Europe in a dedicated stroke unit as the first level of care
3. to have national plans for stroke encompassing the entire chain of care
4. to fully implement national strategies for multisector public health interventions

Information about SAP-E can be found online at https://actionplan.eso-stroke.org/.

Program	Aim	Sponsoring Organization	Participation Region*
Target: Stroke[8]	A quality improvement initiative aimed at reducing door-to-needle time to improve acute stroke care and reduce disparities.	AHA	US
Get With The Guidelines-Stroke[65]	A hospital-based quality improvement initiative aimed at improving stroke care and reducing care disparities	AHA/ASA	US
Canadian Stroke Best Practices[75,76]	To provide evidence-based resources for professionals, patients, and caregivers to prevent strokes and improve stroke outcomes.	The Heart and Stroke Foundation	Canada
Racial and Ethnic Approaches to Community Health (REACH)[77]	A national program to reduce racial and ethnic disparities, including those related to stroke.	CDC	US
Paul Coverdell National Acute Stroke Program (PCNASP)[11]	A national program aimed at reducing the burden of stroke and address disparities via implementing and coordinating stroke systems to improve the quality of care across the care continuum; from stroke onset to in-hospital to post discharge.	CDC	US
Stroke Action Plan Europe (SAP-E)[80]	A pan-European project aimed to set targets and action plan for the implementation of evidence-based preventive best practices and stroke services until 2030.	ESO/SAFE	Europe
Stroke Belt Consortium[7]	To conduct research, implement community-based interventions, and share best practices to address stroke risk factors and disparities in the southeastern US.	Multiple cross-sector organizations	US
Implementation of Best Practices For Acute Stroke Care-Developing and Optimizing Regional Systems of Stroke Care (IMPROVE Stroke Care)[78]	To implement existing guidelines, including AHA guidelines, and develop a regional integrated stroke care system to treat acute ischemic stroke patients rapidly.	Multiple hospitals and pre-hospital agencies	US
Shanghai Stroke Service System (4S)[79]	To improve and standardize the quality of stroke care in the Shanghai area by using a web-based database to analyze electronic medical records and develop site-specific education and training.	Multiple healthcare centers	Asia (China)

Table 1. Established programs for improving overall stroke outcomes

Potential challenges to implementing programs or adhering to guidelines required to close disparities of care within the hospital setting

We have provided recommendations for points along the stroke care continuum where hospitals and other institutions can address racial and ethnic disparities and resources that are available to guide implementation of best practices. However, we acknowledge that there are several potential challenges to implementing these recommendations.

LACK OF AWARENESS OR BELIEF

Racial and ethnic disparities in stroke outcomes are well-established,[3,82] but medical practitioners may not be aware of the research or willing to believe its conclusions due to personal views. Integrating citations to studies establishing the presence of disparities into discussions of best practices to address the disparities can increase awareness and affirm the need to address the problem.

LACK OF BEST PRACTICES

While we have attempted to address the lack of best practices with this review, in many areas of stroke care, the best practice may not be clear. Many practices are supported by observational studies, or studies in particular regions, but need to be verified in larger trials and multiple contexts. More robust trials on the implementation of potential best practices are needed to understand whether these practices truly work to address racial and ethnic disparities in stroke care and in what context.

FEAR OF WORKFLOW DISRUPTION

Even when best practices are clear and the problem is acknowledged, medical practitioners may be hesitant to disrupt their workflow. If it requires changing process of care patterns or adding new data collection steps. Institutions may wish to implement changes gradually to avoid large workflow disruptions. Collecting data on patient demographics and stroke outcomes can serve to both improve patient outcomes, as discussed above, and provide data to show the changes' positive effects and increase support for future changes. Institutions may be able to use lessons from transitions to electronic health records (EHRs), such as proactive, clear communication and monitoring for unexpected disruptions during changes so that they can be addressed quickly.[83,84]

LIMITED RESOURCES OR BUDGET

Many hospitals have limited resources and may not have the budget or staff to pursue best practices or implement programs to address disparities. Programs such as REACH in the US provide funds and other resources for this purpose. Forming networks between hospitals with limited resources and hospitals with more resources may also help leverage the resources and experience from hospitals with more resources to implement programs in cost and time efficient ways in hospitals with lower resources. Further research on best practices will also help hospitals prioritize and choose changes that are most cost efficient; has the largest effect and minimum resource requirements with measurable impact in a specific patient population.

LACK OF DIVERSITY, EQUITY, AND INCLUSION (DEI) LEADERSHIP AND STRATEGIC PRIORITY

While medical practitioners may be able to implement some practices on their own, many recommendations require advocacy and buy-in from department or institution leadership to implement. Specific DEI leadership positions can help advocate for allocating resources to implement recommendations and ensure that addressing health disparities remains part of the institution's strategic priority.

LACK OF DATA COLLECTION AND ANALYTICAL CAPABILITY

Many institutions may lack the capability to collect and analyze data by race as recommended or may not be sure of their capability. The Advisory Board created a hospital-oriented maturity model for reducing health disparities, including metrics for data collection and analysis,[85] which allows hospitals to independently assess their capability and determine what changes are needed to create sufficient capability to implement recommended programs. Hospitals can use this maturity model to assess their current data collection and analytical capability and set goals for improvement.

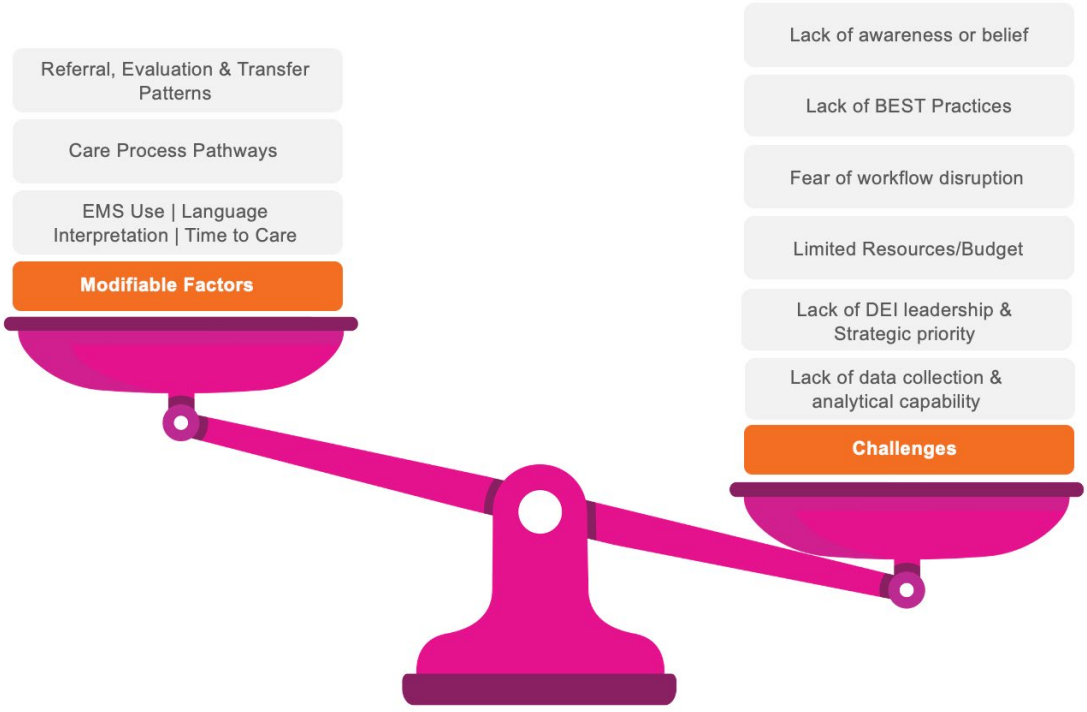


Figure 5. Potential challenges to implementing programs

Hospital-oriented maturity model for reducing health disparities

The Advisory Board's maturity model provides a holistic approach for assessing the current state of practices for addressing health disparities and potential directions for improvement.[85] The model includes criteria for self-assessment in eight categories: governance; social needs and community outreach; data collection; data analysis; goals; staff knowledge, skills, and attitude; culturally sensitive care delivery; and workforce diversity, equity, and inclusion. Each category has criteria broken into four stages: just getting started, hitting the basics, ahead of the curve, and moving the market forward. The criteria for each stage for data collection and data analysis are reproduced in Table 2. By assessing their status in these categories, hospitals can determine where they need improvement and decide how to prioritize their resources. The maturity model can also assist hospitals in setting both short- and long-term goals for progress as they work to move into the next stage.

Category	Question	Just getting started	Hitting the basics	Ahead of the curve	Moving the market forward
Data collection	To what extent do we collect quantitative and qualitative patient data to improve care and support identification of disparities at the population level?	· We collect basic demographic data (age, sex, etc.) at patient intake. · We conduct a community health needs assessment every three years to comply with tax code requirements. · In addition to a community health needs assessment, we occasionally receive and act on qualitative patient and family feedback through satisfaction surveys and complaints.	· We collect REAL data (race, ethnicity, age, and language) and screen for SDOH at patient intake. · We solicit input from employee resource groups on our workforce, patient, and community investments. · We use our community health needs assessment as an opportunity to build connections with diverse local groups. · Together with the needs assessment, we use innovative tactics such as story mapping to understand the makeup of the population we serve and the needs of marginalized and vulnerable groups.	· We collect REGAL (race, ethnicity, gender identity and sexual orientation, age, and language) and SDOH data at registration or intake. · We collect mostly institution-oriented metrics to assess disparate outcomes across our patients and organization. · We conduct a community health needs assessment in partnership with our local municipality and other health care providers within our jurisdiction to create a rich database.	· We favor a self-reporting methodology to collect accurate and complete patient demographic data, prior to the patient's arrival via our portal or at the first touchpoint with the system (e.g., registration). · We have a system to validate patients' self-reported data, checking for completeness and accuracy during at least one touchpoint (registration, triage, intake). · We collect institution-oriented metrics to assess disparate outcomes across our patients and organization. · We combine that data with community-oriented metrics to understand how inequitable community conditions impact health outcomes, so we can understand the full scope of health disparities in our community.

Table 2. Advisory Board assessment criteria for data collection and data analysis

Category	Question	Just getting started	Hitting the basics	Ahead of the curve	Moving the market forward
Data analysis	To what extent do we analyze our data to identify health disparities in our patient population?	· We look for trends in our qualitative patient satisfaction comments, but we don't analyze our clinical outcomes and process metrics data by patient demographics.	· We stratify clinical and process of care outcomes by race and ethnicity data.	· We stratify clinical outcomes and process of care metrics (e.g., time to admit, wait times) by REGAL demographic data across our top clinical morbidities. · We analyze our nursing sensitive indicators and hospital-acquired conditions (HACs) for disparities across demographics. · We track utilization of language services and survey limited English proficiency (LEP) patients and staff with respect to their effectiveness. · We use a dashboard to visualize findings and communicate identified disparities to internal and external stakeholders to create organizational and community-wide awareness of disparities and our plans to address them.	· We examine our clinical outcomes and process-of-care metrics using an intersectional approach to identify groups most at risk of experiencing inequities. In this approach, we layer multiple identities at once to better understand how different types of oppression and privilege interact to impact outcomes. · We analyze cases involving use of physical and chemical restraints or activation of security to examine disparities across demographics. · We share our data and analysis publicly, recognizing that with transparency comes accountability.

Table 2. Advisory Board assessment criteria for data collection and data analysis – **continued**

Conclusions

Healthcare providers and institutions may face many challenges when addressing racial disparities in stroke care. These challenges may include lack of awareness or belief in the racial or ethnic gap in stroke outcomes, non-adherence to best practices, fear of workflow disruption from new practices, limited resources, and lack of leadership or institutional prioritization for diversity, equity, and inclusion. We have outlined several evidence-based, modifiable factors that can be addressed by individual institutions or local healthcare systems in order to close the racial and ethnic gap in stroke outcomes. These factors include referral, evaluation and transfer patterns, care process pathways, EMS use, language interpretation, and time to care.

Established stroke care programs and guidelines have been shown to reduce racial disparities in stroke outcome, while also representing general best practices in stroke care for all patients. In this review, we have compiled and discussed a compendium of current hospital-level programs, best practices, and recommendations to address disparities in stroke care, including lessons learned from non-stroke settings. Healthcare providers can begin addressing disparities in stroke care by using tools such as the Advisory Board's maturity model for reducing health disparities to assess their institution's current status with respect to taking a data collection and analysis approach to implementing strategies to address racial and ethnic disparities.

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