

## Improving Stroke Outcomes: A Roadmap of Care

Charles Ellis<sup>1\*</sup>, Robert J Adams<sup>2</sup> and Gayenell Magwood<sup>3</sup>

<sup>1</sup>Communication Equity and Outcomes Laboratory, East Carolina University, Greenville, NC, USA

<sup>2</sup>MUSC Stroke Center, Medical University of South Carolina, Charleston, SC, USA

<sup>3</sup>College of Nursing, Medical University of South Carolina, Charleston, SC, USA

### Abstract

Estimates indicate that 15 million individuals experience strokes worldwide. The short and long term impact of stroke can be devastating to stroke survivors, their families and their communities. A range of approaches to stroke care currently exist with all attempting to achieve the best outcomes. It has become clear that comprehensive evidence-based models of care should be consistently utilized to reduce the functional disability often associated with stroke. In this article we briefly highlight a “roadmap of stroke care” that offers considerations to the complexities of stroke care and strategies necessary to achieve optimal outcomes.

**Keywords:** Stroke; Roadmap; Stroke care

### Introduction

The global burden of stroke is substantial with world-wide estimates suggesting the incidence of first ever strokes increased from 16 million in 2005 to 23 million in 2013 [1]. It is expected that more than 25% (7.8 million) of those suffering a stroke in 2030 will also experience a stroke-related death [1]. Incidence and outcomes data suggest there are significant discrepancies in incidence and mortality rates among countries and regions [2]. In particular, rates vary greatly between low and high income countries [2]. Additionally, a recent finding suggests there are “stroke belt” regions or geographic variations in the burden of stroke around the globe [3]. Compounding the variability in worldwide stroke rates is a similar high variability in access to quality early stroke medical care followed by organized rehabilitation for stroke survivors with disability [4].

A great emphasis has been placed on primary and secondary stroke prevention to reduce the global burden of stroke. As a result, reductions in stroke mortality have been observed in many developed countries. A consequence of reductions in stroke mortality is an increase in the number of stroke survivors with significant disability who are in need on comprehensive rehabilitation and long-term care [1]. The increased need for rehabilitation and long-term care suggests a need for a cascade of care that accounts for the complex and intersecting biological, neurological and sociological factors that contribute to stroke-related outcomes. In this article we offer a “roadmap of stroke care” to reduce the burden of stroke, improve stroke outcomes while also achieving equity in stroke outcomes (Figure 1).

### Early Stroke Management

Guidelines for the acute management of ischemic stroke specifically emphasize supportive care and treatment of acute complications for such conditions as: hypoxia, oxygen saturation and intracranial pressure along with addressing potential complications associated with hypotension, hypertension and hypoglycemia [5]. For appropriate candidates, intravenous fibrinolytic therapy administered within three hours of stroke onset has been shown to yield increased odds of positive stroke-related outcomes [6]. Yet, the cost of tissue plasminogen activator (tPA) and inconsistencies in the necessary infrastructure for administration has been proposed as a significant barrier to optimal outcomes (i.e., mortality and disability) in some countries [7]. Even in high income countries such as the US, some population groups are less likely to benefit from tPA due to contraindications with the treatment, delays in seeking urgent stroke care, stroke type and stroke severity [8]. However, in order to truly reduce the long-term burden of stroke,

equity in treatment rates must be achieved during this earliest phase of stroke management.

### Organized Rehabilitative Care for Stroke Survivors with Disabilities

According to the National Institute of Neurological Disorders and Stroke (NINDS), 40% of stroke survivors in the US experience moderate to severe disability, resulting in significant limitations to their pre-stroke lifestyles [9]. For these individuals, organized and evidenced-based rehabilitative care is critical to achieving optimal outcomes. Multidisciplinary stroke rehabilitation should be delivered in an organized/coordinated manner and within facilities with the necessary infrastructure to maximize patient function [10]. The efficacy of stroke rehabilitation is well established and evidence indicates that care received in stroke rehabilitation units reduces: (a) the odds of death, (b) post-stroke dependency and (c) the need for long-term institutionalization [11]. Stroke rehabilitation is not a “one size fits all” process because stroke survivors can exhibit a wide range of motor, sensory and cognitive deficits all potentially requiring specialized services. Further, stroke rehabilitation programs do not operate in isolation. Successful stroke rehabilitation should be guided by general evidenced based principles of rehabilitation in conjunction with discipline specific (neurology, speech-language pathology, physical therapy, occupational therapy, rehabilitation nursing, therapeutic recreation, neuropsychology) evidence-based practices. In addition to the rehabilitation professionals, the team should include family, friends and caregivers to ensure that the patient’s goals are adequately represented in the rehabilitation care plan [10].

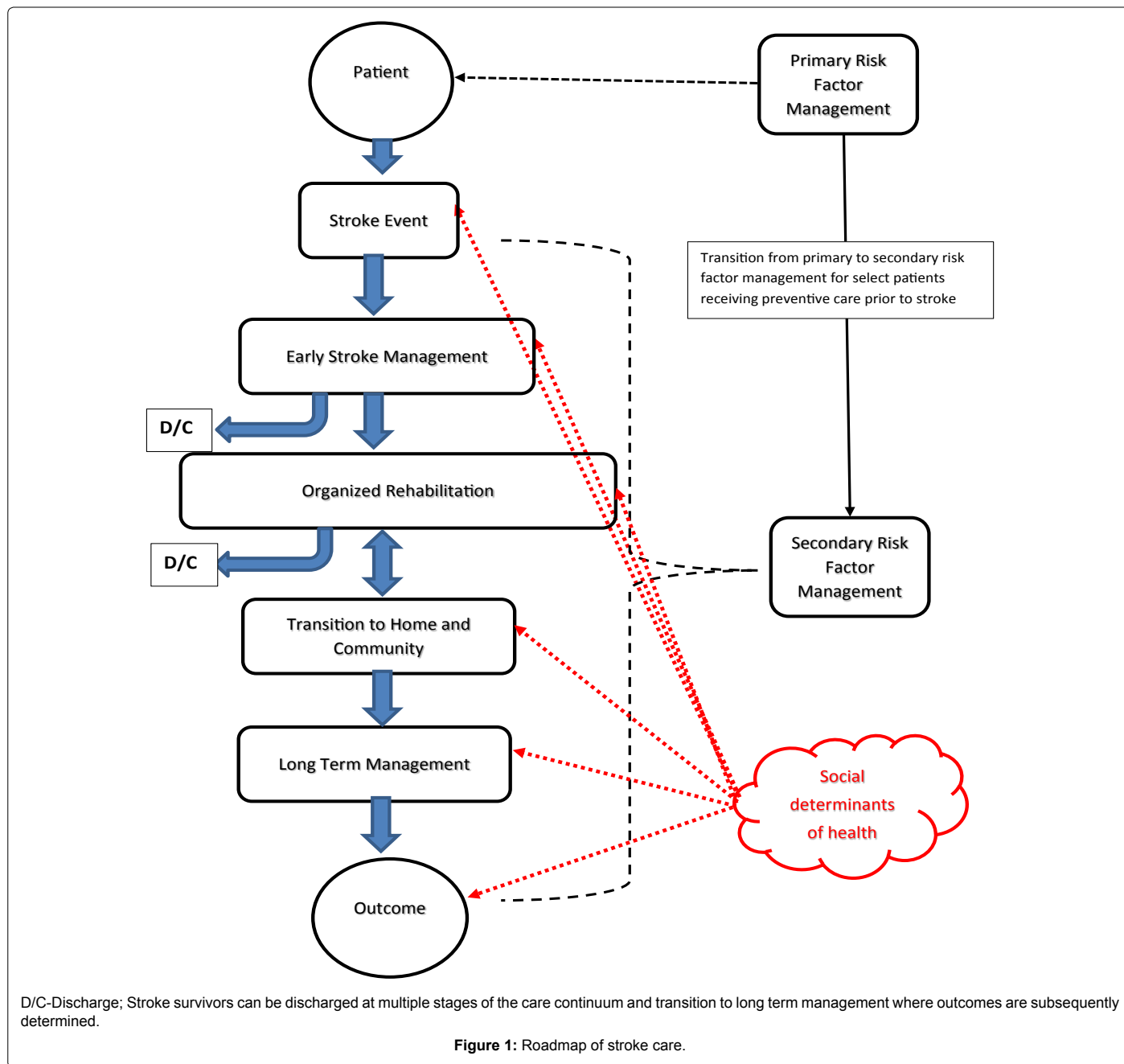
Many stroke rehabilitation programs emerge from and are organized around acute care hospitals with Primary Stroke Center Certification (hospitals that meet the standards to achieve positive stroke outcomes) or Comprehensive Stroke Center Certification (hospitals that treat the most difficult stroke cases) [12,13]. Organized

**\*Corresponding author:** Charles Ellis, Communication Equity and Outcomes Laboratory, Department of Communication Sciences and Disorders, East Carolina University, 3310H Health Sciences Building, MS 668 Greenville, NC 27834, USA, Tel: 2527446098; Fax: 2527446109; E-mail: [ellisc14@ecu.edu](mailto:ellisc14@ecu.edu)

**Received** June 16, 2016; **Accepted** June 28, 2016; **Published** June 30, 2016

**Citation:** Ellis C, Adams RJ, Magwood G (2016) Improving Stroke Outcomes: A Roadmap of Care. Int J Neurorehabilitation 3: 215. doi:10.4172/2376-0281.1000215

**Copyright:** © 2016 Ellis C, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.



stroke care allows patients to be transferred within the same system to the appropriate level of rehabilitation care that aligns with their level of disability. Stroke patients can be discharged for acute care hospitals to: (a) combined acute and rehabilitation units, (b) independent acute intensive rehabilitation units, (c) sub-acute rehabilitation units, home rehabilitation, day treatment centers and/or outpatient rehabilitation units [11]. Therefore, patients should be able to move through a continuum of care with a system-wide approach to stroke management. Organized system-wide stroke care should then culminate with accurate information transfer and continuity of care from acute care through rehabilitation and discharge to community settings [14]. Consequently, healthcare systems with organized stroke rehabilitation care can offer patients the best opportunities for optimal stroke-related outcomes.

### System-Wide Management of Stroke Risk: A Continuous Primary-Secondary Stroke Risk Management Plan

A primary challenge of stroke-related care is secondary stroke prevention. Whether in the early acute management or during the rehabilitation phase, long-term survival and reduction of secondary stroke risk centers on risk factor management. Therefore, a major benefit of organized system-wide care is the ability to utilize a consistent risk factor management approach. Patients who move in and out of different healthcare systems and/or healthcare systems that do not offer a continuum of stroke-related care are at risk of varying management approaches and consequently differential outcomes. For example, secondary risk factor management for hypertension, diabetes, hyperlipidemia can differ among patients seen in a stroke system (or

stroke continuum of care) when compared to patients discharged from hospitals and managed by individual primary care practitioners. Similarly, approaches to smoking cessation, alcohol abuse, diet, physical activity can vary greatly based upon stroke management philosophy and/or access to specialized services to address the specific risk factor. Regardless of approach, secondary prevention of stroke is a key aspect of acute and post-acute management. More importantly, many stroke survivors have a history of the aforementioned comorbid conditions prior to stroke onset. Therefore, the stroke itself must not disrupt the pre-stroke management of comorbid risk factors. Under optimal conditions, the secondary stroke prevention plan should extend from the established pre-stroke primary stroke risk factor management plan to ensure continuous and long-term risk factor control.

### Transitioning for System to Home

Discharge to home is the primary goal of stroke care whether in the acute stage of post-acute rehabilitation stage. Yet, little is known about this transition or the specific facilitators or barriers to a positive transition. Successful transition to the home setting requires an adequate match between the needs of the stroke survivor and community resources available to offer them support [10]. Unfortunately, stroke survivors and their families are oftentimes discharged home with significant information (verbal and written), but without the support of the healthcare system needed to interpret and implement the strategies included in that information. This can be frustrating given that this information was obtained from the same system that guided their care for the previous days, weeks or in some cases months prior to discharge home. Patients and their loved ones are then left to independently address the complicated secondary stroke prevention programs that are necessary to prevent a repeat stroke or to maintain a healthy lifestyle. Other difficulties emerge from the need for physical activity, to maintain a healthy diet, to manage multiple new medications or to cease pre-stroke negative actions such as smoking and alcohol use. For many, the need for these new lifestyle approaches are occurring in the context of a new found stroke-related disability.

Whereas, during their organized stroke care experience, the stroke survivor and their family had immediate access to healthcare professionals with expertise in stroke management and rehabilitation, they are discharged to their homes and/or community without such access. Consequently the social networks of stroke survivors become more critical. Beyond the immediate caregiver, the social networks of stroke survivors may be critically important to obtaining the needed physical and emotional support for a successful transition to home and community. Social networks can be critical to assisting stroke survivors with community participation by helping them gain access to inaccessible situations/settings and adapting activities to their level of disability as well as providing them with practical assistance [15]. In summary, substantial consideration should be given to not only the physical environment the stroke survivor is being discharged to, but also ensuring that a solid social network is in place to support the stroke survivor's recovery.

### Coordinated Management of Long Term Post-Stroke Problem Areas

Despite organized and evidence-based care, some stroke survivors will exit the rehabilitation continuum of care with new problem areas or pre-stroke problem areas exacerbated by the condition. These may include motor deficits, sensory deficits, cognitive deficits, chronic pain and depression [10]. The emergence of these new or worsened problems must be managed during the recovery process in the context

of the recent onset of an ongoing life threatening condition (stroke). For example, traditional pharmacological interventions for these conditions must be carefully considered to avoid drug interactions between the medications needed for the problem area and the medications designed to reduce stroke risk. Additionally, professionals offering complementary health approaches (exercise trainers, yoga and tai chi instructors, chiropractors and osteopathic doctors) must carefully consider the added benefits of their services in relationship to the dangers that may be caused by ongoing problems areas many stroke survivors experience. These services oftentimes occur without the oversight of the healthcare team that has managed the early stage of the recovery process and has the greatest understanding of the patient's overall state of health and potential problems. Yet the expected long term goal for stroke survivors is to live with the condition while achieving positive life satisfaction for both the stroke survivor and his/her spouse/family [16,17]. Therefore, many stroke survivors with disabilities will seek both traditional and alternative methods to achieve optimal recovery and subsequently quality of life and life satisfaction.

### Addressing Disparities in Outcomes

It is well established that racial-ethnic [18-22] and residence [3,22,23] differences exist in stroke-related outcomes. What is not clear is how such disparities can exist in the systems that offer the type of coordinated care outlined here. Reduced access to general stroke care and specialized services for some patients is traditionally posed as a primary factor in disparities in outcomes [24-26]. Yet, disparities in access to care do not fully explain the racial-ethnic and residence differences in outcomes and a clear explanation for long-standing disparities has yet to emerge. Therefore, it has become quite clear that there is a need for greater consideration of cultural nuances of care for minority populations and their potential contributions to observed differences in outcomes [27]. According to Frier and colleagues, the unique circumstances of individuals engaged in neurological rehabilitation must be considered in order to achieve optimal outcomes [28]. More specifically, a range of "social determinants" of health are believed to be contributors to currently observed disparities in outcomes. Social determinants of health are defined as "conditions in which people are born, grow, work, live, and age, and the wider set of forces and systems shaping the conditions of daily life" [29]. Because social determinants of health are primary factors in health disparities it is important to understand their impact on the primary health condition (stroke) and intermittent and long term outcomes resulting from the condition. More specifically, social determinants of health must be considered at all phases of post-stroke care and recovery. Additionally, their impact must be considered when measuring outcomes of conditions such as stroke. Therefore, practitioners providing care to stroke survivors must consider the impact of social determinants at all stages of stroke care and the ultimate impact on long term stroke outcomes.

### Obstructions, Potholes and Hazards on the Road to Optimal Stroke Outcomes

Systems offering organized and coordinated stroke care continues face many challenges in their attempts to achieve optimal outcomes. Our own experiences with providing stroke care and measurement of long term outcomes have resulted in our having a greater appreciation and emphasis on identifying and attempting to solve the problems that negatively impact stroke outcomes. Issues emerge from both the variable characteristics of individual patients/stroke survivors and the health systems where they receive care. For example, stroke outcomes are oftentimes influenced by the beliefs and attitudes of individuals at

risk for stroke. Some individuals, regardless of their family history of stroke have a very poor understanding of primary risk factor control. Consequently, they exhibit poor compliance with traditional risk factor control strategies. Many of these beliefs and attitudes continue after the stroke event itself and impact secondary stroke risk factor control. Therefore, some stroke survivors continue to choose short-term unhealthy lifestyles even after the stroke event. Some report not choosing to engage in healthy risk factor control strategies because such strategies require significant compliance and discipline that do not align with their daily schedules.

Early stroke management approaches can also result in negative outcomes despite offering established evidenced-based approaches. Unfortunately, some patients do not respond to treatment of acute complications. Similarly, some established treatments known to improve stroke outcomes are not available. For example, despite reductions in mortality and morbidity as a result of tPA administration, its use remains limited even among some established healthcare systems committed to stroke care. Therefore, death remains a common consequence of stroke and in the US alone, stroke is the fifth leading cause of death, resulting in ~130,000 deaths each year [30].

Similar to early management issues, the rehabilitation phase of stroke recovery can be a challenge. Although multidisciplinary rehabilitation care can improve outcomes, the nature of multiple disciplines attempting to rehabilitate patients with a range of disabilities comes includes inherent problems. Rehabilitation disciplines (neurology, physiatry, physical therapy, speech therapy, occupational therapy, nursing, etc.) all receive different and unique training and from different perspectives and models of care. Additionally, these rehabilitation professionals all differ in level of experience, level of specialized training and beliefs and attitudes about the rehabilitation process. In addition, the healthcare systems in which these rehabilitation professionals practice may also differ in treatment philosophy and approach. Collectively these factors can contribute to observed differences in outcomes despite the best intentions of all parties. Of even greater concern is the impact of lack of insurance or underinsurance to support the long term rehabilitation needs necessary for many stroke survivors. In the absence of adequate insurance, some stroke survivors do not have access to rehabilitation services known to improve outcomes.

Finally, stroke outcomes can be limited by the direct consequences of stroke in combination with the combined characteristics of patients themselves. The beliefs of stroke survivors about rehabilitation whether optimistic or fatalistic can influence motivation, compliance and persistence with the achieving outcomes. Further, the communities from which stroke survivors emerge can also have a dramatic impact on patient outcomes. The support or lack of support the community provides will assist or limit the stroke survivor's in achieving their long-term potential.

Future work must be designed to identify the facilitators and barriers to positive stroke outcomes and at all levels of care and recovery. Consideration must be given to the positive and negative contributions of the patients (stroke survivor) system (providing stroke care and rehabilitation), caregivers and communities where stroke survivors return to and reside. Our current work has been designed to address the multiple contributors to stroke outcomes and at the various stages of stroke care and recovery. Additionally, our current research has been designed to examine the biological, neurological and sociological factors that contribute to stroke-related outcomes both individually and collectively.

## Conclusion

Stroke is a condition that even in its mildest form can result in significant disability [31]. Worldwide, millions of individuals suffer from the devastating consequences of stroke. Additionally, many require long-term comprehensive care to address risk factor control and the impact of ongoing impairments resulting from stroke. To compound the problem, stroke survivors all differ in the severity of their post-stroke impairments and the functional impact of their residual deficits. A comprehensive and long-term management plan offers the best opportunity for these individuals to experience optimal outcomes and post-stroke life satisfaction. The roadmap outlined in this article offers a basic guide to address the comprehensive and long-term aspects of post-stroke recovery.

## Acknowledgement

This work is partially supported by an American Heart Association Strategically Focused Research Network Grant #15SFDRN25870000 awarded to the third author Gayenell Magwood, PhD, RN.

## References

1. Strong K, Mathers C, Bonita R (2007) Preventing stroke: saving lives around the world. *Lancet Neurol* 6: 182-187.
2. Thrift AG, Cadilhac DA, Thayabaranathan T, Howard G, Howard VJ, et al. (2014) Global stroke statistics. *Int J Stroke* 9: 6-18.
3. Kim AS, Cahill E, Cheng NT (2015) Global stroke belt: Geographic variation in stroke burden worldwide. *Stroke* 46: 3564-3570.
4. Mukherjee D, Patil CG (2011) Epidemiology and the global burden of stroke. *World Neurosurgery* 76: 585-590.
5. Jauch EC, Saver JL, Adams HP, Bruno A, Connors JJ, et al. (2013) Guidelines for the early management of patients with acute ischemic stroke: A guideline for healthcare professional from the American Heart Association/American Stroke Association. *Stroke* 44: 870-947.
6. Marler JR, Tilley BC, Lu M, Brott TG, Lyden PC, et al. (2000) Early stroke treatment associated with better outcome: The NINDS rt-PA stroke study. *Neurology* 55: 1649-1655.
7. Ghandehari K (2011) Barriers of thrombolysis therapy in developing countries. *Stroke Res Treat* 2011: 686797.
8. Hsia AW, Edwards DF, Morgenstern LB, Wing JJ, Brown NC, et al. (2011) Racial disparities in tissue plasminogen activator treatment rate for stroke: A population-based study. *Stroke* 42: 2217-2221.
9. National Institute of Neurological Disorders and Stroke (2016) Stroke rehabilitation information. NIH, USA.
10. Winstein CJ, Stein J, Arena R, Bates B, Cherney L, et al. (2016) Guidelines for adult stroke rehabilitation and recovery. A guideline for healthcare professional from the American Heart Association/American Stroke Association. *Stroke* 46: e98-e169.
11. Foley N, Teasell R, Bhogal S, Speechley M, Hussein N (2013) The efficacy of stroke rehabilitation. *Evidence-Based Review of Stroke Rehabilitation* (16th Edition). Heart and Stroke Foundation, Canada.
12. American Heart Association/American Stroke Association (2016) Primary stroke center certification overview sheet. Primary Stroke Center Certification, USA.
13. American Heart Association/American Stroke Association (2016) Comprehensive stroke center certification overview sheet. Comprehensive Stroke Center Certification, USA.
14. Cameron JI, Tsoi C, Marsella A (2008) Optimizing stroke systems of care by enhancing transitions across care environments. *Stroke* 39: 2637-2643.
15. Anderson S, Whitfield K (2011) An ecological approach to activity after stroke: It takes a community. *Top Stroke Rehabil* 18: 509-524.
16. Ostwald SK, Godwin KM, Cron SG (2009) Predictors of life satisfaction in stroke survivors and spousal caregivers twelve to twenty-four months post discharge from inpatient rehabilitation. *Rehabilitation Nursing* 34: 160-174.

17. Achten D, Visser-Meily JM, Post MW, Schepers VP (2012) Life satisfaction of couples 3 years after stroke. *Disabil Rehabil* 34: 1468-1472.
18. Howard VJ (2013) Reasons underlying racial differences in stroke incidence and mortality. *Stroke* 44: S126-128.
19. Ellis C, Boan AD, Turan TN, Ozark S, Bachman D, et al. (2015) Racial differences in poststroke rehabilitation utilization and functional outcomes. *Arch Phys Med Rehabil* 96: 84-90.
20. Ottenbacher KJ, Campbell J, Kuo YF, Deutsch A, Ostir GV, et al. (2008) Racial and ethnic differences in post-acute rehabilitation outcomes after stroke in the United States. *Stroke* 39: 1514-1519.
21. Ellis C, Hyacinth HI, Beckett J, Feng W, Chimowitz M, et al. (2014) Racial/ethnic differences in poststroke rehabilitation outcomes. *Stroke Research and Treatment* 14: 12.
22. Morgenstern LB, Kissela BM (2015) Stroke disparities: Large global problem that must be addressed. *Stroke* 46: 3560-3563.
23. Liao Y, Greenlund KJ, Croft JB, Keenan NL, Giles WH (2009) Factors explaining excess stroke prevalence in the US Stroke Belt. *Stroke* 40: 3336-3341.
24. El Khoury R, Jung R, Nanda A, Sila C, Abraham MG, et al. (2012) Overview of key factors in improving access to acute stroke care. *Neurology* 79: S26-34.
25. Hsia AW, Edwards DF, Morgenstern LB, Wing JJ, Brown NC, et al. (2011) Racial disparities in tissue plasminogen activator treatment rate for stroke: A population-based study. *Stroke* 42: 2217-2221.
26. Mullen MT, Judd S, Howard VJ, Kasner SE, Branas CC, et al. (2013) Disparities in evaluation at certified primary stroke centers: Reasons for geographic and racial differences in stroke. *Stroke* 44: 1930-1935.
27. Cruz-Flores S, Rabinstein A, Biller J, Eklind MSV, Griffith P, et al. (2011) Racial-ethnic disparities in stroke care: The American experience. A statement for healthcare professionals from the American Heart Association/American Stroke Association. *Stroke* 42: 2091-2116.
28. Frier A, Barnett F, Devine S (2016) The relationship between social determinants of health and rehabilitation of neurological conditions: A systematic review. *Disabil Rehabil* 22: 1-8.
29. World Health Organization (2016) Social determinants of health. WHO, USA.
30. Writing Group Members, Mozaffarian D, Benjamin EJ, Go AS, Arnett DK, et al. (2016) Heart disease and stroke statistics-2016 Update: A report from the American Heart Association. *Circulation* 133: e38-60.
31. Chang WH, Sohn MK, Lee J, Kim DY, Lee SG, et al. (2016) Long-term functional outcomes of patients with very mild stroke: Does a NIHSS score of 0 mean no disability? An interim analysis of the KOSCO study. *Disabil Rehabil*.