ECRONICON OPEN ACCESS

EC NEUROLOGY
Research Article

Changes in Risk Factors and Hospital Cost of Stroke Care Among California Elderly Over Four Years, 2007-2010

Baqar Husaini[1], Malcolm H Blake[2], Robert Levine[3] and Majaz Moonis[4]*

[1]*Tennessee State University, Tennessee, United States*

[2]*American University of the Caribbean; UMASS Medical Center, MA, USA*

[3]*Baylor College of Medicine, Texas, USA*

[4]*UMASS Medical Center, MA, USA*

***Corresponding Author:** Majaz Moonis, UMASS Medical Center, MA, USA.

Received: June 06, 2019; **Published:** July 11, 2019

Abstract

Objective: We examined variations in the prevalence of stroke, associated factors, and hospital costs among California elderly patients over the years 2007 to 2010 by race, ethnicity, and sex.

Methods: California Hospital Discharge Data Files (HDDS) for patients aged 65+ with a diagnosis of stroke (ICD9 codes 430 - 438) were examined in the year 2007 (n = 13,027); 2008 (n = 12,676); 2009 (n = 11,521) and 2010 (n = 7845). Mean age of the study population was about 80 years, females 56%. Data were segregated by sex, race and ethnicity across different sub-populations. Differences between Stroke and Non-Stroke patients as well as the prevalence of stroke and risk factors by race, ethnicity, and sex were evaluated.

Results: Stroke prevalence declined by 40% from 6.3% in 2007 to 4.5% in 2010. Further, during this period, prevalence was higher among females than males and was higher in blacks compared to other race/ethnic groups. Seven (7) established risk factors were consistently associated with stroke including: Depression (OR = 1.10 in 2007, OR = 1.10 in 2008, OR = 1.10 in 2009, and OR = 1.18 in 2010), hypertension (OR = 2.10, OR = 2.32, OR = 2.22, and OR = 1.51), diabetes mellitus (OR = 1.06, OR = 1.12, OR = 1.06 and OR = 1.19) hyperlipidemia (OR = 1.44, OR = 1.49, OR = 1.45, and OR = 1.19), coronary heart disease (OR = 1.06, OR = 1.11, OR = 1.10, and OR = 1.22), atrial fibrillation (OR = 1.57, OR = 1.59, OR = 1.57, and OR = 1.32) and dementia (OR = 1.96, OR = 1.75, OR = 2.02, and OR = 6.08). Obesity was related to stroke only in 2007 (OR = 1.73) and 2010 (OR = 1.43). The cost for stroke in 2007 was $44,327 for the first stroke discharge, which increased to $62,709, $69,512 and $73,878 in 2008, 2009, and 2010, while the total annual cost for stroke patients increased from $141,290 in 2007 to $178,030 in 2008, to $195,420 in 2009, and it decreased to $130,860 in 2010. The cost in all years was higher for males than females, higher for Asian/Pacific islanders (AP) in 2007, 2009, and 2010, and higher for Blacks in 2008.

Conclusions: Conclusions include: (1) stroke prevalence among hospitalized patients and the number of stroke admissions per year declined in California during 2007-2010; (2) decline in Hospital costs in 2010 was associated with shorter length of hospitalization from 23 days in 2007 to 16 days in 2010; (3). Seven traditional risk factors were consistently associated with stroke across all four years.

Keywords: *Stroke Risk Factors; Stroke Prevalence; Race; Ethnicity; Sex; Hospital Costs*

Introduction

More than 795,000 adults experience strokes each year and nearly 88% of strokes are classified as Ischemic strokes (IS) which affect both males and females, with an estimated healthcare cost of $34 billion per year. Stroke prevalence varies according to age and sex, and in general, stroke prevalence is higher among older individuals, among females, and those from certain minority groups [1-11].

Risk factors

Previous studies such as the Northern Manhattan Study (NOMAS) [1] and the Framingham Heart Study (FHS) [2] have pointed to various risk factors associated with stroke that include hypertension (HTN) [11-13], diabetes mellitus (DM) [11,14], hyperlipidemia (HDL) [15], atrial fibrillation (Afib) [11,16], chronic kidney disease (CKD) [17-19], sleep apnea [20], dementia [11,21,22] and depression[23,24]. While we examine these traditional risk factors, what remains unknown is the variation in risk factors by race, ethnicity and sex, and hospital costs of elderly (aged 65 +) stroke patients. Thus in this examination of California stroke patients, we examine three stroke related issues by race, ethnicity and sex: (1) variations in stroke prevalence over four years; (2) variations in stroke risk factors; and (3) variations in Hospital Costs of Stroke patients over four years (2007 - 2010).

Sample characteristics

We obtained 2007 - 2010 Hospital Discharge Data (HDDS) from the California Office of Statewide Health Planning and Development (OSHPD) on patients aged 65+ years. From this cohort, we selected patients with a primary diagnosis of stroke (ICD9 codes 430 - 438, mean age 80, females 56%; stroke sample included in 2007 (n = 13,027); in 2008 (n = 12,676); in 2009 (n = 11,521); and in 2010 (n = 7845) along with their demographics (age, sex), comorbidities, number of admissions, length of stay (days), and charges (cost USD $) for each discharge.

For each patient, two indices of co-morbidities were computed: (i) a simple count of all secondary diagnoses (co-morbidities) that were identified by ICD-9-CM codes; and (ii) Charlson Index [25] of severity of co-morbidity. Further, two measures of cost were developed: (1) cost for 1st stroke discharge, and (2) total cost for the same patient that included the cost for 1st stroke discharge plus the cost for other discharges with different diagnoses during the year.

Statistical analysis: Differences between Stroke and Non-Stroke patients as well as the prevalence of stroke and risk factors by race, ethnicity, and sex, were all evaluated with logistic regression models, Pearson X^2 and the Fisher's Exact Tests. Cost differences between groups were evaluated with ANOVA.

Results

Stroke Prevalence

Stroke prevalence seemingly declined over the study period from 6.3% to 4.5%. As supported by previous studies, the prevalence was higher among females and blacks compared to other groups [4,5]. Moreover, Table 1 shows a decline in stroke admission from 13,027 admissions in 2007 to 7,845 stroke admissions in 2010 (a decline of 40% over four years). Similar decline was noted in Stroke rate per 100,000 population which declined from 235 per 100,000 population in 2007 to 201 in 2010.

Risk factors related to stroke

While 7 of 12 risk factors (HTN, DM, HDL, CHD, AFib, Depression, and Dementia), were consistently associated with strokes in each of 2007, 2008, 2009, and 2010 (See Table 1), obesity was associated with stroke only in 2007 and 2010. Further, there was little variation in stroke risk factors by race, ethnicity or sex as shown in Table 1 below. Chronic kidney disease was not related to stroke in a statistically significant manner.

	2007		2008		2009		2010	
N=→	13027	--	12676	--	11521	--	7845	
Col→→	1	2	3	4	5	6	7	8
Mean age	80.6		80.3		80.9		81.2	
Female %	56.6		57.0		57.2		55.1	
Stroke %	6.3	-----	6.3	----	6.2	-----	4.5	-----
Rate/100	235	----	218	----	200	----	201	----
	OR	CI	OR	CI	OR	CI	OR	CI
DEP %	1.10*	1.04 - 1.16	1.10*	1.04 - 1.07	1.10*	1.0 - 1.1	1.18*	1.14 - .57
HTN %	2.30*	2.10 - 2.51	2.32*	2.12 - 2.55	2.22*	2.0 - 2.4	1.51*	1.45 - 1.57
DM %	1.06+	1.00 - 1.11	1.12*	1.06 - 1.18	1.06	.97 - 108	1.19*	1.16 - 1.23
HDL %	1.44*	1.35 - 1.53	1.49*	1.39 - 1.59	1.45*	134 - 154	1.19*	1.14 - 1.24
CHD %	1.06+	1.00 - 1.11	1.11*	1.05 - 1.16	1.10*	104 - 116	1.22*	1.18 - 1.25
HF %	.50	.47 - .54	.49	.46 - .53	.51	47 - 55	.69	.67 - .72
MI %	.79	.73 - .87	.74	.68 - .80	.78	71 - 85	1.09	1.05 - 1.14
AFIB %	1.57*	1.50 - 1.65	1.59*	1.51 - 1.68	1.57*	151 - 167	1.32*	1.28 - 1.35
CKD %	.87	.82 - .92	.91	.87 - .96	.88	83 - 93	1.08	1.05 - 1.11
COPD %	.80	.76 - .85	.75	.71 - .79	.72	.67 - 76	.82	.85 - .91
Obese %	1.73*	1.28 - 2.33	1.07	.76 - 1.49	1.10	.84 - 1.60	1.43*	1.19 - 1.72
Dement %	1.96*	1.79 - 2.14	1.75*	1.59 - 1.92	2.02*	1.84 - 2.28	6.08*	5.8 - 6.4

Ethnicity	2007	2008	2009	2010
White	HTN, DM, HDL, CHD, AFIB, DEP, DEMENT	HTN, DM, HDL, CHD, AFIB, DEP, DEMENT	HTN, DM, HDL, CHD, AFIB, DEP, DEMENT	HTN, DM, HDL, CHD, AFIB, DEMENT
Black	HTN, HDL, AFIB, DEP, DEMENT	HTN, HDL, CHD, AFIB, DEMENT	HTN, HDL, AFIB, DEMENT	HTN, HDL, AFIB, OBES, DEMENTIA
Hispanic	HTN, DM, HDL, AFIB, OBSES, DEP, DEMENT	HTN, DM.HDL, AFIB, DEP, DEMENT	HTN, HDL, CHD, OBSES, DEP, DEMENT	HTN, HDL, CHD, AFIB, ^{O}BSES, DEMENTIA
Asian/Pacific Islander	HTN, HDL, AFIB, OBES, DEP, DEMENT	HTN, HDL, CHD, AFIB, OBES, DEMENT	HTN, HDL, AFIB, DEP, DEMENT	HTN, HDL, AFIB, DEP, DEMENTIA
Sex				
Male	HTN, DM, HDL, CHD, AFIB. OBES, DEP, DEMENT	HTN, DM, HDL, CHD, AFIB, OBES, DEP, DEMENT	HTN, DM, HDL, CHD, AFIB, OBES, DEP, DEMENT	HTN, HDL, CHD, AFIB, DEP, DEMENT
Female	HTN, DM, HDL, CHD, AFIB, OBES, DEP, DEMENT	HTN, DM, HDL, CHD, AFIB, OBES, DEP, DEMENT	HTN, DM, HDL, CHD, AFIB, OBES, DEP, DEMENT	HTN, DM, HDL, CHD, AFIB, OBES, DEP, DEMENT

Table 1: *Stroke and Risk Factors Among California Elderly Patients Over 2007 – 2010.*

Significant Odds Ratios (p < .001) of Factors Associated with Stroke By Ethnicity And Sex, 2007 - 2010).

*OR: Odds Ratios; CI: 95% Confidence Interval; + & * Values Are Significant At p <. 01 and p <. 001 Respectively; Allpstrk: Stroke As Primary Diagnosis; Dep: Depression; HTN: Hypertension; DM: Diabetes Mellitus; HDL: Hyperlipidemia; CHD: Coronary Heart Disease; HF: Heart Failure; MI: Myocardial Infarction; Afib: Atrial Fibrillation; CKD: Chronic Kidney Disease; COPD: Chronic Obstructive Pulmonary Disease; Obese: Obesity; Dement: Dementia.*

Stroke hospital costs

Three notable results emerged from the hospital cost analyses: (1) Total stroke costs for the year declined by 7% from $141,290 in 2007 to $130,860 in 2010 (Table 2). The higher costs during 2007- 2009 were largely due to longer hospitalization (23.2 days in 2007, 21.9 days in 2008, 21.2 in 2009) compared to fewer days in 2010 (16.0 days); (2) Hospital costs varied by race and sex in that cost for Asian Pacific Islanders (AP) were significantly higher (p .01) each year compared to other racial and ethnic groups. Similarly, the costs for male stroke patients were higher each year compared to females (See bottom of table 2); and (3) More than 50% of the total hospital costs in 2010 were from the cost of 1st stroke hospitalization ($73,878 of $130,860).

	2007		2008		2009		2010	
Cost Factors	**Non- Strk**	**All Strk**	**Non- Strk**	**All Strk**	**Non- Strk**	**All Strk**	**Non- Strk**	**All Strk**
Col→	1	2	3	4	5	6	7	8
#Comorb	4.2	4.44	4.3	4.6*	4.5	4.7*	3.8	3.8
Charlson	3.2	4.1	3.5	4.3*	3.6	4.5*	3.7	3.9
# Adm	2.1	2.7	2,1	2.7*	2,1	2.7*	1.6	1.9*
LOS	15.7	23.2	16.3	21.9*	15.9	21.2*	12.4	16.0*
1st Stroke $	------	44,357	-------	62,709	--------	69,512	--------	73,878
Total Cost $	124,450	141,290*	156,840	178,010*	173,030	195420*	128,130	130,860*

Ethnic Grp	**2007**	**2008**	**2009**	**2010**
Total	141,290	178,010	195,420	130,860
White	128,350	162,410	178,990	120,180
Black	164,140	226,050*	226,620	130,700
Hispanic	157.040	192,800	213,800	145,390
AP	190,060*	218,690	256,430*	187,500*
Sex				
Male	147,580*	188,080*	209,880*	137,060*
Female	136,460	170,620	184,860	125,820

Table 2: *Hospital Cost Factors of California Elderly Stroke Patients, 2007-2010.*

Hospital Cost by Race/Ethnicity And Sex, 2007-2010.

**Differences Are Significant at P < .001'# Comorb= Number of Comorbidities; Charlson: Charlson Index of Comorbidity Severity; # Adm: Number of Hospital Admissions; LOS: Length of Hospital Stay; 1st Stroke $: Cost For 1st Stroke Admission; Total Cost $: Total Stroke Cost for The Year.*

Discussion

Our findings are relevant from multiple perspectives: First, we found that the stroke prevalence declined from 6.3% in 2007 to 4.5% in 2010, which is consistent with the previously seen nationwide pattern of decreasing stroke rates from 1988 on [26,27]. The greater occurrence of stroke amongst blacks and women is consistent with other large observational studies [27-31].

Several hypotheses may be generated by these data. We found that obesity was only a significant risk factor for strokes in our patient population as a whole in 2007 and 2010. While obesity is a known risk factor for stroke independent of race and sex [28-31], we saw

that obesity was a risk factor for Hispanics in 2007, 2009, and 2010, among AP in 2007 and 2008, and among blacks in 2010. This may be related to disparities in access to health care and preventive health campaigns [32-35]. Alternatively, since most stroke deaths occur prior to hospitalization [36], variations in these and other results in the present data could reflect changes in pre-hospital circumstances over time.

The decline in stroke prevalence in patients discharged from California hospitals from 2007-2010 may also be related to cumulative effects of better recognition of stroke and preventive measures including blood pressure control [37-40]. increasing use of cholesterol controlling pharmaceuticals (statins) [41-45], treating AFib before stroke onset [46], a greater focus on exercise, fitness, and other nonpharmaceutical factors [47,48]. Using data from the National Health Survey, Gu and Colleagues [42]reported that statin prescriptions among people aged 40 and over increased from 18.9% to 23.2% from 2007 - 2011. Since the effects of statins on reducing the risk of CVD, including stroke, has been reported in several studies [43-45], it is plausible that the change in our sample (stroke prevalence declined from 6.5% to 4.5%), is may, in part, be due to the increased use of statins. Since data on statin use among our patients is not available, this issue requires further examination.

While most risk factors for stroke were consistent between 2007 and 2010, odds ratios of HTN, HDL, and Afib decreased, while the odds ratios for DM, CHD, and Dementia increased. The increase in odds ratio of dementia, from 1.96 to 6.08, may be partially explained by a change in the definition and diagnosis of Alzheimer's Disease. The International Working Group introduced the framework for new criteria for Alzheimer's Disease in 2007, with a position paper in 2010 [49-51]. Combined with increases in the rate of dementia diagnosis [52], this large increase in odds ratio may reflect, in part a shift in how dementia was recognized more than an increase in dementia in stroke patients. In our analysis, dementia included all sub-types and Alzheimer (AD). There was no need to separate Alzheimer as a separate category since its effect were reported separately [70].

We also found that the cost for the first stroke discharge increased from $44,357 in 2007 to $73,878 in 2010. At the same time, the Total annual Cost initially increased from $141,290 in 2007 to $195,420 in 2009 before falling to $130,860 in 2010 (Table 2). The length of stay (LOS) also decreased from 23.2 days in 2007 to 16.0 days in 2010. Several potential explanations for these changes are offered including that Food and Drug Administration (FDA) approved in 2010 the use of Dabigatran for the prevention of stroke in patients with Afib [53,54], which reduced costs for patients (aged 65 + years old) with prescription drug coverage. Another change in management that may have had an effect on the cost and length of stay (LOS) was the impact of the 2010 American Heart Association (AHA) guideline update [55-57] emphasizing the time sensitive nature of stroke recovery. Further, other factors that may also contribute to lower cost include Get With the Guidelines program [55-57], an AHA nationwide stroke initiative, better systems of stroke care evolved with emphasis on early recognition [57,58], early treatment with intravenous thrombolytics [54-59], or mechanical thrombectomy [60,61], stress on initiating high dose statins at stroke onset [62-65]and addressing underlying etiologies as soon as possible such as an anticoagulation for patients with atrial fibrillation [66-69]. Finally, combined with an emphasis on overhauling the systems behind hospital stroke treatment [69], these administrative changes could be a reason for the change in both cost and length of stay (LOS) for stroke patients. The decrease in LOS is itself a major cause of the reduction in cost. It is well established that a longer LOS is associated with higher costs [66-69] and that lowering the time spent in the hospital directly decreases patient expenses [69].

Data Limitations

The HDDS files do not provide patient clinical data regarding the treatment type or out of hospital treatments, including pharmaceuticals and associated costs. These administrative files further do not contain the marital status, educational level, or annual income of the patients. Moreover, hospital discharge data do not provide information on pre-hospital stroke mortality. Despite these limitations, the current

findings are relevant both as a guide for developing analytic epidemiologic studies to test hypotheses generated by these descriptive data.

Conclusions

Several conclusions can be drawn from these findings: (1) both stroke prevalence per 100,000 population and the number of stroke discharges per year declined from 2007 to 2010 in California; (2) the observed decline in hospital costs in 2010 was associated with shorter length of hospitalization; and (3) the consistent association of traditional risk factors across all four years by race, ethnic and sex groupings may reflect the abiding importance of these factors and the importance of healthcare awareness and/or specific intervention strategies. The results however do warrant population-based epidemiologic research to confirm or deny the many hypotheses generated by these data. Such studies should include both pre- and post-hospital occurrences of stroke.

Acknowledgement

Bibliography

1. Boden-Albala B., *et al*. "Metabolic Syndrome and Ischemic Stroke Risk Northern Manhattan Study (NOMAS)". *Stroke* 39.1 (2008): 30-35.

2. Dawber TR., *et al*. "Coronary heart disease in the Framingham Study (FHS)". *American Journal of Public Health* 47 (1957): 4-24.

3. Benjamin EJ., *et al*. "Heart disease and stroke statistics- 2017 update, a report from the American heart association". *Circulation* 135 (2017): e146-e603.

4. Rojas JI., *et al*. "Acute ischemic stroke and transient ischemic attack in the very old-risk factor profile and stroke subtype between patients older than 80 years and patients aged less than 80 years". *European Journal of Neurology* 14.8 (2007): 895-899.

5. Reeves MJ., *et al*. "Sex differences in stroke: epidemiology, clinical presentation, medical care, and outcomes". *The Lancet Neurology* 7.10 (2008): 915-926.

6. Glader EL., *et al*. "Sex differences in management and outcome after stroke: a Swedish national perspective". *Stroke* 34.8 (2003):1970-1975.

7. Appelros P., *et al*. "Sex differences in stroke epidemiology: a systematic review". *Stroke* 40.4 (2009): 1082-1090.

8. Sacco RL., *et al*. "Race-ethnic disparities in the impact of stroke risk factors: the Northern Manhattan stroke study". *Stroke* 32.8 (2001): 1725-1731.

9. Jiménez MC., *et al*. "Racial Variation in Stroke Risk among Women by Stroke Risk Factors". *Stroke* 50.4 (2019): 797-804.

10. Dong C., *et al*. "Ideal cardiovascular health predicts lower risks of myocardial infarction, stroke, and vascular death across Whites, Blacks, and Hispanics: The Northern Manhattan study". *Circulation* 125.24 (2012): 2975-2984.

11. Husaini BA., *et al*. "Ischemic stroke, risk factors, and hospitalization costs: variation by age and gender in California". *EC Neurology* 10.11 (2018).

12. Dong C., *et al*. "Evidence to maintain the systolic blood pressure at 140 mmHg for stroke prevention (NOMAS)". *Hypertension* 67.3 (2016): 520-526.

13. Kannel WB., *et al*. "Epidemiologic assessment of the role of blood pressure in stroke: the Framingham Study 1970". *Journal of the American Medical Association* 276.15 (1996): 1269-1278.

14. Brand FN., *et al*. "Diabetes, intermittent claudication, and risk of cardiovascular events. The Framingham study". *Diabetes* 38.4 (1989): 504-509.

15. Pikula A., *et al*. "Lipid and lipoprotein measurements and the risk of ischemic vascular events: Framingham study". *Neurology* 84.5 (2015): 472-479.

16. Wolf PA., *et al*. "Atrial fibrillation as an independent risk factor for stroke: the Framingham Study". *Stroke* 22.8 (1991): 983-988.

17. Parikh NI., *et al*. "Chronic kidney disease as a predictor of cardiovascular disease (from the Framingham Heart Study)". *American Journal of Cardiology* 102.1 (2008): 47-53.

18. Khatri M., *et al*. "Chronic kidney disease is associated with white matter hyperintensity volume: the Northern Manhattan Study (NOMAS)". *Stroke* 38.12 (2007): 3121-3126.

19. Chen YC., *et al*. "Chronic kidney disease itself is a causal risk factor for stroke beyond traditional cardiovascular risk factors: a nationwide cohort study in Taiwan". *PLoS ONE* 7.4 (2012): e36332.

20. Moonis M and Husaini B. "Do Co-Morbid Sleep Apnea and Stroke Affect Healthcare Costs? An Analysis of 12,106 Elderly Patients". *EC Neurology* 10.12 (2018): 1039-1044.

21. Kannel WB., *et al*. "Vascular Disease of the Brain--Epidemiologic Aspects: the Framingham Study". *American Journal of Public Health and the Nation's Health* 55.9 (1965): 1355-1366.

22. Seshadri S., *et al*. "Stroke risk profile, brain volume, and cognitive function: the Framingham Offspring Study". *Neurology* 63.9 (2004): 1591-1599.

23. Zahodyne LB., *et al*. "Comparing variability, severity, and persistence of depressive symptoms as predictors of future stroke risk". *The American Journal of Geriatric Psychiatry* 25.2 (2017): 120-128.

24. Glymour MM., *et al*. "Elevated depressive symptoms and incident stroke in Hispanic, African-American, and White older Americans". *Journal of Behavioral Medicine* 35.2 (2012): 211-220.

25. Charlson ME., *et al*. "A new method of classifying prognostic comorbidity in longitudinal studies: development and validation". *Journal of Chronic Diseases* 40.5 (1987): 373-383.

26. Fang MC., *et al*. "Trends in stroke rates, risk, and outcomes in the United States, 1988 to 2008". *The American Journal of Medicine* 127.7 (2014): 608-615.

27. Koton S., *et al*. "Declining Rate and Severity of Hospitalized Stroke From 2004 to 2013, The National Acute Stroke Israeli Registry". *Stroke* 49.6 (2018): 1348-1354.

28. Girijala RL., *et al*. "Sex differences in stroke: review of current knowledge and evidence". *Vascular Medicine* 22.2 (2017):135-145.

29. Howard G., *et al*. "Ethnic differences in stroke mortality between non-Hispanic whites, Hispanic whites, and blacks. The National Longitudinal Mortality Study". *Stroke* 25.11 (1994): 2120-2125.

30. Strazzullo P., *et al*. "Excess body weight and incidence of stroke: meta-analysis of prospective studies with 2 million participants". *Stroke* 41.5 (2010): e418-e426.

31. Yatsuya H., *et al*. "Race- and sex-specific associations of obesity measures with ischemic stroke incidence in the Atherosclerosis Risk in Communities (ARIC) study". *Stroke* 41.3 (2010): 417-425.

32. Soto GJ., *et al*. "Healthcare disparities in critical illness". *Critical Care Medicine* 41.12 (2013): 2784-2793.

33. Stansbury JP., *et al*. "Ethnic disparities in stroke: Epidemiology, acute care, and postacute outcomes". *Stroke* 36.2 (2005): 374-386.

34. Mueller M., *et al*. "Reducing Racial and Ethnic Disparities in Hypertension Prevention and Control: What Will It Take to Translate Research into Practice and Policy?" *American Journal of Hypertension* 28.6 (2015): 699-716.

35. Willey JZ., *et al*. "Social determinants of physical inactivity in the Northern Manhattan study (NOMAS)". *Journal of Community Health* 35.6 (2010): 602-608.

36. US Centers for Disease Control and Prevention. "Place of death after stroke--United States, 1999-2002". *Morbidity and Mortality Weekly Report (MMWR)* 55.19 (2006): 529-532.

37. Moser DK., *et al*. "Reducing delay in seeking treatment by patients with acute coronary syndrome and stroke: a scientific statement from the American Heart Association Council on cardiovascular nursing and stroke council". *Circulation* 114.2 (2006): 168-182.

38. Howard G., *et al*. "Is blood pressure control for stroke prevention the correct goal? The lost opportunity of preventing hypertension". *Stroke* 46.6 (2015):1595-1600.

39. Lawlor DA., *et al*. "Survival with Treated and Well-Controlled Blood Pressure: Findings from a Prospective Cohort Study". *PLOS ONE* 6.4 (2011): e17792.

40. Ford ES., *et al*. "Trends in hypercholesterolemia, treatment and control among United States adults". *International Journal of Cardiology* 140.2 (2010): 226 - 235.

41. Holbrook A., *et al*. "Evidence-based management of anticoagulant therapy: Antithrombotic therapy and prevention of thrombosis, 9th ed: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines". *Chest* 141.2-1 (2012): e152S-e184S.

42. Gu Q., *et al*. "Prescription cholesterol-lowering medication use in adults aged 40 and over: Unites States, 2003-2012". *National Center for Health Statistics Data Brief* 177 (2014): 1-8.

43. Mihaylova B., *et al*. "The effects of lowering LDL cholesterol with statin therapy in people at low risk of vascular disease: Meta-analysis of individual data from 27 randomized trials". *Lancet* 380.9841 (2012): 581-590.

44. Taylor F., *et al*. "Statins for the primary prevention of cardiovascular disease. Cochrane Database". *Systematic Reviews* 1 (2011): CD004816.

45. Wang X., *et al*. "Cholesterol level and risk of hemorrhagic stroke". *Stroke* 44.7 (2013): 1833-1839.

46. Bassand JP. "Review of atrial fibrillation outcome trials of oral anticoagulant and antiplatelet agents". *Europace* 14.3 (2012): 312-324.

47. Sacco RL., *et al*. "Improving global vascular risk prediction with behavioral and anthropometric factors. The multiethnic NOMAS (Northern Manhattan Cohort Study)". *Journal of the American College of Cardiology* 54.24 (2009): 2303-2311.

48. Stoller O., *et al*. "Effects of cardiovascular exercise early after stroke: Systematic review and meta-analysis". *BMC Neurology* 12 (2012): 45.

49. Dubois B., *et al*. "Research criteria for the diagnosis of Alzheimer's disease: revising the NINCDS-ADRDA criteria". *Lancet Neurology* 6.8 (2007): 734-746.

50. Dubois B., *et al*. "Revising the definition of Alzheimer's disease: A new lexicon". *Lancet Neurology* 9.11 (2010): 1118-1127.

51. Mukadam N., *et al*. "Diagnostic rates and treatment of dementia before and after launch of a national dementia policy: an observational study using English national databases". *BMJ Open* 4.1 (2014): e004119.

52. Jauch EC., *et al*. "Part 11: adult stroke: 2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care". *Circulation* 122.18-3 (2010): S818-S828.

53. Nor AM., *et al*. "The recognition of Stroke in the emergency room (ROSIER) scale: development and validation of a stroke recognition instrument". *Lancet Neurology* 4.11 (2005): 727-374.

54. Padma V., *et al*. "Thrombolytic therapy for acute ischemic stroke: 3 h and beyond". *Expert Review of Neurotherapeutics* 5.2 (2005): 223-233.

55. Ormseth CH., *et al*. "The American Heart Association's Get With The Guidelines (GWTG)-Stroke development and impact on stroke care". *Stroke and Vascular Neurology* 2.2 (2017): 94-105.

56. Song S., *et al*. "Association of Get with The Guidelines-Stroke program participation and clinical outcomes for Medicare beneficiaries with ischemic stroke". *Stroke* 47.5 (2016): 1294-1302.

57. Schwamm LH., *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* 119.1 (2009): 107-115.

58. Henninger N., *et al*. "Use of telemedicine to increase thrombolysis and advance care in acute ischemic stroke". *Cerebrovascular Diseases* 27.4 (2009): 9-14.

59. Mehdiratta M., *et al*. "Reduction in IV t-PA door to needle times using an Acute Stroke Triage Pathway". *Canadian Journal of Neurological Sciences* 33.2 (2006): 214-216.

60. Singh J and Nguyen TN. "Endovascular and neurosurgical management of acute ischemic stroke". *Emergency Medicine Clinics of North America* 30.3 (2012): 695-712.

61. Adamczyk P., *et al*. "Mechanical thrombectomy in acute stroke: utilization variances and impact of procedural volume on inpatient mortality". *Journal of Stroke and Cerebrovascular Diseases* 22.8 (2013):1263-1269.

62. Moonis M and Fisher M. "HMG CoA reductase inhibitors (statins): use in stroke prevention and outcome after stroke". *Expert Review of Neurotherapeutics* 4.2 (2004): 241-247.

63. Moonis M. "High-dose statins should be used in all acute ischemic strokes". *Stroke* 43.7 (2012): 1992-1993.

64. Moonis M., *et al*. "HMG-coA reductase inhibitors improve acute ischemic stroke outcome". *Stroke* 36.6 (2005): 1298-1300.

65. Ali A., *et al*. "Stroke prevention with oral anticoagulation in older people with atrial fibrillation—a pragmatic approach". *Aging and disease* 3.4 (2012): 339-351.

66. Diringer MN., *et al*. "Predictors of acute hospital costs for treatment of ischemic stroke in an academic center". *Stroke* 30.4 (1999):724-728.

67. Kwatra G., *et al*. "Cost of stroke from a tertiary center in northwest India". *Neurol India* 61.6 (2013): 627-632.

68. Huang YC., *et al*. "The impact factors on the cost and length of stay among acute ischemic stroke". *Journal of Stroke and Cerebrovascular Diseases* 22.7 (2013): e152-e158.

69. Machlin SR and Carper K. "Expenses for Inpatient Hospital Stays. Statistical Brief #164". Rockville, Md: Agency for Healthcare Research (2004).

70. Husaini BA., et al. "Changes in Alzheimer Disease, Associated Factors, and Hospital Cost among Elderly Patients in 2007 and 2010". EC Neurology 11.6 (2019): 368-375.

Volume 11 Issue 8 August 2019