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Research Article

Sleep Apnea and Depression Effects on Hospital Costs of Elderly: Examining Variations by Ethnicity and Gender

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Abstract

Objectives: We examine the prevalence of sleep apnea (SAP) with and without co-morbid depression and its effects on hospital costs among elderly patients by ethnicity and gender.

Methods: Data on discharged patients from 2010 California hospital discharge data system (HDDS) were examined for a diagnosis of SAP (ICD-9 code 327) along with the demographics, co-morbidities, and hospital costs. Hospital costs of SAP patients (n = 12,106; mean age 76, SD = 7.4) were examined for whites, blacks, Hispanics, and Asians/Pacific Islanders (AP) by comparing first SAP patients vs. non-SAP, and then SAP patients with depression (SAP+D) versus SAP patients without depression (SAP^{ND}).

Results: Prevalence of SAP was higher ($p < 0.001$) among blacks compared to Hispanics, AP and whites, and higher among males than females. One-quarter of SAP patients had depression (higher among females and whites compared to males and other ethnic groups). Further, the hospital cost for SAP was 27% higher compared to Non-SAP patients ($164,950 vs. $125,520, and the costs for SAP^{+D} was additionally 28% higher compared to SAP^{ND} ($202,890 vs. $152,640). These higher SAP^{+D} cost prevailed across all gender and ethnic groups and was associated with higher co-morbidities, more admissions, and longer hospitalization.

Conclusion: SAP and depression were related to gender and ethnicity, and both were associated with higher hospital costs. The higher SAP^{+D} costs among females may reflect the additional burden of such co-morbidities as depression, hypertension and diabetes. Prospective studies are warranted to assess if screening and treating SAP and depression could reduce hospital costs among the elderly.

Keywords: *Sleep Apnea; Depression; Anxiety; Hospital Cost; Ethnicity; Gender*

Statement of Significance

Hospital costs in a year are primarily affected by number of admissions, severity of medical conditions (as measured by Charlson Index [1]), procedures performed, and length of stay (in days). We know very little about the association of sleep apnea and hospital costs among the elderly. From a health policy perspective, knowledge about the prevalence of sleep apnea by race, ethnicity and gender is valuable for better management and prevention in terms of three related issues: (i) public health – the prevalence of sleep apnea and depression among hospitalized elderly is useful for public health planning; (ii) risk estimation - systematic variation in the occurrence of sleep apnea across racial and ethnic groups may ultimately help to identify opportunities for prevention; and (iii) health care costs - realization of preventive opportunities for prevention may help reduce healthcare costs as measured, in part, by continued surveillance of hospitalized elderly. California has a large racially and ethnically diverse elderly population, which provides an appropriate setting to develop a better understanding of sleep apnea management and related conditions. Together with data from other sources, the totality of evidence is potentially useful for state policy development and promoting population health.

Introduction

Sleep apnea (SAP) and sleep disturbance or short sleep (< 6 hours of sleep) is reported to be a growing problem affecting about 15% of American adults [2,3]. SAP is reported to be higher among males than females [2,3], higher among blacks than whites [4,5], and higher among persons in lower socio-economic groups [6,7]. SAP impacts cardiovascular disease as it is related to hypertension [8,9], diabetes [10,11], lipid dysfunction [12], coronary heart disease [13], heart attack [14], heart failure [15,23], stroke [16,17], depression [18,19], metabolic syndrome including obesity [20], and mortality [21].

While some of the correlates of SAP have been examined, what remains unknown is its effect on hospital cost, particularly when depression is a co-morbid condition. This analysis, therefore, focuses on the prevalence of SAP and depression and their combined effects on hospital cost among elderly patients by ethnicity and gender.

Methods

Sample Characteristics

We examined 2010 California Hospital Discharge Data (HDDS, obtained from the California's Office of Statewide Health Planning and Development, OSHPD) on elderly patients (aged 65+; n = 174,311). From this cohort, we selected patients (n = 12,106) who had a diagnosis of SAP (ICD-9 codes 327, primary and secondary diagnosis combined) along with their demographics, diagnoses of depression and anxiety along with other co-morbidities, number of admissions, length of stay, and charges (total cost for 2010$) for each discharge.

Sample Characteristics

HDDS files provide patients' basic demographics along with ICD-9 diagnostic codes (both primary and secondary) for each hospital discharge. Only the attending physicians give diagnoses. Since 48% to 91% of symptoms overlap between depression and anxiety [24,25], we combined them as a single variable (depression) for our analyses. These files provide neither clinical data pertaining to severity of clinical condition, various tests performed, test results, nor medications administered.

Two indices of co-morbidities were computed: (i) a simple count of all secondary diagnoses that were identified by ICD-9-CM codes for each patient, and (ii) Charlson Index of severity of co-morbidities [1] for each patient. Further, a single measure of cost for the year 2010 (Total Cost $) was used which included the cost for SAP discharge plus the cost for the same SAP patient when he/she was discharged with any other diagnoses.

Statistical analysis: Differences between SAP and Non-SAP patients as well as the prevalence of SAP, risk factors by ethnicity and sex, were all evaluated with the Pearson $\chi 2$ and the Fisher's Exact Tests. Cost differences between groups were evaluated with ANOVA.

Results

The SAP sample (n = 12,106, mean age of 75.7 years with a SD=7.3 years) had more males than females (60% vs. 40% respectively). The sample included African Americans (blacks; 9.0%), Hispanics (15.3%), Asian/Pacific Islanders (AP; 4.0%), and whites (71.7%). Age distribution varied by ethnicity whereby white and Asian/Pacific Islander patients were slightly older (76 years respectively; $p < 0.01$) followed by Hispanics (75 years), and blacks (73 years).

Prevalence of SAP and Depression by Ethnicity and Gender

Table 1 shows that overall 6.9% of patients had sleep apnea (SAP) and that SAP was higher ($p < 0.001$) among blacks (8.0%) compared to whites (7.4%), Hispanics (6.5), and Asian/Pacific Islanders (AP; 3.3%). Similarly, males had higher SAP than females (9.1% vs. 5.2%, $p < 0.001$). Further, depression was more prevalent among SAP than non-SAP patients (25% vs. 18%, $p < 0.001$, Cols. 1 and 2). Further, among SAP, depression was also higher among women than men (32% vs. 20%, $p < 0.001$, cols. 9 and 10) and higher ($p < 0.001$) among whites (26%) than other groups including Hispanics (23%), blacks (19%), and Asian/Pacific Islanders (14%, cols. 5-8)

Variable	All Non-SAP Cases	All SAP age	OR	95% CI	Sleep Apnea Patients					
					Black	Hispanic	White	AP	Males	Females
N →	162,205	12,106			1,093	1,853	8,674	486	7,245	4,861
Column #	1	2	3	4	5	6	7	8	9	10
Age	81	76	---	---	73	75	76	76	76	76
SAP %	--	6.9	--	--	8.0	6.5	7.4	3.3	9.1	5.2
Mean # Comorb	3.7	4.3*	---	---	4.3	4.4	4.3	4.5	4.3	4.3
DEP %	18	25*	1.35*	1.29 - 1.41	19	23	26*	14	20	32*
HTN %	83	89*	1.28*	1.21 - 1.36	96*	91	87	93	88	90*
DM %	41	61*	2.14*	2.1 - 2.22	66	74*	56	68	58	61*
Chol %	9	12	1.14*	1.01 - 1.21	12	13	11	13	12	12
CHD %	58	61*	1.03	0.98 - 1.07	62	54	59	68*	67*	53
HF%	25	31*	1.09*	1.04 - 1.14	40*	34	29	34	30	32
MI %	12	9	0.66	0.62 - 0.70	9	10	9	14	9	9
AFib %	55	60*	1.25*	1.20 - 1.30	53	52	64*	61	64*	55
Stroke %	16	14	0.80	0.76 - 0.85	16	13	13	18*	14	13
CKD %	42	51*	1.18*	1.13 - 1.22	60	54	49	64*	53*	48
COPD %	32	48*	1.87*	0.80 - 1.91	48	47	49*	39	47	50*
Obese %	0.4	0.7*	1.55*	1.22 - 1.96	1.0	0.8	0.6	0.8	0.6	0.6

Table 1: *Sleep Apnea (SAP) and Clinical Characteristics of Elderly SAP Patients (Aged 65+) By Ethnicity and Gender. *: Differences between two adjacent columns (e.g., 1 vs. 2) are significant at $p < 0.001$; SAP AP: Sleep apnea in Asians/Pacific Islanders; Mean #Cormob: Average number of comorbidities; Dep: Depression; HTN: Hypertension; DM: Diabetes Mellitus; Chol: High Cholesterol; CHD: Coronary Heart Disease; HF: Heart Failure; MI: Myocardial Infarction; AFib: Atrial Fibrillation; CKD: Chronic Kidney Disease; COPD: Chronic Obstructive Pulmonary Disease.*

Correlates of SAP

Table 1 (cols. 3-4) also shows that SAP patients, on an average, had more co-morbidities than non-SAP patients (4.3 vs. 3.7, $p < 0.001$). These included depression (OR = 1.35, CI = 1.29 - 1.41), hypertension (OR = 1.28, CI = 1.21 - 1.36), diabetes mellitus (OR = 2.14, CI = 2.10 - 2.22), high cholesterol (OR = 1.14, CI = 1.01 - 1.21), atrial fibrillation (OR = 1.25, CI = 1.20 - 1.30), chronic kidney disease (OR = 1.18, CI = 1.13 - 1.22), COPD (OR = 1.87, CI = 0.80 - 1.91), obesity (OR = 1.55, C = 1.22 - 1.96), and discharges for heart failure (OR = 1.09, CI = 1.04 - 1.14; Table 1, Cols 3-4). Interestingly, neither MI nor stroke emerged as a significant correlates of SAP.

SAP Effects on Hospital cost

Table 2 shows that the average total cost per year for SAP was 27% higher compared to Non-SAP patients ($164,950 vs. $125,520, cols. 1-2). The higher cost for SAP patients existed in all ethnic and gender groups though it varied by race/ethnicity in that blacks had higher cost ($193,650; $p < 0.001$) compared to other groups including Asian/Pacific Islanders (AP; $191,090), Hispanics ($165,630), and whites ($159,720). Contrary to our expectation, costs were higher ($p < 0.001$) for women than men ($177,880 vs. $156,280 respectively, cols. 7 and 8).

Cost Factors	Non-SAP 65+	Sleep Apnea Patients (Age 65+)						
		All	Black	White	Hispanic	AP	Males	Females
Column #	1	2	3	4	5	6	7	8
N→	162205	12,106	1,093	8,674	1,853	486	7,245	4,861
Age	81	76	73	76	75	76	76	76
Mean Comorb	3.2	3.8*	4.0	3.7	4.0	4.1	3.8	3.7
Mean Charlson	3.6	4.3*	4.7	4.2	4.4	4.8	4.3	4.3
# Adm	1.6	2.1*	2.5	2.0	2.1	2.1	2.0	2.2
Hosp. Days	12.3	15.0*	19.4*	14.2	16.0	15.8	13.5	17.3*
2010 Total Cost $	125,520	164,950*	193,650*	159,720	165,630	191,090	156,280	177,880*

Table 2: *Average Hospital Cost of Elderly Sleep Apnea (SAP) Patients by Ethnicity and Gender.*
**Differences between adjacent columns (e.g., 1-2) and cols. 3-6 , and 7-8 are significant at $p < 0.001$*
AP: Asian/Pacific Islanders; MeanCormob: Average Number of Comorbidities; #Charlson: Index of Illness Severity; #Adms: Number of Admissions; Hosp. Days: Number of Hospital Days.

Depression Effects on Hospital Cost

Since 25% of SAP patients were diagnosed with depression, we examined the role of depression on hospital cost in table 3. Our analysis shows that depression among SAP patients (SAP^{+D}) added an additional 28% to the SAP cost, meaning that the hospital cost exceeded 50% for patients who had both SAP and depression (27% for SAP + additional 28% for depression). The effect of depression on increasing cost among SAP patients remained intact across all racial/ ethnic and gender groups (Table 3, cols 3-14).

Cost Factors	SAP^{ND}	SAP											
		SAP with Depression (SAP^{+D})	Black		White		Hispanic		AP		Male		Female	
			Depressed		Depressed		Depressed		Depressed		Depressed		Depressed	
			Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Column #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mean Comorb	4.2	4.5*	4.3	3.9	3.9*	3.60	4.2*	3.9	4.3	4.1	4.1*	3.7	3.9*	3.6
Mean Charlson	1.9	2.6*	5.0*	4.6	4.4*	4.1	4.8*	4.3	6.2*	4.6	4.7*	4.2	4.4	4.2
# Adms.	12.9	21.5*	3.3*	2.3	2.5*	1.8	2.7*	1.9	2.7*	2.0	2.6*	1.8	2.6*	2.0
Hosp Days	12.9	21.5*	22.7*	18.6	20.8*	11.9	25.2*	13.2	18.4	15.4	20.0*	11.9	22.9*	14.7
Total 2010 cost $	152,640	202,890*	207,000*	190,580	201,340*	145,050	207,090*	152,990	215,130*	188,718	202,030*	144,910	203,700*	166,080

Table 3: *Cost factors and effect of depression on hospital cost of SAP by ethnicity and gender.*
**: Differences between two adjacent columns (e.g. 1 vs. 2) significant at $p < 0.001$; SAP+D: SAP patients with depression; SAPND: SAP patients without depression; Mean Comorb: Number of comorbidities. Mean Charlson: Charlson Index of comorbidity severity; # Adms: Average number of admissions; Hosp Days: Average number of days in hospital; Total 2010 cost $; Total hospital cost for 2010 in dollars.*

Discussion

These descriptive data are consistent with the hypothesis that depression is associated with increased hospital costs for SAP among men and women regardless of race or Hispanic ethnicity. Additionally, hospital stay appeared to be associated with higher hospital costs among women in these data. The association between co-morbid depression and increased health care costs is consistent with several previous reports [25-31] and extends these reports to SAP.

Both SAP and depression offer opportunities for secondary prevention. The United States Preventive Services Task Force recommends screening for depression in the general population but cautions that there should be adequate provisions in place to ensure accurate diagnosis, effective treatment, and appropriate follow-up [32]. While screening for obstructive sleep apnea is not recommended for the general asymptomatic population [33], opportunities for early diagnosis and treatment include a multitude of symptoms consistent with the diagnosis [34]. While causal links with SAP have not been established, there are several physical/diagnostic findings for which the odds of having the condition plus SAP are significantly greater than having the condition alone. These include atrial fibrillation (odds ratio = 4.0), depression (2.6), congestive heart failure (2.4), stroke (1.6 to 4.3), hypertension (1.4 to 2.9), coronary artery disease (1.3) and diabetes mellitus (1.2 to 2.6) [35]. Our data attest to the importance of many of these conditions among these hospitalized elderly patients (mean age = 76 years) and are consistent with the hypothesis that proactive clinical prevention of these conditions might reap secondary benefits relative to SAP.

While the present observations are consistent with most previous findings linking SAP with other conditions [1-23] neither myocardial infarction nor stroke emerged as significant correlates of SAP in these data. Unfortunately, the present data are derived from administrative claims, which provide no information about treatment. A recent meta analysis36 of randomized controlled trials which assessed cardiovascular outcomes comparing patients with SAP who received continuous positive airway pressure (CPAP) therapy to those receiving medical therapy alone, failed to show an association with improved cardiac outcomes. Subset analyses, however, suggested that use of CPAP for four or more hours may have been significantly protective [36,37]. It is possible that patients in the present data set would have qualified for inclusion in such subsets. A concern, however, is that provider variability in diagnostic criteria may have also affected the present observations.

Blacks, in our data, were observed to have higher hospital costs relative to other racial/ethnic groups, and women were found to have higher costs than men. In addition to increased co-morbidity, the literature suggests that higher costs among black could also be related to several other factors, including: 1) low health literacy/ lower recognition of disease symptoms; 2) poor access to health care providers; 3) distrust of providers; 4) patients' perceived neglect by the providers resulting in longer waiting time; and 5) lower referral to specialists for treatment [38-43]. Additional research is needed to understand possible relationships between these factors and hospital costs. Our findings relative to women run counter to previous observations of higher primary care and overall medical expenses but not hospitalization among women [44,45] and might reflect the significantly higher prevalence of depression among women as compared to men in these data.

As previously noted [46], California Hospital Discharge Data are limited, in part, since hospital discharge files do not include patients from Veterans Affairs hospitals (VA) or patients from mental institutions. Moreover, these data files neither provide reimbursed costs nor information about marital status, education, annual income, nor include clinical data (such as medications, clinical test results or tests performed) or clinical rationales. Follow-up is also limited since patients are assigned different identification numbers each year for purposes of confidentiality. These potential sources of bias might limits generalizability to populations other than those included in California hospital discharge data, and despite these and other limitations, these California results may be useful, in part, because they represent a large sample from a racially and ethnically diverse State. These observations support the need for analytic epidemiologic studies (designed a priori)so to test hypotheses generated by the data and more fully explain the health and financial impacts of depression and SAP on hospitalizations.

Conclusion

These descriptive data are consistent with the hypothesis that depression is associated with increased hospital costs for SAP among men and women regardless of race or Hispanic ethnicity. The higher SAP+D costs among females may reflect additional burdens from such co-morbidities as depression, hypertension, and diabetes. Analytic epidemiologic studies (designed a priori) are needed to test the hypotheses generated by these data. Confirmation of these hypotheses might, in part, form the foundation of clinical trials to determine if screening and treating sleep apnea and depression could reduce morbidity and hospital costs.

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Bibliography

1. 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.

2. Peppard PE., *et al.* "Increased prevalence of sleep-disordered breathing in adults". *American Journal of Epidemiology* 177.9 (2013): 1006-1014.

3. Wheaton AG., *et al.* "Sleep disordered breathing and depression among U.S. adults: National Health and Nutrition Examination Survey, 2005-2008". *Sleep* 35.4 (2012): 461-467.

4. Stamatakis KA., *et al*. "Short sleep duration across income, education, and race/ethnic groups: population prevalence and growing disparities during 34 years of follow-up". *Annals of Epidemiology* 17.12 (2007): 948-955.

5. Ruiter ME., *et al.* "Sleep disorders in African Americans and Caucasian Americans: a meta-analysis". *Behavioral Sleep Medicine* 8.4 (2010): 246-259.

6. Canivet C., *et al.* "Insomnia increases risk for cardiovascular events in women and in men with low socioeconomic status: a longitudinal, register-based study". *Journal of Psychosomatic Research* 76.4 (2014): 292-299.

7. Whinnery J., *et al.* "Short and long sleep duration associated with race/ethnicity, sociodemographics, and socioeconomic position". *Sleep* 37.3 (2014): 601-611.

8. Jamb M and Unruh M. "Bidirectional relationship of hypertension with obstructive sleep apnea". *Current Opinion in Pulmonary Medicine* 20.6 (2014): 558-564.

9. Guillot M., *et al.* "Association between severe obstructive sleep apnea and incident arterial hypertension in the older people population". *Sleep Medicine* 14 (2013): 838-842.

10. Wang X., *et al.* "Obstructive sleep apnea and the risk of type 2 diabetes: a meta-analysis of prospective cohort studies". *Respirology* 18.1 (2013): 140-146.

11. Gangwisch JE., *et al*. "Sleep duration as a risk factor for diabetes incidence in a large U.S. sample". *Sleep* 30.12 (2007): 1667-1673.

12. Karkinski D., *et al.* "Obstructive sleep apnea and lipid abnormalities" *Open Access Macedonian Journal of Medical Sciences* 155.1 (2017): 19-22.

13. Chandola T., *et al.* "The effect of short sleep duration on coronary heart disease risk is greatest among those with sleep disturbance: a prospective study from the Whitehall II cohort". *Sleep* 33 (2010): 739-744.

14. Laugsand LE., *et al.* "Insomnia and the risk of acute myocardial infarction: a population study". *Circulation* 124 (2011): 2073-2081.

15. Gottlieb DJ., *et al.* "Prospective study of obstructive sleep apnea and incident coronary heart disease and heart failure: The Sleep Heart Health Study". *Circulation* 122 (2010): 352-360.

16. Li M., *et al.* "Obstructive sleep apnea and risk of stroke: a meta-analysis of prospective studies". *International Journal of Cardiology* 172.2 (2014): 466-469.

17. Capampangan DJ., *et al.* "Is obstructive sleep apnea an independent risk factor for stroke? A critically appraised topic". *Neurologist* 16.4 (2010): 269-273.

18. Farajzadeh M., *et al.* "The association between obstructive sleep apnea and depression in older adults". *Nursing and Midwifery Studies* 215.2 (2016): e32585.

19. Douglas N., *et al.* "Prevalence of depression in patients referred with snoring and obstructive sleep apnea". *Internal Medicine Journal* 43.6 (2013): 630-634.

20. Togeiro SM., *et al.* "Consequences of obstructive sleep apnea on metabolic profile: a population-based Survey". *Obesity* 21.4 (2013): 847-851.

21. Drager LF., *et al.* "The impact of obstructive sleep apnea on metabolic and inflammatory markers in consequetive patients with metabolic syndrome". *PloS One* 115.8 (2010): e12065.

22. Campos-Rodriguez F., *et al*. "Mortality in obstructive sleep apnea-hypopnea patients treated with positive airway pressure". *Chest* 128.2 (2005): 624-633.

23. Yu-Sheng Lin., *et al.* "Obstructive Sleep Apnea Independently Increases the Incidence of Heart Failure and Major Adverse Cardiac Events: A Retrospective Population-Based Follow-Up Study". *Acta Cardiologica Sinica* 33.6 (2017): 656-663.

24. Zimmerman M., *et al.* "Frequency of anxiety disorders in psychiatric outpatients with major depressive disorder". *American Journal of Psychiatry* 157.8 (2000): 1337-1340.

25. Bowen RC and Kohout J. "The relationship between agoraphobia and primary affective disorders". *Canadian Journal of Psychiatry* 24.4 (1979): 317-322.

26. Husaini BA., *et al.* "Diabetes, depression, and healthcare utilization among African Americans in primary care". *Journal of the National Medical Association* 96.4 (2004): 476-484.

27. Vamos EP., *et al*. "Comorbid depression is associated with increased healthcare utilization and lost productivity in persons with diabetes: a large nationally representative Hungarian population survey". *Psychosomatic Medicine* 71.5 (2009): 501-507.

28. Shin JH., *et al.* "Predictors of and health services utilization related to depressive symptoms among elderly Koreans". *Social Science & Medicine* 75.1 (2012): 179-185.

29. Husaini B., *et al.* "Depression increases stroke hospitalization cost: an analysis of 17,010 stroke patients in 2008 by race and gender". *Stroke Research and Treatment* (2013).

30. Walker S., *et al.* "Cost-effectiveness of combining systematic identification and treatment of co-morbid major depression for people with chronic diseases: the example of cancer". *Psychological Medicine* 44.7 (2014): 1451-1460.

31. Husaini B., *et al.* "Smoking, depression, and hospital costs of respiratory cancers: Examining race and sex variation". *Family Medicine Community Health* 5.1 (2017): 29-42.

32. Siu A., *et al.* "Screening for depression in adults: US Preventive Services Task Force recommendation statement". *Journal of the American Medical Association* 315.4 (2016): 380-387.

33. US Preventive Services Task Force. "Screening for obstructive sleep apnea in adults: US Preventive Services Task Force recommendation statement". *Journal of the American Medical Association* 217.4 (2017): 407-414.

34. Balachandran JS and Patel SR. "In the clinic. Obstructive sleep apnea". *Annals of Internal Medicine* 4161.9 (2014): ITC1-ITC16.

35. Semelka M., *et al.* "Diagnosis and treatment of obstructive sleep apnea in adults". *American Family Physician* 94.5 (2016): 355-360.

36. Abuzaid AS., *et al.* "Meta-analysis of cardiovascular outcomes with continuous positive airway pressure therapy in patients with obstructive sleep apnea". *American Journal of Cardiology* 120.4 (2017): 693-699.

37. Mokhlesi B and Ayas Najib T. "Cardiovascular events in obstructive sleep apnea – Can CPAP therapy SAVE lives?" *New England Journal of Medicine* 8375.10 (2016): 994-996.

38. Greenlund KJ., *et al.* "Low public recognition of major stroke symptoms". *American Journal of Preventive Medicine* 25.4 (2003): 315-319.

39. Resneck J Jr., *et al*. "Medicare, Medicaid, and access to dermatologists: the effect of patient insurance on appointment access and wait times". *Journal of the American Academy of Dermatology* 50.1 (2004): 85-92.

40. Devoe JE., *et al.* "Insurance + access not equal to health care: typology of barriers to health care access for low-income families". *Annals of Family Medicine* 5.6 (2007): 511-518.

41. Karve SJ., *et al.* "Racial/ethnic disparities in emergency department waiting time for stroke patients in the United States". *Journal of Stroke and Cerebrovascular Diseases* 20.1 (2011): 30-40.

42. Cass A., *et al.* "Late referral to a nephrologist reduces access to renal transplantation". *American Journal of Kidney Diseases* 42.5 (2003): 1043-1049.

43. Hsia AW., *et al*. "Understanding reasons for delay in seeking acute stroke care in an underserved urban population". *Stroke* 42.6 (2011): 1697-1701.

44. Bertakis KD., *et al.* "Gender differences in the utilization of health care services". *Journal of Family Practice* 49.2 (2000): 147-152.

45. Bertakis KD and Azari R. "Patient gender differences in the prediction of medical expenditures". *Journal of Women's Health* 19.10 (2010): 1925-1932.

46. Husaini BA., *et al.* "Heart failure hospitalization by race/ethnicity, gender and age in California: implications for prevention". *Ethnicity and Disease* 26.3 (2016): 345-354.

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