

Hypertension Management in Hypertensive Adults with Diabetes in Primary Care setting

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Introduction:

Hypertension is well known as a common comorbidity in patients with diabetes with its prevalence ranging from 60% to 80%.¹ In patients with diabetes, the prevalence of hypertension is up to 3 times more as compared to patients without diabetes.^{2,3} Hypertension comorbidity in diabetics tends to increase the complications of stroke, heart failure, retinopathy and nephropathy.¹ The direct and indirect costs of hypertension have been estimated at \$69.9 billion and \$23.6 billion, respectively.⁴ However, the annual average cost for treatment was substantial, \$2955–\$3402, for both conditions.² Multiple risk factors need controlling for appropriate management of hypertension in patients with diabetes.¹ Lowering the blood pressure below 130/80 mmHg reduces the chances of mortality by 10%.¹

Pharmacotherapy along with behavioral therapy is recommended to diabetic patients with hypertension.¹ Pharmacotherapy includes the use of drugs like Angiotensin Converting Enzyme (ACE) inhibitor, Angiotensin Receptor Blockers (ARB's), diuretics, calcium-channel blockers, beta-blockers and alpha-blockers which are proved beneficial among this population.^{1,2,5} Behavioral therapy would include counseling for exercise, weight reduction and diet/nutrition for management of hypertension among diabetics.^{6,7} Literature suggests first line antihypertensive therapies, ACE inhibitors and ARB's, along with behavioral therapies are necessary to manage hypertension among diabetic population.⁵ American Diabetes Association strongly recommends the use of first line antihypertensive drugs, ACE inhibitors and ARB's, and use of behavioral therapy in the control of hypertension among diabetics.¹

Past literature suggests limited use of ACE inhibitors and ARB's among hypertensive diabetic patients despite beneficial outcomes⁷⁻¹⁰. Previous literature utilized National Health and Nutritional Examination Survey (NHANES) databases for research on hypertensive diabetic patients. Aparasu et. al in 2008 examined the factors associated with hypertension management in diabetes by investigating the 2003-2004 National Ambulatory Medical Care Survey (NAMCS) and outpatient department portion of National Hospital Ambulatory Medical Care Survey (NHAMCS) database⁷. Belue et.al examined the factors associated with hypertension control in diabetics in 2008 NAMCS and NHAMCS data⁵. However, none of the studies used the recently released 2010 NAMCS database to look at differences in hypertension management in diabetics among the primary care physicians, between family practitioners/ general medical practitioners and internists. The study objectives were 1) to investigate the use of behavioral and pharmacotherapy, first line antihypertensive therapy, in office based patient visits by adult hypertensive diabetics and 2) to examine the management of hypertension in hypertensive diabetic patients among the family practitioners/general medical practitioners and internists.

Methods:

Data Source

The cross-sectional study used data from 2010 NAMCS database. NAMCS database have been previously used for research in hypertensive diabetics^{5,7}. These databases are obtained through nationally conducted surveys each year by National Center for Health Statistics (NCHS) which provides cross-sectional physician prescribing information. Further information on NAMCS can be obtained from the NCHS website.

NAMCS is a probability cross-sectional survey of in-person patient visits, conducted by NCHS among office based physicians. It uses a multi-stage probability sample of primary sampling units (PSU), physician practices within the sampling units and randomly selected patient visits in those physician practices.

Data about visiting patients is collected in NAMCS via Patient Record Form (PRF). It collects data on patient demographics, patient evaluation measures like blood pressure, diagnosis by the physician, which are coded according to the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM)¹¹. All the new or continued medications, ordered or supplied or administered during each patient visit are recorded, in the PRF up to 8 medications prescribed can be included. The drug classes are categorized as per National Drug Code (NDC)¹². A total of 31,229 patient visits were recorded in NAMCS in 2010 which were used for analysis of the management of hypertension among diabetics among primary care physicians.

Measures

Patients

Patient visits analyzed in the first and second objectives were diagnosed with Diabetes Mellitus (DM) and hypertension and those > 20 years of age. Patient identification was conducted via International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) code, as per indicated by NAMCS diagnosis variable, and if 'yes' was provided to a question asking whether patient has DM. Patients were also included if their healthcare provider indicated 'yes' to a question asking whether if the patient has hypertension.

Conceptual Framework

Anderson's behavioral model of health services-use was utilized. The predisposing and enabling factors of an individual were included in the model which in turn determined the maintenance of blood pressure $\leq 130/80\text{mmHg}$ ¹³.

Predisposing characteristics include age, sex, race (white, blacks, others), ethnicity (Hispanic, non-hispanic). Enabling factors include insurance (private, public, other insurance), metropolitan statistical area (MSA) and region.

Outcome of interest

Seventh Joint National Committee (JNC 7)⁶ recommended measure of blood pressure maintenance \leq 130/80mmHg for hypertensive diabetics was used as an outcome for study objectives.

Anti-hypertensive drugs

Medication identification was done using National Drug Code (NDC) for all the drug classes. Anti-hypertensive drugs were grouped into ACE inhibitors or ARBs, diuretics, calcium-channel blockers, alpha-blockers and beta-blockers. All drugs included under the ACE inhibitor category (Benazepril, Captopril, Enalapril, Fosinopril, Lisinopril, Moexipril, Quinapril, Ramipril, Trandolapril and Perindopril) and ARBs category (Candesartan, Irbesartan, Olmesartan, Losartan, Valsartan, Telmisartan and Eprosartan) were included as first line antihypertensive drug therapy in this study. The use of behavioral therapy was defined as diet/nutrition control, exercise and weight management for the management of hypertension.

Statistical analysis

The survey analysis should account for the complex survey designs in the NAMCS database. Characterization of study population was done by chi-square tests with 95% confidence interval (CI). Bivariate and multivariate logistic regression analysis were conducted to examine the factors associated with management of BP \leq 130/80 mmHg. Independent variables found significant ($p < 0.25$) in unadjusted analysis were included in adjusted analysis. Face value variable like age, sex, race, ethnicity, region and metropolitan statistical area (MSA) were included in adjusted analysis. Descriptive statistics was conducted with survey frequency procedure, PROC SURVEYFREQ; the multivariable logistic analysis was conducted with survey logistic procedure, PROC SURVEYLOGISTIC, in SAS 9.3.

The survey codes used are as follows:

```
PROC SURVEYFREQ DATA= data_name;  
TABLES cohort * (sex agecat racereth region paytype pcptype msa ace arb acearb bpmngt dietnutr  
exercise wtredc)/clwt row;  
CLUSTER cpsum;  
STRATA cstratm;  
WEIGHT patwt;  
RUN;
```

```
PROC SURVEYLOGISTIC DATA=data_name;  
DOMAIN cohort;  
CLUSTER cpsum;  
STRATA cstratm;  
CLASS sex agecat racereth region pcptype msa wtredc /PARAM=ref REF=first;  
MODEL bpmngt (EVENT="1") = sex agecat racereth region pcptype msa wtredc;  
WEIGHT patwt2;  
RUN;
```

PROC SURVEYLOGISTIC allows the usage of domain analysis as observations cannot be deleted in NAMCS database. With domain function one can conduct specific analysis on their respective cohort population.

Results:

According to 2010 NAMCS data, 51.97 million (95% CI 41.70-62.25) patient visits were made by diabetic patients in 2010. Hypertension as a comorbidity was present in 41.89% i.e. 21 million (95% CI 2.7-16.39) patient visits. The patient visit characteristics of hypertensive diabetic patients are presented in Table 1.

Table 1: Characteristics of visits involving diabetic patients with hypertension. (See Appendix)

Large numbers of hypertensive diabetic visits were made by females (53%), individuals in the age group of 45 years to 64 years (44%), non-hispanic white (65%). Among the population under study, the mean systolic blood pressure was 123mmHg (range 66-254) and mean diastolic blood pressure was found to be 74mmHg (range 19-160). Blood pressure \leq 130/80 mmHg was found in 44.78% of the total hypertensive diabetic visits.

Among the total hypertensive diabetic patient visits 32.95% received diet and nutrition counseling, 22.34% received exercise counseling and 19.85% received weight reduction counseling. ACE inhibitors or ARBs were prescribed in 50.5% of the hypertensive diabetic patient visits.

Table 2: Table showing odds of hypertension management among primary care physicians. (See Appendix)

Multivariate logistic regression revealed that patient visits to internists had 83.8% (OR 1.838, 95% CI: 1.008-3.350) higher likelihood of controlled blood pressure as compared to other primary care physicians. Patient visits in western region showed 53.6% (OR 0.464, 95% CI: 0.226-0.954) lesser likelihood of controlled blood pressure as compared to patient visits in the Midwest region.

Discussion:

Available guidelines namely Seventh Report of the Joint National Committee, Kidney Disease Outcomes Quality Initiative and the American Diabetes Association recommend blood pressure of \leq 130/80 mmHg in patients with diabetes.^{6,14,15} To assess physicians' adherence to these guidelines, evaluation of national pattern of hypertension management is required. This study provides evaluation of hypertension management among the primary care physicians.

The national BP management goal of \leq 130/80 mmHg was obtained in only 44.78% of hypertensive diabetic patient visits. Past literature suggests the BP goal of \leq 130/80 mmHg was met in around 40% of the hypertensive diabetic patients.^{6,7,16} Although the current study shows an improvement compared to past literature, more than 50% of diabetic patients have uncontrolled blood pressure. Greater focus is required on this patient population in order to avoid further medical complications and reduce the increasing costs of treating hypertensive diabetics.

Guidelines suggest requirement of combination therapy, pharmacotherapy and behavioral therapy, for controlling hypertension among diabetics.^{6,7} JNC 7 recommends a lifestyle modification counseling for all patients with BP more than 120/80 mmHg.^{6,17} However, current study results showed only 32.95% received diet and nutrition counseling, 22.34% received exercise counseling and 19.85% received weight reduction counseling. Thus there is a need to increase the behavioral therapy counselling among hypertensive diabetics by physicians.

First line anti-hypertensive therapies like ACE inhibitors and ARBs have been proved to be beneficial in hypertensive diabetic population based on earlier studies.¹ Past literature shows 46% to 64% of patient visits received first line antihypertensives.^{7,9} However the current study findings suggest that, only about 50% of the patient visits were prescribed these medications. The limited use of first line antihypertensive is a concern, since uncontrolled blood pressure can lead to various cardiovascular and renal complications in the future.¹

Multivariable analysis suggests, among the primary care physicians hypertensive diabetic patients visiting internists are 83.8% more likely to have their blood pressure under control as compared to patients visiting family practitioners and general medical practitioners. Primary care physicians' namely family practitioners, general medical practitioners and internists are the first line of defense against hypertension in diabetics as compared to specialists like cardiologists and urologists. Thus there is a need to increase hypertension management among the family practitioners and general medical practitioners as compared to internists.

Limitations:

NAMCS database provides patient visits data rather than individual patient data, thus prevalence estimates cannot be obtained. NAMCS being a cross-sectional database, temporality and therefore causality between hypertension management and behavioral therapy /pharmacotherapy cannot be obtained. Sicker patients with multiple visits lead to oversampling, thus giving inappropriate estimates. Only 3 diagnoses along with 8 medications are recorded during the NAMCS survey, thus leading to under-estimation of disease diagnosis and medication use by the patients. Inherent data limitations such as difficulty in evaluating accuracy due to errors in data collection, analysis and reporting cannot be ruled out from this study. Awareness of physicians and follow-up of guidelines is a complex issue which requires careful consideration of a number of factors, the data for which is not available.

Conclusion:

More than half of the hypertensive diabetic patients did not achieve the desired BP target of $\leq 130/80$ mmHg despite the use of antihypertensive medications. Thus there is a need to improve the management of hypertension among diabetic patients by combining the behavioral and pharmacotherapies by the primary care physicians, especially the family practitioners and general medical practitioners.

Appendix:

Table 1: Characteristics of visits involving diabetic patients with hypertension

VARIABLE	Frequency	Estimated visits (%) (in millions)	Percent receiving ACE inhibitors/ARBs (%)
SEX			
Male	255	10.33(47)	46
Female	281	11.43 (53)	54
AGE			
20<age<= 44	47	1.33 (6)	9
45=<age<=64	254	9.46 (44)	44
65=<age<=74	144	6.78 (31)	28
age>74	91	4.21 (19)	19
Race/Ethnicity			
Whites non-hispanic	274	14.11(65)	66
Blacks non-hispanic	101	3.91(18)	17
Hispanics	115	2.39 (11)	10
Non-hispanic other	46	1.36 (6)	7
Payment Sources			
Private insurance	148	8.09 (37)	41
Public insurance	297	12.19 (56)	51
others	91	1.50 (7)	8
Blood pressure			
> 130/80mmHg	314	11.99(55)	58
≤ 130/80mmHg	204	9 (45)	42
REGION			
Northeast	114	4.03 (19)	26
Midwest	125	5.31 (24)	25
South	192	9.64 (44)	36
West	105	2.79 (13)	13
Physician type			
FP/GP	245	7.17 (33)	31
Internists	146	8.71 (40)	39
Non-PCP	145	5.89 (27)	30

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MSA/non-MSA			
MSA	483	19.85 (91)	93
Non-MSA	53	1.96 (9)	7

Table 2: Table showing odds of hypertension management among primary care physicians

Variables	Unadjusted odds ratio			Adjusted odds ratio		
	Odds ratio	95% CI	P-value	Odds-ratio	95% CI	P-value
BP ≤ 130/80mmHg						
Sex						
Female	Reference					
Male	1.259	0.773 2.050	0.3541	1.398	0.784 2.491	0.2558
Age (in years)						
21-44	Reference					
45-64	1.345	0.486 3.720	0.5686	1.343	0.412 4.378	0.6251
65-74	1.318	0.468 3.716	0.6010	1.246	0.378 4.112	0.7178
>74	1.093	0.446 2.680	0.8451	1.120	0.377 3.325	0.8380
Race/Ethnicity						
Hispanics	Reference					
Non-hispanic whites	1.152	0.468 2.831	0.7584	1.026	0.394 2.672	0.9580
Non-hispanic blacks	0.629	0.217 1.823	0.3927	0.599	0.182 1.970	0.3991
Non-hispanic others	0.830	0.245 2.814	0.7651	0.723	0.223 2.346	0.5894
Payment source						
Private	Reference					
Medicare/Medicaid	0.733	0.420 1.277	0.2723	-	- -	-
Others	0.695	0.315 1.533	0.3671	-	- -	-
Region						
Midwest	Reference					
Northeast	1.663	0.714 3.877	0.2385	1.013	0.546 1.882	0.9664
South	1.187	0.624 2.258	0.6014	0.891	0.482 1.646	0.7122
West	0.647	0.342 1.225	0.1816	0.464	0.226 0.954	0.0368
MSA/Non-MSA						
MSA	Reference					
Non-MSA	1.076	0.583 1.986	0.8152	1.716	0.804 3.664	0.1629
Diet/ Nutrition Counseling						
No	Reference					
Yes	1.049	0.509 2.162	0.8968	-	- -	-
Exercise Counseling						
No	Reference					
Yes	1.187	0.537 2.622	0.6717	-	- -	-
Weight reduction Counseling						
No	Reference					
Yes	1.802	0.845 3.841	0.1275	1.527	0.856 2.724	0.1515

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Drugs prescribed (ACE or ARBs)									
No	Reference								
Yes	0.833	0.526	1.483	0.6389	-	-	-	-	
Physicians									
General and Family Practice	Reference								
Internal medicine Practice	1.696	1.001	2.874	0.0494	1.838	1.008	3.350	0.0471	
Non-PCPs	3.650	1.849	7.208	0.0002	4.207	2.198	8.052	<0.001	

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