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A Cross Sectional Analysis of Hypertension in Canadian Family Physician Practices: A Report from the Canadian Primary Care Sentinel Surveillance Network (CPCSSN)

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Abstract

Background: As one in five Canadian adults has hypertension and another 20% have blood pressure (BP) in the pre-hypertensive range, this disease is commonly seen in primary care practices. The Canadian Primary Care Sentinel Surveillance Network (CPCSSN) provides validated, national EMR data on hypertension.

Methods: By the end of 2012, CPCSSN was collecting data from the EMRs of 444 family physicians in seven provinces and providing data on 441,000 patients. We report on prevalence rates for hypertension, proportions achieving blood pressure targets, and the proportions of patients receiving drug therapy by class.

Results: The study population consisted of 250,346 patients over age 18 years old who had at least one clinical encounter between January 1st, 2011 and December 31st, 2012. Of these, 57,180 (22.8%) had a diagnosis of hypertension. Seventy-eight percent of all patients with a diagnosis of hypertension had achieved both systolic target (≤ 140 mmHG) and diastolic target (≤ 90 mmHG). Those diagnosed with hypertension were significantly more likely to have a comorbidity and visit their primary care provider more often. Twelve percent of hypertensive patients were not on any medication; nearly two thirds (61.7%) were on one or two drugs.

Interpretation: Prevalence rates from CPCSSN data are similar to those from the Canadian Health Measures Survey. There is a high rate of achievement of BP targets but comorbidity is high and patients with hypertension see their primary care provider more often. Most patients have blood pressure controlled with one or two medications.

Introduction

According to the recently published Global Burden of Disease Study¹, high blood pressure (BP) is the greatest risk of ill health and an early death worldwide.^{2,3,4} The recent Canadian Health Measures Survey (CHMS), conducted between March 2009 and February 2011, measured blood pressure directly using an automated blood pressure measurement device. It estimated that one in five Canadian adults has hypertension and another 20% have BP in pre-hypertensive range.⁵ Eighty-three percent of the people with hypertension were aware they had high blood pressure and 80% were receiving treatment for it; 66% had achieved recommended target levels of blood pressure. The lifetime residual risk of developing hypertension in people aged 55 to 65 years with normal BP is estimated to be 90%⁶, making high BP a concern for virtually everyone. Cardiovascular diseases have the highest financial health care cost of all diseases⁷ and are responsible for the greatest number of visits to family physician offices in Canada - more than 20 million visits annually.⁸ In Canada, the costs of hypertension related physician visits, laboratory tests and medications alone were estimated in 2007 to be almost \$2.4 billion.⁹

Most patients with high blood pressure in Canada are managed in the primary care setting by family physicians and other members of the primary care team. It is in this setting that diagnosis and treatment is ideally studied. Data on prevalence and management of chronic disease in Canada and most other countries usually come from cross sectional national or provincial surveys or from billing data from provincial health care plans. Surveys are prone to selection, reporting, and recall bias, and administrative billing data has a number of limitations including the requirement for only one diagnosis, lack of contextual/background information, information collected is restricted to data required for administrative purposes. This is the first

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3 national level report on hypertension in Canada using the CPCSSN data. The purpose of the
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5 report is to provide information from CPCSSN to the health care community (practitioners,
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7 researchers and policy makers) on the current state of hypertension – prevalence, comorbidities,
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9 management, and achievement of recommended targets. It is point-of-care data based on the day-
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11 to-day encounters of family physicians with patients in their practices.
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18 **Methods**

19 Data Source and Study Population

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21 The Canadian Primary Care Sentinel Surveillance Network (CPCSSN)^{9,10} is a rich
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23 database of patient care information collected from electronic medical records (EMRs) of over
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25 500 participating primary care providers (sentinels) across Canada. These sentinel physicians
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27 are located in seven provinces and one territory and provide data on more than 600,000 patients.
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29 Every three months, de-identified data is extracted from the EMRs, cleaned, coded, and
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31 transformed into a common data format for inclusion in the secure CPCSSN database. To-date,
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33 CPCSSN has developed and validated algorithms for the identification of a number of chronic
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35 conditions in primary care: hypertension, diabetes, depression, osteoarthritis, chronic obstructive
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37 pulmonary disease (COPD), dementia, parkinsonism, and epilepsy.^{11,12}
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44 The data within CPCSSN can describe the levels of blood pressure, the demographics of
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46 the people with the condition, the drugs and other strategies used to manage it, and the outcomes
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48 associated with treatment. Prior to the availability of CPCSSN the only hypertension data was
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50 from hospitals, the provincial billing systems, and national/provincial surveys. These sources do
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52 not provide the same level of detail as data from CPCSSN, especially related to information on
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54 point-of-care management, achievement of targets, or other risk factors and comorbidities.
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3 The CPCSSN data extraction process for the use of EMR data, specifically its de-
4 identification, storage, and use has been reviewed and approved by 10 university research ethics
5 boards across Canada, and the Health Canada Research Ethics Board.
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10 This study used CPCSSN data extracted from the EMRs on Dec 31, 2012, at which time
11 444 physicians contributed data on approximately 440,000 patients. All patients who were
12 reported having had at least one encounter with the participating practice in the previous 24
13 months constituted the study population. We used a combination of descriptive statistics and
14 multivariate modeling for data analysis using the statistical software package SAS, version 9.3.
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20 The validated case definition algorithm for determining the presence of hypertension is
21 based on combinations of billing diagnosis data, the problem list table, and use of anti-
22 hypertensive medications. The hypertension case definition algorithm has been validated and has
23 a sensitivity of 84%, specificity of 98% and positive predictive value of 92.9%.¹¹
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31 *Analysis*

32 We estimated the prevalence rates for hypertension by age group and gender. Age-sex
33 standardized prevalence rates were then calculated using the Canadian national age-sex
34 distribution.¹³ Prevalence ratios were estimated by three variables: Location (defined as rural if
35 the second character in the postal code is zero and urban if that character is 1), BMI categories
36 (underweight: BMI<18, normal: 18≤BMI<25, overweight: 25≤BMI<30 and obese≥30), and
37 smoking (never, past, current). Three separate log-binomial regression analyses were carried out
38 to estimate prevalence ratios and 95% confidence intervals (CI) adjusting for age and sex.
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50 To determine if a patient had achieved their blood pressure target we used the average of
51 the last three readings (or whatever was available) of BP measurements taken within the past 24
52 months.
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3 The prevalence of each CPCSSN comorbid conditions, adjusting for age and sex, was
4 estimated for those with and without hypertension, using the same log-binomial approach. The
5 cumulative proportion of patients diagnosed with one or more of the other CPCSSN conditions,
6 with respect to the absence and presence of hypertension, was estimated and the average number
7 of comorbid conditions calculated by age group.
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11 The pattern of medication use by those who were diagnosed with hypertension was
12 examined. In this report, a medication is considered to have been used if there was at least one
13 prescription for that medication recorded in the patient's electronic medical record. The majority
14 (95%) of these prescriptions were recorded last within the previous two years.
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27 Results

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29 The study population consisted of 250,346 patients over age 18 years old who had at least
30 one encounter with the practice within the previous 24 months. Of these, 57,180 (22.8%) had a
31 diagnosis of hypertension. Table 1 and Figure 1 shows the prevalence of hypertension by age and
32 sex. The prevalence of hypertension is higher in rural practices compared to urban practices,
33 increases with increasing BMI, and is more likely in past smokers compared to those who have
34 never smoked (Table 2). There was no statistically significant difference in the prevalence of
35 hypertension between those who currently smoked and those who never smoked.
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46 Seventy-eight percent of all patients with a diagnosis of high blood pressure had achieved
47 both systolic target (≤ 140 mmHG) and diastolic target (≤ 90 mmHG) (Table 3). For the subgroup
48 of hypertension patients who also had diabetes, 45.3% had achieved both the targets of \leq
49 130mmHG for systolic BP and ≤ 80 mmHG for diastolic BP.
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People with a diagnosis of hypertension were significantly more likely to have a diagnosis of diabetes, COPD, osteoarthritis, and depression than those people without a diagnosis of hypertension (Table 4). Even in patients with hypertension, 80% had either none or only one comorbid condition (Table 5). Patients with hypertension were 34% more likely to also have one of the other co-morbid conditions. The mean number of comorbid conditions by age group is shown in Figure 2. As expected, this number increases markedly with age.

Patients with hypertension had a mean of 11.2 encounters with their physician while those without hypertension had a mean of 6.6 encounters over an average of five years. (Table 6) Controlling for other factors using multivariate analysis, patients with hypertension had about 30% more encounters with their practices than patients without hypertension.

Table 7 provides a breakdown of the use of the five major antihypertensive medication groups in patients with hypertension; 12.1% of patients with a diagnosis of hypertension were not on any medication. Nearly two thirds (61.7%) were on one or two drugs (Table 8).

Interpretation

The estimate of the overall prevalence of hypertension in the CPCSSN practices is 22.8%. This is very close to the 22% reported by the Canada Health Measurements Survey conducted between 2009 and 2011. Prevalence based on a clinical population should be higher than a population based estimate since a practice-based population would be expected to have higher rates of morbidity. However since it has been estimated that well over 90% of Canadians have a regular family doctor, this difference should not be great. The difference we measured was not great – less than 1%. The benefit of knowing that CPCSSN provides prevalence rates comparable to a population based survey is that the CPCSSN data is updated every 3 months so

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3 the prevalence can be monitored regularly without the cost of large scale population based
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5 surveys.
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8 In addition to prevalence rates, CPCSSN data can provide an ongoing characterization of
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10 the epidemiology of hypertension in terms of rural/urban, and CVD risk factors such as smoking
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12 status, cholesterol levels, diet, exercise, BMI, and socio-economic status. We report only on
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14 geographical location, smoking status, and BMI in this report because of data availability and/or
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16 quality issues. Some of these issues, such as availability of laboratory data and the ability to
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18 determine SES through Statistics Canada Dissemination Area using the full 6 character postal
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20 code have been resolved since the December 31, 2012 cut-off for this report. However, we can
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22 report that living in a rural area, being overweight or obese, and being a past smoker is
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24 associated with a higher likelihood of having a diagnosis of hypertension. Being a current
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26 smoker was not associated with hypertension. This may be related to the demographics of
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28 current smokers, although age and sex were included in the analytical model.
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34 We were also able to report on the degree to which blood pressure targets are achieved.
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36 Nearly 80% of hypertensive patients are at the target level of < 140/90 mmHg and in diabetic
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38 patients with hypertension nearly 50% have achieved the lower recommended target of <130/80
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40 mmHg. The added value of the CPCSSN database is the estimate of the meeting of BP targets in
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42 primary care across Canada, or by jurisdiction, can be monitored on an annual basis.
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46 We were also able to report on the degree of co-morbidity associated with hypertension,
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48 and while this finding is not new, we have been able to characterize this association to a much
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50 greater degree. We have characterized the association in terms of prevalence ratios, showing the
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52 higher likelihood that people with hypertension have diabetes, COPD, osteoarthritis, and
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54 depression. We were also able to characterize co-morbidity in terms of the number of different
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3 co-morbidities patients with hypertension are likely to experience, and how this changes with age
4 compared to people without hypertension..
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8 Utilization of primary care services (visits to the family doctor) is easily explored with
9 CPCSSN data, but is more difficult with other data sources. We report that people with
10 hypertension make 30% more visits to their family doctor even when controlling for presence of
11 other co-morbidities, age, sex, and rural/urban status. This needs further exploration.
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15 Medication use was also examined. Approximately 12% of hypertension patients were
16 not on any medications, 64% were on one or two drugs, and 26% were on three or four drugs.
17 Other studies suggest that treatment with > 2 medications is required for most patients with
18 hypertension to achieve their BP target.¹⁴ However, these CPCSSN data suggest that in Canada
19 we are doing very well with achieving target and yet most patients are on two or fewer drugs. A
20 study looking at the relationship between achieving BP targets and the number and type of anti-
21 hypertensive medications being used should be conducted.
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33 *Limitations*

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36 There are limitations to the use of EMR data to do research. While it is ideal for
37 prevalence, management, and outcomes studies, it suffers from the fact that the data is collected
38 for a purpose other than research. We would like to have better data regarding socio-economic
39 factors such as income, education, and ethnicity but that data is rarely collected in a clinical
40 setting. Weight is reasonably well documented, but height is less frequently measured and hence
41 BMI cannot always be calculated. Waist circumference is rarely documented. You will notice
42 from Table 2 that we were only able to calculate BMI on 64% of the patients, and smoking status
43 was recorded on only 40% of patients. Some of the sentinel practices have laboratory interfaces
44 incorporated into their EMRs so that laboratory and diagnostic imaging data is directly loaded
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3 into their database. Others have the paper reports scanned as PDFs into their system; the data on
4 these files cannot be accessed for research or surveillance. Some physicians record blood
5 pressure and weight and other such measurements in the text based progress notes rather than in
6 the fields designed for these measures. It is very difficult to extract these data from text based
7 progress notes with any degree of accuracy. We are working with our sentinel physicians to
8 encourage more accurate, complete, and useful recording, but change takes time.
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17 Another issue is generalizability. We have recruited a substantial number of physicians
18 and their practices to CPCSSN. However these are not distributed randomly around the country,
19 but have mostly been recruited opportunistically and have a larger proportion of physicians with
20 academic practices than would be in the general population of physicians. We are beginning to
21 look at the demographics of our sentinel physicians and their practices and recruit more
22 strategically.
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31 *Conclusions*

32 This report is a valuable evaluation of the state of hypertension in Canada. Using a new,
33 unique data source like CPCSSN has allowed us to evaluate not only the prevalence of
34 hypertension and pre-hypertension in a large population of Canadians it has allowed us to report
35 on the treatment of hypertension. It is clear that patients with hypertension constitute a large
36 portion of those seeking primary care and that our family physicians are achieving BP targets
37 with the help of only one or two medications.
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48 There is a large potential for hypertension research using CPCSSN data. The various
49 characteristics and issues related to the prevalence of hypertension can be examined in more
50 detail. Relationships between hypertension and co-morbid conditions, as well the relationships
51 between hypertension and over CVD risk factors can be further explored. Hypertension and its
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effect on health service utilization can be scrutinized, and the relationship between type and intensity of blood pressure management and the achievement blood pressure targets needs to be further studied.

References

1. Lim SS, Vos T, Flaxman AD, Danaei G, et al. A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990-2010: a systematic analysis for the Global Burden of Disease Study 2010. *Lancet* 2013 December 15;380(9859):2224-60
2. Mackay J, Mensah GA, Mendis S, Greenlund K. Atlas of Heart Disease and Stroke. Geneva: World Health Organization; 2004.
3. World Health Organization. Global health risks: mortality and burden of disease attributable to selected major risks. Geneva: WHO Press; 2009.
4. WHO publishes definitive atlas on global heart disease and stroke epidemic. *Indian J Med Sci* 2004 September;58(9):405-6.
5. Canadian Health Measures Survey (CHMS) 2009-2011: Blood pressures of Canadian adults. Statistics Canada, Catalogue no.82-625-X <http://www.statcan.gc.ca/pub/82-625-x/2012001/article/11714-eng.htm>
6. Vasan RS, Beiser A, Seshadri S, Larson MG, Kannel WB, D'Agostino RB et al. Residual Lifetime Risk for Developing Hypertension in Middle-aged Women and Men. *JAMA* 2002; 287(8):1003-1010
7. Hemmelgarn BR, Chen G, Walker R, McAlister FA, Quan H, Tu K, Trends in antihypertensive drug prescriptions and physician visits in Canada between 1996 and 2006. *Can J Cardiol.* 2008;246:507-12
8. Joffres M, Campbell NRC, Manns B, Tu K. Estimate of the benefits of a population-based reduction in dietary sodium additives on hypertension and its related health care costs in Canada. *Can J Cardiol.* 2007;23:437-43
9. Birtwhistle RV, Canadian Primary Care Sentinel Surveillance Network: a developing resource for family medicine and public health *Can Fam Physician* 2011;1219-20
10. Birtwhistle R, Keshavjee K, Lambert-Lanning A, Marshall Godwin M, Greiver M, Manca D, Lagace C. Building a Pan-Canadian Primary Care Sentinel Surveillance Network: Initial Development and Moving Forward. *J Am Board Fam Med*;2009;22(4)12-22.
11. Williamson T, Green M, Birtwhistle R, Khan S, Garies S, Wong S, Natarajan N, Manca D, Drummond N, Validation of eight case definitions for chronic disease surveillance in a primary care database of electronic medical records. *Annals of Family Medicine* 2014, accepted for publication.

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12. Kadhim-Saleh A, Green M, Williamson T, Hunter D, Birtwhistle R. Validation of the diagnostic algorithms for 5 chronic conditions in the Canadian Primary Care Sentinel Surveillance Network (CPCSSN): a Kingston Practice-based Research Network (PBRN) report. *J Am Board Fam Med.* 2013;26(2):159-67.
13. Census 2011, <http://www12.statcan.gc.ca/census-recensement/2011/as-sa/98-311-x/98-311-x2011001-eng.pdf>.
14. Cushman WC, Ford CE, Cutler JA, et al, for the ALLHAT Collaborative Research Group. Success and predictors of blood pressure control in diverse North American settings: the Antihypertensive and Lipid-Lowering Treatment to Prevent Heart Attack Trial (ALLHAT). *J Clin Hypertens.* 2002;4:393-404

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Table 1. Prevalence of hypertension by patient age and sex, CPCSSN 2012-Q4

Age group	Male		Female		All	
	%	n	%	n	%	n
18-29	1.5	17110	1.3	25626	1.4	42736
30-39	5.8	14516	4.1	23839	4.7	38355
40-49	14.0	17508	10.8	24836	12.1	42344
50-59	27.1	20562	22.6	26812	24.5	47374
60-69	40.7	17208	38.0	20798	39.2	38006
70-79	50.8	10446	54.5	13316	52.9	23762
80-89	54.3	5795	62.7	8517	59.3	14312
90+	53.3	1037	62.9	2420	60.0	3457
All ages	24.1	104182	21.9	146164	22.8	250346

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Figure 1.

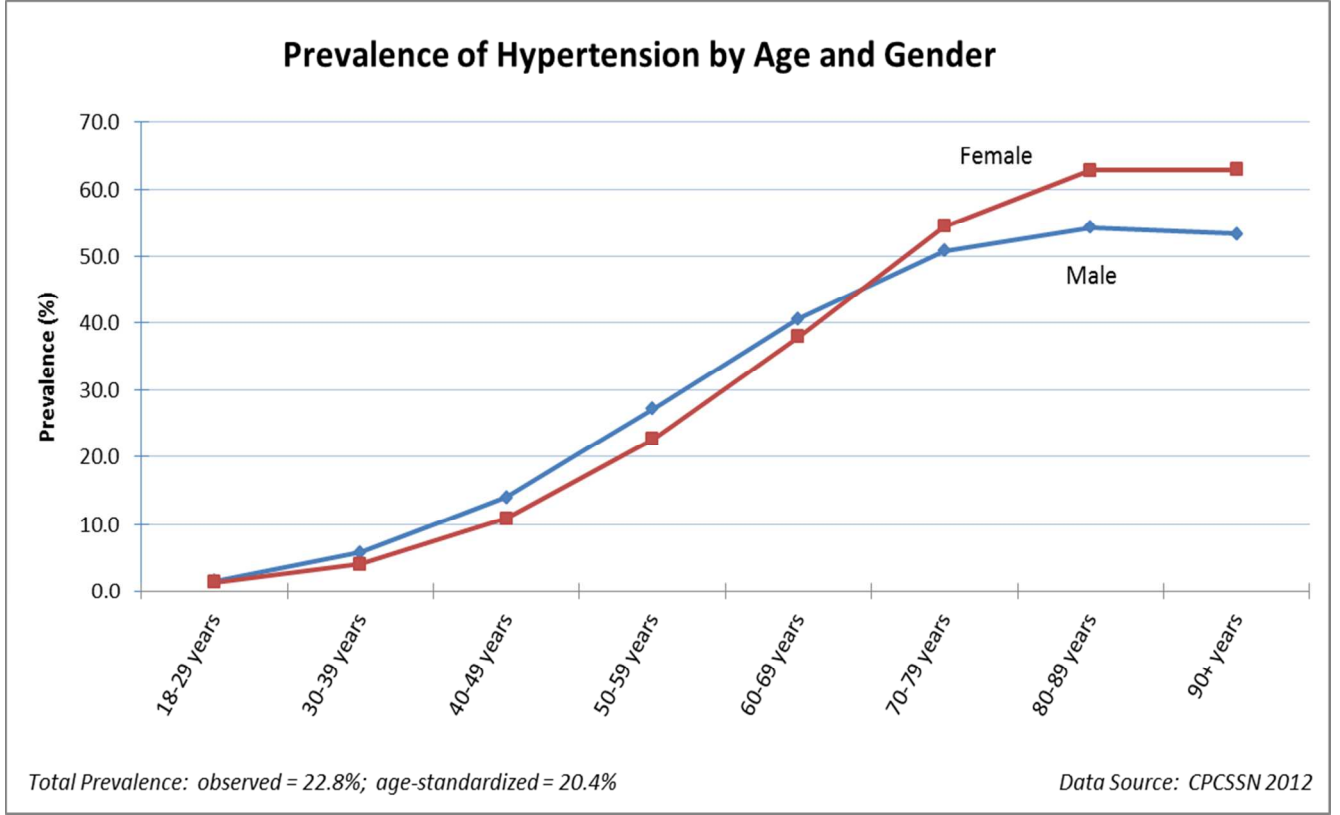


Table 2. Prevalence ratio (full model)

Main effects	n	Unadjusted prevalence ratio	Parameter estimates (log-binomial regression)*			
			Prev. Ratio	Low 95%	High 95%	p
Location [RC=Urban]	188076	1.00	1.00	--	--	--
Rural	54403	1.21	1.24	1.187	1.304	<0.001
Missing	7867	0.71	0.95	0.818	1.110	NS
BMI group [RC=Normal (18-24)]	52989	1.00	1.00	--	--	--
Underweight (<18)	7745	1.09	1.16	0.976	1.392	NS
Overweight (25-29)	51433	1.26	1.54	1.408	1.680	<0.001
Obese (>= 30)	47510	1.46	2.47	2.265	2.688	<0.001
Missing	90669	0.81	1.01	0.932	1.106	NS
Smoking [RC=Never]	62020	1.00	1.00	--	--	--
Current	17629	0.91	1.08	0.947	1.230	NS
Past	20024	1.46	2.02	1.801	2.254	<0.001
Missing	150673	0.94	1.54	1.433	1.650	<0.001

RC=Reference category

* Along with five main effect variables (Age, Gender, Location, BMI, and Smoking), the model also included seven interaction terms (results not reported here): Age*BMI, Gender*BMI, Age*Smoking, Gender*Smoking, Location*BMI, Location*Smoking, and BMI*Smoking. Only the effects of Location, BMI, and Smoking are reported in this table.

Table 3. Managing hypertension, CPCSSN 2012-Q4: Achieving Blood Pressure Targets

Condition		%	n
Patients diagnosed with hypertension (N=57,180)	Systolic<140	79.8	44981
	Diastolic<90	94.5	44981
	Both systolic<140 and diastolic<90	78.0	44981
Patients diagnosed with both hypertension and diabetes (N=12,476)	Systolic<130	51.6	9782
	Diastolic<80	75.1	9782
	Both systolic<130 and diastolic<80	45.3	9782

Note: Used the average of last three readings (or whatever was available) of BP measurements done within the past 24 months. Of 57,180 hypertensive patients, 12,199 or 21.3% had missing BP measurements because measurements were either taken more than 2 years ago or missing from the database. Of 12,476 patients, 2,694 or 21.6% were missing because of the same reasons as mentioned.

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Table 4. Comorbidity – age and sex adjusted prevalence ratio: A log-binomial approach

Comorbidity	Parameter Estimates			p
	Prev. Ratio	Lower 95% CI	Upper 95% CI	
Diabetes**	1.69	1.647	1.729	<0.001
Depression**	1.24	1.216	1.272	<0.001
COPD**	1.22	1.169	1.265	<0.001
Osteoarthritis**	1.35	1.318	1.375	<0.001
Dementia	0.96	0.911	1.009	0.109
Epilepsy	1.05	0.945	1.157	0.390
Parkinsonism	1.01	0.890	1.154	0.842

Modeled the probability of each of the comorbid conditions, for which the predictor is HYPERTENSION (yes/no), along with age and sex. Interpretation: People with HTN are 1.69 times more likely to be diabetic than people without HTN, and so on.

* p <0.01, ** p<0.001.

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Table 5. Comorbidity: hypertension vs. other conditions

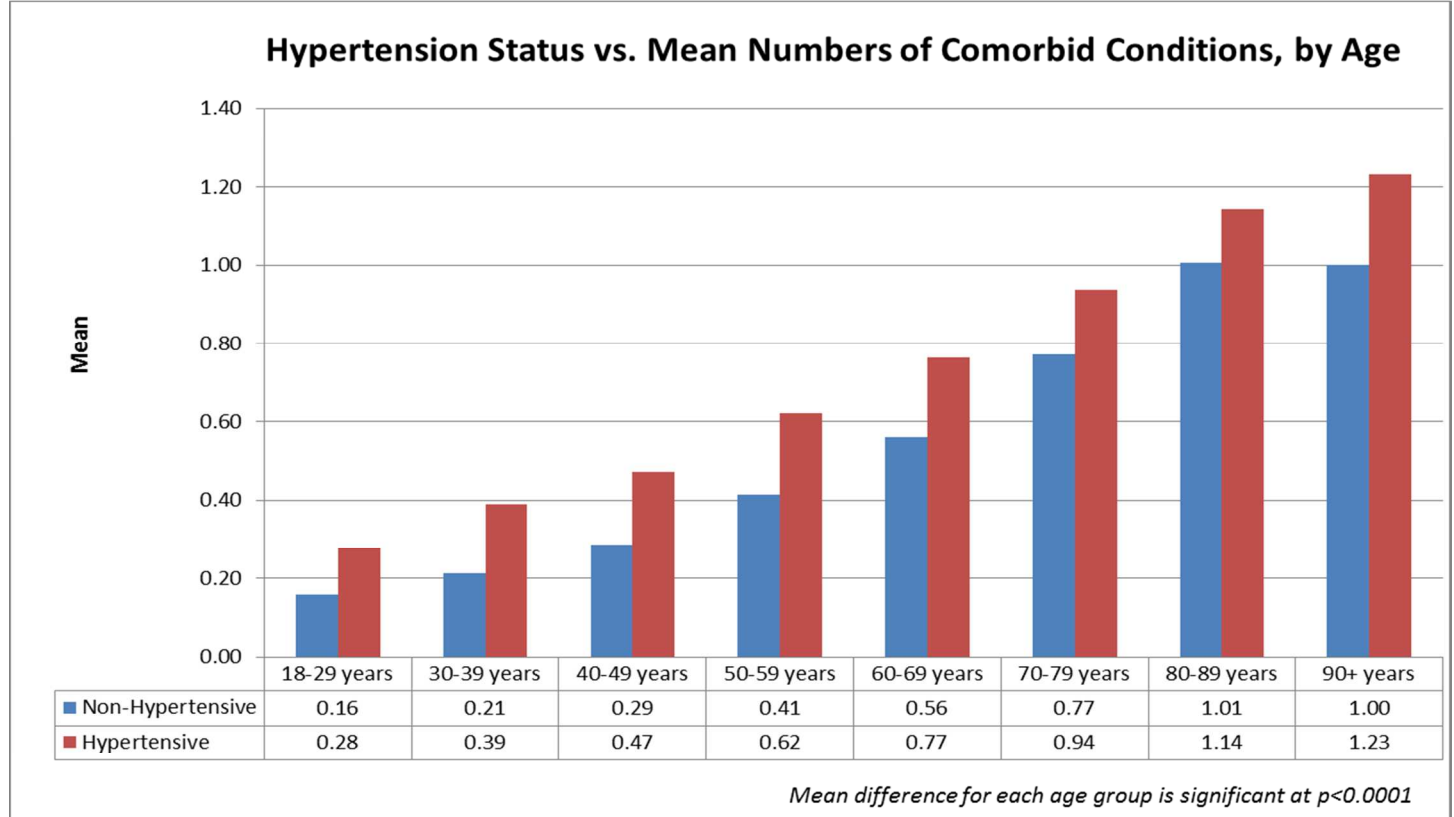
# of comorbid conditions	Hypertension=No (N=193166)	Hypertension=Yes (N=57180)
0 condition	71.0	44.3
1 condition	23.5	36.6
2 conditions	4.6	14.5
3 conditions	0.8	3.8
4+ conditions	0.1	0.8

We also ran a log link function of Poisson regression on the number of other comorbid conditions, taking age and sex as control variables. The summary results are given below:

Contrast Estimate Results					
Label	Mean Estimate	Mean Confidence Limits		Standard Error	Pr > ChiSq
HTN estimate	1.34	1.325	1.360	0.0067	<.0001

Patients with hypertension are 1.34 times as likely to have other chronic conditions as patients without hypertension.

Figure 2.



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Table 6. Utilization: Number of Encounters with the Practice

	Hypertension=No	Hypertension =Yes
Mean (SD)	6.6 (6.9)	11.2 (9.4)
Median	5.0	9.0

We then ran a multivariate analysis on utilization data, taking age, sex, location and all other comorbid conditions into account as control variables and using log link function of Poisson distribution. The summary results are given below:

Contrast Estimate Results					
Label	Mean Estimate	Mean Confidence Limits		Standard Error	Pr > ChiSq
HTN estimate	1.29	1.281	1.290	0.0018	<.0001

Patients with hypertension are 1.29 times as likely to have encounters with their practices as patients without hypertension.

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Table 7. Use of medications by hypertensive patients

Medications	% used (N=57180)
CCB	31.1%
Diuretics	46.8%
ACEI	52.0%
ARB	21.3%
BB	28.5%
No HTN meds	12.1%

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Table 8. Use of multiple medications

# of anti-hypertensive drugs	%	N
0 drug	12.1	6908
1 drug	32.5	18583
2 drugs	29.2	16698
3 drugs	17.4	9949
4+ drugs	8.8	5042
Total	100.0	57180

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