

Article details: 2014-0038	
Title	A Cross Sectional Analysis of Hypertension in Canadian Family Physician Practices: A Report from the Canadian Primary Care Sentinel Surveillance Network (CPCSSN)
Authors	Godwin, Marshall (proxy) (contact); Williamson, Tyler; Khan, Shahriar; Kaczorowski, Janusz; Asghari, Shabnam; Morkem, Rachael; Dawes, Martin; Birtwhistle, Richard
Reviewer 1	Joffres, Michel
Institution	Simon Fraser University, Faculty of Health Sciences
General comments	<p>Very interesting and important paper, which is surprisingly close to the results of the CHMS data. I was expecting, like the authors, a higher prevalence of hypertension in this group.</p> <p>This network is an important network for surveillance of hypertension and other conditions in Canada, providing estimates that seem reliable, and on a significant number of people, and complements existing surveys.</p> <p>A few points:</p> <p>I would hesitate to qualify hypertension as a disease, but rather as a condition.</p> <p>A table with a few demographic variables (age, sex etc.) could have been useful.</p> <p>One of the key issues in this paper is how BP is measured, and I would have liked to see more details about measurement in the methods section.</p> <p>The proportion controlled is high, but given that this study does not include people who are not aware (unlike the CHMS) the 78% controlled corresponds to the 64% controlled if we take into account the 17% unaware.</p> <p>It would be interesting to know why 12% have no medication. Are they on non-pharmacological treatment only? Or recently diagnosed? Or close to the threshold?</p> <p>Table 2, the footnote should mention that the model did not contain, as co-variable, the variable under study.</p>
Reviewer 2	Scourboutakos, Mary
Institution	University of Toronto, Nutritional Sciences
General comments	<p>The authors utilize the Canadian Primary Care Sentinel Surveillance Network (CPCSSN) to provide an overview of hypertension prevalence rates across seven provinces and one territory. While hypertension prevalence has previously been reported using data from the Canadian Health Measures Survey, this study also incorporated additional data from the CPCSSN, such as point-of-care management, achievement of blood pressure targets and other co-morbidities. Their inclusion of data from one territory is a novel contribution to the literature as Canada's hypertension prevalence rates to date have excluded the territories. After adjusting for the Canadian national age-sex distribution they found a similar prevalence rate compared to that found by the Canadian Health Measures Survey. Additionally, the authors report that 78% of patients with hypertension have achieved the systolic and diastolic target, and show that people with a diagnosis of hypertension are more likely to have co-morbidities, and have more visits with physicians.</p> <p>MAJOR COMMENTS</p> <ol style="list-style-type: none"> The authors state that data was collected from seven provinces and one territory. In the discussion they acknowledge that a limitation of this study is its generalizability, as the physicians included in the dataset "are not distributed randomly around the country". It would be useful to provide a summary table with information regarding the number of clinics that are from each province, the number of patients in each clinic, and any other available details that would better characterize the population of clinics included in the study. On the same note, despite the fact that many of the sample characteristics are currently indirectly reported in the tables, it might be useful to include a single table outlining the characteristics of the study participants including the average age, proportion of males vs females, province of residence, and any other relevant details for which data is available. Figure 1 suggests that there is interaction between gender and age when it comes to prevalence of hypertension. However, it seems that AGE by GENDER was not included as an interaction term in the prevalence ratio model in table 2, despite the fact that many other interaction terms were tested. Is there a specific reason for this? Based

	<p>on figure 1, it seems that this may in fact be an important predictor. If there is indeed a significant interaction, can you elaborate on this in the interpretation?</p> <p>4. Because data on hypertension rates in the Canadian territories have never been reported, it might be interesting to include a supplementary table illustrating hypertension rates by province/territory. This would be a novel contribution to the literature as this population's data has not been previously reported. Alternatively, province/territory could be included in the prevalence ratio model in table 2. Or, if there is no difference in hypertension prevalence rates across provinces/territory than this fact could simply be stated.</p> <p>MINOR COMMENTS</p> <p>1. In the intro, the authors should clearly state the added value of this paper. It might be easier for readers to appreciate the uniqueness of the paper if you outright state the gap in the current literature.</p> <p>2. Currently there is no mention of gender whatsoever in the results section. Would be useful to add something to describe the relationship between gender and hypertension.</p> <p>3. Page 5, Line 25 – might be useful to include a reference for the “problem list table” to assist non-clinicians who are unfamiliar with the features of the EMR.</p> <p>4. Page 5, Line 19 – “we used a combination of descriptive statistics and multivariate modeling...” perhaps this sentence would be better placed in the “analysis” section.</p> <p>5. Page 8, Line 48-49 – After recognizing that the association between co-morbidity and hypertension is not new, could you briefly discuss the other studies that have examined this association and put your findings within the context of those other studies? Are your findings in complete agreement with the other studies that have shown the same thing?</p> <p>6. Page 7 Line 39, p. 8 line 37-41 and p. 9 lines 13 and 18 – It's unnecessary to restate the results within this section. Eliminating this can free up more words for further interpretation.</p> <p>7. Concerning the interaction terms that were reported in the footnote in table 2, could the authors also mention in the footnote whether or not these interaction terms were significant?</p> <p>8. Abstract says “family physicians in seven provinces” methods says “seven provinces and one territory” please harmonize.</p> <p>9. Page 10, lines 48 onward – The statement concerning the next steps and further research should be precede the conclusion</p>
Reviewer 3	Xu, Yan
Institution	Queen's University, School of Medicine
General comments	<p>SUMMARY</p> <p>This manuscript provides a unique, nationwide perspective on the prevalence of hypertension, its associated co-morbidities, as well as its control at the primary care level. It leverages data from the Canadian Primary Care Sentinel Surveillance Network (CPCSSN), a group of over 400 physicians who submit clinical data over several electronic medical record (EMR) programs to a centralized system capable of cleaning, coding and analysis.</p> <p>The study demonstrates a 20.4% age-standardized prevalence of hypertension, consistent with results of the Canadian Health Measurements Survey. It reports a statistically significant association between hypertension and BMI, as well as an age-related increase in the prevalence of hypertension. Health care resource utilization in the form of physician visits nearly doubled among patients with a diagnosis of</p>

	<p>hypertension.</p> <p>MAJOR COMMENTS</p> <p>The main strength of the paper lies in its use of micro-level EMR data; while there have been several studies utilizing administrative databases to study characteristics of hypertensive patients in Canada, the largest of which included 3.5 million cases (Quan et al., Can J Cardiol, 2013), this is to my understanding the first Canada-wide study that contains blood pressure measurements taken in the routine clinical setting at the primary care level. Additionally, the concurrent inclusion of demographic, anthropometric and therapeutic data further strengths its analytic power and impact.</p> <p>There are, however, several limitations to this approach, some of which were noted by the authors.</p> <p>1) Selection bias and generalizability: CPCSSN captures 600,000 patients across Canada, approximately 1.2% of the general population. It is especially important, thus, to provide sufficient baseline characteristics regarding the CPCSSN cohort from which the hypertension subgroup is derived. For example, Statistics Canada reports that 81% of Canadians live in urban areas (defined by population > 1000 and density > 400 persons/square km); looking at Table 2, it appears that rural hypertensive patients are over-represented in the study (22.4%). It is uncertain whether this is due to a greater number of rural patients in the CPCSSN database, or reflective of a true increased prevalence ratio. Of note, incident hypertensive cases reported by Quan et al were 80.4% urban and 17.2% rural, consistent with distributions seen in the general population.</p> <p>In summary, a baseline table describing the CPCSSN cohort (age, sex, region of residence, comorbidities, province of residence, BMI) from which the hypertension subgroup was derived would be beneficial to convince the readers that patients captured by CPCSSN is truly representative of the Canadian population.</p> <p>2. Missing data: It is noted that some variables used in the univariate analysis contain a significant proportion of missing data. For example, variable "smoking status" was missing in >70% of individuals in the cohort. The data in itself gives pause to the fact that collection of smoking status is suboptimal among patients with hypertension, a group with an already elevated risk of cardiovascular disease. I would suggest that the decision to perform a subgroup analysis be reconsidered given this level of missing data, especially without proof that the remaining cases are phenotypically similar to those censored from the analysis. Data from the Women's Health Study show that the rate of incident hypertension is not increased among former smokers compared to never smokers (Bowman et al., J Am Coll Cardiol, 2007); use of cross-sectional prevalence data to test for this association raises concerns of ecological fallacy.</p> <p>3. Validation of medication data: a study employing a new method of cohort identification requires rigorous validation; it is encouraging to see the PPV for hypertension in the CPCSSN cohort at >90%. However, there is no mention with respect to validation of the medication data contained in the CPCSSN dataset. The EMRALD study recently published the % agreement in laboratory, medication and visit data between the EMR and administrative data from the Ontario Health Insurance Program (Tu et al., Am J Manag Care, 2014). Similar validation using administrative database housed by one of the provinces in which CPCSSN collects data would be welcome.</p> <p>MINOR COMMENTS:</p> <p>1. Postal code analysis for rurality: The paper may benefit from use of a more precise measurement of rurality, such as using the PCCF (Postal Code Conversion File) from Statistics Canada using its Community Size (CSIZE) field.</p>
<p>Author response</p>	<p>Reviewer 1: Michel Joffres Simon Fraser University Faculty of Health Sciences</p> <p>Comments to the Author Very interesting and important paper, which is surprisingly close to the results of the CHMS data. I was expecting, like the authors, a higher prevalence of hypertension in this group. This network is an important network for surveillance of hypertension and other conditions in Canada, providing estimates that seem reliable, and on a significant</p>

number of people, and complements existing surveys.

A few points:

1. I would hesitate to qualify hypertension as a disease, but rather as a condition. **(This only occurred in Abstract and we have changed disease to condition)**

2. A table with a few demographic variables (age, sex etc.) could have been useful.
Done Table 2

3. One of the key issues in this paper is how BP is measured, and I would have liked to see more details about measurement in the methods section. **Done...acknowledged heterogeneity of BP measurements across practices**

4. The proportion controlled is high, but given that this study does not include people who are not aware (unlike the CHMS) the 78% controlled corresponds to the 64% controlled if we take into account the 17% unaware. **I believe CHMS used only a single assessment and may have overestimated the number of people who were unaware of having high blood pressure. In clinical practice three assessments on separate occasions are needed to make a diagnoses of hypertension. Even though the CHMS used the average of 5 readings on an automated BP device, and this would have decreased the likelihood of 'white coat hypertension', three separate assessments are still required to label someone as hypertensive.**

5. It would be interesting to know why 12% have no medication. Are they on non-pharmacological treatment only? Or recently diagnosed? Or close to the threshold? **This question would not be accurately answered with CPCSSN data. We could look at time of diagnoses, actual BP levels, etc and make an educated guess. But it still would only be an educated guess. The question 'why' is difficult to answer using secondary analysis. Needs qualitative research methods to do a proper job.**

6. Table 2, the footnote should mention that the model did not contain, as co-variable, the variable under study. **Table changes and change in text, as indicated in response to editors comments, has dealt with this.**

Reviewer 2: Yan Xu
Queen's University School of Medicine

Comments to the Author
SUMMARY

This manuscript provides a unique, nationwide perspective on the prevalence of hypertension, its associated co-morbidities, as well as its control at the primary care level. It leverages data from the Canadian Primary Care Sentinel Surveillance Network (CPCSSN), a group of over 400 physicians who submit clinical data over several electronic medical record (EMR) programs to a centralized system capable of cleaning, coding and analysis.

The study demonstrates a 20.4% age-standardized prevalence of hypertension, consistent with results of the Canadian Health Measurements Survey. It reports a statistically significant association between hypertension and BMI, as well as an age-related increase in the prevalence of hypertension. Health care resource utilization in the form of physician visits nearly doubled among patients with a diagnosis of hypertension.

MAJOR COMMENTS

The main strength of the paper lies in its use of micro-level EMR data; while there have been several studies utilizing administrative databases to study characteristics of hypertensive patients in Canada, the largest of which included 3.5 million cases (Quan et al., Can J Cardiol, 2013), this is to my understanding the first Canada-wide study that contains blood pressure measurements taken in the routine clinical setting at the primary care level. Additionally, the concurrent inclusion of demographic, anthropometric and therapeutic data further strengthens its analytic power and impact.

There are, however, several limitations to this approach, some of which were noted by

the authors.

1) Selection bias and generalizability: CPCSSN captures 600,000 patients across Canada, approximately 1.2% of the general population. It is especially important, thus, to provide sufficient baseline characteristics regarding the CPCSSN cohort from which the hypertension subgroup is derived. For example, Statistics Canada reports that 81% of Canadians live in urban areas (defined by population > 1000 and density > 400 persons/square km); looking at Table 2, it appears that rural hypertensive patients are over-represented in the study (22.4%). It is uncertain whether this is due to a greater number of rural patients in the CPCSSN database, or reflective of a true increased prevalence ratio. Of note, incident hypertensive cases reported by Quan et al were 80.4% urban and 17.2% rural, consistent with distributions seen in the general population. **Canada Posts use of zero in the second character in the postal code as a definition of rural includes many areas with populations greater than 1000 but is generally less than 10,000. Discussed in text under Methods**

In summary, a baseline table describing the CPCSSN cohort (age, sex, region of residence, comorbidities, province of residence, BMI) from which the hypertension subgroup was derived would be beneficial to convince the readers that patients captured by CPCSSN is truly representative of the Canadian population. **Done Table 2**

2. Missing data: It is noted that some variables used in the univariate analysis contain a **significant proportion of missing data. For example, variable "smoking status" was missing in >70% of individuals in the cohort.** The data in itself gives pause to the fact that collection of smoking status is suboptimal among patients with hypertension, a group with an already elevated risk of cardiovascular disease. I would suggest that the decision to perform a subgroup analysis be reconsidered given this level of missing data, especially without proof that the remaining cases are phenotypically similar to those **censored from the analysis. Data from the Women's Health Study show that the rate of incident hypertension is not increased among former smokers compared to never smokers (Bowman et al., J Am Coll Cardiol, 2007); use of cross-sectional prevalence data to test for this association raises concerns of ecological fallacy. We used a separate group "Missing Data" in the analysis to deal with this issue.**

3. Validation of medication data: a study employing a new method of cohort identification requires rigorous validation; it is encouraging to see the PPV for hypertension in the CPCSSN cohort at >90%. However, there is no mention with respect to validation of the medication data contained in the CPCSSN dataset. The EMRALD study recently published the % agreement in laboratory, medication and visit data between the EMR and administrative data from the Ontario Health Insurance Program (Tu et al., Am J Manag Care, 2014). Similar validation using administrative database housed by one of the provinces in which CPCSSN collects data would be welcome. **We have not conducted such validation studies on medication. We report medications as prescribed not as used. See response to editor's comment.**

MINOR COMMENTS:

1. Postal code analysis for rurality: The paper may benefit from use of a more precise measurement of rurality, such as using the PCCF (Postal Code Conversion File) from Statistics Canada using its Community Size (CSIZE) field. **Addressed in text. Under Methods. See response to editors comments**

Reviewer 3: Mary Scourboutakos
University of Toronto Nutritional Sciences

Comments to the Author

The authors utilize the Canadian Primary Care Sentinel Surveillance Network (CPCSSN) to provide an overview of hypertension prevalence rates across seven provinces and one territory. While hypertension prevalence has previously been reported using data from the Canadian Health Measures Survey, this study also incorporated additional data from the CPCSSN, such as point-of-care management, achievement of blood pressure targets and other co-morbidities. Their inclusion of data from one territory is a novel contribution to the literature **as Canada's hypertension prevalence rates to date have excluded the territories.**

After adjusting for the Canadian national age-sex distribution they found a similar

prevalence rate compared to that found by the Canadian Health Measures Survey. Additionally, the authors report that 78% of patients with hypertension have achieved the systolic and diastolic target, and show that people with a diagnosis of hypertension are more likely to have co-morbidities, and have more visits with physicians.

MAJOR COMMENTS

1. The authors state that data was collected from seven provinces and one territory. In the discussion they acknowledge that a limitation of this study is its generalizability, **as the physicians included in the dataset “are not distributed randomly around the country”**. **It would be useful to provide a summary table with information regarding the number of clinics that are from each province, the number of patients in each clinic, and any other available details that would better characterize the population of clinics included in the study. New Table 1**

2. On the same note, despite the fact that many of the sample characteristics are currently indirectly reported in the tables, it might be useful to include a single table outlining the characteristics of the study participants including the average age, proportion of males vs females, province of residence, and any other relevant details for which data is available. **Done Table 2**

3. Figure 1 suggests that there is interaction between gender and age when it comes to prevalence of hypertension. However, it seems that AGE by GENDER was not included as an interaction term in the prevalence ratio model in table 2, despite the fact that many other interaction terms were tested. Is there a specific reason for this? Based on figure 1, it seems that this may in fact be an important predictor. If there is indeed a significant interaction, can you elaborate on this in the interpretation? **Done. Addressed in text and Table 3**

4. Because data on hypertension rates in the Canadian territories have never been reported, it might be interesting to include a supplementary table illustrating hypertension rates by province/territory. This would be a novel contribution to the **literature as this population’s** data has not been previously reported. Alternatively, province/territory could be included in the prevalence ratio model in table 2. Or, if there is no difference in hypertension prevalence rates across provinces/territory than this fact could simply be stated. **We have too little data from territories to make any reasonable comment.**

MINOR COMMENTS

1. In the intro, the authors should clearly state the added value of this paper. It might be easier for readers to appreciate the uniqueness of the paper if you outright state the gap in the current literature. **Discussed in intro and Interpretation.**

2. Currently there is no mention of gender whatsoever in the results section. Would be useful to add something to describe the relationship between gender and hypertension. **Gender is addressed in Table 2, Figure 1, and Table 3**

3. Page 5, Line 25 – **might be useful to include a reference for the “problem list table” to assist non-clinicians** who are unfamiliar with the features of the EMR. **(described as health condition list.**

4. Page 5, Line 19 – **“we used a combination of descriptive statistics and multivariate modeling...” perhaps this sentence would be better placed in the “analysis” section.** **Moved to analysis section**

5. Page 8, Line 48-49 – After recognizing that the association between co-morbidity and hypertension is not new, could you briefly discuss the other studies that have examined this association and put your findings within the context of those other studies? Are your findings in complete agreement with the other studies that have shown the same thing? **This statement is no longer in the manuscript. However since hypertension is often part of a broader constellation of health conditions we were simply stating that what we found was what would be expected to be found.**

6. Page 7 Line 39, p. 8 line 37-41 and p. 9 lines 13 and 18 – **It’s unnecessary to restate the results within this section.** Eliminating this can free up more words for further interpretation. **This conflicts somewhat with the editors comments to include ‘main findings’ in the Interpretation section.**

	<p>7. Concerning the interaction terms that were reported in the footnote in table 2, could the authors also mention in the footnote whether or not these interaction terms were significant? Discussed in text under Results. And table 3. None of interaction terms were significant.</p> <p>8. Abstract says “family physicians in seven provinces” methods says “seven provinces and one territory” please harmonize. Territory not mentioned now.</p> <p>9. Page 10, lines 48 onward – The statement concerning the next steps and further research should be precede the conclusion Done</p>
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