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Chronic Disease Management in Primary Health Care: A Demonstration of EMR Data for Quality and Health System Monitoring

Executive Summary

Non-communicable diseases, referred to here as chronic diseases, are the leading cause of death in the world.[1] Adults with multiple chronic diseases, or multimorbidity, tend to be high users of health care services and account for more than two-thirds of health care spending.[2] Since the prevalence of multimorbidity increases with age, effectively managing patients with multiple chronic diseases in primary care is critical.[3] Data on primary health care (PHC) has been identified as a major gap and has been highlighted as a priority for jurisdictions looking to measure and improve chronic disease prevention and management.[4, 5] While billing and survey data can provide part of the picture, a more complete picture of PHC patient encounter data is needed.

Use of electronic medical records (EMRs) is increasing rapidly across Canada. Several provinces are investing in programs to encourage the use of EMRs in PHC settings. Because EMR data is designed to include lab results, height, weight, blood pressure measurements and other information used to prevent and manage chronic diseases, it has the potential to inform a wide range of questions on chronic disease management in PHC at the patient, practice and health system levels. This data could be used to inform health policy, resource and population health planning, and evaluation. This study investigates the burden of chronic disease and multimorbidity (the presence of two or more chronic diseases) using EMR data.

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Analyses using EMR data submitted to the prototype PHC Voluntary Reporting System (VRS) at the Canadian Institute for Health Information (CIHI) indicate the following:

- PHC plays a critical role in chronic disease management:
  - About 4 out of 10 (41%) patients had at least one of seven chronic diseases, and 6% had three or more diseases. The number and type of conditions varied by age.
  - More chronic diseases led to higher PHC service utilization across all age groups.
- There is variation among practices and room for improvement in chronic disease monitoring:
  - Two out of five patients with coronary artery disease and nearly one out of four patients with diabetes did not have a recommended test to measure low-density lipoprotein and blood glucose control levels (LDL and HbA1c), respectively, recorded in their EMR in the last 12 months; of those with measures recorded, only half were meeting recommended targets.
  - Younger patients with one chronic disease were more likely to not have any monitoring recorded in their EMR.
  - These findings point to the need for reminders and individualized treatment plans—both of which can be implemented in a patient's EMR—as well as health policy focused on improvements in chronic disease monitoring.

Currently, EMR data has limitations. The population covered by PHC EMRs is limited, as nearly half of family physicians in Canada do not use an EMR. Of the EMR users, many still use it solely for scheduling and billing, rather than as a fulsome patient care record. Much of the information contained in an EMR is non-standard, unstructured and largely made up of free-text entries. Furthermore, current EMR systems were designed to replace paper charts and to capture characteristics of patients and patient visits—they were not created to facilitate data query and extraction. As a result, EMR data is labour-intensive to query, manipulate and analyze, and it is mostly limited to use by the clinic. This study demonstrates the potential of EMR data to support chronic disease prevention and management in PHC settings, as well as the need for PHC EMR data standards.

EMR Use in Canada: An Emerging Trend

According to surveys by The Commonwealth Fund, the adoption of EMRs by primary care physicians in Canada has more than doubled, from 23% in 2006 to 56% in 2012. With more than half of family physicians using EMRs, this data source is becoming increasingly relevant to clinical practices, policy- and decision-makers, and researchers. While patient self-reported survey and administrative data has provided important information on the burden of chronic disease in PHC, these sources contain limited information on patient characteristics, clinical measures and clinical care. With the added dimensions of clinical measures and lab results, EMR data stands to be a potentially powerful tool to answer questions about best practices for optimal patient outcomes. A recent study by Canada Health Infoway highlighted a significant opportunity for EMRs to support chronic disease management through the use of more advanced EMR functions, such as medication alerts, test duplication alerts and chronic disease flow sheets, which in turn could produce benefits for the health care system at large.[6]

According to the 2010 National Physician Survey, however, the tendency is still to use the EMR simply as a replacement for a paper chart: 39% of clinicians used their EMR to enter and retrieve patients' clinical notes, while only 20% used the EMR for more advanced functions such as automated reminders for recommended patient care.[7] In addition, Canada still lags behind other countries in terms of EMR adoption: countries such as Australia and the U.K. currently report that more than 90% of their clinicians use an EMR in their practice.[8] In its current state, most EMR data is non-standard, unstructured and consists of large amounts of free text. A significant level of effort is involved in cleaning and processing the data for analysis and reporting. Implementing data standards into EMR specifications would go a long way to improving the usability of

EMR data to support quality of care and indicator monitoring, and jurisdictions are beginning to recognize the importance of collecting standardized EMR data in PHC settings.[9] In addition to the EMR data standards, CIHI and others have found that additional levers—including clinician leadership, policy- and governance-enabling frameworks, and capacity-building—are needed to ensure that more structured data is captured efficiently at the point of care.[10]

Chronic Disease in Primary Health Care

The World Health Organization has declared chronic disease an epidemic with a large economic impact: currently, chronic diseases are the leading cause of death in the world.[1] Adults with multiple chronic diseases tend to be high users of health care services and account for more than two-thirds of health care spending.[2] Since the prevalence of multimorbidity increases with age, effectively managing patients with multiple chronic diseases in primary care is critical.[3] Part of effective chronic disease management is adherence to clinical practice guidelines.[11] For example, recommended care guidelines for patients with diabetes include regular blood glucose level (HbA1c) monitoring and suggest that a target for blood glucose levels should be less than 7%.[12] Proper monitoring of hypertension includes regular blood pressure measurement,[13] and the monitoring of low-density lipoprotein (LDL) is important in the management of coronary artery disease[14] and diabetes.[12]

This Analysis in Brief demonstrates the potential of EMR data to provide information on the prevalence of various chronic diseases, patient characteristics of those with multimorbidity and health system utilization related to multimorbidity. Given the availability of lab results and clinical measures, EMR data also offers the potential to analyze quality of care in terms of whether recommended care guidelines have been implemented and achieved. The intent of this study is to showcase the importance of EMR data to

- Improve our understanding of PHC;
- Support quality of care initiatives and, therefore, better health outcomes;
- Improve evidence-based disease management; and
- Answer critical policy-related questions on chronic disease and multimorbidity in PHC.

Methodology

Data Source

The data source for this demonstration is the prototype PHC VRS, an initiative led by CIHI to pilot the extraction and analysis of EMR data for comparative reporting purposes. The PHC VRS includes EMR data collected between 2009 and 2013 from 489 primary care clinicians and 337,793 patients. This sample represents a mix of urban and rural practices with various delivery models (such as family health teams, family health groups and community health centres) from PHC clinics primarily in Ontario, with some data also collected in British Columbia and Nova Scotia.

Patients younger than 18, those missing age or gender information and patients not seen in the previous two years were excluded from the study. Data captured in the PHC VRS is a mixture of semi-structured and free-text entries. Data analysis in this study was limited to fields that were more than 70% complete across EMRs; for example, data elements involving referrals and body mass index were not addressed in this study, as these fields are not well populated in the data. Completion rates are expected to improve as PHC EMR data standards are implemented in EMR specifications.

Patients suffering from any of seven chronic diseases were identified using validated algorithms (see sidebar). These algorithms, designed in collaboration with PHC clinicians, identified patients as having one or more of the following: asthma, chronic obstructive pulmonary disease (COPD), coronary artery disease (CAD), depression, diabetes, hypertension and/or osteoarthritis.

Identifying Patients With Chronic Disease

In order to address the predominance of free text in EMR systems and identify patients with chronic diseases, a case definition methodology was developed. While data elements such as health condition, reason for visit and billing codes are all currently captured in EMR systems, the fields are not standardized or structured, or may not be up to date, and so by themselves are not sufficient to identify patients with chronic disease. To illustrate, a physician could see a patient to confirm diabetes, request a lab test, receive positive results, employ a detailed care plan and prescribe a medication, all without ever entering the actual diagnosis of diabetes into the EMR. The case definition used the reason for visit, lab test results and medications to surmise that the patient has diabetes. This methodology was developed and used for seven chronic diseases: asthma, COPD, CAD, depression, diabetes, hypertension and osteoarthritis. The case definition algorithms used to identify diabetes, depression, CAD and hypertension were validated by participating clinicians; sensitivities ranged from 80% to 95%. Hux, et al., reported that the sensitivity of currently in-use claims data for actual diagnoses is about 86%, comparable to the present study.[15] Other studies have established the use of case-defined methodologies to identify disease in EMRs.[16] A more complete description of the case definition methodology can be found in Appendix A.

Results

Patient Characteristics

Table 1 provides a detailed description of the patient population used for this study. All patients were older than 18, had a visit to a participating PHC VRS clinic in the last two years and had a valid date of birth and gender recorded in their EMR. Of the 337,793 patients, 57% were female, 21% were age 65 and older and 41% had at least one of seven chronic diseases. Whereas the majority of younger patients (77%) had no chronic disease, only 31% of patients age 65 and older had no identified chronic disease. Multimorbidity increased with age, with adults 65 and older being twice as likely to have three or more chronic diseases as adults age 45 to 64. Similar trends have been reported elsewhere.[17]

Table 1: Patient Characteristics					
	Patients With No Chronic Diseases	Patients With One Chronic Disease	Patients With Two Chronic Diseases	Patients With at Least Three Chronic Diseases	Total
Gender					
Male	86,759 (59%)	34,771 (24%)	15,980 (11%)	8,938 (6%)	**146,448**
Female	111,103 (58%)	47,316 (25%)	20,896 (11%)	12,030 (6%)	**191,345**
Age					
18–44	108,202 (77%)	25,826 (18%)	5,111 (4%)	1,258 (1%)	**140,397**
45–64	68,049 (53%)	35,357 (28%)	15,705 (12%)	8,596 (7%)	**127,707**
65+	21,611 (31%)	20,904 (30%)	16,060 (23%)	11,114 (16%)	**69,689**
Total	**197,862**	**82,087**	**36,876**	**20,968**	**337,793**

Note
Chronic diseases include asthma, chronic obstructive pulmonary disease, coronary artery disease, diabetes, depression, hypertension and osteoarthritis.
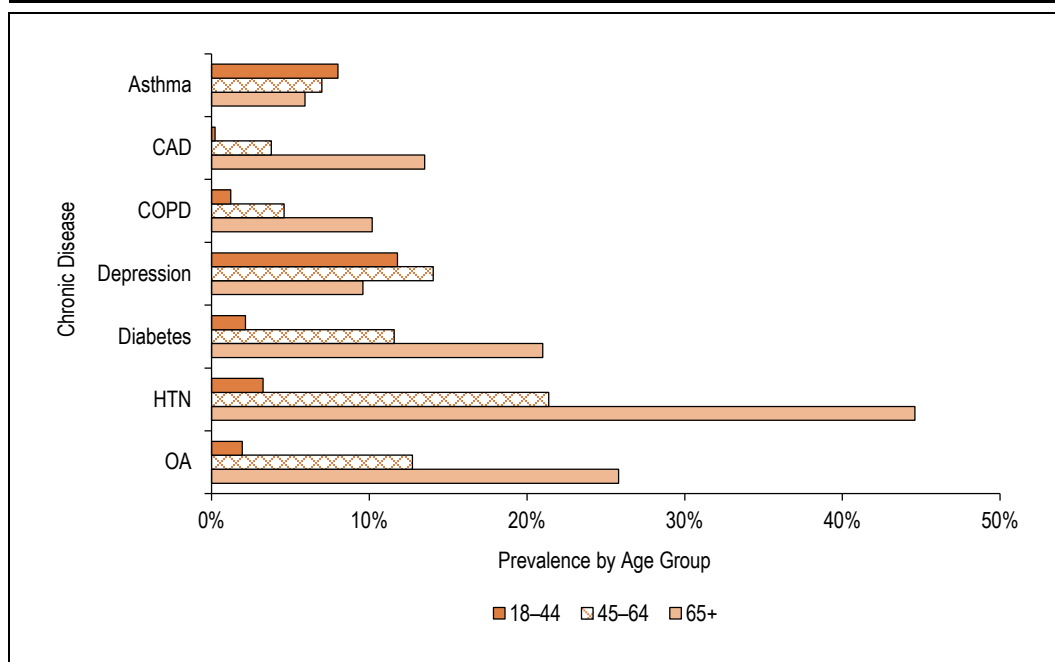**Source**
Primary Health Care Voluntary Reporting System, 2013, Canadian Institute for Health Information.

Prevalence of Chronic Disease in the PHC VRS

Figure 1 depicts the prevalence of each chronic disease by age group. Overall, hypertension had the highest prevalence at 19%, followed by depression (12%), osteoarthritis (11%), diabetes (10%), asthma (7%), COPD (4%) and CAD (4%). These numbers are comparable with those reported by other sources. For example, Statistics Canada reported the prevalence of hypertension and COPD in Canadian adults to be 19%[18] and 4%,[19] respectively, and the Public Health Agency of Canada reported rates of osteoarthritis to be 10% (in 2010),[20] depression to be 12% (in 2009)[21] and CAD to be 4.8% (in 2009).[22]

Hypertension and osteoarthritis were more prevalent in older patients, while asthma and depression were more prevalent in younger patients. Hypertension was the most common chronic disease in patients age 65 and older, followed by osteoarthritis and diabetes. In patients age 18 to 44, depression (12%) was the most common diagnosis, with asthma (8%) a close second.

Figure 1: Prevalence of Seven Chronic Diseases by Age Group

Note
Chronic diseases include asthma, chronic obstructive pulmonary disease (COPD), coronary artery disease (CAD), diabetes, depression, hypertension (HTN) and osteoarthritis (OA). N = 337,793.
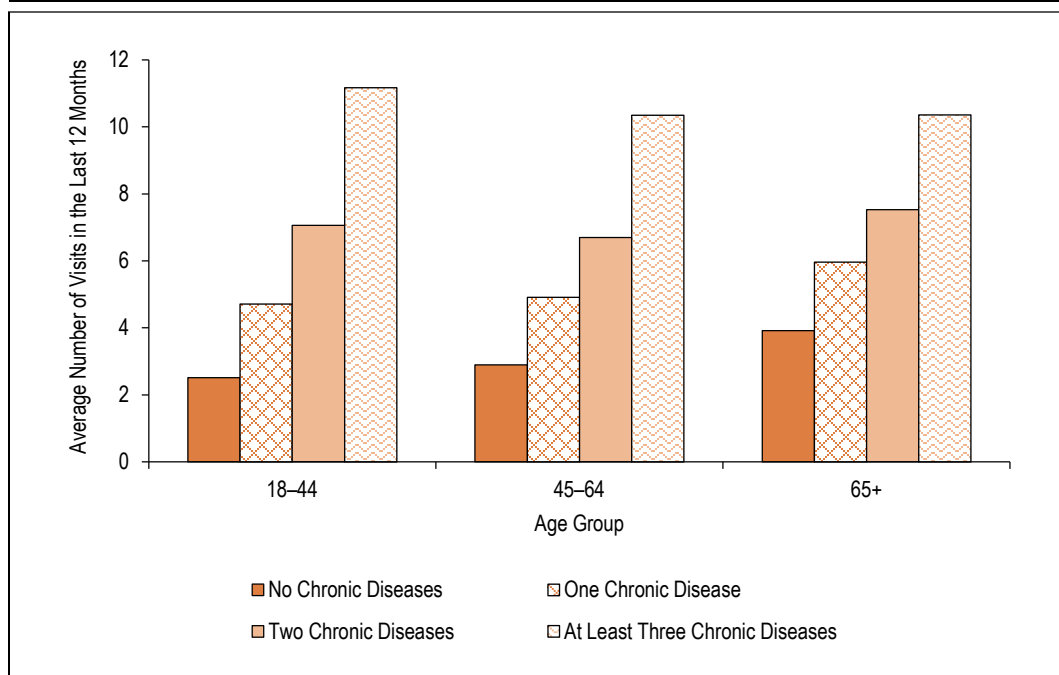**Source**
Primary Health Care Voluntary Reporting System, 2013, Canadian Institute for Health Information.

The alignment between the reported prevalence in this report and the prevalence numbers reported elsewhere supports the use of EMR data to inform questions about prevalence of various chronic diseases in Canada.

PHC Visits in Patients With Chronic Disease

Figure 2 shows the number of visits made to PHC practices over the last 12 months by age and disease status. Overall, patients with at least one chronic disease (41% of the study population) accounted for 62% of PHC visits in the last 12 months. Naturally, patients with more chronic diseases visited PHC clinics more often than those with fewer or no chronic diseases. This was true regardless of age. In a study released by CIHI in 2011 using data from the 2008 Canadian Survey of Experiences in Primary Health Care, the presence of chronic disease rather than age was determined to be the main driver of health system utilization in seniors; the same appears to be the case in this study.[23] It is important to note that patients identified as having no chronic disease may have a chronic disease other than the seven studied here. Further development of the case definition methodology to identify other chronic diseases was out of scope for this project, but this could be done with more structured data capture in EMRs and considered in future studies.

Figure 2: Average Number of Visits by Age and Disease Status

Notes
Chronic diseases include asthma, chronic obstructive pulmonary disease, coronary artery disease, diabetes, depression, hypertension and osteoarthritis.
Only patients with a visit to the primary care clinic in the last two years were included in the analysis (N = 337,793).
Source
Primary Health Care Voluntary Reporting System, 2013, Canadian Institute for Health Information.

A regression analysis evaluating the impact of chronic disease status, age and gender on health service utilization indicated that patients with three or more chronic diseases were 3.5 times more likely to be high service users (defined as 10 or more visits to a PHC clinic in the last 12 months). Patients age 65 and older were twice as likely to be high service users, and females were 30% more likely to be high service users. See Appendix B for additional results.
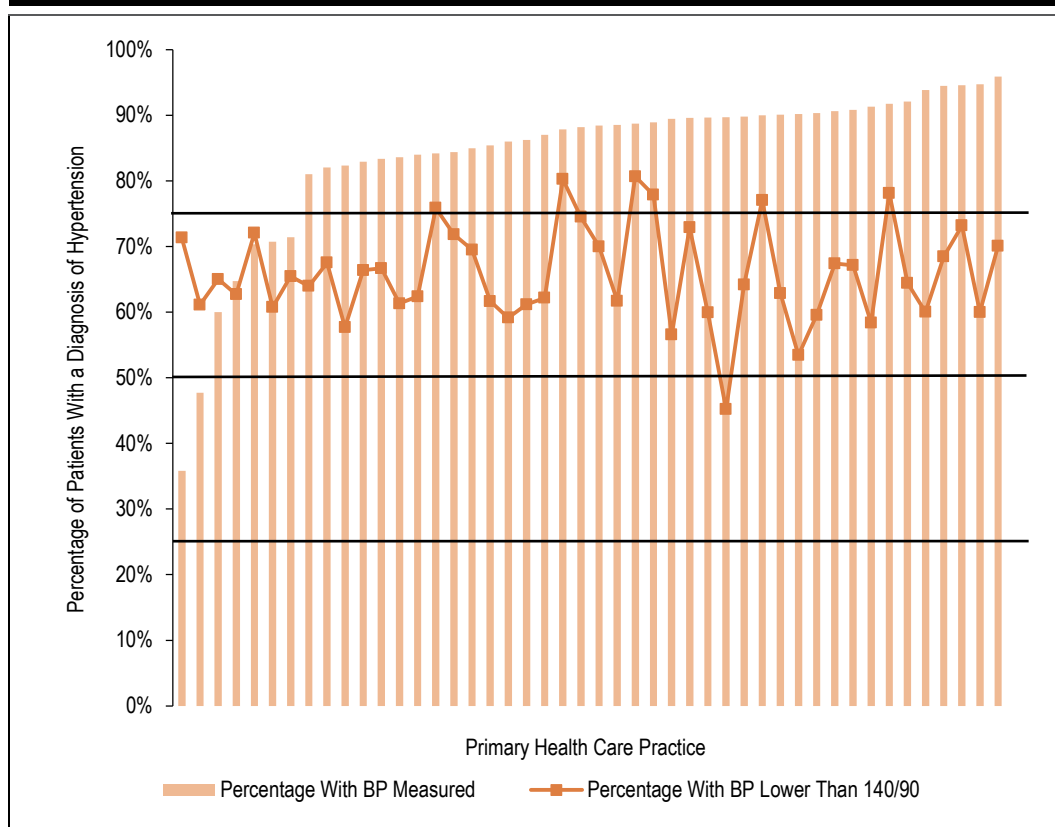
Clinical Care of Patients With Chronic Disease

The clinical data captured in EMR systems offers an opportunity to explore adherence to clinical practice guidelines for patients with chronic disease using measures such as lab results, blood pressure measurements and weight. The following section explores three specific areas: blood pressure results in patients with hypertension, blood glucose control level (HbA1c) results in patients with diabetes and LDL results in patients with CAD or diabetes.

Blood Pressure Screening and Outcomes in Patients With Hypertension

The Canadian Hypertension Education Program's 2013 guidelines recommend a blood pressure assessment at every visit, with a recommended target of lower than 140/90 for patients with exclusive hypertension; targets are more stringent for patients with certain comorbidities (for example, the target is lower than 130/80 for patients with diabetes).[13] For the purposes of consistency, this analysis used lower than 140/90 as a target for all patients. Figure 3 displays, by individual PHC clinic, the percentage of patients with a diagnosis of hypertension (either exclusively or in addition to other comorbidities) who had at least one blood pressure measurement recorded in their EMR over the last year and the percentage of patients who met the recommended target of lower than 140/90. About 44% of practices recorded at least one blood pressure measurement in the past year for at least 90% of their patients with hypertension. Of patients with a blood pressure measurement, about 35% did not meet the recommended target of lower than 140/90. Interestingly, Statistics Canada reported a similar trend: only 66% of patients with hypertension had their blood pressure controlled to this level.[18]

Figure 3: Variation in Blood Pressure Measurement by Practice

Notes

BP: Blood pressure.

Chronic diseases include chronic obstructive pulmonary disease, coronary artery disease, diabetes and hypertension.

Only patients with a diagnosis of hypertension who had a blood pressure measurement result in the last 12 months are included (N = 52,081).

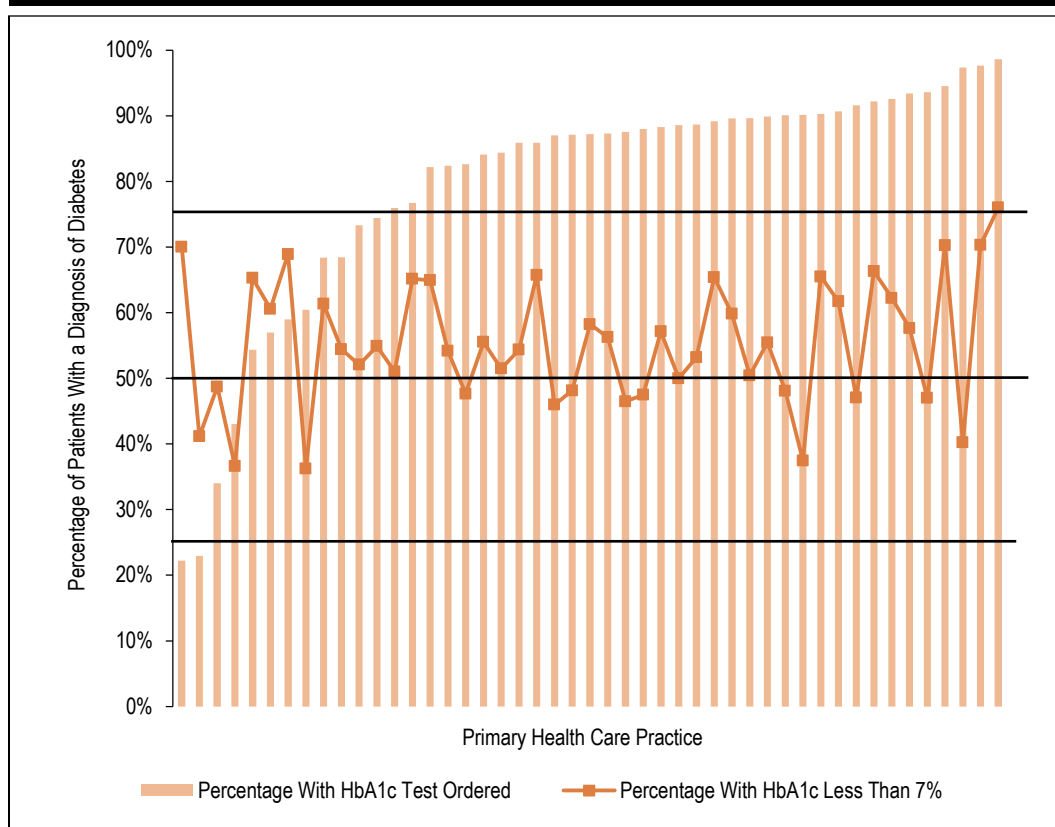Two practices were suppressed due to small sample size.

Source

Primary Health Care Voluntary Reporting System, 2013, Canadian Institute for Health Information.

There is wide variation among practices on blood pressure measurement and the extent to which patients are achieving the recommended target. Some variation can be expected, depending on the individual patient's profile, as in the case of patients with comorbid diabetes or frail elderly patients.[13]

Blood Glucose Control Screening and Outcomes in Patients With Diabetes

For patients with diabetes, Canadian clinical practice guidelines recommend blood glucose control testing in most patients as often as every three months and optimal glycemic control at HbA1c less than 7.0%.[12] Figure 4 depicts, by PHC practice, the percentage of patients with a diagnosis of diabetes who had an HbA1c test result recorded in their EMR in the past 15 months. In this study, 34% of practices had an HbA1c test recorded for at least 90% of their patients with diabetes. Of the patients with a test result available, about 53% had their HbA1c in the desired range of less than 7.0%. Of patients with HbA1c higher than 7.0%, approximately 26% had their HbA1c between 7.0% and 8.0%; 10% of patients had their HbA1c higher than 9.0%.

Figure 4: Variations in Blood Glucose Control Measurement by Practice
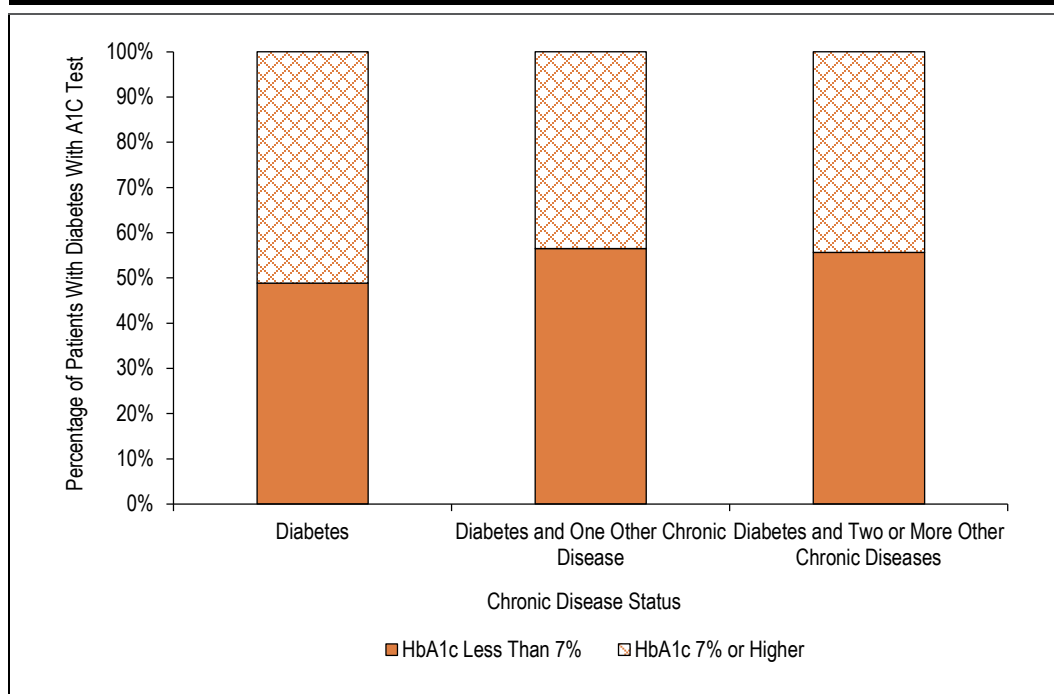
Notes

Chronic diseases include chronic obstructive pulmonary disease, coronary artery disease, diabetes and hypertension.

Only patients with a diagnosis of diabetes who had a valid HbA1c test result in the last 15 months are included (N = 24,801).

Four PHC practices were suppressed due to small sample size.

Source

Primary Health Care Voluntary Reporting System, 2013, Canadian Institute for Health Information.

Figure 5 highlights that a higher percentage of patients with diabetes and at least one other chronic disease had their HbA1c levels at less than 7%, compared with patients with diabetes alone.

Figure 5: HbA1c Levels by Disease Status

Notes
Chronic diseases include chronic obstructive pulmonary disease, coronary artery disease, diabetes and hypertension.
Only patients with a diagnosis of diabetes who had a valid HbA1c test result in the last 15 months are included (N = 24,801).
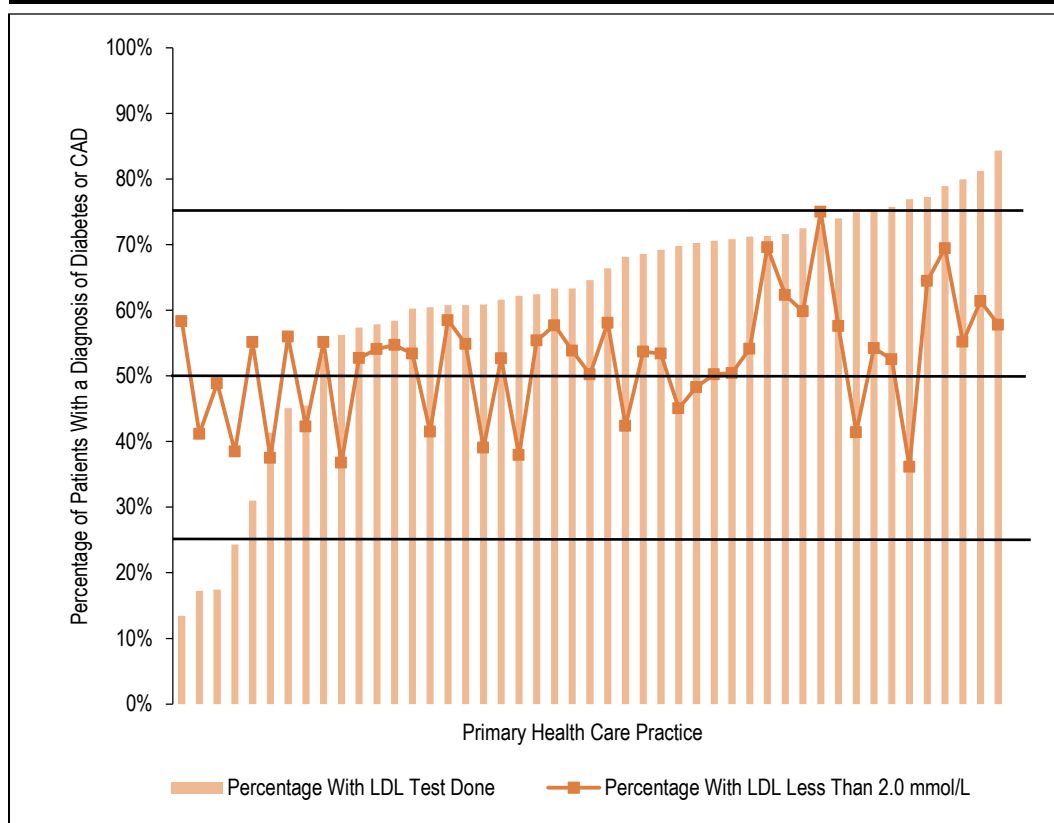**Source**
Primary Health Care Voluntary Reporting System, 2013, Canadian Institute for Health Information.

Other studies have found similar trends in better diabetes control in patients with multimorbidities. In one U.S.-based study, patients with the greatest clinical complexity (due to multiple chronic diseases) were more likely to receive high-quality diabetes care.[24] The same study also found that patients with more than three chronic diseases were more likely than the least-complex patients to be controlled for blood pressure (at less than 130/80), HbA1c (at less than 7.0%) and LDL (at less than 100 mg/dl; the Canadian equivalent is less than 2.6 mmol/L). Patients with diabetes with more chronic diseases had more frequent office-based physician visits, and patients with more annual office-based physician visits were more likely to receive HbA1c tests, compared with patients with diabetes who had fewer office-based physician visits.[25, 26]

LDL (Cholesterol) Screening and Outcomes in Patients With Coronary Artery Disease or Diabetes

The 2009 Canadian Cardiovascular Society Guidelines recommend an LDL target of less than 2.0 mmol/L.[14] Figure 6 displays, by PHC practice, the percentage of patients with a diagnosis of CAD or diabetes who had at least one LDL test recorded in their EMR in the past 12 months and the percentage of patients who met the recommended target. In this study, 19% of practices recorded at least one LDL test in the last 12 months for at least 75% of their patients with CAD or diabetes; of these patients, 54% had the desired LDL level of less than 2.0 mmol/L. Forty percent of patients did not have an LDL test result recorded. Interestingly, patients with *only* diabetes or CAD were *less* likely than patients with at least two conditions in addition to diabetes or CAD to have their LDL in the target range of less than 2.0 mmol/L (48% and 62%, respectively). This is similar to the finding reported with HbA1c levels.

Figure 6: LDL Measurement Variation by Practice

Y-axis: Percentage of Patients With a Diagnosis of Diabetes or CAD

X-axis: Primary Health Care Practice

Legend: Percentage With LDL Test Done — Percentage With LDL Less Than 2.0 mmol/L

Notes

Chronic diseases include chronic obstructive pulmonary disease, coronary artery disease (CAD), diabetes and hypertension.

Only patients with a diagnosis of coronary artery disease or diabetes who had a low-density lipoprotein (LDL) test result in the last 12 months are included (N = 25,064).

Four practices were suppressed due to small sample size.

Source

Primary Health Care Voluntary Reporting System, 2013, Canadian Institute for Health Information.

Summary of Findings Related to Chronic Disease in PHC

According to the analyses above, a large percentage of patients (17%) in PHC settings suffer from multiple chronic diseases. In addition, having multiple chronic diseases is related to large increases in visit volumes. This information may be helpful to planners who are estimating the future need for physicians, nurses and other health care personnel. Such estimates should take into account the size of the future chronic disease population and the proportion of these patients in various PHC practices.

The analyses indicate that there may be some gaps in the care of patients with chronic diseases, in that some patients do not appear to be receiving the recommended monitoring (as indicated in their EMRs); as well, of the patients who do receive testing, many are not meeting the recommended target outcomes. Further analyses may include determining how EMRs can be optimized and used to support chronic disease monitoring. Additionally, further studies may look at how far above the recommended target most patients are and whether particular multimorbidities are related to higher HbA1c, blood pressure or LDL measurements.

In terms of inter-practice variation, across all three recommended tests investigated, there was no relationship between the number of tests recorded and achieving recommended targets. Interestingly, this has been noted in other studies.[27]

Perhaps most importantly, this study demonstrates that EMRs can be used both to support quality improvement activities in PHC practices and to inform system-level planning on chronic disease management. Increasingly, family practices across Canada are engaging in quality improvement activities in areas such as hypertension, diabetes and CAD. Multiple quality improvement campaigns have been established in B.C., Saskatchewan and Ontario over the past decade.[4, 5] The proliferation of these improvement activities suggests that there will be a growing demand for this type of EMR-generated quality data in the future. Using EMR data, individual practices could access up-to-date information on their patient populations and identify subpopulations that require individualized care, thus helping to prioritize their efforts. In addition, intra- and inter-practice comparisons might enable peer learning opportunities. Collected over time, EMR data could be used to display trends and allow for monitoring of the effectiveness of quality improvement initiatives put in place in PHC practices.

As more and better EMR data becomes available in Canada, there is also increased potential to use the data for health system planning. Studies such as this one could help system planners understand how the presence of multiple chronic diseases affects health care utilization or how effective management of chronic disease by PHC practitioners might translate into reduced use of urgent care or acute care services. This data has wide-reaching potential, but work must be done to ensure that it is structured and comparable across jurisdictions.

Strengths and Limitations of Using EMR Data

Administrative and claims data captures demographic information, diagnoses and procedures, primarily for billing purposes, and on its own does not fully depict the complexity of a patient's health. EMR data captures a complementary picture of the observations and actions recorded at the point of care: EMRs are longitudinal, and they cover all visits and clinically relevant interventions.[28] This data could include blood pressure values, diagnostic test results, risk factors, medications and diagnoses. As a result, EMRs present a new opportunity to use clinical data to provide insights into morbidity, health system utilization and chronic disease management. All of these were highlighted in the above analyses. In addition, EMR data has the potential to inform practice-level program management and quality improvement initiatives, assist with resource allocation planning and inform key policy questions at the jurisdictional level.

EMRs offer a unique source of information to bridge existing gaps in knowledge, but a key component today is having priority data in standardized, structured format. For example, "health condition" is not a standard, structured field across EMR systems: the preponderance of free-text entries makes it difficult to identify specific health conditions within and across EMRs. Current EMRs are not necessarily designed for data extraction and analysis, but rather for patient-level clinical note-taking. Extracting, processing and analyzing EMR data involves a significant amount of manual effort, and long-term, large-scale extraction and analysis of EMR data is not sustainable. Pan-Canadian adoption and use of the PHC EMR Content Standard at the point of care will increase the availability of structured, coded data in EMRs and support quality improvement and health system management (see sidebar).

PHC EMR Content Standard

Across Canada, EMRs are being implemented to support improvements in PHC, including improved access, quality, outcomes, and chronic disease prevention and management. To ensure that this pan-Canadian initiative yields the desired results, the use of standardized EMR data is essential. Data that is standardized is both comparable and can be better analyzed to determine trends, evaluate the impact of health initiatives and support health system planning. To this end, working with jurisdictions and Canada Health Infoway, CIHI led the development and release of a common and agreed-upon PHC EMR Content Standard (PHC EMR CS) in early 2011. The PHC EMR CS is a specification of key concepts and reference sets that describes a subset of important data elements (such as health conditions, risk factors and procedures). Our goal is to enable jurisdictions to implement this standard in PHC EMRs across Canada. The PHC EMR CS directly supports patient care improvements through the development of more effective EMRs and by potentially enabling health system use of EMR data. The PHC EMR CS was developed through a broad consultation process that engaged clinicians, standards experts, researchers and vendors to obtain their valuable expertise and insight on the standard and its implementation.

Conclusions

This study provides an illustrative example of how EMRs are an emerging and rich source of important data that can be used to provide information on the prevalence of chronic diseases and the quality of care. It demonstrates how EMR data can

- Support primary care providers in providing high-quality care to patients with chronic disease;
- Support quality improvement initiatives across physicians, practices and jurisdictions by indicating, with aggregated, comparable data, where there is room for improvement in both screening and outcomes; and
- Monitor the impact of chronic diseases on health care utilization, which can inform PHC resource planning.

To promote increased availability of this type of data in the future, it is important to ensure the adoption of the pan-Canadian PHC EMR Content Standard: standardized data collection at the point of care may improve EMR data quality for data analysis in the future. The demand for data on quality is growing among primary care providers, and data standardization is critical to the health system's ability to meet this demand. Please refer to CIHI's report *Insights and Lessons Learned From the PHC VRS Prototype* for more information.[10]

Appendix A: Case Definition Methodology

The case definition methodology used to identify patients with any of seven chronic diseases (diabetes, hypertension, CAD, depression, asthma, COPD and osteoarthritis) was developed in consultation with participating PHC VRS clinicians and through a case validation exercise. The following rules-based approach was used to identify patients with chronic disease:

- ICD-9/ICPC-2 codes and some billing codes (for example, ICD-9 code 250 for diabetes mellitus);
- Relevant text in the encounter table, problem list (diagnosis) or health issues table;
- Prescription of chronic disease–related medications (for example, metformin for diabetes mellitus);
- Relevant lab tests or assessment measurements (for example, A1C test or blood pressure measurements); and
- Relevant risk factors (for example, smoking for COPD).

Table A1: Chronic Disease Case Definition Methodology

Diabetes Mellitus At least two different	Hypertension At least three different	Coronary Artery Disease At least three different	Depression At least two different	Asthma At least two different*	Chronic Obstructive Pulmonary Disease At least two different*	Osteoarthritis At least two different*
Encounter	Encounter	Encounter	Encounter	Encounter	Encounter	Encounter
Health issues/ problem list	Health issues/ problem list (counts as 2)	Health issues/ problem list (counts as 2)	Health issues/ problem list (counts as 2)	Health issues/ problem list (counts as 2)	Health issues/ problem list (counts as 2)	Health issues/ problem list (counts as 2)
2 or more high labs (A1C or FBG) or 5 or more labs total	2 or more high blood pressure or 3 or more blood pressure measurements	2 or more high labs (LDL, HDL or triglycerides)		1 or more PFTs/ spirometry tests or risks (smoking, family history)*	1 or more PFTs/ spirometry tests/ chest X-rays or risks (smoking)*	1 or more procedures (arthroplasty of knee or hip) or risks (obesity, family history)*
Relevant medication	Relevant medication	Relevant medication	Relevant medication	Relevant medication	Relevant medication	Relevant medication

Notes
*   Asthma, COPD and osteoarthritis cases are identified using the following criteria: a relevant diagnosis (in the problem list) **or** a combination of a disease-specific encounter (visit) and a lab, a risk factor or one or more medications recorded in the EMR.
FBG: Fasting blood glucose.
LDL: Low-density lipoprotein.
HDL: Total cholesterol/high-density lipoprotein ratio.
PFT: Pulmonary function test.
Source
Primary Health Care Voluntary Reporting System, 2013, Canadian Institute for Health Information.

Appendix B: Predicting High Service Utilization

Table B1: Factors Associated With High Service Utilization			
	Odds Ratios	95% Confidence Intervals	
Predictor (Reference Group)	10 or more visits to a PHC clinic in 12 months		
Disease Status (Three or More Chronic Diseases)	3.5*	3.3	3.8
Age (65+)	1.9*	1.8	2.0
Gender (Female)	1.3*	1.3	1.4

Notes

* Odds ratio estimate is significantly different.

N = 337,793.

Chronic diseases include asthma, chronic obstructive pulmonary disease, coronary artery disease, depression, diabetes, hypertension and osteoarthritis.

Source

Primary Health Care Voluntary Reporting System, 2013, Canadian Institute for Health Information.

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