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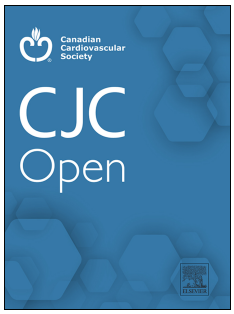

Adherence to cardiovascular prevention guidelines in an academic center

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Adherence to cardiovascular prevention guidelines in an academic center

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Brief summary

Cardiovascular prevention is essential to reduce the morbidity and mortality of cardiovascular diseases. Our study aims to identify the practice gaps in the adherence to cardiovascular prevention guidelines among cardiologists. This retrospective study reveals a suboptimal adherence to cardiovascular prevention guidelines for both pharmacological and non-pharmacological interventions. Strategies such as professional development programs and application-based decision support are potential solutions.

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Abstract

Background

Adherence to guidelines is associated with better patient outcomes. While studies show suboptimal adherence to cardiovascular prevention guidelines among general practitioners, adherence among specialist physicians is understudied. The aim of this analysis was to identify practice gaps among cardiologists in a tertiary academic center.

Methods

We retrospectively audited cardiology outpatient clinic notes at the *CHUM* from January 1st, 2019 to February 28th, 2019. Data were abstracted from hospital medical records. The primary outcome of interest was the rate of adherence to cardiovascular prevention guidelines. We compared the chart documented practice at our center to the Canadian hypertension, lipid, diabetes, antiplatelet and heart failure guidelines in effect at the time of the audit. We also collected information regarding discussions of smoking, alcohol consumption, physical activity and diet.

Results

A total of 2503 patients were included with a mean age of 65.6±14.5 years. Dyslipidemia occurred in 63%, hypertension in 55% and coronary artery disease in 41%. Optimal LDL control was documented achieved in just 39% of cases. Blood pressure control was adequate for 65% of patients, and glycemic control was achieved in 47% of patients with diabetes. Heart failure treatment was optimal in 34%. Nearly all (95%) patients with CAD had appropriate antithrombotic therapy. Discussion of non-pharmacologic interventions varied from 91% (smoking) to 16% (diet).

Conclusions

Primary and secondary prevention of cardiovascular events was found to be suboptimal in an academic tertiary care outpatient cardiology clinic and may be representative of similar shortcomings nationwide. Strategies to ensure guideline adherence are needed.

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Introduction

Cardiovascular disease (CVD) has been the leading cause of death in North America for many years.[1, 2] Morbidity and mortality associated with CVD represent significant costs and burden of care for the healthcare system globally.[3] As it is well known that adverse cardiovascular events can be prevented through healthy behaviors and optimal treatment of cardiovascular risk factors,[4] national scientific societies have published evidence-based guidelines for the prevention of CVD events through management of diabetes, lipid disorders, hypertension, heart failure, coronary artery disease (CAD) and peripheral artery disease (PAD), including both pharmacologic and non-pharmacologic interventions.[4-12] The American College of Cardiology (ACC) also recommends a team-based approach to optimize preventive cardiology aspects and minimize CVD.[4]

Despite strong evidence that adherence to prevention guidelines is associated with better outcomes for patients,[4, 13-16] studies have shown that adherence to these guidelines remains suboptimal.[13, 17-22] For example, adherence rate to individual guideline recommendations was found to range between 5% to 34% even among patients with prior myocardial infarction.[21] The Million Hearts study also assessed quality of adherence to preventive cardiology concepts. Antiplatelet prescription, hypertension control, hyperlipidemia control amongst patients with diabetes and tobacco use screening and intervention were appropriate according to guidelines in 71.9%, 66.6%, 75.8% and 79.8% of cases, respectively.[18]

Despite the availability of well-developed cardiovascular prevention guidelines, a number of barriers appear to limit their application in clinical practice.[23] However, while guideline adherence has been evaluated among general practitioners,[17-21] there is limited data regarding guideline adherence among cardiologists.[24] Better defining treatment gaps among specialists may shed important light on the nature of these barriers to improve real-world prevention and lead to specific interventions.

Methods

This study consisted of a retrospective chart audit of all patients ≥ 18 years of age seen by a cardiologist in the outpatient Cardiology Clinic at the *Centre hospitalier de l'Université de Montréal* (CHUM) from January 1st, 2019, to February 28th, 2019. This period was chosen as it allowed a second follow-up audit of the same period in 2020 prior to the COVID-19 pandemic reaching North America. Cardiologist visits occurring both in general cardiology and specialized cardiology clinics were included.

The CHUM is a large Canadian tertiary care academic center that uses the OACIS electronic medical record (EMR) system (Telus Santé, Montréal, Québec, Canada). Outpatient cardiology notes can be made using either a structured digital form or a hand-written note (subsequently scanned into the EMR) according to individual physician preference. The primary outcome of interest was adherence to cardiovascular prevention guidelines in an outpatient setting. We compared the documented practice at our center to the most recent Canadian diabetes, lipids, antiplatelets, hypertension, and heart failure guidelines published at the time of the patient visits.[4-12]

Patients who consulted the Cardiology service more than once during the study period were analyzed based on their more recent visit. Visit notes by non-cardiologist health professionals were not audited (the vast majority of patients were seen only by their cardiologist during the period of study). All data were abstracted from the EMR.

For hypertension, we compared charted practice to the 2018 Hypertension Canada guidelines.[8] Treatment was analyzed for each patient first by collecting medications that were initiated (ACE inhibitor (ACEi), angiotensin receptor neprilysin inhibitor (ANRI), beta-blocker (BB), calcium channel blocker (CCB), diuretics, mineralocorticoid antagonist (MRA), thiazides or angiotensin receptor blocker (ARB)). Blood pressure targets were <130/80 mmHg for patients with diabetes and <140/90 mm Hg for others, needing to reach systolic and diastolic values to be considered on target.

Regarding dyslipidemia, we used the 2016 Canadian Cardiovascular Society (CCS) dyslipidemia guidelines and the 2018 CCS familial hypercholesterolemia update.[6, 7] We looked at the rate of lipid treatment target achievement (LDL <2 mmol/L or reduction of 50% of LDL level compared to baseline values), adequacy of screening, and the types of lipid-lowering therapy prescribed to patients with indication of treatment.

We used the 2018 Canadian Diabetes Association Guidelines[5] to assess adherence to diabetes recommendations. Outcomes of interest included the rate of diabetes screening among cardiology patients without diabetes older than 40 years of age or risk factors for diabetes, as well as the rate of glycosylated hemoglobin (A1C) evaluation and adequate glycemic control (A1C $\leq$ 7.0%) among patients with diabetes. We also assessed the use of SGLT-2 inhibitors (SGLT2i) and GLP-1 receptor agonists (GLP1RA); antidiabetic agents with known cardiac benefit.

The 2018 CCS antiplatelet therapy guidelines, the 2016 American Heart Association (AHA)/ACC guideline on lower extremity PAD and the 2018 AHA/American Stroke Association Guidelines for management of ischemic stroke[10-12] were all used to assess the

adequacy of antiplatelet therapy among CAD and PAD patients. Appropriateness of prescription was defined as prescription of aspirin when there was an indication or omission of prescription when not indicated. For example, patients with stable CAD with an indication for anticoagulation, omission of aspirin prescription was judged to be appropriate. We also assessed if gastroprotective therapy was prescribed according to the 2008 American College of Cardiology Foundation, American College of Gastroenterology and AHA expert consensus recommendations.[25] Indications for gastroprotective therapy included the need of aspirin therapy and history of ulcer disease, gastro-intestinal bleeding, dual antiplatelet therapy (DAPT) or concomitant anticoagulant therapy. Gastroprotective therapy was also indicated if more than one of these risk factors are met: age greater than 60 years old, corticosteroid use, dyspepsia or gastroesophageal reflux symptoms. The criterion regarding gastrointestinal symptoms was not taken into account because of the anticipated likelihood that such data might be missing from a cardiologist's visit documentation. We also screened the cohort to determine the proportion of patient who would be eligible for dual pathway inhibition (low-dose rivaroxaban plus aspirin) based on the Rivaroxaban with or without Aspirin in stable Cardiovascular Disease (COMPASS trial[26]) that was already published at the time, but not yet incorporated into guidelines and *Régis de l'assurance maladie du Québec* (RAMQ) reimbursement criteria (co-existence of CAD and PAD).

We referred to the 2017 CCS Heart Failure Guidelines to assess treatment of patients with heart failure.[9] We collected the left ventricular ejection fraction (LVEF) for all patients. We considered patients with and LVEF $\leq 40\%$ as having heart failure with reduced ejection fraction (HFrEF), for whom optimal medical therapy consisted of at least triple therapy with a BB, an MRA and an ACEi/ARB/ARNI. Patients in sinus rhythm with a resting heart rate more than 70 beats per minute despite adequate treatment with BB were expected to receive ivabradine. Treatment with SGLT2i was not included in the heart failure guidelines at the time of the chart audit. If LVEF was <35% after 3 months of optimal medical therapy, patients were expected to be offered an implantable cardioverter-defibrillator (ICD), plus cardiac resynchronization therapy (CRT) if they were in sinus rhythm with a QRS that was more than 130ms (left bundle branch pattern).

For all patients, we also collected any documented information regarding their lifestyle, including smoking, alcohol consumption, physical activity and nutrition. For patients drinking more than the recommended amount of alcohol (>14 drinks per week for men, >11 drinks per week for women),[27] we took note of whether the cardiologist addressed this aspect during the patient visit. For active smokers, we verified if a smoking cessation therapy had been

prescribed or discussed. We also evaluated if there was a discussion about physical activity and nutritional or referral to a nutritionist. We also recorded whether the body mass index (BMI) was documented or available in the EMR.

Continuous data are reported as means and standard deviations or medians and interquartile ranges (IQR), as appropriate, and categorical/binary data are reported as counts and percent proportions. The study protocol was consistent with the ethical guidelines of the 1975 Declaration of Helsinki and was conducted in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines[28]. The CHUM Research Center institutional ethics board approved the study and provided a waiver for informed consent.

Results

We included 2503 patients seen at the CHUM cardiology clinic from January 1st, 2019 to February 28th, 2019. The mean age was 66 ± 15 years, with 94% of patients being over 40 years old. Sixty percent of patients were men. The most prevalent comorbidities were dyslipidemia (63%), followed by hypertension (55%) and CAD (41%). Active smokers represented 8% of our population (Table 1).

Management of hypertension

More than half (55%) of patients suffered from hypertension. Of them, 311 (64%) also had diabetes. Optimal blood pressure control was achieved for 62% of all hypertensive patients and 66% of patients with diabetes (Table 2). The most frequent medications used were BB (62% for all, 67% for patients with diabetes) followed by CCB (43% for all, 43% for patients with diabetes) and ACEi (36% for all, 39% for patients with diabetes). The use of ARNI in the whole cohort was low (2%) but higher (17%) for patients with HFrEF (Supplemental Table S1 and S6).

Management of dyslipidemia

1567 patients (63%) had dyslipidemia (Table 1). Lipid treatment was at target dose in 608 (39%, Table 2) patients with dyslipidemia. Adequate LDL control was reached in 46% of patients with CAD. Thirty-five patients (3%) with CAD had LDL level above target without any lipid-lowering therapy. Assessment of lipid levels was documented at least once in the last 5 years in 66% of patients with known CAD, 52% with PAD, 62% with diabetes over the age

of 40, and 59% of patients with CKD over the age of 50. PCSK9 inhibitors prescription was low (1%; Supplemental Table S2).

Management of diabetes

Among the entire cohort, 644 patients had diabetes (26%; Table 1). Documentation of HbA_1C was found in 37% of patients without diabetes compared to 75% of patients with diabetes within the previous 5 years. Among patients with diabetes, target A1C (≤ 7.0%) was achieved in 47% of cases (Table 2). GLP1RA and SGLT2i were used in 2.0% and 7.0% of patients with diabetes, respectively, and neither were prescribed to patients without diabetes. In CAD or PAD patients with diabetes, SGLT2i were prescribed in 7% and 9% of cases, respectively. GLP1RA were prescribed to 4% of patients with diabetes with BMI ≥ 30 (Supplemental Table S3).

Management of CAD/PAD

Forty-six percent of patients suffered from either CAD and/or PAD. Among the 1032 patients with CAD, 989 (96%) were on antithrombotic or anticoagulant therapy. Of the 821 patients with CAD and an aspirin indication, 782 (95%) had an appropriate prescription. Among the 318 patients with PAD, 296 (93%) were on antithrombotic or anticoagulant. Of the 173 patients with PAD and an indication for aspirin, 160 (92%) had an appropriate prescription (Table 2). Ninety-six (4%) patients in our cohort were taking aspirin without a guideline approved indication.

A total of 1665 patients were taking an antiplatelet or anticoagulant. In this population, 828 (50%) were on single antiplatelet therapy (SAPT), 163 (10%) were on double antiplatelet therapy (DAPT), 584 (35%) were on anticoagulation therapy alone, 80 (5%) were on SAPT plus an anticoagulant and 10 (<1%) were on triple therapy (DAPT plus anticoagulant). Among DAPT patients, 101 (62%) were also prescribed a gastroprotective medication, compared to 36 (45%) of patients receiving SAPT plus an anticoagulant. All 10 patients on triple therapy had gastroprotective medication.

Among the 1172 patients that suffered from either CAD or PAD in our study, 616 were on ASA alone, who could potentially benefit from the addition of low dose rivaroxaban as per the COMPASS study[29] (Supplemental Tables S4, S5).

Management of heart failure

Seven percent of patients had HFrEF (Table 1). Of them, 40% had a NYHA functional class greater than one. Fifty seven percent of patients had an LVEF $\leq$ 35%. Treatment with a BB was frequent (88%). A renin-angiotensin modulator (ACEi or ARB or ARNI) was part of the treatment in 73% of cases. Only 40% of patients were on MRA however. Overall, therefore, only 62 patients (34%) were optimal medical therapy defined as triple therapy (BB + renin-angiotensin modulator + MRA, Table 2). This percentage increased to 49% in patients followed at the specialized heart failure clinic, suggesting that the low overall proportion might have been due to legitimate limiting factors like low blood pressure or marginal renal function. Forty seven percent of patients with LVEF≤35% either had and ICD or documentation that ICD had been discussed. CRT devices were implanted in 28% of eligible patients with a large QRS and LVEF≤35%. About a quarter (27%) of HFrEF patients were followed in a specialized heart failure clinic (Supplemental Tables S6).

Non-pharmacological prevention

A minority of patients were active smokers (8%, table 1), of whom 91% had a documented discussion or intervention. Of 40 patients with documented excessive alcohol consumption, 36 (90%) had their alcohol consumption addressed by their cardiologist. In contrast, physical activity was discussed with 650 patients (26%), and diet was discussed with 223 (16%) patients. Similarly, when considering only obese patients, 27% and 11% received physical activity and nutrition advice, respectively. For patients referred to the specialized preventive cardiology clinic, documentation of physical activity and diet discussions increased to 86% and 57% respectively (Supplemental Table S7).

Discussion

Our study evaluated adherence to CVD prevention guidelines among cardiologists in a Canadian tertiary academic center. We demonstrated that there appears to be suboptimal application of many aspects of the guidelines even by academic cardiovascular specialists, based on available EMR.

Treatment to target of blood pressure, HbA1C, and LDL levels was disappointing overall. Regarding dyslipidemia, particularly, it is noteworthy that, despite low rates of achieving target LDL in our cohort, add-on molecules to statin therapy such as PCSK-9 inhibitors were rarely prescribed. This may be partially explained by administrative hurdles to obtaining PCSK-9 reimbursement in Québec.

Rates of appropriate aspirin prescription were overall encouraging. However, prescription of gastroprotection, particularly among patients receiving SAPT plus an anticoagulant requires improvement. Diabetes treatments with known cardiac benefits such as SGLT2i and GLP1RA[30, 31] were rarely prescribed, but also were not included in the guidelines in force at the time of the audited visits. Similarly, studies showing benefits of SGLT2i for heart failure patients[32-35] were not published at the time.

The results of our study are consistent with other studies regarding CVD prevention among non-specialist practitioners. In the Million Hearts study[18], which included more than 100 000 patients in the United States, hypertension control ranged from 49% to 75% compared the rate of 65% in our study. Dyslipidemia control amongst patients with diabetes was in contrast higher than in our population. Though it is not immediately clear why this would be, an hypothesis could be that the CHUM serves a downtown population that frequently doesn't benefit from an identified primary care physician. A large European registry of patients with CAD also similarly showed that less than 60% of patients had good risk factor control in a population care for by both primary care physicians and specialists.[13] While CHUM patients frequently do not have primary care physicians, patients with diabetes and chronic renal failure patients frequently benefit from concurrent specialist follow-up in those areas.

While discussions of smoking cessation and alcohol consumption were frequently documented, discussion of exercise and diet appeared to occur infrequently unless patients were also followed at our specialized prevention cardiology clinic. This could partially be explained by the fact that physicians who refer their patients to a preventive clinic might be more likely to document these discussions. Similarly, HFrEF treatment appeared slightly better among patients followed at our heart failure clinic, but still limited, possibly explained by low blood pressure and poor renal function limiting treatment options. Data regarding contra-indication to or side-effects due to specific treatments was not analyzed because it was too inconsistently documented in the medical chart. While it justify the absence of some treatments for some patients, it would be unlikely to explain the extent of non-adherence that we have observed.

Taken together, these observations would seem to support the ACC recommendation for a team-based approach to optimize prevention.[4] In line with this, an Iranian study found better adherence rates than we observed among academic specialists in an in-patient setting,[24] where patients benefit from multidisciplinary care and relatively prolonged or repeated contact with the treating team. Multidisciplinary care may also be a means of compensating for the time pressures of a busy outpatient clinic and allow for more complete assessment of the full

spectrum of prevention in cardiology. Despite the potential benefit of lifestyle modifications,[36] patients were counselled on physical activity and diet in only a minority of patient visits (26% and 16%, respectively) whether the patient was obese or not in our cohort. This might be underestimated as it might have been discussed but not reported in the medical chart. It may also be that physicians do not have the time to adequately address these issues during the visit. A survey of physicians from diverse specialties, including cardiologists, revealed that less than two thirds of physicians were likely to give nutritional or physical activity advice to their patients. However, this was influenced by their perception of a patient's risk.[37] In either case, increasing access to multidisciplinary follow-up could lead to substantial improvement in outcomes.

Some limitations of the present study should be acknowledged. First, this is a single center analysis which may limit generalizability. However, our results are consistent with similar studies in the literature and extend the findings to specialized cardiology centers. We therefore believe that they are likely indicative of practice in other academic centers. Second, it is possible that guideline adherence is underestimated and that we have instead captured poor documentation of adherence. We unfortunately don't have data allowing comparison between hand-written and digital medical notes. However, given the very low rates of documentation of certain interventions, it appears unlikely that documentation shortcomings explain the entirety of the adherence gaps that we have identified. Third, whether a patient is also followed by a family doctor or another specialist is known to be inconsistently documented in the cardiology clinic chart. It is therefore possible that overall adherence across providers is better than what is reported here. On the other hand, as our population included patients followed in specialized clinics, such as the heart failure clinic, it is possible that the rate of guideline adherence would have been lower if patients exclusively followed in general cardiology clinics would have been lower than what we have observed. Finally, reimbursement criteria for medications vary from province to province, and it is possible that such differences may lead to variations in adherence to certain prevention recommendations.

Bearing in mind these limitations, there is clearly an opportunity for quality improvement. In addition to continuing medical education initiatives for both patients and physicians, given typical time pressures and the complexity of patients who consult in academic centers, it is likely that system level interventions are necessary. The most obvious intervention at this level is to broaden the availability and use of multidisciplinary care in the outpatient setting based both on our findings and guideline recommendations.[23] In addition, the randomized BRIDGE cardiovascular prevention study [20] showed that a combination of case

management, feedback reports and educational materials for physicians and patients lead to increased use of evidence-based therapies. It should also be possible to several current technologies to provide real-time checklists and decision aids to providers while also aiding in the proper documentation of important prevention interventions.

Conclusions

Prevention of CVD through lifestyle behavior modification and optimization of cardiovascular risk factors is essential. Our study reveals that despite appropriate guidance and continued medical education efforts, adherence to prevention recommendations remain suboptimal even in an academic cardiology clinic. Combining a multidisciplinary approach with standardized updated algorithms with technology that facilitates both documentation and the patient encounter appear well-positioned to improve patient CVD outcomes.

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Disclosures

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514 **Tables**

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516 **Table 1.** Characteristics of the total cohort.

Characteristic	**Total cohort** (N=2503)
Age, mean ± SD	66 ± 15
Age >40 years, n (%)	2346 (94)
Male, n (%)	1506 (60)
Weight, mean± SD (Kg)	79 ± 20
BMI ≥ 30, n (%) Missing data, n (%)	339 (14) 1468 (59)
NYHA, median (IQR) Missing data, n (%)	2 (1-2) 1513 (60)
≥ 2 heart failure hospitalizations in the past year, n (%)	45 (2)
Comorbidities	
Diabetes, n (%)	644 (26)
Dyslipidemia, n (%)	1567 (63)
CAD, n (%)	1032 (41)
PAD, n (%)	318 (13)
HFrEF, n (%)	184 (7)
Hypertension, n (%)	1378 (55)
CKD, n (%)	438 (18)
Lifestyle habits	
Active smoking, n (%)	188 (8)
Alcohol more than recommendations*, n (%)	40 (2)
Physical activity >150 minutes per week, n (%)	83 (3)

BMI: body mass index, CAD: coronary artery disease, Chronic kidney disease (eGFR<60ml/min/m^2), HFrEF: heart failure with reduced ejection fraction, IQR: interquartile range; Kg: kilogram, NYHA: New York Heart Association functional class, PAD: peripheral artery disease, SD: standard deviation.
*(Women > 11 drinks per week, Men > 14 drinks per week[27])

517 **Table 2.** Adherence to prevention guidelines in a cardiology clinic.

Risk factor	**Optimal adherence to respective guidelines** n (%)
Diabetes Glycemic control	 300 (47)
Dyslipidemia N=1567 LDL control	 608 (39)
Vascular disease Accurate aspirin therapy CAD PAD	 782 (95) 160 (92)
HFrEF Triple therapy	 62 (34)
Hypertension BP control	 899 (65)
Smoking discussion	172 (91)
Alcohol discussion	36 (90)
Obesity Physical activity discussion Diet discussion	 93 (27) 45 (11)

BP: blood pressure, CAD: coronary artery disease, HFrEF: heart failure with reduced ejection fraction, PAD: peripheral artery disease.

518

519

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