

Improved Cardiovascular Prevention Using Best CME Practices: A Randomized Trial

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Introduction: It was hypothesized that after a continuing medical education (CME) event, practice enablers and reinforcers addressing main clinical barriers to preventive care would be more effective in improving general practitioners' (GPs) adherence to cardiovascular guidelines than a CME event only.

Methods: A cluster-randomized trial was conducted on a convenience sample of 122 GPs who were randomly assigned to either CME only (control group) or CME with practice enablers and reinforcers (PER group). In the PER group, nurses visited GPs' offices once a month to implement the clinical intervention on patients ≥ 55 years old with a scheduled visit in the month following the nurse visit: (1) screening medical records for potentially undermanaged high-risk patients; (2) prompting physicians to reassess preventive care in these patients; (3) enclosing a checklist reporting most recent information relevant to guidelines' implementation; and (4) enclosing a summary of experts' recommendations in the form of a follow-up and treatment algorithm.

Results: A retrospective chart audit of 2344 consenting patients, potentially undermanaged at baseline, demonstrated that the PER intervention following CME significantly improved adherence to guidelines compared to CME alone (OR: 1.78, 95% CI: 1.32–2.41).

Discussion: The intervention was designed for self-implementation in primary care practices that have their own nursing staff. PER GPs were highly satisfied with the intervention; the majority said that they would implement it in their practice if someone trained their nurse, thus suggesting support for development of a multiprofessional CME program to disseminate this clinical approach to primary care practice groups.

Key Words: education, medical, continuing, knowledge translation, practice guidelines, physician performance, cardiovascular prevention, high-risk cardiovascular patients, general practice

Cardiovascular (CV) patients with additional risk factors have an annual risk of 4 to 8% of dying from a CV event or having a nonfatal myocardial infarction, stroke, or heart failure.¹ Large clinical trials have shown that lifestyle ad-

justments and pharmacological agents can significantly reduce mortality and morbidity in these patients. This evidence was used to develop clinical practice guidelines (CPG) by leading medical societies in Canada,² Europe,³

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and the United States.⁴ However, field studies indicate that only between 20 to 75% of CV patients are managed according to CPGs.^{5–17} Various barriers related to physicians, patients, or external factors explain this failure to translate evidence into practice.^{18,19}

Can CME providers help improve cardiovascular prevention? Traditionally, CME has focused on disseminating knowledge in the classroom, using lecture or learner-centered interactive teaching methods.^{20,21} But to go beyond dissemination and achieve better knowledge translation, practice enablers and reinforcers that address workplace implementation barriers have to be offered as well.^{22,23} CME coupled with interventions in the practice setting seems more likely to produce changes in practice than one-time event-based interactive CME. Several models such as the PRECEDE-PROCEED model²⁴ were developed to facilitate the design of such strategies in preventive care.

In the CIME Study (*Collaboration infirmière-médecin*), our goal was to develop and test a CME intervention that could be deployed in the context of Quebec's universal health care system. In an effort to improve accessibility and continuity of care, the government decided in 2002 to provide nurses to GPs who would create family practice groups (FPGs). Definite nurse responsibilities were not determined, offering us an opportunity to influence practice organization. In our project, we explored the possibility of involving FPGs' nurses to address important physician-level practice barriers to prevention: time to screen for at-risk patients, time to search for clinical information in support of decision making, and timely access to experts' recommendations.^{18,19} We hypothesized that training FPGs' nurses to provide practice enablers and reinforcement after CME would be more effective in improving GPs' adherence to CV prevention guidelines than CME alone. This article reports on a cluster randomized trial conducted to test this hypothesis.

Methods

Participants

All GPs practicing in 5 regions of Quebec, Canada, were eligible to participate. To be included, they had to see at least 25 patients ≥ 55 years old in any 2-week period in a community setting.

To be included, their patients had to: be ≥ 55 years old; visit their GP at least once between February 7 and August 6, 2005; be high risk (HR) CV patients; be potentially undermanaged for at least 1 of 9 recommendations from 2004 Canadian CPGs^{25–29} (TABLE 1); and sign consent for the research team to retrieve and analyze data from their medical records. HR CV patients were defined as patients with a history of at least 1 of the following: myocardial infarction; stable angina; revascularization procedure; stroke or transient ischemic attack; peripheral vascular disease; or diabetes. Patients were excluded if they had one of the following: unstable cardiovascular state ≤ 4 weeks; constrictive

pericarditis; complex congenital disease; significant valvular heart disease; planned cardiac or arterial surgery or angioplasty within 3 months; required dialysis; major noncardiac illness expected to reduce life expectancy or interfere with study participation; were on warfarin; or were already enrolled in a research project.

Intervention

Physicians received either CME only (control group) or CME with practice enablers and reinforcers (PER group). CME consisted of a 2-hour, small-group interactive workshop, which included a presentation of the latest CPGs by an expert cardiologist, discussion of 4 cases facilitated by a GP and an interactive response system, and discussion about barriers to guidelines implementation in their practice. A summary of CPGs in the form of a patient follow-up and treatment algorithm was provided to all participants (Appendix 1).

In the PER group, nurses visited GPs' offices to implement the clinical intervention. To be acceptable for most GPs and easy to integrate in current practice organization, we determined that the intervention had to meet the following criteria: could be carried out routinely by FPGs' nurses; maximum 15 minutes per patient; minimum nurse training requirements; avoid fostering misperceptions about GPs' competencies; preserve GPs' prerogative in exercising clinical judgment; and, eventually, could be carried out by electronic medical record systems. As a result, the clinical intervention was defined as follows: (1) screening medical records of patients ≥ 55 years old for potentially undermanaged HR CV patients; (2) prompting physicians, without clinical judgment, to reassess preventive CV care in these patients by placing a label in front of the chart; (3) filling out and enclosing a 1-page checklist (Appendix 2) reporting the most recent information relevant to CPGs' implementation (diagnoses associated with high CV risk, smoking status, body mass index, physical activity, blood pressure, LDL, A1C, and recommended drugs; source and date of each item of information). No indication was provided as to which guideline(s) triggered prompting. We considered screening, prompting, and providing the checklist as practice enablers that allowed fast recognition of patients with potentially suboptimal care and quick access to clinical data. The follow-up and treatment algorithm was printed at the back of the checklist as a reminder of experts' recommendations.

A cardiologist trained project nurses, and a set of clinical tools (list of target diagnoses; lists of generic and commercial names of all antidiabetic and CV drugs available on the market; decision-making algorithm for chart prompting) was developed to support intervention implementation in the practice. At the end of 1 training day, nurses had to achieve, spending no more than an average of 15 minutes per chart, a threshold of 80% accuracy in identifying and prompting patients with potentially suboptimal care.

TABLE 1. Assessment of High-Risk Cardiovascular Patient Management in the CIME Study

2004 Canadian Cardiovascular Recommendations Assessed in This Study ¹⁸⁻²²	Potentially Undermanaged HR CV Patients (at least one of the following characteristics) ^a	Permanent or Temporary Contraindications to CPGs ⁷ Recommendations	Preventive Care Actions Assessed in the 12 Months Prior to the First Visit Following Patient's Recruitment in the Study	Preventive Care Actions Assessed at the First Visit Following Patient's Recruitment in the Study
Smoking cessation	Smoking	None	Prescription of smoking cessation agents; referral to smoking cessation clinic; counseling; reduction in tobacco consumption	Prescription of smoking cessation agents; referral to smoking cessation clinic; counseling
Physical activity \geq 30 min/3 times a week	Physical activity $<$ 30 min/3 times per week	Lower limbs joint diseases; morbid obesity; precarious balance	Referral to rehabilitation program; counseling	Referral to rehabilitation program; counseling
Body mass index $<$ 25 kg/m ²	Body mass index \geq 25 kg/m ²	None	Prescription of an antiobesity drug; referral to nutritionist, weight-loss program or diabetes clinic; counseling	Prescription of an antiobesity drug; referral to nutritionist, weight-loss program or diabetes clinic; counseling
LDL \leq 2.5 mmol/L	LDL $>$ 2.5 mmol/L	None	Prescription of a lipid-lowering agent (statin, ezetimibe, fibrate, or resin; including increase of dosage) following last LDL test	Prescription of a lipid-lowering agent (statin, ezetimibe, fibrate, or resin; including increase of dosage)
A1C \leq 7% in diabetic patients, ideally \leq 6%	Diabetes I or II and A1C $>$ 7%	None	Prescription of an antidiabetic drug; referral to diabetes clinic, nutritionist, endocrinologist, internist, weight-loss program or rehabilitation program; counseling	Prescription of an antidiabetic drug; referral to diabetes clinic, nutritionist, endocrinologist, internist, weight-loss program or rehabilitation program; counseling
Blood pressure \leq 140/90 mm Hg or \leq 130/80 mm Hg in diabetic patients	Blood pressure $>$ 140/90 mm Hg or $>$ 130/80 mm Hg in diabetic patients	None	Prescription of antihypertensive medication; referral to hypertension clinic, cardiologist, nephrologist or internist	Prescription of antihypertensive medication; referral to hypertension clinic, cardiologist, nephrologist or internist
Antiplatelet	No antiplatelet used in cardiac prevention	Intolerance; allergy; upper digestive hemorrhage; thrombopathy; uncontrolled or refractory hypertension		Prescription of antiplatelets used in cardiac prevention
ACE-inhibitor	No ACE-inhibitor	Allergy; cough; hyperkalemia; angioedema; symptomatic hypotension		Prescription of ACE-inhibitors
Beta-blocker if history of myocardial infarction	Myocardial infarction and no beta-blocker	Severe asthma; erectile dysfunction; symptomatic fatigue; bradycardia; AV bloc; Raynaud's disease; hypoglycemia in insulin dependent diabetes; anaphylactic shock; symptomatic hypotension		Prescription of beta-blockers

Note: HR CV = High-risk cardiovascular; CPG = Clinical practice guideline.

^aUsing the most recent value indicated in the chart for the 12 months prior to patients' recruitment in the study (6 months in the case of A1C). Patients for whom there was missing information in the previous 12 months with respect to smoking status, physical activity, body mass index, LDL, blood pressure, and A1C (previous 6 months) were also considered as potentially undermanaged.

Study Objectives

The main objective was to determine if the PER intervention delivered by the nurse after the CME activity increased GPs' adherence to CPGs' recommendations. A secondary objective was to assess participants' opinions about the clinical intervention.

Outcomes and Variables

The primary endpoint was the proportion of patients, undermanaged at baseline for at least 1 recommendation, for which study physicians undertook at least 1 preventive-care action in the first visit following patients' recruitment in the study. Additional analyses were done for each specific recommendation. CPGs encourage clinicians to use every clinical encounter, regardless of reason, as an opportunity to provide preventive care. Using the first visit postintervention avoided standardization problems associated with outcomes based on time or multiple visits, which are very sensitive to differences in length of follow-up periods.³⁰

Outcomes were assessed by the investigators, using retrospective audit information abstracted by trained nurses. Patients were considered as undermanaged at baseline if there was no record, for at least 1 recommendation, of a preventive-care action undertaken by their GP in the 12 months prior to the first visit following recruitment (TABLE 1). If data revealed a temporary or permanent contraindication with respect to a specific recommendation, the management of that recommendation was judged as acceptable. For a given recommendation, patients were excluded from the analyses if there were no baseline data for the associated risk factors because there was no evidence for or against implementation. Recommendations on blood pressure and A1C had to be removed from the analyses because data on antihypertensive and antidiabetic drugs were not recorded due to a flaw in the audit instrument. Patients were excluded from the analyses if none of the 7 remaining recommendations was deemed as undermanaged.

Preventive-care actions undertaken during the first patient follow-up visit were measured as the presence of at least 1 record of an appropriate prescription, referral, or counseling (TABLE 1).

Physician and practice characteristics were measured using a self-report questionnaire. At the end of the study, an anonymous opinion survey was sent to each GP of the PER group along with a prestamped return envelope.

Physician Recruitment and Randomization

A convenience sample of GPs was assembled after protocol approval by an Institutional Review Board. The annual directory published by the provincial licensing board was used to identify currently practicing GPs in each of the selected regions. Regionally based GP investigators made a tele-

phone call to each physician, briefly describing the study and assessing for eligibility. Regionally based project nurses met with interested GPs to explain study requirements, consent forms, and administer the questionnaire eliciting demographic and practice information.

Consenting GPs were randomized after the CME intervention. First, GPs were stratified by region and by estimated time available per patient encounter. Stratification by region was deemed necessary to control for potential systematic errors associated with possible differences in screening and prompting abilities among study nurses. Since nurses had to be assigned to one specific region due to the long distances between practices, we decided to minimize this bias by providing nurses with balanced groups. One barrier most frequently mentioned by physicians with respect to preventive care is lack of time.^{18,19} Other studies reported reduced frequency of preventive care in the busiest practices.³¹ To obtain a crude estimate of the number of minutes available per patient encounter, we divided reported number of working hours by the number of patients seen per week. We used the median to stratify GPs. Using a computer-generated list of random numbers (MS Excel: RANDOM), half of the GPs within each stratum were randomly assigned by one investigator to the PER group and the other half to the control group. Nurses informed GPs about their group assignment. Neither nurses nor GPs were blinded.

Patient Recruitment and Delivery of the PER Intervention

During a 6-month period, nurses visited practices of the PER group for 1 day each month to administer the PER intervention (total of 6 visits) on the first 25 patients ≥ 55 years old with a scheduled visit in the month following the nurse visit. GPs' receptionists were responsible for selecting patients from the office schedule. Nurses inserted a consent form in charts of eligible patients. Receptionists asked patients for consent when they presented themselves to their appointment. There was no personal contact between nurses and patients. During that same 6-month period, receptionists of the control group were responsible for printing and filing daily patient schedules and indicating which patients were ≥ 55 years old. These lists were used at the end of the study to identify retrospectively patients who had visited control GPs during the intervention period.

As in the PER group, we selected, for each month of the intervention period, the first 25 patients ≥ 55 years old who had had a visit with one of the control GPs in the month following a given recruitment date. In the PER group, the recruitment date was the date of the nurse visit ($n = 6$). As such, 6 recruitment dates were assigned to each control GP to mimic the patient recruitment process in the PER group. To obtain similar recruitment dates in the 2 groups, we matched physicians within strata of region and time and as-

signed to each control GP the dates of the nurse visits to the corresponding PER GP. As in the PER group, charts of selected patients were screened for eligibility. A consent form was mailed to eligible patients along with an invitation letter from their physicians and a prestamped, preaddressed envelope.

Analyses

Using SAS software, the impact of the intervention was assessed using logistic regressions, within the framework of a generalized estimating equation.^{32–34} The patient was the unit of analysis and GPs were identified as the clustering factor. An exchangeable correlation structure was used to take into account autocorrelation between observations for patients of the same GP. A binary outcome was used to identify an appropriate preventive-care action that occurred during the first visit following a patient's recruitment in the study. General descriptive and univariate statistics were used to summarize and compare baseline physicians and patient characteristics in the 2 groups, and results from the opinion survey.

Results

The flow of physicians in the study is shown in FIGURE 1. One hundred thirty-three GPs who had consented between September 17, 2004, and February 2, 2005, were randomized after attending one of the 9 CME workshops that were provided to study GPs. Four GPs were subsequently found ineligible and excluded before the start of the intervention. Nurses started monthly visits to the PER group on February 7, 2005. Two GPs from the control group were lost to follow-up before the end of the intervention on August 6, 2005. Five of the 127 GPs who had completed the study were randomly excluded from the analyses in order to maintain control over systematic errors associated with nurses and clinical time available per patient (see "Methods"). TABLE 2 demonstrates that this process yielded 2 groups of GPs who were similar in their demographic and practice characteristics.

Patient flow in the study is presented in TABLE 2. GP receptionists selected a total of 16,050 patients ≥ 55 years old. On average, receptionists of the PER group selected more patients than the control group (140.2 patients, SD = 16.8 vs 122.4 patients, SD = 25.5; $F = 20.656$; $p < .001$). All patients received the allocated intervention. Nurses' ability to make a good decision with respect to prompting or rejecting a chart during screening ranged between 81% and 89%. Screening yielded similar proportions of HR CV patients in the 2 groups. Overall, HR CV patients represented 34.8% ($n = 5,593/16,050$) of patients ≥ 55 years old that were selected for the study. After applying exclusion criteria, the proportion of eligible HR CV patients who were potentially undermanaged for at least 1 of the 9 targeted recommendations was similar for control (70.3%; $n = 2603/$

2278) and PER GPs (69.3%; $n = 1885/2721$). All were provided with a consent form. Lower selection and consent rates in the control group yielded fewer patients for the analysis in this group than in the PER group.

Baseline demographic and clinical characteristics of participating patients (TABLE 3) and adherence rates of study physicians to CPGs (TABLE 4) were similar in both groups. Overall, 47.3% ($n = 1111/2344$) of participating patients had more than 1 targeted disease before entering the study, and 81.4% ($n = 1909/2344$) were found to be undermanaged for at least 1 of the 7 recommendations included in the analyses (mean no. of undermanaged recommendations: 1.51; SD = 1.05; range: 0–5). The most common problem of adherence among study physicians was the absence of an ACE-inhibitor ($n = 1475$; 62.9%), followed by the absence of an antiplatelet ($n = 861$; 36.7%). Few problems of adherence were observed in the case of lifestyle risk factors (smoking, physical activity, and body mass index) due to the high frequency of missing baseline chart information.

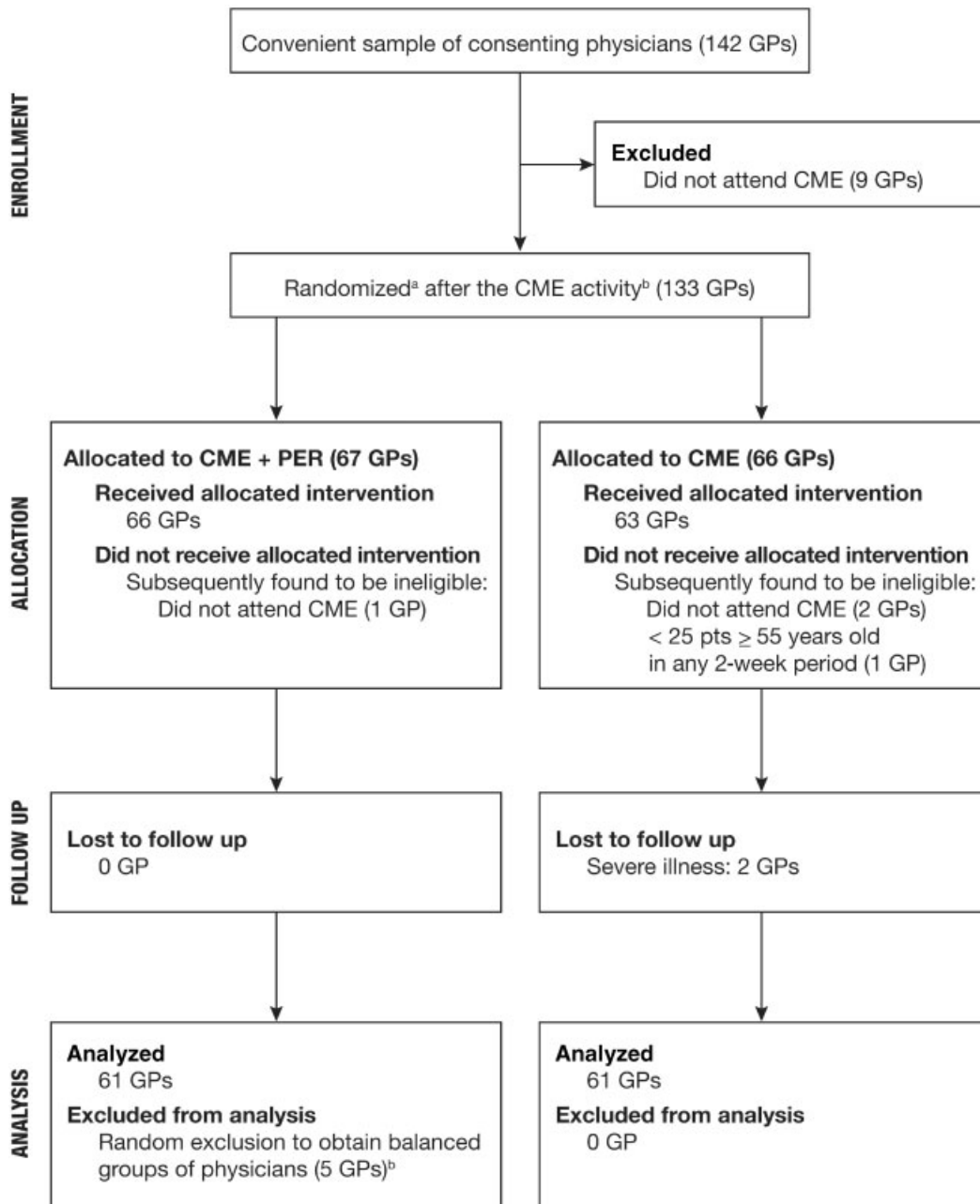
Results of the analysis on the impact of the intervention are shown in TABLE 5. The proportion of undermanaged patients for whom GPs undertook at least 1 preventive-care action in the first visit following patients' recruitment in the study was significantly higher (78%) in the PER group than in the control group. Adjusting for GPs' differences in region/nurse, gender, mean years in practice, and estimated time available per patient encounter did not significantly modify the measured impact (OR: 1.89, 95% CI: 1.37–2.61, $p = .0001$). The impact was also significant for patients who were smoking or needed an ACE-inhibitor, and positive trends were evident for patients who needed an antiplatelet or a lipid-lowering agent (TABLE 5).

Few additional analyses that were not specified in the protocol were carried out to explore other aspects of the intervention. Using subgroups of patients who had missing baseline information for risk factors (TABLE 4), we found a nonsignificant trend for PER GPs to be more likely than control GPs to document physical activity status (OR: 1.76, 95% CI: 0.98–3.16, $p = .0590$) and smoking status (OR: 1.53, 95% CI: 0.77–3.04, $p = .2245$) in the first visit following patients' recruitment. There was no trend for blood pressure. As results of lab tests ordered in the first visit following recruitment would only be available in subsequent visits, we did not carry out similar assessments for missing baseline A1C and LDL values. Another subgroup analysis was conducted using patients who made 3 postrecruitment visits to their GP during the intervention period (TABLE 3). In the 299 patients who were undermanaged for at least 1 of 7 recommendations at baseline, results suggest that the average cumulative number of undermanaged recommendations for which GPs undertook a preventive-care action increased from the first to the third visit, and that the rate of increase was greater in the PER group (FIGURE 2).

The results of the opinion survey are presented in TABLE 6. Respondents from the PER group of GPs ($n = 55/61$; 90.2%) believed that the data in the checklist pro-

vided by the nurse was similar to their medical records, and that the clinical intervention helped them integrate CPGs in their practice. They rated each of the 3 components of the intervention as useful. About 80% said that the PER intervention had an impact on the management of their patients, even those not included in the study. Of those who said that

someone in their office would be able to implement the intervention, 70% said they would like for someone to train their staff for integrating it in their practice. The vast majority of respondents (92%) believed that this type of intervention should be part of Family Practice Groups nurses' roles. Most respondents mentioned lack of time, human



Note: CPGs = Clinical practice guidelines; HR CV = High risk cardiovascular; PER = Practice enablers and reinforcers.

^aRandom assignment was within strata defined by regions/nurses ($n = 5$) and estimated time available per patient encounter (<18 min/pt or ≥ 18 min/pt).

^bRandom exclusion was done within strata.

FIGURE 1. The CIME Study: Flow diagram of physicians enrolled in a cluster randomized trial assessing the effect of practice enablers and reinforcers after a CME activity on CPGs' implementation in HR CV patients.

TABLE 2. Characteristics of GPs Included in the Analysis and Flow of Patients in the CIME Study

Variable	Control Group (n = 61)	PER Group (n = 61)
Sociodemographic characteristics		
Region/Nurse, n (%)		
Drummondville-Victoriaville	14 (23.0)	14 (23.0)
Laval-Basses Laurentides	11 (18.0)	12 (19.7)
Montreal South Shore	10 (16.4)	11 (18.0)
St. Hyacinthe	16 (26.2)	14 (23.0)
Trois-Rivieres	10 (16.4)	10 (16.4)
Sex, n (%)		
Male	45 (73.8)	44 (72.1)
Female	16 (26.2)	17 (27.9)
Mean years in practice ± SD, y	23.4 ± 7.6	22.5 ± 7.7
Practice characteristics		
Type of practice, n (%)		
Solo	11 (18.0)	10 (16.4)
Group	50 (82.0)	51 (83.6)
Hospital privileges, n (%)		
Mean no. of hours working in the office ± SD, h	35.0 ± 10.8	36.2 ± 9.9
Mean no. of patients/week in the office ± SD, n	116.6 ± 39.6	119.3 ± 40.6
Mean no. of patients ≥ 55 yr old/week in the office ± SD, n	53.3 (29.2)	51.1 (27.8)
Estimated time available per patient encounter, n (%)		
Less than 18.5 min per patient	33 (54.1)	33 (54.1)
18.5 min and more per patient	28 (45.9)	28 (45.9)
Guidelines implementation and patient flow in the study		
Charts of patients ≥ 55 yr old selected by GPs' receptionists and screened by a nurse in the clinic, n	7496	8554
None of the targeted cardiovascular diagnoses, n (%)	4931 (65.8)	5526 (64.6)
HR CV patients, ^a n (%)		
Excluded as per protocol, ^b n (%)	287 (11.1)	307 (10.1)
Assessed for 2004 CPGs implementation, n (%)	2278 (88.8)	2721 (89.9)
Managed according to 2004 CPGs, n (%)	676 (29.7)	836 (30.7)
Eligible patients, potentially undermanaged for at least one of 9 recommendations, ^c n (%)	1602 (70.3)	1885 (69.3)
Consenting to chart audit, n (%)	948 (59.2)	1396 (74.1)

Note: CPG = Cardiovascular prevention guidelines; HR CV = High-risk cardiovascular; PER = Practice enablers and reinforcers.

^aPatients with documented myocardial infarction, stable angina, revascularization procedure, stroke or transient ischemic attack, peripheral vascular disease, or diabetes.

^bExclusion criteria: unstable cardiovascular state in the last 4 weeks, constrictive pericarditis, complex congenital disease, significant valvular heart disease, planned cardiac or arterial surgery or angioplasty within 3 months, requiring dialysis, major noncardiac illness expected to reduce life expectancy or interfere with study participation, on warfarin, or already recruited in another research project.

^cPatients with one or more of the following characteristics: smoking, physical activity < 30 min/3 times per week, body mass index ≥ 25 kg/m², LDL > 2.5 mmol/L, diabetes and A1C > 7%, blood pressure > 140/90 mm Hg or > 130/80 mm Hg in diabetic patients, no antiplatelet used in cardiac prevention, no ACE-inhibitor, myocardial infarction and no beta-blocker. Patients for whom there was missing chart information in the previous 12 months with respect to smoking status, physical activity, body mass index, LDL, blood pressure, and A1C (previous 6 months) were also considered as potentially undermanaged.

TABLE 3. Baseline Demographic and Clinical Characteristics of Participating HR CV Patients Who Were Potentially Undermanaged for at Least 1 of 9 2004 Canadian CPGs' Recommendations

Characteristic	Control Group (<i>n</i> = 948)	PER Group (<i>n</i> = 1396)
Demographic characteristics		
Mean age \pm SD, y	69.0 \pm 8.3	69.0 \pm 8.3
Sex, <i>n</i> (%)		
Male	540 (57.0)	761 (54.5)
Female	408 (43.0)	635 (45.5)
Target cardiovascular diseases		
Diabetes (Type I or II), <i>n</i> (%)	526 (55.5)	817 (58.5)
Stable angina, <i>n</i> (%)	427 (45.0)	633 (45.3)
Revascularization procedure, <i>n</i> (%)	247 (26.1)	307 (22.0)
Myocardial infarction, <i>n</i> (%)	238 (25.1)	301 (21.6)
Stroke or transient ischemic attack, <i>n</i> (%)	160 (16.9)	207 (14.8)
Peripheral vascular disease, <i>n</i> (%)	140 (14.8)	219 (15.7)
One target disease only, <i>n</i> (%)	479 (50.5)	754 (54.0)
Two target diseases, <i>n</i> (%)	240 (25.3)	336 (24.1)
Three or more target diseases, <i>n</i> (%)	229 (24.2)	306 (21.9)
Number of postrecruitment visits to the study physician during the 6-month follow-up		
1 visit	526 (55.5)	727 (52.1)
2 visits	270 (28.5)	441 (31.6)
3 visits	152 (16.0)	228 (13.3)

Note: HR CV = High-risk cardiovascular; CPG = Cardiovascular prevention guidelines; PER = Practice enablers and reinforcers; SD = Standard deviation.

resources, and/or money as the main barriers to routine implementation of the intervention. Suggested improvements included: tailoring guidelines to specific patients (eg, including contraindications and alternative treatments), multiple-diseases approaches, patient education and follow-up by the nurse, computer tools, and greater collaboration between nurses and physicians. Diabetes (*n* = 23), MPOC (*n* = 11), and hypertension (*n* = 10) were most frequently mentioned as priorities for the development of similar interventions.

Discussion

In this study, prompting GPs to reassess preventive measures for potentially undermanaged HR CV patients and providing quick access to relevant patient information and experts' recommendations significantly increased GPs' adherence to CPGs following a CME event. The clinical intervention was designed to allow self-implementation in current practice setup of primary care groups who have nursing staff. Participating GPs were highly satisfied with the intervention and the majority believed it could be implemented in their own practice if someone trained their nurse.

Therefore, the tools developed in this project could form the basis of a multiprofessional CME program where physicians and their nurses could not only be provided with knowledge, but also with tools and training to facilitate and sustain knowledge integration in the workplace. GPs who have electronic medical records could also be provided with plug-in software carrying out similar functions after CME.³⁵⁻³⁷

These results are consistent with CME and knowledge-translation literature about most effective strategies for practice change.^{22-24,38,39} We designed a clinical intervention to address barriers associated with lack of time, lack of patient detection systems, and lack of reminders, which are most frequently mentioned by GPs as barriers to preventive care.⁴⁰ The magnitude of the difference observed between the 2 groups in absolute pre-post intervention change (12.8%) is consistent with previous studies on the effectiveness of chart prompting in preventive care. However, these studies were rarely conducted in an outpatient setting and most focused only on a few recommendations.³⁰

Our results suggest that the effect of the intervention might vary depending on the specific recommendation assessed. It may be difficult for GPs to implement several recommendations in a single visit.⁴¹ A greater impact for a given recommendation may be related to the decision-making process

TABLE 4. Baseline Management of Participating HR CV Patients Who Were Potentially Undermanaged for at Least 1 of 9 2004 Canadian CPGs' Recommendations

Cardiovascular Prevention Guidelines Management	Control Group (<i>n</i> = 948)	PER Group (<i>n</i> = 1396)
Smoking, <i>n</i> (%)		
Nonsmoking	262 (27.6)	439 (31.4)
Preventive care	25 (2.6)	40 (2.9)
Undermanaged	55 (5.8)	86 (6.2)
Missing baseline data	606 (63.9)	831 (59.5)
Body mass index, <i>n</i> (%)		
< 25 kg m ³	14 (1.5)	21 (1.5)
Preventive care	26 (2.7)	26 (1.9)
Undermanaged	59 (6.2)	95 (6.8)
Missing baseline data	849 (89.6)	1254 (89.8)
Physical activity, <i>n</i> (%)		
≥ 30 min 3 times a week	61 (6.4)	134 (9.6)
Contraindicated	5 (0.5)	12 (0.9)
Preventive care	22 (2.3)	18 (1.3)
Undermanaged	31 (3.3)	60 (4.3)
Missing baseline data	829 (87.4)	1172 (84.0)
LDL, <i>n</i> (%)		
≤ 2.5 mmol/L	383 (40.4)	548 (39.3)
Prescribed a lipid-lowering agent	106 (11.2)	148 (10.6)
Undermanaged	224 (23.6)	345 (24.7)
Missing baseline data	235 (24.8)	355 (25.4)
Blood pressure, <i>n</i> (%)		
Normal	323 (34.1)	410 (29.4)
Elevated	537 (56.6)	834 (59.7)
Missing baseline data	88 (9.3)	152 (10.9)
A1C in diabetic patients, <i>n</i> (%)		
No diabetes	422 (44.5)	579 (41.5)
< 7%	220 (23.2)	338 (24.2)
≥ 7%	82 (8.6)	121 (8.7)
Missing baseline data	224 (23.6)	358 (25.6)
Antiplatelet, <i>n</i> (%)		
Prescribed	539 (56.9)	831 (59.5)
Contraindicated	42 (4.4)	71 (5.1)
Undermanaged	367 (38.7)	494 (35.4)
ACE-inhibitor, <i>n</i> (%)		
Prescribed	263 (27.7)	381 (27.3)
Contraindicated	85 (9.0)	140 (10.0)
Undermanaged	600 (63.3)	875 (62.7)
Beta-blocker in myocardial infarction, <i>n</i> (%)		
No myocardial infarction	710 (74.9)	1095 (78.4)
Prescribed	105 (11.1)	131 (9.4)

(continued)

TABLE 4. Continued

Cardiovascular Prevention Guidelines Management	Control Group (n = 948)	PER Group (n = 1396)
Beta-blocker in myocardial infarction, n (%) (continued)		
Contraindicated	23 (2.4)	27 (1.9)
Undermanaged	110 (4.7)	143 (6.1)
Number of undermanaged recommendations/patient ^a , n (%)		
None	172 (18.1)	263 (18.8)
1	313 (33.0)	452 (32.4)
2	282 (29.7)	449 (32.2)
3–5	181 (19.1)	232 (16.6)

Note: HR CV = High-risk cardiovascular; CPG = Cardiovascular prevention guidelines; PER = Practice enablers and reinforcers.

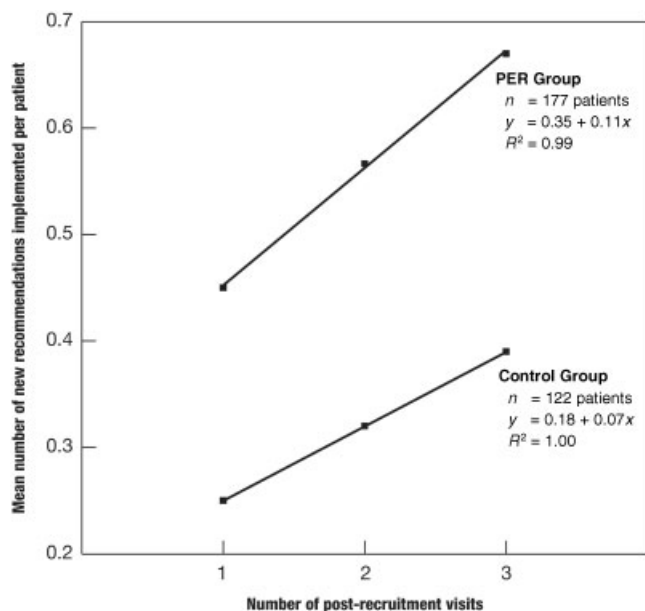
^aNot taking into account recommendations on blood pressure and A1C in diabetic patients, and recommendations for which there were missing baseline data on the associated risk factor.

about preventive-care priorities. Priorities may depend on GPs' perceptions of comparative efficacy of suggested recommendations, implementation difficulties with patients, required clinical time, or patients' preferences for a given option. On the other hand, some recommendations such as

beta-blockers' initiation may be considered as a specialist's responsibility.^{37,42}

The small number of patients included in the analysis for lifestyle recommendations due to frequently missing information in patients' charts may have been insufficient to detect differences attributable to the intervention. Quality of record maintenance has been documented elsewhere and is often associated with suboptimal practices.⁴³ The exploratory analysis for physical activity suggests that the intervention may have an impact on the recording of these risk factors.

The analysis of patients who had 3 visits following recruitment suggests that the cumulative impact of the intervention as time progresses could even be greater. It also suggests that GPs' approach to multiple treatment implementations is progressive.



Note: CPGs = Clinical practice guidelines; HR CV = High risk cardiovascular; PER = Practice enablers and reinforcers.

^aResults based on the analysis of a subgroup of patients who made three post-recruitment visits to their GP during the six-month follow-up period.

FIGURE 2. Cumulative implementation of CPGs in previously undermanaged HR CV patients in relationship to the number of visits made after enrollment in the CIME Study.^a

Limitations

Several limitations need to be mentioned when considering the results and implications of this study. Physicians were volunteers and may not be representative of GPs elsewhere, hence limiting the generalizability of the results. Assessment of clinical encounter time used to stratify GPs was based on self-reported data. The effect size may be overestimated if participating GPs had better medical records or were more interested in prevention than the general GP population.

On the other hand, several factors may have contributed to underestimating the intervention effect size: not analyzing blood pressure and A1C recommendations; not taking into account, in the outcome, recommendations for which there were no baseline risk-factor information; basing our outcome only on the first visit following recruitment; and

TABLE 5. Implementation of 2004 Canadian CPGs' Recommendations in Undermanaged HR CV Patients at the First Visit Following Recruitment in the CIME Study

Outcomes and Study Groups	No. of Undermanaged Patients at Baseline	No. of Patients with a Preventive Care Action in the First Postrecruitment Visit (%)	Odds Ratio (and 95% CI)	P Value	Exchangeable Working Correlation
Primary					
At least one of the secondary outcomes below					
PER	1133	474 (41.8)	1.78 (1.32–2.41)	0.0002	0.1057
Control	776	225 (29.0)	Reference		
Secondary					
Prescription of a pharmacological agent, referral or counseling:					
In smokers					
PER	86	24 (27.9)	4.99 (1.65–15.10)	0.0044	0.0300
Control	55	4 (7.3)	Reference		
When body mass index $\geq 25 \text{ kg.m}^3$					
PER	95	60 (63.2)	1.12 (0.42–3.00)	0.8214	0.4863
Control	59	27 (45.8)	Reference		
When physical activity < 30 min 3 times a week					
PER	60	8 (13.3)	0.48 (0.24–2.64)	0.7066	0.1452
Control	31	6 (19.3)	Reference		
Prescription of:					
Antiplatelets					
PER	494	235 (47.6)	1.50 (1.00–2.24)	0.0516	0.1940
Control	367	136 (37.1)	Reference		
Angiotensine converting enzyme inhibitor					
PER	875	179 (20.5)	2.19 (1.45–3.30)	0.0002	0.0855
Control	600	66 (11.0)	Reference		
Lipid-lowering agent when LDL > 2.5 mmol/L					
PER	345	119 (34.5)	1.50 (0.99–2.30)	0.0586	0.0477
Control	224	58 (25.9)	Reference		
Beta-blockers in post-MI patients					
PER	143	24 (16.8)	1.12 (0.57–2.18)	0.7337	-0.0111
Control	110	17 (15.5)	Reference		

Note: HR CV = High-risk cardiovascular; CPG = Cardiovascular prevention guidelines; PER = Practice enablers and reinforcers.

possible Hawthorne effect as physicians were not blinded to study group assignment.

Though the different patients' selection and recruitment rates between the groups could introduce unknown confounders in the study, it is most unlikely that they affected results because patients in both groups had similar clinical characteristics required by GPs to make an evidence-based

decision related to CPGs' recommendations assessed in this study.

Conclusion

The CIME study provides new evidence supporting that providing PER after a CME event is more effective in

TABLE 6. PER Group Physicians' Opinions About the PER Intervention^a

Questions ^b	No. of Respondents	Somewhat or Totally Disagree <i>n</i> (%)	Somewhat or Totally Agree <i>n</i> (%)
It was easy for the receptionist to pull out the charts of my patients \geq 55 years old before the nurse's visit.	55	1 (1.8)	54 (98.2)
The nurse integrated herself well in my clinic.	55	2 (3.6)	53 (96.4)
Chart prompting allowed me to quickly identify patients who needed reassessment of cardiovascular prevention.	55	5 (9.1)	50 (90.9)
The clinical intervention helped me integrate in my practice the knowledge acquired during the initial CME activity.	55	4 (7.3)	51 (92.7)
Given the information available in my medical records, the nurse correctly detected patients who were potentially undermanaged according to the guidelines.	54	7 (13.0)	47 (87.0)
The information on the checklist, filled out by the nurse, was similar to the information available in my medical records.	55	5 (9.1)	50 (90.9)
The treatment and follow-up algorithm contained all essential information for the management of HR CV patients.	55	2 (3.6)	53 (96.4)
The checklist contained all essential information needed for practice guidelines' implementation.	55	3 (5.5)	52 (94.5)
The clinical intervention prompted me to adjust the treatment of many of my patients included in the study.	54	10 (18.5)	44 (81.5)
The treatment and follow-up algorithm provided clear instructions on the management of HR CV patients.	55	4 (7.3)	51 (92.7)
The clinical intervention prompted me to adjust the treatment of many of my patients who were not included in the study.	54	11 (20.4)	43 (79.6)
I would like someone to train my staff to implement this clinical approach in my practice.	52	22 (42.3)	30 (57.7)
I think this model of collaboration between nurses and physicians should be extended to other therapeutic areas.	54	4 (7.4)	50 (92.6)
I think this type of approach should be part of nurses' role in the Family Practice Groups.	51	4 (7.8)	47 (92.2)
I would be willing to participate in a similar study in another therapeutic area.	52	6 (11.5)	46 (88.5)
	<i>N</i>	Yes	No
Is there someone in your staff who has the capability to implement this intervention?	54	22 (40.7)	32 (59.3)
On a scale of 1 (lowest score) to 5 (highest score), please rate the usefulness of each of the following tools used in the study:	<i>N</i>	Mean	95% Confidence interval
Chart prompting	48	4.21	3.95–4.47
Checklist	49	4.29	4.04–4.53
Treatment and follow-up algorithm	50	4.26	3.99–4.53

Note: PER = Practice enablers and reinforcers; HR CV = High-risk cardiovascular.

^a Open-ended questions: In practices such as yours, what are the major implementation barriers for this type of clinical interventions? If someone wanted to deploy this intervention province-wide, what would be major improvements to make? What other types of clinical interventions would help you implement prevention guidelines in your daily practice?

^b In French in the questionnaire.

changing physicians' performance than a one-time CME event. It also illustrates how CME providers may develop CME strategies to address barriers to knowledge implementation in the workplace. Finally, results suggest some future research directions: development of clinical inter-

ventions and tools tailored to specific patients and using multiple-diseases approaches; assessment of the long-term impact of PER interventions; and investigating GPs' decision-making process in multiple guidelines implementation.

Lessons for Practice

- Practice enablers and reinforcers after a CME event may be more effective in changing physicians' performance than a one-time-based CME event.
- CME providers may develop CME strategies to address barriers to knowledge implementation in the clinical environment and build a CME program that may facilitate and sustain knowledge integration in the practice.

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Appendix 1: Intervention tools used in the CIME Study: Treatment and follow-up algorithm inserted in the charts of potentially undermanaged high-risk cardiovascular patients.



CIME Study

Date of nurse's visit (YYYY/MM/DD) _____

Patient's chart number

Cardiovascular Profile	Information Source <small>(Referral letters, chart notes, others)</small>	Date* <small>(YYYY/MM/DD)</small>
<input type="checkbox"/> Post myocardial infarction		
<input type="checkbox"/> Stable angina		
<input type="checkbox"/> Revascularization procedure		
<input type="checkbox"/> Percutaneous transluminal coronary angioplasty		
<input type="checkbox"/> Coronary artery bypass graft		
<input type="checkbox"/> Diabetes <small>(type 1 or type 2 or current prescription of antidiabetic drugs)</small>		
<input type="checkbox"/> Peripheral vascular disease		
<input type="checkbox"/> Intermittent claudication or Leriche's syndrome		
<input type="checkbox"/> Stenosis ≥ 50% on angiography or positive doppler <small>(inferior limbs or carotids)</small>		
<input type="checkbox"/> Limb amputation secondary to vascular disease		
<input type="checkbox"/> Transluminal angioplasty		
<input type="checkbox"/> Lower limb bypasses		
<input type="checkbox"/> Endarterectomy		
<input type="checkbox"/> Resection of an abdominal aneurysm		
<input type="checkbox"/> Stroke or transient ischemic attack		

Risk Factors	Information Source <small>(Referral letters, chart notes, others)</small>	Date* <small>(YYYY/MM/DD)</small>
Physical activity <small>(≥ 30 min/ 3 times a week)</small> <input type="checkbox"/> Yes <input type="checkbox"/> No		
Smoking <input type="checkbox"/> Yes <input type="checkbox"/> No		
Body mass index (BMI) _____		
Blood pressure (mmHg) _____		

Laboratory Tests	Results <small>(Most recent test results)</small>	Date* <small>(YYYY/MM/DD)</small>
<input type="checkbox"/> LDL (mmol/L)		

Pharmacological Treatments			
Class	Name	Dosage	Date* <small>(YYYY/MM/DD)</small>
Antiplatelet			
Beta-blocker			
ACE-inhibitor			
Statin			

* Date of the most recent information or prescription

Appendix 2: Intervention tools used in the CIME Study: Risk assessment checklist inserted in the charts of potentially undermanaged high-risk cardiovascular patients.

