

## Quality indicators for cardiovascular primary care

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**BACKGROUND:** The Canadian Cardiovascular Outcomes Research Team was established in 2001 to improve the quality of cardiovascular care for Canadians. Initially, quality indicators (QIs) for hospital-based care for those with acute myocardial infarctions and congestive heart failure were developed and measured. Qualitative research on the acceptability of those indicators concluded that indicators were needed for ambulatory primary care practice, where the bulk of cardiovascular disease care occurs.

**OBJECTIVES:** To systematically develop QIs for primary care practice for the primary prevention and chronic disease management of ischemic heart disease, hypertension, hyperlipidemia and heart failure. **METHODS:** A four-stage modified Delphi approach was used and included a literature review of evidence-based practice guidelines and previously developed QIs; the development and circulation of a survey tool with proposed QIs, asking respondents to rate each indicator for validity, necessity to record and feasibility to collect; an in-person meeting of respondents to resolve rating and content discrepancies, and suggest additional QIs; and recirculation of the survey tool for rating of additional QIs. Participants from across Canada included family physicians, primary care nurses, an emergency room family physician and cardiologists.

**RESULTS:** 31 QIs were agreed on, nine of which were for primary prevention and 22 of which were for chronic disease management.

**CONCLUSIONS:** A core set of QIs for ambulatory primary care practice has been developed as a tool for practitioners to evaluate the quality of cardiovascular disease care. While the participants rated the indicators as feasible to collect, the next step will be to conduct field validation.

**Key Words:** *Congestive heart failure; Coronary disease; Health care delivery; Hypercholesterolemia; Hypertension; Primary care*

Cardiovascular diseases (CVD) are, collectively, the leading cause of death in Canada (1). The Canadian Cardiovascular Outcomes Research Team (CCORT), a multi-province interdisciplinary research group funded by the Canadian Institutes of Health Research and the Heart and Stroke Foundation in 2001, was created to improve the quality of cardiovascular care for Canadians (2). Initially, quality indicators (QIs) for hospital-based care for those with acute myocardial infarctions (3) and congestive heart failure (CHF) (4) were developed and measured.

Cardiovascular patients receive substantial amounts of care from family physicians (FPs). Twelve per cent of all FP office

## Indicateurs de qualité pour la prestation de soins primaires en cardiologie

**CONTEXTE :** L'Équipe canadienne d'analyse de résultats en matière de maladies cardiovasculaires a été fondée en 2001 afin d'améliorer la qualité des soins cardiovasculaires offerts au Canada. Au départ, des indicateurs de qualité (IQ) visant les soins fournis aux patients hospitalisés pour un infarctus aigu du myocarde ou pour de l'insuffisance cardiaque ont été élaborés, puis mesurés, mais une recherche qualitative sur l'acceptabilité des indicateurs a révélé la nécessité d'élaborer des indicateurs de qualité en soins primaires ambulatoires, là où est fournie la majeure partie des soins cardiovasculaires.

**BUT :** L'exercice avait pour but d'élaborer systématiquement des IQ pour la prestation de soins primaires liés à la prévention primaire et à la prise en charge de maladies chroniques comme les cardiopathies ischémiques, l'hypertension, l'hyperlipidémie et l'insuffisance cardiaque.

**MÉTHODE :** Nous avons eu recours à une analyse Delphi modifiée, en quatre étapes, qui comportait un examen de la documentation sur des lignes directrices de pratique clinique, fondées sur des preuves, et sur des IQ déjà existants; l'élaboration et la distribution d'un outil d'enquête dans lequel on demandait aux répondants de coter, pour chacun des IQ proposés, la validité, la nécessité de la consignation et la faisabilité de la collecte de données; une entrevue personnelle avec des répondants afin de mieux comprendre certains écarts d'évaluation et de contenu et de leur permettre de suggérer des IQ; une redistribution de l'outil d'enquête pour l'évaluation d'autres IQ. Les participants, qui provenaient de toutes les régions du Canada, comprenaient des omnipraticiens, des infirmiers en soins primaires, un généraliste urgentologue et des cardiologues.

**RÉSULTATS :** Les répondants se sont mis d'accord sur 31 indicateurs de qualité : 9 d'entre eux portaient sur la prévention primaire et 22, sur la prise en charge de maladies chroniques.

**CONCLUSIONS :** Un ensemble de base d'IQ visant la prestation de soins primaires ambulatoires a été élaboré à l'intention des praticiens comme outil d'évaluation de la qualité des soins cardiovasculaires. Pendant que les participants évalueront les indicateurs du point de vue de la faisabilité de la collecte de données, la prochaine étape consistera en une enquête de validation sur le terrain.

visits in Ontario are for CVD or undiagnosed chest pain (5). Hospital discharge data show that 35% of patients admitted for acute myocardial infarction and approximately 50% of those admitted with CHF were cared for by FPs (6). Six months after hospitalization for myocardial infarction, patients make four or five visits to their FPs for follow-up care for every one or two visits to specialists (5). As part of this care, FPs write the vast majority of the prescriptions for cardiovascular drugs. For example, 95% of all cardiovascular drug prescriptions for seniors in Nova Scotia are attributable to FPs (7). Moreover, angina and CHF are identified as ambulatory conditions for which there are strong and inverse relationships

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with high-quality ambulatory care and hospitalization rates (8).

Our previous qualitative research found that the hospital-based QIs developed by CCORT were generally acceptable to the community physicians who participated (9). Additionally, we were told that indicators were also needed for ambulatory primary care practice, where much of cardiovascular disease care occurs. This is timely, given that the lens of the Canadian health care system is increasingly focusing on primary health care. The Romanow Commission (10), the Kirby Report (11) and the 2003 First Ministers Accord call for a strengthening of primary health care. To move in this direction and benchmark progress at the same time, tools need to be developed to measure quality of care.

QIs for primary care have been developed in the United States, the United Kingdom and New Zealand using Delphi and modified RAND Corporation techniques (12-15). Indicators were developed to capture the broad range of services provided in family practice, with data to measure these indicators coming from patients' charts. In Canada, Katz et al (16) developed QIs for a spectrum of primary care services using literature reviews and physician advisor groups, with the data coming from administrative databases.

Conducting evaluations of quality of care for multiple conditions in family practice is highly resource intensive (17). Our goal was to develop QIs for cardiovascular primary care while adhering to criteria for developing such indicators. These criteria directed us to be parsimonious and not impose undue burden on those providing data, and to help providers improve care delivery (18). Thus, the objective of the present study was to systematically develop QIs of ambulatory primary care practice for the primary prevention and chronic disease management of ischemic heart disease, hypertension, hyperlipidemia and CHF.

## METHODS

Using a modified Delphi approach based on the RAND Corporation consensus panel method, the present study had four stages: literature review of evidence-based practice guidelines and previously developed QIs; development and circulation of a survey tool with proposed QIs, asking respondents to rate each indicator for validity, necessity to record and feasibility to collect; an in-person meeting of respondents to resolve rating and content discrepancies and suggest additional QIs; and recirculation of the survey tool for the suggested additional QIs (15,19-21).

### In-depth literature review on previous indicators

Literature was searched for evidence-based reviews, practice guidelines and previous QI development relating to the primary prevention and chronic disease management of ischemic heart disease, hypertension, hyperlipidemia and CHF. Information sources included PUBMED, RAND Corporation, the British National Health Service, the Joint Commission on Accreditation of Healthcare Organizations, Google, the Agency for Healthcare Research and Quality, the Australian Primary Health Care Research and Information Service, and personal contacts. Search terms included 'clinical audit', 'quality indicators', 'league tables', 'measuring', 'measurement', 'primary care or family practice', 'family medicine', 'general practice', 'cardiovascular diseases', 'ischemic heart disease', 'hypertension', 'hyperlipidemia' and 'heart failure'.

Based on these data sources, potential indicators were developed using the following criteria: the indicator had to have been

based on primary care interventions for which there was evidence that increased uptake resulted in improved health outcomes; the indicator had to have been considered by the study team as meaningful, valid and reliable; the indicator could adjust for patient variability; the indicator could be modified by improvements in the process of care; and the indicator was feasible to measure (22).

Eighty QIs were originally proposed after the research team (WP, FB, JC) reviewed the previously developed QIs and relevant practice guidelines. After vetting the indicators for duplications and primary care relevance, this list was pared down to a draft list of 31 QIs that were included in the survey tool.

### Circulation of the survey tool

Participants for this stage were chosen through a search and nomination process, which is typical of modified Delphi and RAND Corporation techniques (13,15,20). Nominations of participants were requested from The College of Family Physicians Canada, the Heart and Stroke Foundation of Canada, the Canadian Society of Internal Medicine, the Canadian Cardiovascular Society, Primary Care Nursing groups from British Columbia, Ontario and Nova Scotia, and the North American Primary Care Research Group. Individuals did not, however, participate 'representing' these organizations.

The panel consisted of 12 people: four academic FPs, three practising community FPs, a family medicine emergency room doctor, a family practice nurse, a family practice nurse practitioner and two cardiologists.

After the nomination process was completed, each panellist was sent the survey tool, which was organized by QI. Each QI subsection of the survey tool included the measure, references and an indicator for the quality of evidence for the measure. Respondents were then asked to rate the validity, the necessity to record and the feasibility to collect by marking on 9-point Likert scales adapted from Marshall et al (15) and Normand et al (21).

An indicator was considered valid if the panellist thought that there was adequate scientific evidence and/or professional consensus to support it, that there were identifiable health benefits to the patients, that higher rates of adherence were judged as higher quality service and that it was within the control of the provider. An indicator score of 1 to 3 was deemed not valid, 4 to 6 indicated uncertain validity and 7 to 9 was valid.

An indicator was considered necessary to record if failure of documenting the information could itself be judged as a marker of poor quality or if estimates of adherence to the indicator based on medical records data were likely to be reliable and unbiased. A score of 1 to 3 indicated that it should not be recorded, 4 to 6 indicated legitimate uncertainty and 7 to 9 indicated that it should be recorded.

An indicator was considered feasible to collect if it was easy to collect the data needed to construct the measure. A score of 1 to 3 indicated that it was not feasible to collect this information, a score of 4 to 6 indicated legitimate uncertainty and a score of 7 to 9 indicate that it was feasible to collect.

The quality of the evidence for the proposed indicators was described as high, intermediate or consensus. High-quality evidence included randomized controlled trials, or evidence classified by others as grade A or level I. Intermediate-quality evidence included observational studies (cohort, case control, etc) and evidence classified by others as grade B or C, or level II. Consensus-level evidence included evidence from consensus panels, or grade D or level III evidence.

Participants were given the opportunity to make written comments on the indicators and suggest additional QIs that should be captured by writing them on the survey. The surveys were then returned to the Department of Family Medicine at Dalhousie University (Halifax, Nova Scotia).

Results were tabulated, and QIs for which there was substantial disagreement were identified. Tabulation of the data from the modified Delphi approach was performed, and the QIs for which there was disagreement were identified first by applying an absolute measure (any indicator with an observed range of the overall rating of 8 was considered a 'disagreeing' QI [ie, one panelist gave the QI a rating of 1 and another gave it a rating of 9]) and then by applying a relative measure, as outlined in the equation below and defined by Normand et al (2000) (21).

After removing the 'disagreeing' QIs using the absolute measure, the relative measure was applied to the remaining QIs. For each measure  $i$ , the coefficient of variation (CV) across the raters was calculated:

$$CV_i = \frac{SD_i}{\text{mean}_i}$$

The observed  $CV_i$  values were ordered from smallest to largest, and measures corresponding to the top 20% of  $CV_i$  values were considered to be rated with disagreement.

### In-person meeting

In stage 3, an in-person meeting of panel members was organized. Members confidentially received copies of their own rankings for each QI, as well as the location of their responses relative to the overall distribution of the group. With the help of a moderator, the group discussed the QIs for which there was disagreement. After the discussion, participants confidentially rerated these QIs, and results were once again tabulated as described above. At this meeting, participants suggested further revisions to indicators and any new QIs.

### Recirculation of survey tool

This last stage repeated stage 2 by recirculating the survey tool with the revised and new QIs for rating by panellists. Using the applied absolute and relative measures previously noted, these additional QIs were added to those already agreed on in stages 2 and 3.

## RESULTS

The approach of the present study resulted in reducing the 80 initially proposed QIs to a final set of 31 (see Appendix). Nine QIs were arrived at for all patients who generally have no disease or situation to put them at particular risk of CVD. The QIs determined for those with a cardiovascular condition included nine for hypertension, four for ischemic heart disease, five for CHF and four for hyperlipidemia patients. One of the hyperlipidemia indicators was actually for those patients who have particular risk states for which they should be screened for hyperlipidemia (ie, hypertension, chronic ischemic heart disease and, if the category had been included, diabetes). It could be argued that this indicator may have also been placed among the patients with those particular risk states. Fifteen of the QIs were about diagnosis and treatment, five were about follow-up care and two were measured outcomes. Five QIs were considered important but not currently feasible and were therefore excluded. One important caveat to the indicator set is that the panel thought that, unless otherwise specified, an

overall time period for eligibility for the indicator should be established. Our panellists agreed that a two-year time frame would usually be appropriate for at-risk patients (eg, QI number 28), but they also approved of three years, particularly for those indicators applying to otherwise healthy individuals (eg, QI number 7). (For a copy of the original set of 80 indicators, please contact the authors.)

## DISCUSSION

At the completion of the modified Delphi process, we had identified 31 potential QIs for CVD care in the primary care setting. Expanding the quality of care work of CCORT into community-based care is an important step in ensuring quality across the care continuum.

Because many sources of the recommendations were existing published guidelines, there are clear similarities between some of the QIs we developed and the ones previously published. Several of the latter, however, were based only on the evidence of effectiveness in the literature and not on the thoughtful integration of that evidence with the day-to-day realities of family practice. We believe that the set we have created is more likely to balance these two realities.

While we have developed a core set of QIs for CVD in primary care, it is not a comprehensive set. Because FPs care for such a range of conditions, we decided to restrict QIs to aspects of care that occurred commonly enough in this setting to have a sufficient sample for the measure to be useful (this idea was also supported by our participants). It is also important to understand the broader context of CVD care in the primary care setting. Quality assessment that focuses on diseases or conditions in isolation without acknowledging the impact of comorbidities on achieving goals fails to reflect the nature of primary care (17). Nevertheless, this process has provided us with a 'template' for QI panel work in primary care in the future.

Another important consideration is that these indicators focus on quality of clinical performance, but do not account for two very important aspects of that performance: continuity of care and interpersonal effectiveness (eg, patient-physician interaction). Both of these aspects of family practice are known to have an impact on outcomes of care, particularly in patient self-reporting, as well as in achieving prevention, improving medication adherence and reducing hospitalizations (23-25).

The next step will be to test the feasibility of actually measuring these indicators. Experience among members of the research team and among panel participants has led us to believe that although panellists agreed that some indicators were valid and thought to be feasible to collect, the realities of practice may dictate otherwise. For example, recommendations about exercise and diet are often vaguely recorded in the clinical record, if they are documented at all (26). In addition, we may find that the prevalence of some conditions, such as CHF, is so low in single practices that few data elements are found, limiting our ability to assess the quality of care provided in such settings. Finally, before QIs can be used for comparisons across practices, work needs to be conducted on how to best standardize results for practices for characteristics such as age, sex, socioeconomic status and education.

QI development is only one piece of the 'quality' puzzle in primary care, just as in health care in general. The Agency for Healthcare Research and Quality recently created a

taxonomy of strategies to improve quality (27). This taxonomy had nine components, including practice organization, educational strategies (for both patients and providers), audit and feedback, and financial incentives, among others. As we move forward with efforts at enhancing the clinical effectiveness of primary care through innovations in practice, QIs may represent a foundation on which we can base measurement of such interventions. Many countries, including the United Kingdom (28), New Zealand (29) and Australia (30), are actively implementing quality improvement strategies, and all are based on the use of QI benchmarks. In our own country, we are not yet that far down the indicator path, but work is underway (31).

Crampton et al (32) outlined the potential uses for quality measurement. They asserted that QIs are tools for assessing the effectiveness of primary care organizations for the public, providers, payers and researchers. As each constituency uses them for their different purposes, we should ultimately see assessments of how the organization of primary care changes to improve quality as measured by the QIs. Performance measurement through the use of QIs is not without controversy. Despite the growing international trend to make health care systems more accountable for money spent, there are pros and cons to this approach. On the upside, defining QIs requires us to stop and evaluate our goals for care, and to align our clinical and organizational processes to better achieve these goals. Ultimately, the desire is to reduce mortality and morbidity for more of the population. On the downside, QI development and reporting may marginalize and divert resources away from some patients with clinical conditions for which there are no QIs.

QIs are also only one technical component of the broader issue of performance management (33). Such management includes attention to the organization's culture (leadership, value of research), infrastructure (staffing, communication, information technology), personnel characteristics (skills, attitude) and external relationships (collaboration) (34). Also necessary are other forms of quality assessment, including the evaluation of patient access to care and patient satisfaction with care (35). Sheldon (33) viewed performance management as a health care technology and believed it should be subjected to rigorous evaluation. There is some evidence that assessing the outcomes of the care we provide, as well as giving this information back to the providers (audit and feedback), has a positive impact on improving these outcomes (36). In primary care in particular, McElduff et al (37) provided a modelling estimate for the potential impacts of achieving treatment targets in the general practice contract on cardiovascular health gains specifically. Although not a 'real-world' evaluation, this analysis has direct bearing on how the QI set we have developed may have benefits in the Canadian setting. When one considers the other elements of a performance management system and the potential cost of their full implementation, the need for critical evaluation as Sheldon (33) outlined is essential. Currently, the policy imperative for accountability 'trumps' the paucity of substantial evidence that QI measurement and feedback leads to major improvements in health outcomes. In the face of this, we must continue to conduct research in this area so that it might inform the development of policies that provide incentives to reach performance targets.

It is our hope that this particular work relating to CVD will complement other work being performed around chronic

disease care more broadly and that it will be used in the evaluation of innovations in primary care delivery structures. The use of common sets of indicators, with appropriate standardizations, will allow comparisons among primary care practices, health authorities and provinces as we strive to improve the outcomes for those at risk of, and individuals already living with, CVD.

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## APPENDIX A

### Revised list of 31 quality indicators

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#### Quality indicators applicable to all patients

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1. Percentage of adult patients who have weight and height or waist circumference recorded on the chart.
2. Percentage of adult patients who have alcohol consumption recorded on the chart.
3. Percentage of adult patients who have smoking status recorded on the chart.
4. Percentage of patients who are current smokers and have smoking cessation counselling or a referral for counselling recorded on the chart.
5. Percentage of patients 40 years and older with no risk factors, or any adults with cardiovascular risk factors (eg, hyperlipidemia, hypertension, ischemic heart disease, etc), who have had a fasting plasma glucose level recorded on the chart in the past three years.
6. Percentage of healthy patients (no previous cardiovascular risk) 40 to 80 years of age (men) or 50 to 80 years of age (women) who have lipid testing at least every five years recorded on the chart.

Note: 'Lipid testing' is intentionally nonspecific to allow local variation in application in audit

7. Percentage of adult patients who have had a visit to their usual primary care provider's office in the previous three years whose blood pressure was recorded on the chart.

Note: Definition of 'adult' is left to a local decision

8. Percentage of patients older than 40 years of age (men) and older than 50 years of age (women) for whom a global risk assessment (eg, Framingham model) has been recorded on the chart.

Note: Age levels decided by consensus at in-person meeting

9. Percentage of patients with a systolic blood pressure of 140 mmHg to 159 mmHg or diastolic blood pressure of 90 mmHg to 99 mmHg who have a follow-up visit in a six-month period recorded on the chart.

Note: We ignored the suggestion of 'asymptomatic' for two reasons: the numbers are low enough already, and it would be very hard to perform the audit if it were necessary to identify asymptomatic patients from the record

#### Quality indicators for hypertension

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10. Percentage of patients with an average systolic blood pressure of greater than 160 mmHg and/or a diastolic blood pressure greater than 100 mmHg, as determined on at least three separate visits, who have a diagnosis of hypertension recorded on the chart.

Note: Timeframe over which these three or more visits can occur is left to the local auditor's definition, unless guidelines emerge with a clearer standard

11. Percentage of adult patients whose blood pressure is 180/110 mmHg or greater, or 140/90 mmHg or greater and who have diabetes, chronic renal disease or target organ damage, who have a record on the chart of a second visit for blood pressure within two months of the first elevated blood pressure visit.
12. Percentage of adult patients whose blood pressure is 180/110 mmHg or greater, or 140/90 mmHg or greater and who have diabetes, chronic renal disease or target organ damage on a second visit, who were labelled as hypertensive on the chart.
13. Percentage of patients with an average systolic blood pressure of 160 mmHg or greater, or a diastolic blood pressure of 100 mmHg or greater with a recommendation for drug therapies recorded on the chart.
14. Percentage of patients with an average diastolic blood pressure of 90 mmHg or greater with a recommendation for drug therapies recorded on the chart if target organ damage is present or if they have independent cardiovascular risk factors (elevated systolic blood pressure, cigarette smoking, abnormal lipids, family history of premature cardiovascular disease, truncal obesity, sedentary lifestyle).
15. Percentage of patient visits (for blood pressure follow-up) for those with hypertension whose blood pressure is above target (140/90 mmHg, or 130/80 mmHg for patients with diabetes or renal disease) with a plan of care for hypertension recorded on the chart that includes a change in dose or regimen of medications, and/or repeated education regarding lifestyle modification and/or planned reassessment.
16. Percentage of patients identified as hypertensive, but who are at target blood pressure levels and who have had blood pressure recorded in the chart in the past six months.
17. Percentage of adult patients with hypertension and diabetes who have a measure of urinary protein excretion (eg, 24 h urine, dipstick for microalbuminuria, etc) on the chart.
18. Percentage of patients identified as hypertensive for longer than 12 months whose most recent blood pressure was at target:
  - a. Nondiabetic patients having a systolic blood pressure of less than 140 mmHg and a diastolic blood pressure of less than 90 mmHg.
  - b. Diabetic patients or patients with renal disease having a systolic blood pressure of less than 130 mmHg and a diastolic blood pressure of less than 80 mmHg.
  - c. Patients with proteinuria having a systolic blood pressure of less than 125 mmHg and a diastolic blood pressure of less than 75 mmHg.

#### Quality indicators for chronic, stable ischemic heart disease

19. The percentage of patients with ischemic heart disease who are taking acetylsalicylic acid or have a contraindication to, or side effects from, acetylsalicylic acid.
20. The percentage of patients with ischemic heart disease who have had a myocardial infarction and are taking a beta-blocker or have a contraindication to, or side effects from, a beta-blocker.
21. The percentage of patients with ischemic heart disease who are on an angiotensin-converting enzyme inhibitor, or have a contraindication to, or side effects from, an angiotensin-converting enzyme inhibitor.
22. The percentage of patients with ischemic heart disease who have had a fasting blood sugar level recorded on chart at least once since diagnosis.

#### Quality indicators for congestive heart failure

23. Percentage of patients with a diagnosis of congestive heart failure who have had an ejection fraction value recorded in the chart at least once.
24. Percentage of patients with left ventricular systolic dysfunction (ejection fraction of less than 40%), whether symptomatic or asymptomatic, who are taking an angiotensin-converting enzyme inhibitor or an angiotensin receptor II blocker, or have a contraindication to, or side effects from, both an angiotensin-converting enzyme inhibitor and an angiotensin receptor II blocker.

25. Percentage of patients with left ventricular systolic dysfunction (ejection fraction of less than 40%) who are taking a beta-blocker or have a contraindication to, or side effects from, beta-blockers.
26. Percentage of patients with congestive heart failure on an angiotensin-converting enzyme inhibitor or an angiotensin receptor II blocker who have had potassium and creatinine levels recorded on the chart in the past year.
27. Percentage of patient visits for congestive heart failure during which weight was recorded in the chart.

#### Quality indicators for hyperlipidemia

28. Percentage of adult patients with one or more of the following who have lipid testing recorded on the chart every two years: diabetes mellitus; hypertension and/or risk factors, such as smoking or abdominal obesity and/or strong family history of premature ischemic heart disease; or evidence of symptomatic or asymptomatic coronary artery or vascular disease.
29. Percentage of patients with hyperlipidemia for whom a therapeutic target, based on their global risk assessment and lipid profile, has been recorded on the chart.

Note: Definition of 'hyperlipidemia' is left nonspecific to allow for changes in acceptable blood levels

30. Percentage of patients with hyperlipidemia who are at high risk for ischemic heart disease, for whom it has been recorded on the chart that pharmacological treatment was recommended immediately, concomitant with dietary and lifestyle changes.

Note: 'High risk for ischemic heart disease' is defined in indicator #31

31. Percentage of hyperlipidemia patients (who have been diagnosed for longer than 12 months) at risk for ischemic heart disease who are at target levels for low-density lipoprotein cholesterol (LDL-C) and total cholesterol to high-density lipoprotein cholesterol (HDL-C) ratios:
  - a. High risk – LDL-C level of less than 2.5 mmol/L and total cholesterol to HDL-C ratio of less than 4.0.
  - b. Medium risk – LDL-C level of less than 3.5 mmol/L and total cholesterol to HDL-C ratio of less than 5.0.
  - c. Low risk – LDL-C level of less than 4.5 mmol/L and total cholesterol to HDL-C ratio of less than 6.0.

Note: Definitions of risk categories from Genest et al (38): high risk includes a 10-year risk of ischemic heart disease of 20% or greater, or history of diabetes mellitus or any atherosclerotic disease; moderate risk includes a 10-year risk of 11% to 19%; and low risk includes a 10-year risk of 10% or less

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