

Cardiologists' charting varied by risk factor, and was often discordant with patient report

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Abstract

Objective: To assess the completeness of cardiac risk factor documentation by cardiologists, and agreement with patient report.

Study Design and Setting: A total of 68 Ontario cardiologists and 789 of their ambulatory cardiology patients were randomly selected. Cardiac risk factor data were systematically extracted from medical charts, and a survey was mailed to participants to assess risk factor concordance.

Results: With regard to completeness of risk factor documentation, 90.4% of charts contained a report of hypertension, 87.2% of diabetes, 80.5% of dyslipidemia, 78.6% of smoking behavior, 73.0% of other comorbidities, 48.7% of family history of heart disease, and 45.9% of body mass index or obesity. Using Cohen's κ , there was a concordance of 87.7% between physician charts and patient self-report of diabetes, 69.5% for obesity, 56.8% for smoking status, 49% for hypertension, and 48.4% for family history.

Conclusion: Two of four major cardiac risk factors (hypertension and diabetes) were recorded in 90% of patient records; however, arguably the most important reversible risk factors for cardiac disease (dyslipidemia and smoking) were only reported 80% of the time. The results suggest that physician chart report may not be the criterion standard for quality assessment in cardiac risk factor reporting.

Keywords: Medical charts; Risk factors; Cardiologist; Concordance; Completeness; Patient self-report

1. Introduction

Medical records are customarily used as the criterion standard to assess quality of care in the health care setting. Accurate and complete medical record documentation by physicians is essential to ensure appropriate treatment and optimal continuity of care. Missing information in medical charts can lead to medication errors, poorer quality patient management, and may have a negative effect on patient outcomes [1]. The poor quality of patient health records

has been repeatedly documented in hospital settings [1–4]. An alternative to medical records as a quality assessment tool, patient self-report surveys are increasingly being used, and shown to be valid and accurate [5–9]. It is important in both clinical practice and research to identify patient treatment plans and clinical history; however, it is often difficult to obtain a complete and accurate patient profile using one data source alone as the standard.

To our knowledge, there is no multisite study that has examined the quality of physician charting and patient self-report of cardiac risk factors in a large sample of ambulatory cardiac outpatients. Given that cardiovascular disease is the leading cause of death in the developed world, and there are major reversible risk factors that are directly related to atherosclerotic disease progression, total risk

What is new?

Key findings:

- 1 Less than 20% of the outpatient charts completely denoted all major cardiac risk factors. Most frequently, charts were missing one risk factor.
- 2 Modifiable risk factors for cardiac disease such as dyslipidemia and smoking were reported 80% of the time.
- 3 Agreement between chart and patient report of cardiac risk factors ranged from substantial to moderate, whereas concordance for comorbid conditions was poor.

What this paper adds: Neither the medical record nor patient report were necessarily the “gold standard” for risk factor documentation, and each source has distinct advantages and disadvantages for specific risk factors.

Implications: Initiatives such as electronic patient records and standardized reports should be explored as avenues to improve chart reporting and potentially patient risk-factor management.

assessment is essential to ensure better patient care, improve disease prognosis and outcomes, and to aid in the informed decision-making process. The current study aimed to assess the completeness of reporting of cardiac risk factors within cardiologists' outpatient charts, and concordance with patient report of diabetes, hypertension, smoking history, family history, and obesity. Patient and physician characteristics related to degree of chart completeness were also examined.

2. Methods

2.1. Design and procedure

This study represents a cross-sectional component of a larger longitudinal observational study on access to cardiac rehabilitation. Upon receiving ethics approval from participating institutions, a sample of Ontario-based cardiologists was generated through a national physician registry, CMD Online, and basic sociodemographic data were extracted. Consent to participate was solicited via mail, and included a brief survey. Subsequently, the research assistant performed on-site screening on a retrospective, sample of 20 of the cardiologists' most recent patients with coronary artery disease (CAD).

With informed patient consent, clinical and risk factor data were recorded from charts, and patients were mailed a self-report survey assessing cardiac risk factors. Patient

and chart report data were entered by different research assistants to minimize bias.

2.2. Chart extraction

Charts of patients that had been seen by the cardiologist in the outpatient clinic between 2004 and 2006 were eligible for review. After patient consent, demographic data, cardiac risk factors (e.g., diabetes, hypertension, smoking status, family history, obesity, and dyslipidemia), cardiac medications, and disease severity indicators were extracted from charts using a standardized form. Following training, the charts were systematically reviewed by the first author prior to patient report of risk factors (i.e., blind). The complete medical record of every patient was reviewed to obtain a comprehensive overview of the medical history and current status. Chart extraction was completed between May 2005 and September 2006.

2.3. Participants

Sixty-eight nonpediatric Ontario cardiologists consented to participate, and their characteristics are shown in Table 1. A retrospective sample of 1,376 CAD outpatients were mailed to ask for their consent to participate in this study. CAD diagnosis was confirmed based on indication in patient chart of detailed history, focused physical examination, diagnostic ECG changes (i.e., Q waves, and/or ST-T segment changes), troponin levels above the 99th percentile of normal, and/or receiving revascularization such as a percutaneous coronary intervention or acute coronary bypass. Patients who had concurrent valve repair/replacement or arrhythmia or had received a diagnosis of heart failure were also eligible. Reasons for ineligibility were based on exclusion criteria for the larger study as follows: lack of English language proficiency ($n = 87$; 33.5%), inaccurate/outdated contact information ($n = 62$; 23.8%), orthopedic, neuromuscular, cognitive or vision impairment, which would preclude cardiac rehabilitation participation ($n = 31$; 11.9%), unconfirmed CAD diagnosis ($n = 26$; 10.0%), index event or treatment prior to 2004 ($n = 17$; 6.5%), death ($n = 14$, 5.4%), residence outside the province of Ontario ($n = 8$, 3.1%), ineligibility for cardiac rehabilitation based on Canadian guidelines [10] ($n = 7$; 2.7%), previous

Table 1
Characteristics of participating cardiologists

Characteristics	Participants ($N = 68$)
Sex (% female)	11 (16.2%)
Graduation year—medical degree (mean \pm SD)	1,982 \pm 8.3
Location of medical school (% Ontario)	40 (58.8%)
University appointment (% yes)	28 (42.4.0%)
Subspecialty (% internists/no subspecialty)	44 (64.7%)
Self-reported volume of patients/week (mean \pm SD)	51.4 \pm 33.02

participation in cardiac rehabilitation ($n = 5$; 1.9%), and comorbid nonaffective psychiatric disorders ($n = 3$, 1.2%).

2.4. Measurements

Clinical and risk factor data extracted from outpatient medical charts included sex, age, date of last outpatient visit, cardiac event or procedure, Canadian Cardiovascular Society (CCS) angina class [10], New York Heart Association class (NYHA) class [11], blood pressure, lipids, smoking status (i.e., current smoker or nonsmoker [inclusive of those that quit smoking]), family history of CAD, body mass index or obesity status, and comorbid conditions including diabetes. Hypertension and dyslipidemic status were recorded, and where values were presented cut-off values of 140/90 for systolic and diastolic blood pressure and lipid levels above reference ranges [10,12] were used.

In the self-report survey, patients were asked through forced-choice options to report if they had been diagnosed with hypertension, diabetes, whether they had a family history of CAD, and their current smoking status. Body mass index was computed based on self-reported height and weight, with overweight/obesity defined as a body mass index (kg/m^2) > 25 [10,13]. Patients also completed the Duke Activity Status Index [14] to determine functional capacity.

2.5. Statistical analyses

During data entry in SPSS 14.02, all missing fields were coded as such. To assess completeness of outpatient charts, frequencies were used to enumerate missing risk factor data. Using one-way ANOVA, t -tests, and chi-squared analysis, as appropriate, differences in the number of risk factors missing were compared based on patient characteristics. Differences in risk-factor charting based on cardiologist characteristics were analyzed using linear mixed modeling with a random intercept for physician in R [15,16].

With regard to concordance, Cohen's κ was used to assess agreement of risk factor information between physician charts and patient self-report. For the Cohen's κ statistic, the classification system suggested by Fleiss (1973) [17,18] was applied, where κ less than 0.40 represents poor to fair agreement, 0.40–0.60 represents moderate agreement, 0.60–0.8 represents substantial agreement, and 0.80–1.00 represents almost perfect agreement. Sensitivity, specificity, positive predictive values (PPV), and negative predictive values were computed using the medical record review as the criterion standard.

3. Results

A total of 789 patients agreed to participate (789/ (1,376–260) = 71% response rate). This represents a mean of 11.6 patients per cardiologist, with a range from 6 to 18. Participating patient characteristics are shown in Table 2.

Table 2
Sociodemographic and clinical characteristics of patient sample ($N = 789$)

Characteristics	Mean \pm SD or n (%)
Age	66.46 \pm 11.35
Sex (% female)	224 (28.4%)
BMI ^a	27.39 \pm 5.33
Marital status ^a (% married)	550 (69.7%)
Ethnocultural background ^a (% minority)	109 (13.8%)
Education ^a (% > high school)	425 (53.9%)
Family income ^a (% \$50,000CAD or more)	345 (43.7%)
Work status ^a (% retired)	422 (53.5%)
Systolic BP mm Hg (mean \pm SD)	131.8 \pm 20.61
Diastolic BP mm Hg (mean \pm SD)	75.48 \pm 10.37
Total cholesterol/HDL ratio	3.74 \pm 1.50
HDL mmol/L (mean \pm SD)	1.20 \pm 0.37
LDL mmol/L (mean \pm SD)	2.34 \pm 0.93
NYHA Class II–IV (%)	64 (8.1%)
CCS angina class 2–4 (%)	183 (23.2%)
Multivessel disease (> 1 diseased coronary arteries)	238 (30.2%)
Duke Activity Status Index ^a	36.23 \pm 16.12
Current or previous MI	366 (46.4%)
Current or previous PCI	365 (46.3%)
Current or previous ACB	233 (29.5%)
Current or previous HF	140 (17.7%)
Current or previous arrhythmia	166 (21.0%)
Current or previous of valve repair/replacement	121 (15.3%)

Note: Percentages take into account missing data for some variables.

Abbreviations: BMI, Body Mass Index; BP, blood pressure; HDL, high-density lipoprotein; LDL, low-density lipoprotein; CCS, Canadian Cardiovascular Society; NYHA, New York Heart Association, MI, Myocardial Infarction; PCI, Percutaneous Coronary Intervention; ACB, Acute Coronary Bypass; HF, Heart Failure.

^a Denotes data from patient report.

The mean number of days between last outpatient visit or index event and the date the survey was completed was 208.11 ± 143.17 (approximately 7 months).

3.1. Chart completeness

With regard to completeness of risk factor documentation, Table 3 depicts the risk factor, clinical and disease

Table 3
Presence of cardiac risk factor data in cardiologist charts

Clinical data	Data present n (%)
Hypertension	713 (90.4%)
Recent BP values	667 (84.5%)
Diabetes	688 (87.2%)
Dyslipidemia	635 (80.5%)
Lipid values	567 (40.1%)
Smoking status	620 (78.6%)
Comorbidities	576 (73.0%)
FHx of CAD	384 (48.7%)
BMI or overweight/obesity	362 (45.9%)
CCS anginal class	230 (29.2%)
NYHA class	148 (18.8%)

Abbreviations: BP, blood pressure; CCS, Canadian Cardiovascular Society; NYHA, New York Heart Association; FHx, Family History; BMI, Body Mass Index.

severity information that was denoted in patient charts. Of diabetes, hypertension, dyslipidemia, obesity, family history, and smoking, charts were missing a mean of 1.64 ± 1.35 risk factors. Figure 1 presents the number of missing risk factors in each chart. One hundred fifty-three (19.4%) charts were complete with all risk factors denoted. Most frequently ($n = 270$; 34.2%) charts had one risk factor missing. Over three-quarters ($n = 625$; 79.2%) of the charts had less than three risk factors missing. Data were split by cardiologist. The lowest mean number of missing risk factors was 0.32 ± 0.48 and the highest was 3.9 ± 1.6 .

Cardiologist and patient correlates of mean number of missing risk factors were computed. With regard to the former, there was no significant relationship between number of missing risk factors and cardiologist sex, subspecialty, graduation year, location of medical school, and whether they held a university appointment. However, cardiologists who had lower self-reported weekly volume of patients had significantly less missing data in their charts ($F = 6.23$, $P = 0.01$ in adjusted hierarchical regression). With regard to patient characteristics, there was no significant difference in the number of missing risk factors in the charts based on sex, whether they had a previous acute coronary bypass, and the total number of self-reported comorbid conditions ($P > 0.05$). Based on Pearson's correlation, there was significantly less missing risk factor data for older patients ($P < 0.001$) and those with lower activity status ($P = 0.02$).

3.2. Chart accuracy

Table 4 reports the concordance between physician chart report and patient self-report of cardiac risk factors and comorbid conditions. According to the classification system, there was almost perfect agreement between the two sources for diabetes and substantial agreement for obesity. There was moderate agreement for smoking status, hypertension, and family history. There was poor concordance for the presence of one or more comorbid conditions (illness other than diabetes).

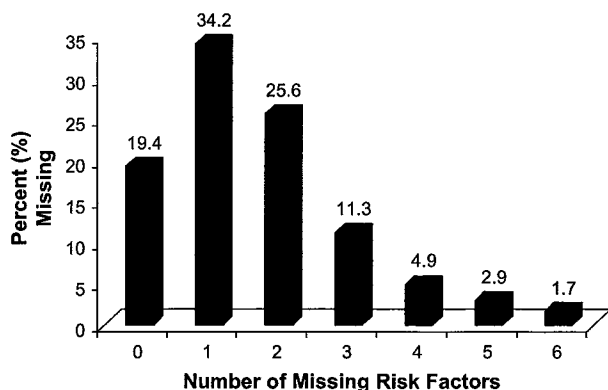


Fig. 1. Total number of cardiac risk factors missing in outpatient charts.

4. Discussion

Independent risk factors for the development and prognosis of CAD are well established. Total risk assessment and subsequent treatment is essential to optimize disease prognosis [19]. Treatment-to-target can only be achieved through charting risk factors to monitor response to therapies.

4.1. Chart completeness

In the current study, established cardiac risk factors were fairly consistently recorded in cardiologists' outpatient charts. Overall, one-fifth of charts had more than two key risk factors missing. Results revealed that two major cardiac risk factors, hypertension and diabetes, were recorded in 90% of patient records. However, arguably important reversible risk factors for cardiac disease, dyslipidemia, and smoking, were only reported 80% of the time. Notation of family history and overweight/obesity were reported in less than 50% of patient charts. Finally, CCS Angina and NYHA Class were reported in approximately 30% and 20% of charts, respectively. In addition to cardiac risk factor profiles, clinical histories of other diseases (comorbid conditions) were reported in 73% of the outpatient charts. These results suggest that physician chart report may not be the criterion standard for quality assessment in cardiac risk factor reporting and clinical history assessment.

Reasons for underreporting of some data in the charts may be somewhat explicable. For instance, CCS and NYHA class may have been less consistently reported if the patients were stable and asymptomatic at the time of assessment. Family history and obesity may have been less frequently reported as they are not, or are less, amenable to treatment respectively [20,21]. With regard to serum cholesterol tests, physicians often do not copy results to other providers [22], thus leading to over or undertesting and chart inconsistency. Finally, smoking status is paramount to patient assessment, and initiatives should be taken to ensure higher rates of chart notation.

With regard to correlates of chart completeness, perhaps fittingly, there was less missing data where patients were older and had lower activity status. This indicates that cardiologists document more completely with patients for whom there likely are more risk factors and greater overall risk. Secondly, cardiologists with higher patient volumes had lower risk factor reporting. This suggests that time is a key commodity for complete charting. Means to facilitate charting within busy practices should be explored and exploited, including use of electronic records, standardized forms, and office support.

4.2. Chart accuracy

It remains undetermined in the literature as to which tool, chart, or self-report is the criterion standard to estimate risk factor burden. Some studies have found the medical record to be more accurate than patient self-report

Table 4
Agreement between patient report and medical outpatient chart

Risk factors	Chart		Totals
	Yes	No	
Diabetes mellitus			
Patient survey			
Yes	167 24.4%	9 1.3%	176 25.7%
No	24 3.5%	484 70.8%	508 74.3%
Chart totals	191 27.9%	493 72.1%	684 100.0%
Sensitivity	87.4%		
Specificity	98.2%		
PPV	94.9%		
NPV	95.3%		
Cohen's κ	0.88		
Obesity			
Patient survey			
Yes	166 46.5%	28 7.8%	194 54.3%
No	26 7.3%	137 38.4%	163 45.7%
Chart totals	192 53.8%	165 46.2%	357 100.0%
Sensitivity	86.5%		
Specificity	83.0%		
PPV	85.6%		
NPV	84.0%		
Cohen's κ	0.69		
Current smoking status			
Patient survey			
Yes	61 9.9%	12 2.0%	73 11.9%
No	59 9.6%	483 78.5%	542 88.1%
Chart totals	120 19.5%	495 80.5%	615 100.0%
Sensitivity	83.6%		
Specificity	97.6%		
PPV	50.8%		
NPV	89.1%		
Cohen's κ	0.57		
Hypertension			
Patient survey			
Yes	321 45.8%	40 5.7%	361 51.5%
No	137 19.5%	203 29.0%	340 48.5%
Chart totals	458 65.3%	243 34.7%	701 100.0%
Sensitivity	70.1%		
Specificity	83.5%		
PPV	88.9%		
NPV	59.7%		
Cohen's κ	0.49		
Family history of CAD			
Patient survey			

(Continued)

Table 4
Continued

Risk factors	Chart		Totals
	Yes	No	
Yes	213 55.8%	42 11.0%	255 66.8%
No	45 11.8%	82 21.5%	127 33.2%
Chart totals	258 67.5%	124 32.5%	382 100.0%
Sensitivity	82.6%		
Specificity	66.1%		
PPV	83.5%		
NPV	64.6%		
Cohen's κ	0.48		
Comorbid conditions^a			
Patient survey			
Yes	361 62.7%	93 16.1%	454 78.8%
No	73 12.7%	49 8.5%	122 21.2%
Chart totals	434 75.3%	142 24.7%	576 100.0%
Sensitivity	83.2%		
Specificity	34.5%		
PPV	79.5%		
NPV	40.2%		
Cohen's κ	0.19		

Abbreviations: PPV, Positive Predictive Value; NPV, Negative Predictive Value; CAD, Coronary Heart Disease.

^a Conditions other than diabetes.

[23,24] whereas other studies have found the medical record to be unreliable [25,26]. Further studies have shown that one source may be better at indicating certain conditions than others [27]. In this study, there was large variation in concordance between patient surveys and chart report of cardiac risk factors and comorbid conditions. These findings raise key methodological challenges considering self-report data is generally perceived as inferior to chart report, and indeed the latter is often used to verify self-report data. Overall, there was significant underreporting or overreporting of traditional cardiovascular risk factors in both the medical record and patient self-report despite the fact that both methods use primary data collection. Reasons for discordance between outpatient charts and patient report likely vary by risk factor.

Similar to much of the existing literature, the results showed almost perfect agreement between patient self-report and the medical chart for diabetes. The literature shows that there is very good agreement for diabetes in various patient populations [6–8,24,27]. The excellent agreement between the two sources can be explained by the fact that diabetes mellitus is a chronic condition requiring repeated health care visits and has concrete diagnostic criteria. PPV and specificity values showed that where there was slight discordance such that patients underreported diabetes compared to their medical charts. This could

potentially occur if the physician minimized the results of borderline blood glucose tests. Secondly, if patients require only dietary changes rather than pharmacological management for diabetes, they may be unaware of their diagnosis.

There was substantial agreement for overweight/obesity. However, considering that notation of overweight/obesity was missing from over 50% of the charts, this rate of agreement may be inflated.

Smoking cessation can be considered the most effective lifestyle modification in the management of patients with CAD [28] as it can significantly reduce the risk of cardiovascular events [29,30]. The results in this study found only moderate agreement between patient and chart report for smoking status. PPV and sensitivity values showed medical charts underreported smoking status compared to self-report. It is worrying that there is a lack of agreement for such an important modifiable risk factor and that the root of the problem may stem from patients' reluctance to discuss their smoking status with their cardiologist. It is important for not only cardiologists, but also all health care professionals to open the lines of communication to discuss smoking status and subsequently promote smoking cessation.

Hypertension is an asymptomatic condition, which may result in low awareness among patients. The preponderance of literature shows good agreement for hypertension between the medical record and patient self-report [7,8,27,31]; however, this study revealed only moderate agreement. The hypertension PPV value showed that patients reported hypertension less often than what was recorded in their medical chart. Some studies within the literature support our findings [6,24]. Reasons for discordance include patient perception that they no longer have hypertension if it is controlled pharmacologically, or the changing thresholds for defining hypertension. Cardiologists must communicate blood pressure status to their patients to support risk-reducing behaviors such as medication adherence and sodium reduction.

Moderate agreement was also found for family history of CAD. Finally, with regard to comorbid conditions, there was poor agreement between charts and patient report. Based on the PPV value, patients reported more health problems than were recorded in their charts. Previous literature has found that patients and physicians may differ in their report on comorbid illnesses [27] and that there tends to be a wide variation in agreement between questionnaires and medical records by specific diagnosis. Patients in our study may have more often reported minor illnesses (i.e., muscle/joint pain or allergies), whereas cardiologists more often focused on serious conditions (i.e., cancer or neurological problems). Moreover, comorbid conditions which are diagnostically complex or require clinical judgment in addition to laboratory testing may be more vulnerable to error in self-report [32]. This may have partly accounted for the high discordance.

There are other potential explanations for chart and patient-report discordance that are not specific to any risk

factor. For example, discordance could reflect lack of assessment of a risk factor or condition by the cardiologist, while the patient is aware of their status through communication from another physician. The intermittent nature of diabetes symptoms or those from other comorbid conditions may also affect the awareness and accuracy of patient self-report. Moreover, risk factors and chronic conditions which have diagnostic values that fluctuate over time such as dyslipidemia and hypertension, may not be clearly communicated to the patient, therefore yielding lower agreement rates [31]. Finally, discordance could be due to lack of communication of risk factor status to the patient, or perhaps the information was reported to the patient but the patient did not comprehend or retain the information. Future research should be conducted to explore what factors account for risk factor discordance.

Based on these results and those in the literature, it may be implied that neither chart nor patient report can serve as the criterion standard as also suggested by Dendukuri et al. [23]. Arguably both patient self-report and medical records should be used in combination to produce a complete and valid patient profile. Indeed, depending on one's purposes, both forms of report have distinct advantages and disadvantages. For example, to determine whether a patient meets diagnostic criteria for a given risk factor or condition, the medical chart would be the criterion standard. However, for an exhaustive list of comorbid conditions or for smoking status, the patient would likely be the preferred source.

Caution is warranted when interpreting results. First, this study did not incorporate a second extractor to examine a random subsample of charts for coding consistency. However, as only one research assistant examined the patient charts across all sites, reporting should be highly consistent. Second, where we reported a lack of agreement in risk-factor reporting, this discordance between physician chart and patient report may be due not to poor quality charting but to lack of patient awareness or the failure to disclose the risk factor to the patient. Therefore, the accuracy of risk factor charting data should be interpreted with caution.

In conclusion, cardiac risk factors are consistently reported in outpatient charts, and most risk factors charted were at least moderately concordant with patient report. However, neither the medical record nor patient report were necessarily the "gold standard" for risk factor documentation, and indeed each source has distinct advantages and disadvantages for specific risk factors. Initiatives such as electronic patient records and standardized reports should be explored as avenues to improve chart reporting, and potentially patient risk-factor management.

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